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INTERNATIONAL AEROSOL SYMPOSIUM IAS-4

from 06 July 1998 to 09 July 1998, Sankt-Petersburg, Russia

Conference chair Prof.. Nick.N.Belov

pnbelov@orc.ru belov@tehno.mmtel.msk.su Phone/Fax: +7-095-1474361
Please note that my e-mail communication is not stable.

исх.№ 3/10049 от 17.07.98

/ summarization of IAS-4 -contract No 68171-98-M-5377/

United States Army Materiel Command , US Army Research, Development and Standardization Group(UK), Environmental Sciences Branch

FOR: JERRY C. COMATI

Dear Mr. Comati

Your organisation supported very important meeting devoted to Aerosol Science and Technology. International Aerosol Symposium (IAS-4) gathered together in Sankt Petersburg scientists from **Europe, Asia, Africa** and **America: Russia, Ukraine, Belorussia, USA, Germany, UK, Denmark, Italy, Spain, France, Poland, Israel, Korea, Japan, Austria and Australia.** Poster sessions of IAS-4 included presentations of scientists from **Turkey, Yugoslavia, Romania, Mexico, India, Azerbaijan, Greece and Canada.**

This meeting was supported by US Army science foundation *(financial support)* , Aerosol Technology LTD *(financial support),* Russian Aerosol Society *(informational support),* American Physical Society *(informational support),* Moscow Department of Russian Aerosol Society*(informational support).*

IAS-4 gathered aerosol scientists and technologists, engineers and administrators in most actual direction for environmental science and technology. Symposium activity includes interaction of Aerosol And Climate, Urban Aerosols, Filtration, Aerosol and Health, Space Debris, Bacteria in Air, Aerosol Measurements, Radiological aerosols, Ecological Problems of Aerosols, Ultradispersed Powders, Membranes etc.

Symposium held in hotel SOVETSKAY (Lermantovky prospekt 43/1). Conference hall placed 18th floor. Session halls placed on 18th and 9th floors.

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

Each day of IAS-4 was devoted to specific direction

6/July/98: BIOLOGICAL sessions of IAS-4 were presented during one day.

Besides that this day includes MODELING OF AEROSOL TRANSFER IN ATMOSPHERE.

This day includes: Bacteria in Air, Bioaerosol sampling, Suspension of soil bacteria ... and Modeling of aerosol transfer in atmosphere...

AEROSOL AND HEALTH - Bacteria in air, Medicine in Aerosol forms, Penetration of aerosol in Lung,
AEROSOL THEORY - Aerosol optics, Coagulation, Nucleation, Condensation...

7/ July /98 Second day included sessions devoted to AEROSOL TECHNOLOGIES (filtration, production of new materials, aerosol generation, spray technologies, burning of aerosols for engine, diamond like materials, Ultradispersed powders, Membranes ...

FULLERENE - synthesis, properties, chemistry, applications, theory , nanotubes...

Besides that this day includes session Aerosol and Ocean,

8/ July /98 Third day - AEROSOL AND ENVIRONMENT - space technology for aerosol monitoring, Global effects , Aerosol and climate, Radiological aerosols, Urban aerosols, antropogenious aerosols, Volcanic aerosols, Space Debris...

9/ July /98 Last day -

Discussion of Aerosol Society Award candidates and selection of best investigations.

Election of the new President of the Russian Aerosol Society. Academician Prof. Zuev V.E. was elected as New President of Russian Aerosol Society. Prof. Belov N.N. became the Honour President of Russian Aerosol Society.

Closure of symposium.

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SESSIONS *of the IAS-4*

Sponsors of the IAS-4 are ERO US ARMY, AEROSOL TECHNOLOGY LTD

== *Session* BIOAEROSOL SAMPLER (*1998 July 06) == IAS book number* **1** *Chair of session* Dr. Birenzvige A. phone +1 -410-6712469 fax +1 -410-6711912 email axbirenz@cbdcom.apgea.army.mil

Chair of session Prof Vlodavets V.V.

== *Session* MESUREMENT, MONITORING, BIOLOGICAL EFFECT, HYGIENIC ASSESSMENT. (*1998 July 06) == IAS book number* **2** *Chair of session* Prof Vladimir V.Tkachiov phone +7 -095-3653130 fax +7 -095-3660583

== *Session* AEROSOL DEVICES FOR MEDICINE (*1998 July 06) == IAS book number* **2** *Chair of session* Dr.Konovalov S.I. phone +7 -812-2452554 fax +7 -812-1195832 email Oleg@aeromed.spb.su

== *Session* DIAGNOSTICS OF EQUIPMENT BY DISPERSED PHASE (*1998 July 06) == IAS book number* **2** *Chair of session* Prof Logvinov phone +7 -8462-357356 fax +7 -8462-357356 email andrew@gw.med.samara.ru

== *Session* MEASUREMENT EQUIPMENT (*1998 July 06) == IAS book number* **2** *Chair of session* Prof Mikhailov O.M. phone +7 -812-2189952 fax +7 -812-2183720

== *Session* AEROSOL MEASUREMENT (*1998 July 06) == IAS book number* **2** *Chair of session* Professor Milazzo phone +39 -2-2665468 fax +39 -2-2665922 email Mario.Milazzo@mi.infn.it

== *Session* STANDARD, METROLOGY & TECHNIQUE OF AEROSOL MEASUREMENTS. (*1998 July 06) == IAS book number* **2** *Chair of session* Dr. Balahanov Michail V. phone +7 -095-5359359 fax +7 -095-5357386 email balah@ftri.extech.msk.su

== *Session* AEROSOL OPTICS (*1998 July 06) == IAS book number* **4** *Chair of session* Dr. Ackermann I. phone +49 -241-9421205 fax +49 -241-9421301 email iackerma@ford.com

== *Session* AEROSOLS AND POLARISATION (*1998 July 06) == IAS book number* **4** *Chair of session* Prof. Germogenova T.A. phone +7 -095-2507861 fax +7 -095-97207737 email Germ@kiam.ru

== *Session* CONDENSATION AEROSOL THEORY (*1998 July 06) == IAS book number* **3** *Chair of session* Prof Uvarova L.A. email uvarova@stanmat.mian.su

== *Session* THEORY OF AEROSOLS (*1998 July 06) == IAS book number* **3** *Chair of session* Professor Castillo J. phone +34 -91-3987122 fax +34 -91-3986697 email castillo@apphys.uned.es

== *Session* AEROSOL TRANFER (*1998 July 06) == IAS book number* **4** *Chair of session* Prof. Garger phone +7 -044-2205313 fax +7 -044-2209346 email garger@garger.pp.kiev.ua.

== *Session* MULTIPHASE JET FLOWS (*1998 July 07) == IAS book number* **6** *Chair of session* Prof Lepeshinskii phone +7 -095-1584063 fax +7 -095-1582977 email aet@tk.mainet.msk.su

== *Session* AEROSOL TECHNOLOGIES 1 (*1998 July 07) == IAS book number* **6** *Chair of session* Professor Nikitin P.V. phone +7 -095-1584930 fax +7 -095-1582977 email alt@tk.mainet.msk.su

== *Session* BURNING & COMBUSTION OF AEROSOLS (*1998 July 07) == IAS book number* **6** *Chair of session* Prof. V.A.Puhlyi phone +7 -095-9095629 fax +7 -095-4823876

Chair of session Dr. SEO

== *Session* ULTRADISPERSED POWDERS: SYMNTHESIS, PROPERTIES, APPLICATION (*1998 July 07) == IAS book number* **7** *Chair of session* Prof Buinovsky S.N. phone +7 -095-5230017 fax +7 -095-2734914 email Chteos@chteos.extech.msk.su

== *Session* ULTRAFINE POWDERS (*1998 July 07) == IAS book number* **7** *Chair of session* Prof Arsentieva fax +7 -095-3611446 email andreeva@ipmt-hpm.ac.ru

== *Session* FILTRATION (*1998 July 07) == IAS book number* **6** *Chair of session* Dr.Choi phone +82 -591-7515387 fax +82 -591-531906 email jhchoi@nongae.gsnu.ac.kr

== *Session* HOT GASES CLEANING (*1998 July 07) == IAS book number* **6** *Chair of session* Professor Chung J.D. phone +82 -2-405463 fax +82 -2-405460 email jdonchung@dogsuri.hoseo.ac.kr

== *Session* WET CLEANING OF GASES (*1998 July 07) == IAS book number* **6** *Chair of session* Professor Lorber K. phone +43 -3842-4610350 fax +43 -3842-4610352 email enttech@grz08u.unileoben.ac.at

== *Session* THEORETICAL & COMPUTATIONAL ASPECTS OF FULLERENE SCIENCE (*1998 July 07) == IAS book number* **5** *Chair of session* Professor Vinogradov Georgy A. phone +7 -095-9380561 fax +7 -095-1374101 email GAVIN@DEOM.CHPH.RAS.RU

== *Session* FULLERENES AND NANOTUBES (*1998 July 07) == IAS book number* **5** *Chair of session* Professor Shinohara H. fax +81 -52-7892962 email nori@chem2.chem.nagoya-u.ac.jp

== *Session* ATMOSPHERIC AEROSOLS (*1998 July 08) == IAS book number* **8** *Chair of session* Prof Zuev V.E. phone +7 -3822-258737 fax +7 -3822-259086 email zuev@iao.tomsk.su

== *Session* AEROSOLS IN STRATOSPHERE (*1998 July 08) == IAS book number* **9** *Chair of session* Prof Hamill phone +1 -408-9245241 fax +1 -408-9242917 email hamill@light.arc.nasa.gov

== *Session* AEROSOL & CLIMATE (*1998 July 08) == IAS book number* **8** *Chair of session*

== *Session* AEROSOLS & EARTH RADIATION BUDGET (*1998 July 08) == IAS book number* **9** *Chair of session* Prof Arking A. phone +1 -301-2992478 fax +1 -301-2992479 email arking@aa.gsfc.nasa.gov

== *Session* AEROSOL AND OCEAN (*1998 July 08) == IAS book number* **10** *Chair of session* Dr.Weinstein A. phone +44 -171-5144964 fax +44 -171-7236359 email aweinstein@onreur.navy.mil

== *Session* RADIOACTIVE AEROSOLS (*1998 July 08) == IAS book number* **10** *Chair of session* Dr. Tschiersch J. phone +49 -89-31872763 email Tschiersch@gsf.de

== *Session* RADIOACTIVE AEROSOLS (*1998 July 08) == IAS book number* **10** *Chair of session* Prof Kogan phone +1 -614-4247970 fax +1 -614-4244185 email koganv@battelle.org

== *Session* ANTROPOGENIC AEROSOLS AND ENVIRONMENT (*1998 July 08) == IAS book number* **8** *Chair of session* Professor Geernaert phone +45 -46-46301101 fax +45 -46-46301214 email GLG@dmu.dk

== *Session* ANTROPOHENIOUS ATMOSPHERIC AEROSOLS (*1998 July 08) == IAS book number* **8** *Chair of session* Prof Ivlev L.S. phone +7 -812-4287349 email vlas@aero.phys.pu.ru

== *Session* NONLINEAR OPTICS OF AEROSOLS (*1998 July 06) == IAS book number* **4** *Chair of session* Dr. Letfullin R.R. phone +7 -8462-340536 fax +7 -8462-355600 email skobelev@artlog.samara.su



List of COUNTRIES - CITIES -INSTITUTES of participants of IAS-4

Australia *Brisbane* Griffitii University
Austria *Leoben* Montanuniversitat Leoben
Wien Universitat Wien
Azerbaijan *Baky* Ecological Society of RUZGAR
Sector of Radiation Researches
Belorus *Minsk* Institute of Engineering Cybernetics
Canada *Ottava* Canada centre for remote sensing
Pinawa Manitoba AECL
Denmark *Roskilde* National Environmental Research Institute
France *Paris* Centre des faibles radioactivites
Germany *Berlin* Max-Born-Institut
Aahen Ford Center
Duisburg Gerharg Mercator University of Duisburg
Munchen GSF - Forschungszentrum fur Umwelt und Gesundheit
Potsdam Universitat Potsdam
Stahnsdorf Goldstein & Lewin technology GmbH
Greece *Athens* University of Athens
Israel *Ierusalem* The Hebrew University of Jerusalem
Italy *Bologna* Institute of physics and chemistry of the lower and upper atmosphere
University of Bologna
Milano Instituto di Fisica Generale Applicata, University of Milano
Japan *Aichi* Toyohashi University of Technology
Nagoya Nagoya University
Romania *Bukharest* Institute of Atomic Physics
Russia:
Chernogolovka Institute of Chemical Physics of RAS
Dolgoprudnii MR Moscow Physical & Technological University
Ekateinburg Ural State Technical Univerity
Irkutsk Limnological Institute
Polytechnic university of Irkutsk
Ivanovo Ivanovo Technical University
Kazan Chebotarev Institute of Mathematics and Mechanics at Kazan University
The federal research & production centre the state institute of applied optics - the fnpts gipo
Kemerovo State University of Kemerovo
Krasnoyarsk Forest Institute
Moscow Physical Institute named LEBEDEV
Novorossisk Kuban State Technological University, Novorossiysk Department
Noginsk Administration of Noginsk region
Novosibirsk Institute of Catalysis of RAS, Russian State Scientific Biological Center VECTOR
Obninsk Institute of Experimental Meteorology SPA Typhoon , LLNL
Samara Aerospace University of Samara
Samara Branch of P.N.Lebedev Physical Institute
Tomsk Institute of High Current Electronics
Institute of the Optics of the Atmosphere
Tomsk University
Tver Tversky State University
Tyumen Institute of Cryosphere of the EARTH
Yaroslavl Yaroslavl State University
South Korea
Andong Urban centre of the housing grants
Seoul Gyeongsang National University
Spain
Madrid Universidad Nacional de Educacion a Distancia
Taiwan *Taipei* National Taiwan University
UK *London* Naval Research Europe
Ukraine:
Ceverodonetsk Institute of Chemical Engineering KHIMTEKHNOLOGIYA
Kiev Astronomical Observatory of Kiev University
Institute for Problems of Materials Science
Institute of Energy Saving Problems.
Institute of Radioecology (Ukraine Sci.Academy)
USA:
Aber.Prv.Grd. US Army laboratory
Adelphi US Army Research Laboratory
Baltimore Johns Hopkins University
College Park University of Maryland
Engewood Area Edgewood Research Development and Engineering Center
Hinsdale Zaromb Corporation
Lanham Raytheon STX Corporation
NASA
Illinois University
Indiana Indiana Univ.
New York BGI INCORPORATED
San Jose San Jose State University
San Ramon Research and Development Pacific Gas and Electric Company
Urbana University of Illinois at Urbana-Champaign
Yugoslavia *Beograd* Institute of Chemistry, Technology and Metallurgy

IAS AWARD PROCEDURE

1) Selection of best investigation for each session by session chair
2) Presentation of session (by session chair) and best session presentation (10 min by author) during plenary
3) Selection of two awarded presentations from all list of best session presentations by bureau of award committee. This bureau of Award committee consists form session chairs which sessions are active today .
4) Final selection of award value for each awarded presentation.

Short information about award rules

Awarded investigation must be

- selected by session chair
- present during two plenary sessions (immediately after selection by session chair and during closing procedure at 9 July

One author can be selected for awarding only once.

AWARDS OF IAS-4

ALBERT MIRLESSE AWARD $500

Ms Albert Mirlesse is Swiss citizen. He is interested in new technologies in different directions (road, aerosol filtration, new materials, oil industry...)
He has offices in Swiss and in France.
His phones 41-22-3470614 , 41-22-3470645 Fax 41-22-3463654
ADDRESS: Rue de Villersexel, 4 75007 Paris France
e-mail: AMirless@IPROLINK.ch
Ms.Mirlesse is opened for contacts with IAS participants.
You are invited to phone, fax him.

AEROSOL TECHNOLOGY AWARDS - four awards , each $100.

Aerosol Technology LTD is scientific company. 90% of its budget is scientific grants and contracts for scientific investigations, preparing of PC codes, new equipment...
Aerosol Technology LTD main sponsor and organiser of INTERNATIONAL AEROSOL SYMPOSIUM
Unique equipment and high technologies of ATECH help us to publish IAS-4 materials very fast and with excellent quality.
You are invited to collaborate with ATECH.
Director ATECH - Prof Belov Nick N.
Phone and fax 7-095-1474361
e-mail : Belov@tehno.mmtel.msk.su
address 119285 Moscow 2-Mosfilm 21-117

Dear Colleagues,
If you are interested in aerosol science and technology, if you have $100 - $500 for supporting of this direction of knowledge - Please contact with Prof Belov .Your name or name of your organisation will be included in award certificate.

During IAS-4 selected series most interested presentations.

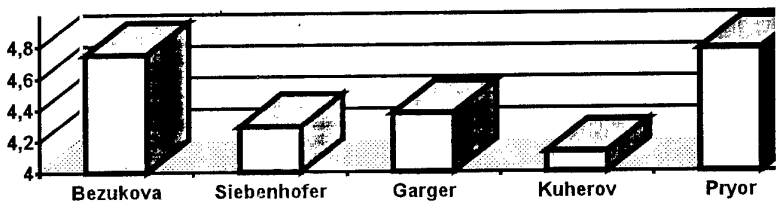
Presenter	*Authors of presentation*	Title of presentation	Session (where was made selected presentation)
Zvonov V.A.	*Kutenev V.F., Zvonov V.A., Kornilov G.S.*	Problems of the disel particulates assessment and reduction	session: Aerosol Measurement Dr Balakhanov, Prof Milazzo
Bezrukova A.G.	*Bezrukova A.G.*	Multiparametric optical study of biological and others disperse systems	Session: BIOAEROSOL SAMPLER Prof. Vlodavets
Kucherov A.N.	*Kucherov A.N.*	Laser beam evaporation of ice plate aerosol particle	session: Aerosol Optics, Dr Letfullin ., Dr Ackermann I.J.
Zaripov Sh.Kh.	*Kiselev O.M., Zaripov Sh.Kh., Zigangareeva L.M.*	Mathematical model of aerosol aspiration in calm air	session:Theory of Aerosols Professor Castillo
Heusler G.	*Heusler G, Campbell E.E.B.*	Alignment effects in Na*(3p) - C60 charge transfer reactions	session: Fullerene Prof Shinohara N, Prof Vinogradov
Siebenhofer M.	*Siebenhofer M., Lorber K.E.*	Wet electrostatic precipitation of fine particles	session: Filtration Professor Lorber, Prof Chung
Pryor S.	*Pryor S.C. , Barthelmie R.J. , Geernaert L.L.S., Ellermann T., Perry K.D.*	The role of aerosols in dry deposition to coastal waters	Session:Marine aerosols Dr Weinstein
Glikin M.A.	*Glikin M.A., Kutakova B.I., Pikhtovnikov B.I., Prin E.M., Viks I.N.*	Aerosol Catalysis	session Aerosol Technology Dr.Choi
Rublev A.N.	*Rublev A.N. ,Chubarova N.Ye., Trotsenko A.N, Trembach V.V., Zaharova P.V.*	The evaluation of the applicability of the continental aerosol model for radiative calculations	session: Aerosol and Climate Professor Arkin Acad, Prof Zuev
Kiseleva M.	*Kiseleva M., Reshetnikova I., Kazbanov W.*	Altitudinal & spectral profiles of atmospheric aerosol extinction in 0.4-12.0 m region: stratospheric balloon experiments	session: Stratospheric Aerosols Professor Hamil

Garger E.K.	*Garger E.K., Tschiersch J.*	Size distribution of radioactive particles resuspended in the Chernobyl area	Session: Radioactivity Aerosols Prof Kogan, Dr Tschiersch

Only 5 presentations from this list may be awarded. List of recipients of IAS-4 AAWARDS was prepared in last day of IAS-4 during plenary immediately after speeches of award candidates.

Vote on award candidates bulletin

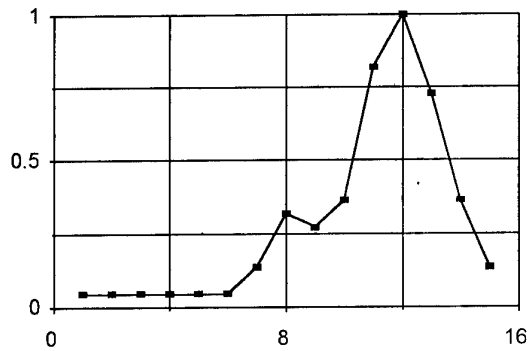
Candidate name	Votes			Wrongly marked	Total	Average score
	Excellent	Good	Poor			
1. Bezrukova	6	2	0	1	9	(6*5+2*4+0*3)/8= 4,75
2. ~~Kiseleva~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
3. Siebenhofer	4	2	1	2	9	(4*5+2*4+1*3)/7= 4,429
4. Garger	4	3	1	1	9	(4*5+*3*4+*1*3)/8= 4,375
5. Kucherov	3	3	2	1	9	(3*5+3*4+2*3)/8= 4,125
~~6. Zaripov~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
7. Pryor	7	2	0	0	9	(7*5+2*4)/9= 4,778



Finally, award winners are:

1st	Pryor
2nd	Bezrukova
3rd	Garger
4th	Siebenhofer
5th	Kucherov

First prize received Dr Pryor Sara (Certificate and $500 - Albert Mirlesse Award)
Four prizes from Aerosol Technology LTD (certificate and $100) received Prof Bezrukova A.G., Prof Garger, Dr. Kucherov, Dr. Siebenhofer M.



Receiving of abstracts

Time distribution of IAS-4 abstracts. Time =0 is last date of IAS-3 (5 December of 1996). Time 16 - is starting date iof IAS-4. Time 8 is dead-line for abstract submission.

month from IAS-4 announcement
16 - start of IAS-4
8- dead-line for submission of abstracts.

Practically 80% of abstracts was received after dead-line.

Publications of IAS-4

IAS-4 has great number of publications in English (22 volumes) and its translation in Russian (11 volumes). It was published all submissions received before 22 June (1 week before Symposium)! Only high technology and excellent software of Aerosol Technology LTD helps us to made this giant job. Niow I see that support of Aerosol Technology LTD may help us to received high level publication immediately before meeting. It is very inmportant for next Ias - meeting. Its dead-line will be closed to start date of symposium.

Problem of org fee payment

Org committee has not money for reservations of conference hall before April 1998. Moreover I can not pay only for conference halls. I must pay for insurance of hotel reservation of conference halls. I am sure that without this payment IAS-4 hall reservation may be cancelled.

Crisis in Russia - attendance of presenters can not be definite to last days.

Great part of participants pays their org fees after dead-line. Only financial support from Aerosol Technology LTD and sponsorship declaration of ERO US Army saved our meeting.

E-mail communication

40% of foreign IAS-4 participants (Prof Lorber, Dr Pryor, Dr Balkansky, Prof. Olivieri...) received modificated information by e-mail that SOVETSKAY hotel is full now and their reservation cancelled. It was modification of e-mail communication. Administration of the hotel was waiting for our colleagues. Moreover Hotel is very interested in their participation - it was empty during IAS-4.

Competition conferences

More than hundred Russian scientists pay org fee and wave IAS-4. I think that they was pressed (or bought) by IAS-4 unvisible enemy. During spring of 1998 there was established more than 20 conferences in all great cities of Russia for dates 6-10 July. All Russian session chairs of IAS-3 received money and invitation to work with these conferences instead IAS-4. Someone spent great money for reducing of IAS-4 influence.

Some of these conferences were established to steal paricipants from IAS-4:

TOMSK - Ecology and Mechanics prof. Grishin Anatoliy Mihayilovich fire@fire.tsu.tomsk.su

OBNINSK - Ultradispersed Powders - Martunov Petr Nikiforovich fax 7-(08439) 9-80-57;

RYAZAN - All-Russian Conference on Gas Discharge Physics - contact person: Prof Arefjev Alexander S.,. arefjev@ ttc.ryazan.ru

SANKT PETERSBURG

Nondestructive Testing and Computer Simulations in Science and Engineering (NDTCS-98)

Prof. Alexander Melker melker@phmet2.stu.neva.ru

Fullerene chemistry - (seems to be Prof. Vul')

MOSCOW, PUSCHINO, ETC ... A lot of conferences .

Summarizing of this report one can say that:

⇒ ERO supported extremely important meeting.

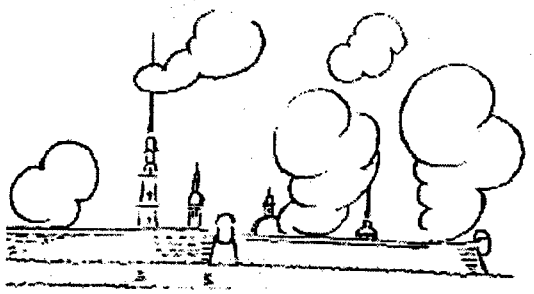
⇒ Organizers of this meeting (Aerosol Technology LTD and Russian Aerosol Society) made their job well and Symposium was held with a high level accuracy.

THANK YOU from all of IAS-4 participants!

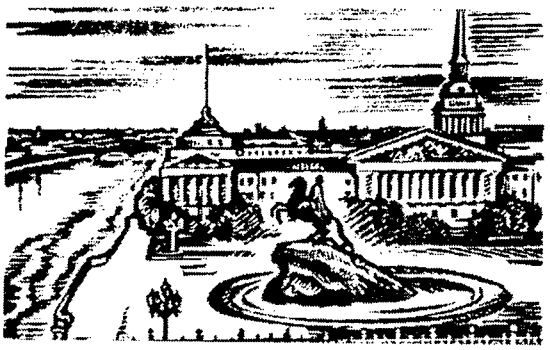
Honor President of Russian Aerosol Society

Chair of IAS-meetings  **BELOV**

RUSSIAN AEROSOL SOCIETY



PROGRAMM OF IAS-4



Printed in Russia

address Belov N 21-117
2-Mosfil 119285
tel/fax (095)1474361
BELOV@TEHNO.MMTEL.MSK.SU

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6 JULY 98 Room No 1 *(18th floor)* session Bioaerosol sampler co-chairs: Dr. Birenzvige A. , Prof. Vlodavets V.V.



(9.00-9.20) Agaltsov A.M., Bordeniouk A.N., Gorelik. V.S. THE ULTRAVIOLET RADIATION OF BACTERIA UNDER PULSE LASER INFLUENCE
(9.20-9.40) Vlodavets V.V., Lysenko S.U. THE PRINCIPLES AND METHODS OF BIOLOGICAL AEROSOL INVESTIGATION
(9.40-10.00) Toporkov V.S., Bakirov T.S., Generalov V.M. , Medvedev A.A. SAMPLING, SEPARATION AND ACCOUNT OF BIOLOGICAL PARTICLES
(10.00-10.20) Omeljanets T.G., Artyukh V.P., Ganeva S.L. THE METHODICAL APPROACHES TO BIOLOGICAL INDICATIONS OF AIR WASTES OF THE ENTERPRISES OF A MICROBIOLOGICAL INDUSTRY
(10.40-11.00) Vorobeychikov E.V., Granstrem K.O., Ivanov V.P., Kurtzer G.M. METHODOLOGICAL ASPECTS OF ESTIMATING THE MICROBIAL AEROSOL PARAMETERS INDOORS
(11.00-11.20) Bezrukova A.G. MULTIPARAMETRIC OPTICAL STUDY OF BIOLOGICAL & OTHERS DISPERSE SYSTEMS
(11.20-11.40) Belov N.N., Belova N.G., Ugarova N.N. DIAGNOSTICS OF VITAL MICROORGANISMS IN AEROSOL SAMPLES
(11.40-12.00) Glushchenko N.N., Bogoslovskaya O.A., Olkhovskaya I.P. CORRELATION OF E.COLI LIPID PARAMETERS WITH CELL SURVIVAL IN AEROSOL
(12.40-13.00) Dirksen V.G. RECENT AND SUBRECENT POLLEN SPECTRA OF GLACIER SURFACES AND MOUNTAIN VEGETATION AS A SOURCE OF BIOECOLOGICAL INFORMATION (SOUTH- WESTERN TUVA, RUSSIA)
(13.00-13.20) Ukraintseva V.V. AEROPALYNOLOGY IN RUSSIA: RECENT STATE AND PROSPECTS

6 JULY 98 Room No 1 *(18th floor)* session AEROSOLS and HEALTH. Co-chairs: Prof. Tkachiov, Prof. Geernaert



(13.20-13.40) Geernaert G.L., Wahlin P. EXTREME AEROSOL EVENTS AND HEALTH IMPLICATIONS
(13.40-14.00) Tkachiov V.V., Subbotin V.V., Kirin B.F., Dremov V.I. HYGIENIC CONTROL OF INDUSTRIAL AEROSOLS: PROBLEMS OF INTERNATIONAL UNIFICATION

6 JULY 1998 Room 1 *(18th floor)* PLENARY CEREMONY (14.20-15.40)
Brief estimation of best presentations by session chairs.
Speeches of session chairs: Prof. Vlodavets, Dr Birenzvige, Prof. Geernaert, Prof. Germogenova,. Dr. Ackermann I.J, Dr. Balakhanov, Prof. Millazzo, Prof. Castillo, Prof. Uvarova



Reccomendations for IAS-5 (new sessions...)

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6 JULY 98 Room No 2 session Aerosols Optics Chairs: Prof. Germogenova, Dr. Ackermann I.J.,Dr. Letfullin



(10.40-11.00) Uvarova L.A.,Krivenko I.V.,Smirnova M.A. COLLECTIVE ELECTROMAGNETIC & HEAT EFFECTS IN AEROSOL SYSTEMS TWO AEROSOL INTERACTED PARTICLES - CONTINUOUS MEDIUM
(11.00-11.20) Germogenova T.A., Konovalov N.V., Pavelyeva E.B. CONCEPT OF POLARIZED LIGHT SCATTERING MATRIX CORRECTNESS
(11.20-11.40) Letfullin R.R., Igoshin V.I., Sannikov S.P. AEROSOL REACTOR FOR CREATION OF BIPHASE ACTIVE MEDIUM OF LASERS
(11.40-12.00) Bonch-Bruevich A .M., Smirnov V.N. LOW THRESHOLD OPTICAL BREAKDOWN OF AIR & FORMATION OF DAMAGES TO ALKALI HALIDE SURFACES
(12.20-12.40) Pokrovsky S.G., Fannibo A.K. CREATING OF MICRON-SIZE AEROSOL IN LASER ABLATION OF THIN METAL FILMS ON THE POLYATHYLENTEREPHTHALAT SUBSTRATE
(13.00-13.20) Kucherov A.N. LASER BEAM EVAPORATION OF ICE PLATE AEROSOL PARTICLE
(13.20-13.40) Wolkov S.A. THE LASER WITH INTRACAVITY REACTOR FOR PROCESSING OF DISPERSIBLE PARTICLES.

6 JULY 98 Room No 3 session Standard, Metrology & Technique of Aerosol Measurements. Dr. Balahanov Michail V., Prof. Mikhailov O.M., Prof. Millazzo



(10.40-11.00) Balakhanov M.V., Bolshakov V.A., Kudrjashov V.V., Petrov A.A., Sevastjanov V.D., Solnykov V.V. DEVELOPMENT AND METROLOGICAL QUALIFICATION OF THE RADIOACTIVE ISOTOPE DUST-METER IKAR.
(11.00-11.20) Balakhanov M. V., Gritzenko A. P., Kocherga V. G., Trotzenko N.P. EQUIPMENT FOR MEASUREMENTS AND TESTING OF AIR CONTAMINATION AND CERTIFICATION OF CLEAN ROOMS
(11.20-11.40) Chechik O.S. MONODISPERSE LATEXES. MAKING, USING, CHARACTERISTICS.
(11.40-12.00) Terentiev V.E. OPTICAL DISTANCE PROBING OF EXTRACTIVE PULPS
(12.40-13.00) Agranovski I.E. NEW TECHNIQUE FOR MONITORING OF AEROSOL CONCENTRATION
(13.00-13.20) Logvinov L.M., Malygin N.A., Smagin W.A., Courdin G.A. INDICATOR OF QUALITY CONTROL OF JET FUELS OF A TYPE POTOK-RT
(13.20-13.40) Kameshkov G.B. , Mirzoeva L. A., Grammatin A.P., Lustberg E.A., Makovtsov G.A. UV, VISIBLE & IR HIGH-QUALITY SMALL-SIZED OBJECTIVES FOR RESEARCH OF ATMOSPHERE OPTICAL PARAMETERS
(13.40-14.00) Mikhailov O.M. , Kanatenko M.A. METROLOGICAL PROVISION OF AEROSOL MEASUREMENTS



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6 JULY 98 Room No 4 *(9th floor)* session Aerosol Theory Co-chairs Prof. Uvarova L.A., Prof. Castillo

(10.40-11.00) Kiselev O.M., Zaripov Sh.Kh., Zigangareeva L.M. MATHEMATICAL MODEL OF AEROSOL ASPIRATION IN CALM AIR

(11.20-11.40) Chernyak V. , Klitenik O. LIGHT-INDUCED EVAPORATION AND GROWTH OF AEROSOL PARTICLES

(11.40-12.00) Aloyan A.E., Arutyunyan V.O., Louzan P.I. NUMERICAL MODELING OF GAS-AEROSOL INTERACTION IN WET ATMOSPHERE

(12.00-12.20) Grigorev A.I., Sidorova T.I. SOME REGULARITIES OF A PRECIPITATION OF STOKE AEROSOL & ITS ACCUMULATION ON A SOIL & A VEGETATION

(13.00-13.20) Redcoborody Yu.,Grinshpun S.,Zadorozhnii V. EXPERIMENTAL INVESTIGATION OF DRIFT MOTION IN AEROSOLS AND HYDROSOLS UNDER PROPAGATING ACOUSTIC WAVE

(13.20-13.40) Castillo J.L., Garcia-Ybarra P.L. INFLUENCE OF DIFFUSIVE LEAKAGE IN METHODS OF PARTICLE REJECTION FROM SURFACES

(13.40-14.00) Seo T., Choi J.-H., Chung J.-H., Jeong H.-I. NUMERICAL ANALYSIS OF FLOW FIELD IN THE CERAMIC CANDLE FILTER USED IN INTEGRATED GASIFICATION COMBINED CYCLE

(14.00-14.20) Podvysotsky A.M. MICROMECHANICS OF DROPS INTERACTION IN AEROSOL FLOWS

15.00-16.00 Posters

17.00 -18.00- Excurtion



7 JULY 98 Room No 1 *(18th floor)* session Fullerenes and Nanotubes co-chairs: Professor Shinohara, Professor Chernozatonsky, Professor Vinogradov

(9.00-9.20) Lozovik Yu. E., Popov A. M. THE PRINCIPLES AND METHODS OF BIOLOGICAL AEROSOL INVESTIGATION

(9.20-9.40) Ivanov-Omskii V.I, Yastrebov S.G. DIAMOND NANOCLUSTERS NUCLEATION IN AMORPHOUS CARBON MEDIA

(9.40-10.00) Chernozatonskii L.A., Lebedev N.G., Litinski A.O., Zaporotskova I.V. HYDRIDES OF SINGLE-WALLED CARBON NANOTUBES

(10.00-10.20) Lavrov V.V., Arkhangel'skii I.V., Skokan E.V. SYNTHESIS OF HIGHLY DISPERSED PRECURSORS FOR C60 PHOTOPOLYMERIZATION

(10.40-11.00) Astakhova T.Yu., Buzulukova N.Yu., Vinogradov G.A. NEW ISOMERIZATION REARRANGEMENTS FOR FULLERENES

(11.00-11.20) Losovik Yu.E., Popov A.M. FORMATION OF FULLERENES AND THEIR ISOMERS

(11.20-11.40) Shinohara H. PUTTING METAL ATOMS INTO FULLERENES: ENDOHEDRAL METALLOFULLERENES

(11.40-12.00) Heusler G, Campbell E.E.B. ALIGNMENT EFFECTS IN NA*(3P) - C_{60} CHARGE TRANSFER REACTIONS



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(12.40-13.00) Volkov I.A. TO THE HIGHER FULLEREN PROBLEM
(13.00-13.20) Krestinin A.V. MECHANISM OF SOOT FORMATION IN PYROLYSIS AND COMBUSTION OF HYDROCARBONS
(13.20-13.40) Lebedev N.G., Zaporotskova I.V., Litinsky A.O., Chernozatonsky L.A. ELECTRON STRUCTURE OF CARBON NANOTUBES MODIFIED BY ALKALI METAL ATOMS

7 JULY 98 Room 1 *(18th floor)* PLENARY CEREMONY (14.20-15.40)
Brief estimation of best presentations by session chairs.
Speeches of session chairs: Professor Shinohara, Professor Chernozatonsky, Professor Vinogradov, Professor Lorber K., Professot Chung, Dr.Weinstein A., Dr Radionov, : Prof. Bazarov. Dr Choi, Prof. Arsentieva, Dr Seo
Reccomendations for IAS-5 (new sessions...)

7 JULY 98 Room No 2 *(18th floor)* session Cleaning of gases Co-chairs: Professor Lorber K., Professot Chung

(9.00-9.20) Agranovski I.E., Myojo T., Braddock R. D. STUDY OF THE PERFORMANCE OF DIFFERENT FILTERS UTILIZED IN FILTRATION OF AEROSOLS BY BUBBLING
(9.20-9.40) Siebenhofer M., Lorber K.E. WET ELECTROSTATIC PRECIPITATION OF FINE PARTICLES
(9.40-10.00) Chung J.D. , Choi J.H., Kanaoka C. EXPERIMENTAL RESULTS OF HIGH TEMPERATURE FILTRATION AND DUST CAKE ANALYSIS BY CERAMIC CANDLE FILTER
(10.00-10.20) Choi J-H, Seo Y-G, Jeong H-I , Chung J-H THE PULSE CLEANING BEHAVIOURS OF GROUP CANDLE FILTER IN A HOT BENCH UNIT

7 JULY 98 Room No 2 *(18th floor)* session Marine Aerosol co-chairs Dr.Weinstein A., Dr Radionov

(10.40-11.00) Geernaert G. L., Geernaert L. L. S. THE ROLE OF MARINE SPRAY AND AEROSOLS ON THE AIR-SEA EXCHANGE OF HEAT AND GASES
(11.00-11.20) Nguyen B. C., Mihalopoulos N., Sciare J., Baboukas E. SEASONAL VARIATION OF AEROSOL DEPOSITION FROM BIOGENIC SULFUR GASES IN REMOTE MARINE ATMOSPHERE AT AMSTERDAM ISLAND IN THE SOUTHERN INDIAN OCEAN
(11.20-11.40) Pryor S.C. , Barthelmie R.J. , Geernaert L.L.S., Ellermann T., Perry K.D. THE ROLE OF AEROSOLS IN DRY DEPOSITION TO COASTAL WATERS
(11.40-12.00) Zielinski T. , Zielinski A., Piskozub J. INFLUENCE OF DYNAMIC ATMOSPHERIC CONDITIONS ON THE CONCENTRATIONS AND PARTICLE SIZE DISTRIBUTION OF THE MARINE AEROSOL



7 JULY 98 Room No 2 *(18th floor)* session *(18th floor)* Aerosol Technology co-chairs: Prof. Bazarov. Dr Choi

(12.40-13.00) Gertsenshtein S.Ya., Lyakhov A.G., Nekrasov I.V. ON SPRAYING OF ELECTRIFIED CAPILLARY JETS
(13.00-13.20) Zvereva N.S. DUST GENERATOR QUARTZ
(13.20-13.40) Varushchenko R.M.,Druzhinina A.I.,Pashchenko L.L. THERMODYNAMIC INVESTIGATION OF THE ALTERNATIVE FREONS R-122 AND R-122A
(13.40-14.00) Glikin M., Kutakova D. , Prin E. UNSTEADY-STATE PROCESSES IN AEROSOL OF CATALYST

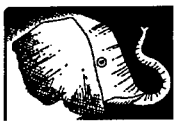
7 JULY 98 Room No 3 *(9th floor)* session Ultrafine powders Prof. Arsentieva, Dr Seo

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(9.00-9.20) Jigatch A.N., Leypunsky I.O., Kuskov M.L, Verzhbitskaya T.M. ULTRA-FINE POWDERS OF METALS, PRODUCED BY EVAPORATION-IN-FLOW TECHNIQUE
(9.20-9.40) Kostiuk V.V., Lepeshinsky I.A., Ivanov O.K., Zuev Yu.V., Reshetnikov V.A., Voronettsky A.V., Tsipenko A.V. SOME RESULTS OF THE INVESTIGATION OF TWO-PHASE JETS.
(9.40-10.00) Pokropivny V.V., Skorokhod V.V., Pokropivny A.V., Krasnikov Y.G. MECHANICAL PHENOMENA AT SHOCK AND DESTRUCTION OF METALLIC NANOPARTICLES STUDIED BY MOLECULAR DYNAMICS SIMULATION
(10.00-10.20) Arsentyeva I., Talian N., Iordovich D., Krsmanovich D., Sokolova E. ANALYSIS OF THE HIGHDISPERSED METALS AND OXIDES POWDERS

15.00-16.00 POSTERS

17.00 -18.00- Excurtion

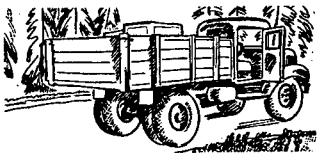


8 JULY 98 Room No 1 *(18th floor)* session Aerosols & Earth Radiation Budget
Prof. Arking A., Prof. Schlesinger M., Academician Prof. Kondratiev

(9.00-9.20) Shilkov A.V., Shilkova S.V. A COMPUTER CODE SYSTEM ATRAD FOR EFFICIENT PRECISE CALCULATIONS OF ATMOSPHERIC RADIATION
(9.20-9.40) Russell P. B.,Livingston J. M. ,Schmid B. ,Hignett P. ,Durkee P. A. ,Hobbs P. V. , Gasso S., Hegg D. ,Stowe L.L. ,Bates T. S., Quinn P. K.,Hamill P. URBAN-MARINE AND MINERAL-DUST AEROSOL PROPERTIES, RADIATIVE EFFECTS AND CLOSURE STUDIES OVER THE ATLANTIC OCEAN: AN OVERVIEW AND SELECTED RESULTS FROM TARFOX AND ACE-2
(9.40-10.00) Rublev A.N.,Chubarova N.Ye.,Trotsenko A.N,Trembach V.V.,Zaharova P.V. THE EVALUATION OF THE APPLICABILITY OF THE CONTINENTAL AEROSOL MODEL FOR RADIATIVE CALCULATIONS
(10.00-10.20) Li Z. , Kou L. DIRECT RADIATIVE FORCING AT THE SURFACE BY SMOKE AEROSOLS DETERMINED FROM SATELLITE & SURFACE MEASUREMENTS
(10.40-11.00) Kato S., Charlock Th.P., Clothiaux E.E., Long C.L., Charles N. Mace C.N., Ackerman T.P. CHARACTERISTICS OF AEROSOL AT THE NORTHERN OKLAHOMA
(11.00-11.20) Feigelson E.M., Gorchakova I.A., Shilovtseva O.A. THE INFLUENCE OF AEROSOL ON THE FLUXES OF SOLAR RADIATION IN ATMOSPHERE, CLOUDS AND ON THE EARTH SURFACE
(11.20-11.40) Balkanski Y.,Guelle W.,Schulz M., Claquin T.,Marticorena B.,Bergametti G.,Chazette P.,Pelon J. MODELING THE ATMOSPHERIC CYCLE AND THE RADIATIVE EFFECT OF SAHARAN DUST
(11.40-12.00) Arking A. THE INFLUENCE OF AEROSOLS ON ATMOSPHERIC ABSORPTION OF SOLAR RADIATION
(12.40-13.00) Aristova E.N., Goldin V.Ya. CALCULATION OF ANISOTROPIC SCATTERING OF SOLAR RADIATION IN ATMOSPHERE (MONOENERGETIC CASE)
(13.00-13.20) Stenchikov G., Kirchner I. , Robock A. , Graf H-F. RADIATIVE FORCING AND CLIMATE RESPONSE FROM THE 1991 MT. PINATUBO AEROSOL CLOUD
(13.20-13.40) Ackermann I.J., Hass H. REGIONAL AEROSOL MODELLING WITH A EULERIAN MODEL
(13.40-14.00) Zuev V.E. COMPLEX AEROSOL PROGRAM OF THE INSTITUTE OF ATMOSPHERIC OPTICS SB RAS, TOMSK, RUSSIA



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8 JULY 98 Room 1 PLENARY CEREMONY (14.20-15.40)
Brief estimation of best presentations by session chairs.
Speeches of session chairs: Prof. Arking A., Prof. Schlesinger M., Academician Prof. Kondratiev, Prof. Hamill, Prof. Ivlev, Prof. Mikhailov O.M., Prof. Zuev V.E., Prof. Hamill, Professor Geernaert, Prof. Gavrilov, Prof. Kogan, Dr. Tschiersch
Reccomendations for IAS-5 (new sessions...)

8 JULY 98 Room No 2 session Aerosols in Stratosphere co-chairs: Prof. Hamill, Prof. Ivlev, Prof. Mikhailov O.M.

(9.00-9.20) Ivlev L.S., Melnikova I.N. MICROPHYSICAL PARAMETERS OF STRATUS CLOUDS
(9.20-9.40) Kuznetsova I. N., Shakina N. P. STRATOSPHERIC INTRUSIONS AS TRANSFERRING RADIOACTIVE AEROSOL TO THE ATMOSPHERIC SURFACE LAYER
(9.40-10.00) Ivlev L.S., Chelibanov V.P. AEROSOLS AS A CAUSE OF OZONE'S VARLABILITY IN SPACE AND TIME
(10.00-10.20) Holben B., Tanre D. , Kaufman Y. , Smirnov A., Eck T., Slutsker I., Dubovik O., Markham B., Abuhassan N., ATMOSPHERIC AEROSOL OPTICAL PROPERTIES MEASURED THROUGH THE NASA AEROSOL ROBOTIC NETWORK (AERONET)

8 JULY 98 Room No 2 session Measurement equipment Prof. Mikhailov O.M.



(10.40-11.00) Mikhailov O.M. MEASUREMENT CHARACTERISTICS OF RECEIVERS & SOURCES OF RADIATION
(11.00-11.20) Yevsikova L.G. , Puisha A.E. TOOLS OF MEASURING VISIBILITY OF OBJECTS THROUGH AEROSOL MEDIA
(11.20-11.40) Koudryashov V.I., Ivlev L.S. PHYSICAL TECHNIQUES OF ULTIMATE ANALYSIS IN ENVIRONMENTAL MONITORING
(11.40-12.00) Lobanova G.I., Mirsoeva L.A., Popov O.I. BALLOON - BORNE STUDIES OF AEROSOL OPTICAL PROPERTIES OF FREE ATMOSPHERE AT ALTITUDES UP TO 30 KM IN VISIBLE & NEAR IR SPECTRAL RANGES

8 JULY 98 Room No 3 session Atmospheric aerosols Prof. Zuev V.E.
session Aerosols in Stratosphere Prof. Hamill

(9.00-9.20) Kolesnikov E.Yu., Ivlev L.S., Efremov M.N. MODEL FOR PROPAGATION OF AEROSOLS OF VARIOUS ORIGIN UNDER THE CONDITIONS OF FOREST VEGETATION.
(9.20-9.40) Veremei N.E., Dovgaluk Yu.A., Egorov A.D., Ishenko M.A., Ponomaryov Yu.Ph., Sinkevich A.A., Stalevich D.D., Stepanenko V.D., Khvorostovsky K.S. THE INVESTIGATION OF THE INFLUENCE OF CLOUDS AND PRECIPITATIONS ON THE PROCESSES OF SCAVENGING THE AEROSOL FROM THE TROPOSPHERE
(9.40-10.00) Hamill P. MICROPHYSICAL PROCESSES AFFECTING THE FORMATION OF THE BACKGROUND STRATOSPHERIC AEROSOL
(10.00-10.20) Stenchikov G., Dickerson R., Kondragunta S., Park R. THE IMPACT OF AEROSOLS ON SOLAR UV ACTINIC FLUX AND PHOTOLYSIS RATES

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(10.40-11.00) Kiseleva M., Reshetnikova I., Kazbanov W. ALTITUDINAL & SPECTRAL PROFILES OF ATMOSPHERIC AEROSOL EXTINCTION IN 0.4-12.0 M REGION: STRATOSPHERIC BALLOON EXPERIMENTS.
(11.00-11.20) Skrotskaya O.P., Degtiarev A. I. THE CLIMATE SIMULATION BY THE ACCOUNT OF' THE RADIACTIVE EFFECT OF AN ATMOSPHERIC AEROSOL.

8 JULY 98 Room No 4 session Antropogenic Aerosols and Environment Professor Geernaert, Prof. Gavrilov

(11.40-12.00) Li Z. REMOTE SENSING OF FOREST FIRES AND THE DIRECT RADIATIVE FORCING OF FIRE SMOKE
(9.00-9.20) Garger E.K. AEROSOL EMISSION FROM CONTAMINATED STRIP OF SOIL DURING HARROWING & TRUCK MOVING
(9.20-9.40) Degtiarev A.I., Naumov A.D., Valteran V.P. THE INFORMATION-ANALYTICAL COMPLEX FOR THE ACCOUNT OF AEROSOL EMISSIONS IN THE ATMOSPHERE
(9.40-10.00) Barthelnie R.J. , Pryor S.C. DMS OXIDATION IN A NON-REMOTE LOCATION
(10.00-10.20) Geernaert G. AEROSOL RESEARCH ISSUES RELATED TO HEALTH AND DEFENCE POLICY
(10.40-11.00) Glushchenko N.N., Bogoslovskaya O.A., Olkhovskaya I.P. ENVIRONMENTAL DAMAGE OF FLY ASH FROM THERMOELECTRIC POWER STATIONS FOR THE LIVING ORGANISMS - MODELLING WITH ULTRADISPERSED METAL POWDERS
(11.20-11.40) Radionov V.F., Rusina Ye. N. AEROSOL-OPTICAL CHARACTERISTICS OF THE ATMOSPHERE IN HIGH AND TEMPERATE LATITUDES OF RUSSIA
(11.40-12.00) Zakharenko V.S., Parmon V.N. METAL OXIDES - THE MAIN COMPONENTS OF TROPOSPHERIC SOLID AEROSOLS UNDER THE EARTH'S ATMOSPHERE CONDITIONS

8 JULY 98 Room No 4 *(9th floor)* session Radioactive Aerosols Prof. Kogan, Dr. Tschiersch J.,

(11.40-12.00) Kogan V., Schumacher P.M. PLUTONIUM RELEASE FRACTIONS FROM ACCIDENTAL FIRES
(12.40-13.00) Garger E.K., Tschiersch J. SIZE DISTRIBUTION OF RADIOACTIVE PARTICLES RESUSPENDED IN THE CHERNOBYL AREA
(13.00-13.20) Tschiersch J., Wagenpfeil F. HOT PARTICLES OF CHERNOBYL ORIGIN IN ENVIRONMENTAL SAMPLES
(13.20-13.40) Garger E.K., Kashpur V., ParetzkeH.G., Tschiersch J. RADIOACTIVE DISTRIBUTION OF SIZE PARTICLES FOR SIMULATION OF SOME ANTROPOGENIC ACTIVITIES

15.00-16.00 POSTERS

17.00 -18.00- Excurtion

9 JULY 98 Room No 1 *(18th floor)*

Plenary meeting
9.00-10.20 and 10.40-12.00 Best presentations selected during plenary ceremonies from 6 to 8 July 98. Selection of recipients of AWARDS
12.20 - 12.40 Discussing features of IAS-5
12.40 - 13.00 Presentation of President of Russian Aerosol Society
13.00-13.20 AWARDS CEREMONY

BANQUETTE
CLOSURE OF IAS-4

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POSTERS 18-th floor -conference hall

6 JULY 1998 Poster presentations (18 th-floor conference hall)

1528 Adams P.A., Spendlove J.C. BIOLOGICAL AEROSOLS GENERATED BY SHOWER BATHING

1534 Aleksashenko V. A. , Stupnikova L. I. , Solovyov A. A., Sukhoverkhov L. G. EFFECT OF FILIFORM-STRUCTURE-BASED, SPACIALLY-DISTRIBUTED AEROSOL FORMATIONS ON ELECTROMAGNETIC WAVE PROPAGATION OVER A SUPER-WIDE RANGE OF FREQUENCIES

1405 Alvarez, M. L., Canals, A., Mora, J., Todolí, J.L. APPLICATION OF TIKHONOV REGULARIZATION METHOD TO OBTAIN SIZE DISTRIBUTIONS

1282 Anisimov M.P., Nasibulin A.G., Timoshina L.V. NUCLEATION IN THE VICINITY OF CRITICAL PARAMETERS OF THE 1,3-PROPANDIOL - CO2 BINARY SYSTEM

1285 Anisimov M.P., Nasibulin A.G., Timoshina L.V. 1,3-PROPANDIOL - SULFUR HEXAFLUORIDE VAPOR NUCLEATION IN THE VICINITY OF CRITICAL TEMPERATURE

1374 Ankudinov V. B. , Klyonov M. G. , Maruhin U. A. , Ogorodnikov V. P. EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER IN REGULAR FLOW OF MONODISPERSE DROPS.

1540 Aponin G.I., Besshaposhnikov A.A., Kulakov D.M., Pal' A.F., Serov A.O., Suetin N.V. MICROPARTICLE CONCENTRATION MEASURING IN THE NON-SELF-SUSTAINED GAS DISCHARGE DUSTY PLASMA

1053 Arguchintsev V.K. MODELLING OF MESOMETEOROLOGICAL PROCESSES & POLLUTANTS TRANSPORT IN THE BOUNDARY LAYER

1174 Belov N.N., Belova N.G., Galkin À.S. MICRODROPLET METHOD FOR DIAGNOSTICS OF BIOLOGICAL ACTIVE SUBSTANCES IN AEROSOL SAMPLE

1177 Belov N.N., Belova N.G., Morosov S.Yu. DIAGNOSTICS OF POLYNUCLEOTIDES IN SAMPLES OF AEROSOL (AIRBORNE)

1176 Belov N.N., Belova N.G., Tychinsky V.P. PHASE MICROSCOPE FOR BIOAEROSOL DIAGNOSTICS

1316 Beresnev S.A., Pasechnik A.S. DIFFUSIOPHORESIS OF AEROSOL PARTICLES AT ARBITRARY KNUDSEN

1318 Beresnev S.A., Starinov S.A. AEROSOLS ELECTRODYNAMICS PARAMETERS INVESTIGATION: IMPORTANCE FOR A NUMBER PHENOMENON

1216 Beschastnov S.P., Naidenov A.V. SPATIAL VARIABILITY OF WIND FIELD AND ITS EFFECT ON POLLUTION CONCENTRATION NEAR THE GROUND FOR A LOCAL SYSTEM OF RADIATION MONITORING

1280 Beschastnov S.P., Naidenov A.V. ON A CONTRIBUTION OF WIND SHEARS INTO HORIZONTAL DISPERSION OF POLLUTION PLUME FROM A CONTINUOS POINT SOURCE

1283 Beschastnov S.P., Naidenov A.V. THE INVESTIGATIONS OF SPATIAL VARIABILITY FOR WIND FIELD AND ITS EFFECTS ON POLLUTION CONCENTRATION NEAR THE GROUND FOR A LOCAL SYSTEM OF RADIATION MONITORING

1238 Bockmann C., Bernutat C., Fischer S. THE NONLINEAR LIDAR-EQUATION - AN INVERSE ILL-POSED PROBLEM



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1496 Boyko B.N., Matiashov I.I. BIOTEST, AN INSTRUMENT FOR MEASURING METABOLIC ACTIVITY OF MICROORGANISMES

1361 Castillo J.L., Garcia-Ybarra P.L. PRESENCE OF DIFFUSIVE LEAKAGE IN METHODS OF PARTICLE REJECTION FROM SURFACES

1223 Charty P.V., Shemanin V.G. SOLID PARTICLES CONCENTRATION OPTICAL MEASURERING INSTRUMENTS ON THE BASIS OF INTEGRATES LIGHT SCATTERING METHOD APPLICATION FEATURES

1314 Chernyak V.G., Beresnev S.A., Starikov S.A. KINETIC THEORY OF DIFFUSIOPHORESIS OF AEROSOL PARTICLES IN A BINARY GAS MIXTURE

1583 Curto E., Lin J.-C., Gentry J.W. APPARENT CHARGE METHOD FOR INVERSION OF CHARGE DISTRIBUTIONS

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1407 Kadygrib A.M., Kashparov V.A., Lundin S.M., Prister B.S., Protsak V.P., Levchuk S.E., Yoschenko V.I., Garger E.K., Kashpur V.A., Talerko N.N.. THE RESULTS OF EXPERIMENTAL RESEARCH OF THE FOREST FIRES INFLUENCE ON THE RADIOACTIVE CONTAMINATION OF ENVIRONMENT AND THE ASSESSMENT OF DOSES TO FIRE FIGHTERS.

1241 Karelsky K. V., Petrosyan A. S. SOLID PARTICLES DISPERSION IN TURBULENT PLANETARY BOUNDARY LAYER FLOWS

1269 Katkov V. MODELING OF ATMOSPHERIC TRANSPORT OF AEROSOL

1266 Khelkovskiy-Sergeev N. BERILLIUM AEROSOL: HIGH DANGER YET POSSIBLE PREVENTION OF HARMFUL EFFECTS

1613 Kirin B.F., Tkachev V.V., Dremov V.I. SYSTEM OF CONTROL OF SPRAYS IN THE LIMITED AND FREE AIR FLOWS, RECOMMENDATIONS ON PREVENTING OF HARMFUL ACTING OF DUST ON PEOPLE AND ECOLOGY OF THE REGION

1478 Kondrasheva M.N., Nayidenskiyi M.S., Nesterov V.V., Gritsyuk V.A., Gordeev V.V., Lukicheva V.A. SUCCINATE-STIMULATOR OF EMBRIO AND POSTEMBRIO DEVELOPMENT OF EGG BREAD POULTRY

1673 Kondrashova M. N., Naidensky M. S., Lazareva N, U., Luzbaev K. V., Karmoliev R. H. USING OF SPRAY WATER SOLUTION OF SUCCINATE FOR THE STIMULATION OF EMBRYOGENESIS & RISE OF RESISTANCE & PRODUCTIVITY OF MEAT POULTRY

1009 Koromyslov V.A., Shiryaeva S.O. INSTABILITY OF A CHARGED DROP FREELY FALLING IN THE ATMOSPHERE



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1298 Kostyuk V.A., Potapovich A.I., Maslova G.T., Korkina L.G., Ostrakhovich E.A. , Afanas'ev I.B. PHARMACOLOGIC APPROACH TO THE STUDY AND MANAGEMENT OF PRIMARY MECHANISMS RESPONSIBLE FOR ASBESTOS-RELATED DISEASES

1498 Kotelnikov G.V., Shkidchenko A.N., Permyakov E.A. TITRATION CALORIMETER IN DIAGNOSIS OF MICROORGANISMS

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1000 Kudriavtcev I.A., Fadeev V.V. APPLICATION OF MICROCOMPUTERS IN SYSTEMS OF RECOGNITION OF COMPLEX PULSES FROM PARTICLES ON THE OUTPUT OF PHOTOELECTRIC GAUGES

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1201 Letfullin R.R., Melikhov K.G. , Igoshin V.I. TIME DYNAMICS OF THE DISPERSE COMPONENT OF THE BIPHASE LASER ACTIVE MEDIUM

993 Logvinov L.M. BUILT - IN SENSORS (BIS) FOR DIAGNOSTICS OF LIQUID SYSTEMS ON PARAMETERS OF PARTICLES OF WEAR.

1294 Lysak L.V., Sidorenko N.N. CONTRIBUTION OF SOIL BACTERIA IN AIR-PLANKTON OF URBAN ENVIRONMENT

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1482 Mikhailov E. F., Vlasenko S. S., Kiselev A. A. SOOT PARTICLES RESTRUCTURING IN FLOW CONDENSATION CHAMBER

1543 Mikhailov E. F., Vlasenko S. S., Kiselev A. A., Saphronova J. F. EXTINCTION OF LIGHT BY AEROSOL SOOT PARTICLES WITH DIFFERENT MORPHOLOGY

1406 Mora J., Todolí J.L., Canals A. NUCLEATION PROCESSES IN ANALYTICAL HOT LIQUID AEROSOLS

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1286 Nasibulin A.G., Shandakov S.D., Anisimov M.P., Timoshina L.V. DETERMINATION OF SURFACE ENERGY OF CRITICAL EMBRYOS

1412 Nekrasov V.V., Gasanov D.R., Portyan A.T., Ryjakova N.V., Surin N.M. PORTABLE CORRELATED OPTICAL DETECTOR FOR EXPRESS REMOTE ANALYSIS OF POLLUTING SUBSTANCES IN ATMOSPHERE

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1237 Persiantseva N.M., Popovitcheva O.B., Rakhimova T.V. PHASE STATE AND REACTION ABILITY OF WATER/ICE CONTRAIL AEROSOLS.LABORATORY STUDIES.

1204 Philippov V.L., Makarov A.S., Ivanov V.P., Kozlov S.D. A COMPLEX OF INSTRUMENTS FOR REALIZING THE BASIC TECHNOLOGIES OF ENVIRONMENTAL-STATE EXPRESS-ANALYSIS



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1203 PhilippovV.L., MAKAROV A.S., IVANOV V.P. MODEL OF OPTICAL WEATHER IN THE SURFACE ATMOSPHERIC LAYER AND ITS AEROSOL SECTION

1310 Polyanskay M.L. MICROBIAL BIOMASS AS FACTOR OF STABILITY OF EARTH ATMOSPHERE COMPOSITION

995 Pominov E.I. PIEZOELECTRICAL CONVERTERS IN MONITORIN⊱ SYSTEMS OF PARAMETERS OF METAL PARTICLES

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1007 Shiryaeva S.O., Jarov A.N., Koromyslov V.A. THE DISPERSION OF A BUBBLE IN A UNIFORM ELECTROSTATIC FIELD IN DIELECTRIC LIQUID

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1302 Starik A.M., Lebedev A.B., Saveliev A.M., Titova N.S., Zaychik L.I. MODELIN⊱ OF NUCLEATION AND ICE PARTICLE FORMATION IN THE PLUME OF HYPERSONIC AIRCRAFT WITH HYDRO⊱EN COMBUSTION EN⊱INE.

1423 Sutherland R.A., Klett J.D. OPTICAL PROPERTIES OF NON-SPHERICAL AEROSOL PARTICLES IN RANDOM ORIENTATIONS

1003 Varekhov A.⊱. THE ELECTROSTATICS OF INDOOR ENVIRONMENTAL AEROSOL

983 Veselov D.P., Mirsoeva L.A., ⊱ripost S.B., Semenova V.I., Lobanova ⊱.I., Popov O.I. METHODS & COMPUTATION CODES FOR CALCULATION OF BACK⊱ROUND OBJECT RADIANCES WITH ACCOUNT OF AEROSOL SCATTERIN⊱

1019 Voszhennikov O.I., Nikonov S.A. ON DEFINITION OF ABSORPTION AND REFLECTION COEFFICIENTS OF PARTICLES BY UNDERLAYIN⊱ SURFACE

1272 Vozszennikov O.I., Nikonov S.A. ABOUT DETERMINATION OF COEFFICIENTS OF ABSORPTION AND REFLECTIVITY OF MATERIAL PARTICLES FROM THE UNDERLYIN⊱ SURFACE

1270 Vozszennikov O.I., Zhukov ⊱.P., Svirkunov P.N. AN EFFECT OF SOURCE TERM IMPURITY CLOUD CENTER RANDOM WALKS ON IMPURITY CONCENTRATION FLUCTUATIONS

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1046 Zaromb S., Birenzvige A., Doherty R.W. A PORTABLE HI⊱H-THROU⊱HPUT LIQUID-ABSORPTION AIR SAMPLER [PHTLAAS]

1023 Zhukov ⊱.P., Nikonov S.A. THEORETICAL & EXPERIMENTAL STUDYIN⊱ OF LAN⊱EVIN MONTE-CARLO SCHEME FOR ATMOSPHERIC TURBULENT DIFFUSION

1277 Zhukov ⊱.P., Nikonov S.A. EXPERIMENTAL AND THEORETICAL STUDYIN⊱ OF LAN⊱EVEN SCHEME OF STOCHASTIC WANDERIN⊱

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1020 Zhukov S.P., Svirkunov P.N. ACCOUNT OF IMPURITY CLOUD CENTER RANDOM WALK AT CALCULATIONS OF CONCENTRATIONS UNDER EMERGENCY RELEASES

1021 Zhukov S.P., Svirkunov P.N., Yurchak B.S. DETERMINATION OF SOME MODEL PARAMETERS OF THE ATMOSPHERIC BOUNDARY LAYER BY THE RADAR-TRACER METHOD



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1400 Altman I.S. DETAIL APPROACH TO DESCRIPTION OF NANOOXIDES CONDENSATION GROWTH DURING METALS COMBUSTION

1398 Altman I.S., Shoshin Yu.L. EXPERIMENTAL STUDY OF ULTRA-FINE MgO PARTICLES DURING THEIR CONDENSATION GROWTH NEAR THE BURNING MAGNESIUM PARTICLE

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1569 Aurea_Espinosa C. SLABS AND FIBERS DEFORMATIONS IN INORGANIC FULLERENE-LIKE STRUCTURES

1441 Bazarov V.S. POCULIARITIES OF LIQUID ATOMIZATION BY MEANS OF POROUS SWIRL INJECTOR

1032 Belov N.N., Simanchev S.K., Tokarevskikh A.V. FUNCTION OF DISTRIBUTION OF FULLERENE SOOT PARTICLES.

1035 Belov N.N., Simanchev S.K., Tokarevskikh A.V. STRUCTURE OF SURFACE OF CATHODE DEPOSIT, FORMED DURING FULLERENES SYNTHESIS IN ARGON.

1488 Bordiakovskiy A.B., Kozhushkov N.P., Golotaystrov A.V., Pukhiiy V.A. RESEARCH OF DYNAMICS OF DEVELOPMENT AND SUPPRESSION OF EXPLOSION IN CLOSED VESSELS

1636 Buynovskii S.N., Saponenko L.A., Serlivanov V.S., Chernyshev E.A. PRODUCTION OF HIGH-DISPERSED OXIDES OF ELEMENTS BY "TECHNOLOGIC COMBUSTION" METHOD IN REACTORS BASED ON COMBUSTION CHAMBERS OF LIQUID-PROPELLANT ROCKET ENGINES.

1038 Choi J.-H., Park S.-W., Jeong H., and Chung J.-H. OPERATION OF HOT BENCH FILTRATION SYSTEM OF DUST REMOVAL FOR ADVANCED COAL UTILIZING COMBINED SYSTEM

1293 Cicardi C., Salli A., Milazzo M. NON DESTRUCTIVE EXAMINATION BY TXRF (TOTAL REFLECTION X-RAY FLUORESCENCE) OF AIR NUCLEOPORE FILTERS



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1182 Despa F. POINT IONS APPROXIMATION WITHIN THE MARCH MODEL FOR THE FULLERENE MOLECULE

1551 Dzidziguri E.L., Levina V.V., Ryzhonkov D.I. THE STUDING OF FORMING PROCESSES OF ULTRAFINE POWDER OF FE-CO ALLOYS BY METHOD CHEMICAL DISPERSING

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1397 Maricic A., Radic S., Ristic M.M. KINETICS OF FREE VOLUME CHANGES OF THE FE89.8NI1.5SI5.2B3C0.5 AMORPHOUS ALLOY

1024 Milani P., Piseri P., Barborini E., Bottani C.E., Ferrari A., Bassi A.Li. SYNTHESIS OF NANOSTRUCTURED MATERIALS FROM AGGREGATES PRODUCED BY A PULSED ARC GAS AGGREGATION CLUSTER SOURCE

1349 Milosevic O., Mancic L., Nikolic N., Ristic M.M. NANOSTRUCTURE CERAMIC OXIDE SYNTHESIS FROM THE AEROSOL

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1473 Nikitin P.V. THE BASIS OF MECHANISM FOR SYNTHESIS THE PROTECTIVE COATS DEPOSITED WITH LOW-TEMPERATURE SUPERSONIC HETEROGENEOUS FLOW

1475 Nikitin P.V., Andreev N. A., Prorokov S.M., Smolin A. G. LOW-TEMPERATURE GAS DYNAMIC METHOD OF DIFFERENT COATINGS DEPOSITION ONTO THE SURFACES

1350 Nikolic N., Milosevic O., Mancic L., Sreckovic T., Marinkovic B., Ristic M.M. CONSOLIDATION OF ULTRADISPERSED POWDERS SYNTHESIZED FROM AEROSOLS

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1230 Puhliyi V.A., Taubkin I.S., Plahov S.I., Akhachinskii A.V., Saklantin A.R. FIELD EXPERIMENTAL INVESTIGATION OF EXPLOSION OF ORGANIC DUST IN FILTERS



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1229 Pukhiiy V.A.. Kozhushkov N.P., Golotaystrov A.V., Litvinenko V.N RESEARCH OF PROCESSES OF BURNING AND EXPLOSION IN PIPELINES

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1463 Romakhin S.S., Bazarov V.G., Shmirkov O.V., Rudakov V.P., Baskasrev B.N., Vavilov A.P., Matveyev A.G., Chegis I.L. GENERATORS OF WATER-FUEL EMULSIONS IN POWER PLANTS

1457 Romakhin S.S., Bazarov V.G., Shmirkov O.V., Rudakov V.P., Chegis I.L. EVALUATION OF LIQUID SPRAYING DISPERSITY BY THE PNEUMATIC SPRAYERS WITH MIXING OF THE COMPONENTS IN THE POROUS ELEMENT

1458 Romakhin S.S., Baskarev B.N., Shmirkov O.V., Rudakov V.P., Mescheryakov A.A., Vorobyov S.V., Tsimin N.I, Chegis I.L. DISPERSION OF EMULSIONS IN DEVICES FOR HOMOGENIZATION OF DAIRY PRODUCE

1465 Romakhin S.S., Panchenko N.N., Shmirkov O.V., Rudakov V.P.,

1459 Rudakov V.P., Romakhin S.S., Baskarev B.N., Shmirkov O.V., Sergeeva L.L., Chegis I.L. OPTIMIZATION OF THE FLOW-THROUGH CHANNELS GEOMETRY OF MULTIPURPOSE EMULSION GENERATORS ON THE BASIS OF NUMERICAL MODELING

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1209 Sedoi V.S., Valevich V.V., Chemezova L.I. PRODUCTION OF SUBMICRON AEROSOLS BY THE EXPIRING WIRE METHOD

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1461 Shmirkov O.V., Rudakov V.P., Romakhin S.S., Bondareva N.V., Chegis I.L. STUDY OF THE EXPLOITATION CHARACTERISTICS FOR THE GAS-DYNAMIC VOLUMETRIC FILTER OF EMULSIFIER TYPE

1401 Shoshin Yu.L. ULTRAFINE TIO2 PARTICLES SYNTHESIS BY COMBUSTION OF TITANIUM DUST IN O2+N2 (PREMIXED AND SEPARATED REAGENTS JETS)

1402 Shoshin Yu.L. SYNTHESIS OF ULTRAFINE ZNO PARTICLES IN DIFFUSION (ZNO DUST+ PROPANE)/O2 FLAME

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1351 Talijan N., Milutinovic-Nikolic A., Jovanovic Z. THE CHARACTERIZATION OF SMCO5 POWDER

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1501 Zagnitko A.V., Trotsenko N.M., Prusakov V.N., Gnedenko V.G., Kosaykov A.N., Chapligin Y.O., Pyshko G.I. HIGH TEMPERATURE REGENERATIVE MULTILAYER METALCERAMIC FILTERS FOR HIGH EFFICIENCY COLLECTION OF RADIOACTIVE AEROSOL PARTICLES IN NUCLEAR FUEL AND RADIOACTIVE WASTE REPROCESSING

1599 Zaporotskova I.V., Lebedev N.G., Litinskii A.O.,Chernozatonskii L.A. FEATURES OF THE SORPTION OF LIGHT ATOMS ON SINGLE WALL CARBON NANOTUBES



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974 Andreyev E. THE EFFECT OF MAN FACTOR ON ATMOSPHERIC ECOLOGY (AEROSOL POLLUTION)

1092 Andronova N.G., Rozanov E.V., Yang F., Schlesinger M.E., Stenchikov G.L. RADIATIVE FORCING BY VOLCANIC AEROSOLS FROM 1850 THROUGH 1994

1054 Arguchintseva A.V. MATHEMATICAL MODELLING OF DISTRIBUTION OF ECOLOGICAL RISK ZONES IN ATMOSPHERE & ON THE UNDERLYING SURFACE FROM AIR ANTHROPOGENIC SOURCES

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1291 Gurbanov.M.A. MODELLING OF GAS PHASE REACTIONS IN POLLUTED AIR, INITIATED BY IONIZING IRRADIATION

1240 Kashkin V.B.,Romasko V.U., Sukhinin A.I. TOTAL OZONE CONSENTRATION INVESTIGATION USING NOAA SATELLITE INFRA-RED DATA

1388 Koc T. AIR QUALITY AND ITS HEALTH CONSEQUENCES IN CENTRAL BALIKESIR TOWN

1591 Kokorin A.M. THE EFFECT OF INTERNAL STRUCTURE OF THE RADIALLY NON-UNIFORM PARTICLES OF MARINE AEROSOL ON LIGHTSCATTERING

1104 Krotkov N.A. , Bhartia P.K., Herman J.R., Fioletov V., Kerr J. SATELLITE ESTIMATION OF SPECTRAL SURFACE UV IRRADIANCE IN THE PRESENCE OF TROPOSPHERIC AEROSOLS 1: CLOUD-FREE CASE

1103 Krotkov N.A., Krueger A.J., Bhartia P.K. ULTRAVIOLET MODEL OF VOLCANIC CLOUDS FOR REMOTE SENSING OF ASH AND SULFUR DIOXIDE

1358 Kutenev V.F., Zvonov V.A., Kornilov G.S. PROBLEMS OF THE DIESEL PARTICULATES ASSESSMENT AND REDUCTION



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1062 Liu C.-M. A PROGRAM TO STUDY THE EFFECT OF AEROSOLS ON ATTENUATING THE SOLAR RADIATION IN TAIWAN (1994)

1545 Marov M.Ya , Shari V.P. THE OPTICAL CHARACTERISTICS OF MODEL AEROSOLS IN THE ATMOSPHERES OF EARTH, MARS & VENUS: METHODICAL QUESTIONS & RESULTS OF ACCOUNTS

1308 Melnikova I.N., Sorokina I. RETRIEVAL THE PHASE FUNCTION SPECTRAL PARAMETERS FOR CLEAR SKY FROM SPECTRAL RADIATIVE MEASUREMENTS

1307 Melnikova I.N., Varocos K., Guschin G.P. , Noskova V. OZONE CONTENT, ATMOSPHERIC AEROSOLS AND CLOUDS IMPACT ON SURFACE UV RADIATION: SIMULATIONS AND OBSERVATIONS

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1556 Miroshnichenko A.N. ON THE REASONS OF THE ATMOSPHERIC POLLUTION WITH THE CARCINOGEN AROMATIC CARBOHYDRATES OF STRIY AND STRIY DISTRICT, LVIV REGION (UKRAINE)

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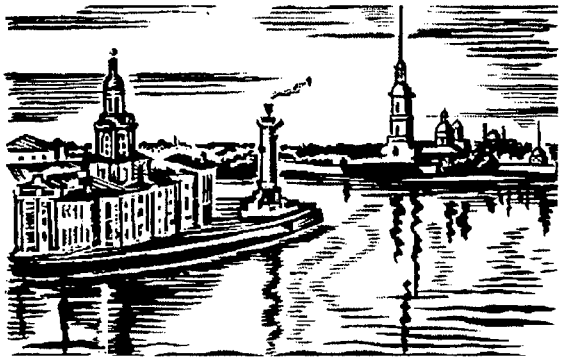
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1174.

MICRODROPLET METHOD FOR DIAGNOSTICS OF BIOLOGICAL ACTIVE SUBSTANCES IN AEROSOL SAMPLE

Belov N.N. (1), Belova N.G. (1), Galkin A.S.(2)

(1) - Aerosol Technology Ltd,
Phone/Fax: 7-(095)-1474361, EMail: belov@tehno.mmtel.msk.su

(2) - Moscow State University, Biological Faculty, Biochemistry Department,
Phone: 7-(095)-9391376

Concentration of biological active substances in aerosol samples is low and sample itself is very complex. Two particles from the same sample can have completely different properties, structure and history. The investigation of such a complex mixture is non trivial task.

Let's imagine that sample contain few small (about 1 micrometer) particles with biological active substances, for example, proteins. All other components of collected sample and instrument surfaces are source of noise. It would be great to establish some kind of preliminary selection for the next step of analysis. Such methods were developed for chemical analysis of aerosol particles. Usually, particle is evaporated and then analyzed on mass-spectrograph [1].

There are instruments that can measure fluorescence of single particles during sampling process. However particle velocity is too high for detailed (for example biochemical) analysis.

In present work it is suggested to use virtual impactor with transparent bottom and special optics for diagnostics biological substances in aerosol sample. As shown, there is an opportunity to use single particle precise mechanism for sensitive and rapid bioaerosol analysis of single particles. Some of used methods were developed for microelectronics [2-3].

There are elements of Virtual impactor architecture that useful for installation of an additional optic devices. Source of ultraviolet radiation can be positioned in the horizontal air-output slot of the impactor. So there is an opportunity of detection of fluorescent signal from biological particle. To determine location of the fluorescent particle position-sensitive photo pipe can be used. All this data gives complete information about location of impactor bottom particles (at least the big ones) and their quantity.

Fig.1. Virtual impactor with simple optics installed enabled to determine the moment and position at what biological substance appears.

The another way to monitor biological particles is to use fluorescent microscope. Such microscope with great sharpness length and low resolution.

Impactor bottom (3) is quartz window. Light divider (5) leads UV light of lamp (4) on particles at bottom and flying ones (2).

Position-sensitive indicator (6), can be video camera or Position Charged Links matrix. It measures number of fluorescent particles in impactor. Such data is important to monitor dynamics of biologic debris concentration in air. However for complete information about bioaerosol an additional analysis have to be performed on the sediment.

According to the experiments [4] bacteria get into the sampler rarely. It is necessary to pump tens and hundreds of liters of air to capture a single particles. When quantity of captured particles is big enough air flow is redirected to another virtual impactor. This enables to continue collecting the sample for more detailed biochemical analysis.

Transparent bottom of virtual impactor provides optical measurement of colour changes after analytical biochemical reactions. Single particle technology with precise placing of each droplet used for input of biochemical reagents on surface of each bioaerosol particle. The Precise single particle technology uses for droplet printers widely.

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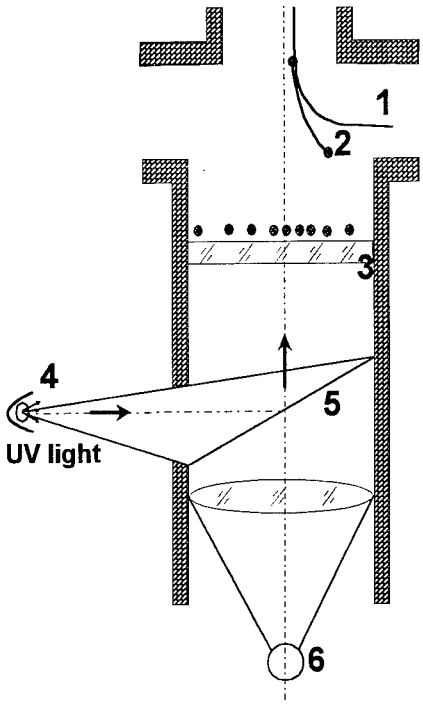


Fig. 1.

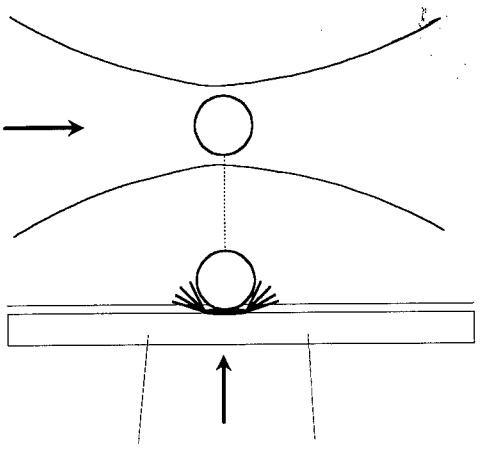


Fig.2.

Our investigation devoted to application of common analytical biochemical reactions [5-9] with single particle technology for investigations of bioaerosols. The offered methods have general character and are used by the scientists for realisation of the quantitative analysis at determination of the contents of biologic active substances, such as proteins, nucleic acid (NA), carbohydrate.

The physical-chemical properties of proteins are determined qualitative and quantitative structures of amino acid included. Methods of quantitative determination of NA are based on determination of the contents of making their components: of the nitrogen basis, leptos and phosphorus NA.

The Mainbaum method of determination of the RNA with orcine contents is based on reaction of orcine with ribose, from RNA. As a result RNA hydrolyse in presence of HCl acid, furfurole derivative will be formed. It gives a product of green colour at heating with orcine. The reaction is not high specifics - painted products will form deoxyriboses, polysaccharides and some other chemicals. However sensitivity of the reaction of orcine with rebose is high [7].

Derivatives of hydrocarbon (furfurole type), formed at heating with concentrated H_2SO_4 and artron, give colour chemicals. The developed colouring is proportional to quantity of taken glucose [8].

Proteins of microscopic particle from aerosol sample may be coloured by single droplet (50 mkm) of Fomins reagent with bi-ureton reagent for detection of the peptide links. This reaction proceeds coloured products of aromatic NA. This products may be detect by microscopy easy. For more thin determination of protein concentration in a preparation it is possible to use coomassie brilliant blue. The method is based on linkage with proteins of one of acid colour -

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coomassie brilliant blue. At linkage with proteins, the absorption spectrum of colour is varies.

These investigations of selected micro pieces of aerosols sample provides important information about biological active components of bioaerosol sample.

Present investigation uses laser technology for take-off single particle from sampler surface [2-3] for additional analysis. Particles selected from air places with random order on transparent surface of aerosol sampler. Some of them may be microorganisms. These particles must be investigated more careful. Such distribution is received at fall of particles on the bottom of virtual impactor.

Figure 2 presents the scheme of removing of single particle from sampler surface by laser beam of sharp focusing (indicated by arrow) [2], [3].

In this scheme the particles fly away from a plate owing to evaporation of thin sorbing layer on a surface of a glass. Intensive laser radiation forms local gas explosion that pushes a particle from a glass surface. The evaporation of a sorbing liquid requires an appreciable intensity of radiation. The process can be initiated by cowering the plate with a thin film which has high absorption on a wave length of used laser.

This thin film evaporation provides taking off microorganisms from sampler surface without damage of their membrane.

Investigations of optical fields inside of bacteria shows that their membrane may be opened without stressing it's main organs. This effect can be reached by focusing the laser beam inside of bacterium. For this operation Nd or ruby compact laser may be used. Chosen particle can be measured alone after it was took off the plate and passed into the laser beam area for analysis.

This technology leads to increasing of sensitivity of bioaeosol investigations.

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1175.

DIAGNOSTICS OF VITAL MICROORGANISMS IN AEROSOL SAMPLES

Belov N.N. (1), Belova N.G. (1), Ugarova N.N. (2)

(1) - Aerosol Technology Ltd,
Phone/Fax: 7-(095)-1474361, EMail: belov@tehno.mmtel.msk.su

(2) - Moscow State University, Biological Faculty, Enzymology Department,
Phone: +7-(095)-9392660, Fax: 9393589, EMail:UNN@enzyme.chem.msu.su

Bioaerosol sampler has two conflicting demands. From one side biosampler needs in great air volume of sample with great efficiency of separation of aerosol particles from measured air. From another side all selected particles needs in great care. This demand carried out from method of measurement of bacteria in sample by counting of colonies that grew from bacteria on nutrient media after incubation time. It is a problem to prevent bacterial flora from death during collecting aerosol sample.

From the one side, sampler should provide collecting enough aerosol particles to contain no less than 3-10 bacteria. Bacteria concentration in air is about one in tens or even hundreds of liters **[1]**. Accordingly, sample should contain particles collected out of few hundreds of liters of air. Moreover sample have to be collected each 1-2 hours. This leads to implementation of high efficient air filtration when throughput is about ten liters per minute. Debris particles that collected from a huge volume of air should be transferred into a much more less volume of sorption liquid or be immediately placed into the nutrient medium.

There are methods of detection of bacteria in aerosol sample, based upon calculation of colonies, produced by bacteria. This is the reason why sample for such methods should be made very gentle from aerosol sample volume. There should not be any collisions of bacteria with dry surface. Nearly all ways of increasing filtration efficiency - charging particles, collision of particle on a high velocity with an obstacle, acoustic or ultraviolet fields - lead to the death of bacteria or make bacteria unable to multiplicate.

From the other side when sample is ready it takes colony a lot of time to grow enough to become detectable. So information about dangerous concentration of bioaesorol comes late enough to become not the in-time warning but the explanation of happened disaster.

In this study it is suggested to use bioluminescence for detection of vital cells.

Bioluminescence is the light emission upon oxidation of the organic substance, luciferin, catalyzed by enzyme, luciferase. For firefly luciferase-luciferin system, a necessary and compulsory component of the reaction is adenosine-5'-triphosphate (ATP). It is only at the presence of ATP that the yellow-green light is appeared in this system. Bioluminescence intensity is directly proportional to ATP concentration. Owing to a high quantum yield of bioluminescence in firefly luciferase-luciferin reaction, fairly simple instruments can be used to detect so small ATP quantities as femtomoles by bioluminescence. Bioluminescent ATP assay is the most specific, sensitive, rapid and convenient method to detect ATP micro quantities.
ATP is present in all living cells - plants and animals, microorganisms and man. When the cell dead, the intracellular ATP disappears very rapidly (during minutes) under the action of specific biocatalysts, ATP-ases. The synthesis of new ATP portions is stopped much more quickly. Bioluminescent ATPmetry is a rapid, simple and highly sensitive method for detection of living matter. ATP amount is directly proportional to the number of cells in the sample. The

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sensitivity of detection is less than a thousand cells per ml of the sample. Analysis takes only several minutes.

During the last years ATPmetry has become a basis for so termed "rapid microbiology". Compared to conventional microbiological tests, the "rapid microbiology" method decreases ten-folds the analysis time, gives quantitative parameters, markedly simplifies the analysis procedure and makes automation feasible. Basic field of "rapid microbiology" applications is detection and control of microbial contamination in biological samples, food products, environment (air, water, etc.). Special methods are used to destroy all cells except bacterial ones and eliminate the nonbacterial ATP from the sample to be analysed. At the same time bacterial cells and its intracellular ATP are not changed. So, it is possible to detect microbial contamination even in the sample that contains both bacterial and somatic cells, for example, the animal or human cells.

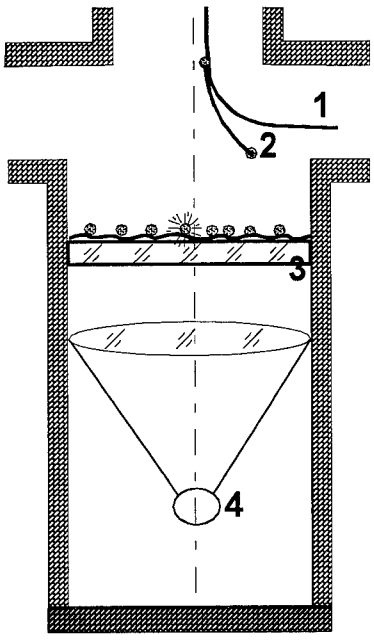


Fig.1.

Best results for measurement of alive bacteria shows virtual impactor with transparent bottom (3). This bottom covered by thin film of reagents for opening of membrane of microorganisms and for activation of ATP-reaction. Each cell gives series of visual quantums. Measurements of bioluminescence pulses sequence by high sencitivity photopipe (4) provides real-time information about bacteria concentration in air.

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1176.

PHASE MICROSCOPE FOR BIOAEROSOL DIAGNOSTICS

Belov N.N. (1), Belova N.G.(1), Tychinsky V.P.(2)

(1) - Aerosol Technology Ltd,
Phone/Fax: 7-(095)-1474361, E-Mail: belov@tehno.mmtel.msk.su

(2) - Moscow State University of Radioengineering, Electronics and Automatics
Phone: 7-(095)-4346792

Concentration measurement and identification of microorganisms, collected from monitored air, is important problem. At present for these purposes a following technique is used. Aerosol particles from monitored air are collected and placed on a surface of nutrient medium. Each alive bacterium produces colony by self duplication. Colony border is nearly a circle. The differences of refraction parameters of biomass, that forms colony, enables determine colony position and their quantity.

The opportunities to determine a bacterium kind are rather limited. For this purpose the test sowing on various nutrient mediums are used.

This investigations introduces the phase microscopy technology for the diagnostics of microorganisms in sample of bioaerosols. This method provides super resolution with using of optical laser radiation with small intensity. Phase microscope [1] gives the distribution of a phase in the interference image of object. It enables to reach the resolution up to tens nanometers, which is characteristically for electronic microscope. At the same time Phase Microscope does not distort a test and does not kill microorganizms. Moreover investigations by this microscope of the functioning of live bioorganizms can be used for identification of their class and type.

Phase microscope gives a possibility of direct determination of the form and sizes of viruses. Phase microscope used for measurements of height profile of viruses Influenza A. This viruses is about 200 nm in diameter. Results of measurements selects its dense nucleocapcid and protein membrane. Phase microscope technology provides topogrammes of phase image of vaccine of pox-viruses, Riccetsia provazecii[1].

Phase microscope may be applied for investigation of virus structure (nuclea, metahondrii and analysis of cell-virsuses interaction [1]. This technology used for decoding of the structure of the petide-lipide membrane with thickness 50 and 80 nm of cell of Cjriolus fungus [1]. This microscope used for investigation of This microscope has given a opportunity to study in a real time disease of a cell by Influenza A virus [1].

These measurements do not require hard influence on biological structures. It need not in vacuuming of sample. It uses small intensity laser beam in visual spectrum. (Vacuum and electron ray destroy microorganizms). There is no influence on biological processes during experiment.

Membrane fluctuation is a common process of living cells. Another common process is ATP-reaction. Both of this effects were investigated using dynamic phase microscopy. These processes shows micro fluctuation of optical path on membrane surface with measured square near 0.01 micron^2. Position of fluctuation area correlates with local variations of height profile near ATP-cluster.

Spectral analysis of space and temporal fluctuations during ATP-reaction shows that there are contrast components with range of frequency 2-8 Hertz. Intensity of such fluctuation indicates changes on distances near 30 nm. Such spectrums helped to discover basic space-

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temporal shifted components and correlated areas (50-200 nm) for several active points.

The study of a microorganism structure with the resolution up to hundreds nanometers provides wide opportunities for their identification. However the most wide opportunities become available by method of dynamic microscopy - second step of Phase microscopy application. Changes of correlation characteristics under displacement of different points can be measured. The resolution that is fine enough to detect a single liposome or molecule of ATP lead to new methods of microorganizms identification. Direct measurement of frequency ATP simulation in microorganism, the displacement of optical active parts of microorganism gives contribution to a dynamic correlation picture, given by phase microscope. Urgent problem of certification of such spectra and connection them to particular kinds of microorganisms becomes very important. Interesting that such measurements can be conducted all time of development of microorganism colony in medium.

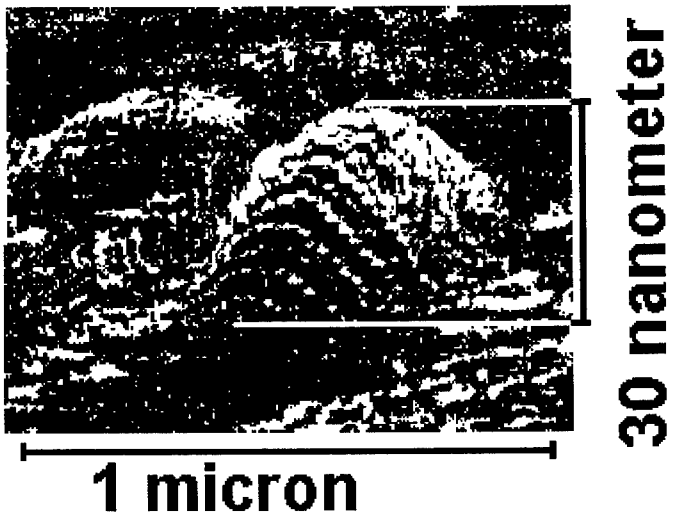


Fig.1.

The method of active spectroscopy of bacteria colonies is carried out of the method of dynamically spectroscopy. First step is periodical measurement of phase portrait of precise surface part until area of regularly changed structure detected. This mechanism provides early diagnostics of colonies.

At study of dynamics of movement of microobjects the kind of microorganism can be established by use of the super resolution. After this it is advisable to stop a growth of microorganisms in this colony. The local lighting of this microcolony by UV-radiation through objective of phase microscope can be used for this purpose. For this purpose the UV-radiation by a additional mirror cut from the measuring circuit and is directed on nutrient medium through objective of phase microscope, for example, from small-sized spark gap. Such suppression of identified microorganism colony permits to lower masking of one colony by another.

Use of optical microscope with the super resolution allows to observe alive microorganisms during their living. The resolution of phase microscope is sufficient to show their internal structure. Thus a wide spectrum of the additional information, necessary for

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identification of microorganism occurs. This information on the sizes of separate microorganism particles and character (speed, frequency, availability of pulsation,...) their mutual displacement. Such approach permits to increase aerosol concentration of aerosol sample on nutrient medium.

The sight field of phase microscope (5 x 5 micron) can be essentially reduced by electronic zooming. As a result the given equipment permits essentially to increase the accuracy of the bacterium analysis for case of slow changing bacteria. For the modern measuring techniques it is the principal restriction.

On the other hand the detecting ability of a equipment permits essentially to increase bacterium concentration on unit of a surface of nutrient medium..

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1177.

DIAGNOSTICS OF POLYNUCLEOTIDES IN SAMPLES OF AEROSOL (AIRBORNE)

Belov N.N. (1), Belova N.G. (1), Morosov S.Yu. (2)

(1) - Aerosol Technology Ltd,
Phone/Fax: 7-(095)-1474361, EMail: belov@tehno.mmtel.msk.su

(2) - Moscow State University, Biological Faculty, Virusology Department,
Phone: 7-(095)-9395534

Sample of bioaerosols is a collection of great number of microscopic organic and inorganic particles. The analysis of this complicated mixture is an important problem that has no solution yet. Usually analysis consists of indentification and detemrmination of type of microorganisms at random position. Present investigations are devoted to using of PCR-method for analysis of sample that consists of aerosol particles collected from monitored air.

DNA contains the main information about microorganism. Multiplication of DNA by PCR method creates area with equivalent DNA molecules (like colony). All this DNA molecules are equal to source DNA. These source DNA molecules are extracted from bacteria sampled from air. (Please note, that concentration of bacteria in air so small that probability of close neighbourhood of two or more microorganisms is negligable small).

Method of Polymerase Chain Reaction (PCR) initially was described in 1985 by Saiki et al. (Science: 230, 1350-1354). Now many variants of PCR are widely used in different fields of molecular biology, genes engineering and biotechnology. The basics of this method is amplification of DNA fragments while having surplus of DNA-replica and ferment DNA-polymerase. Usually thermostable DNA-polymerase, such as Taq-polymerase from thermoohilic bacterium Termus aquaticus, are used. At the beginning of Polymerase Chain Reaction highmolecular two-chain DNA (or single-chain DNA for example cDNA-copy RNA) after melting and annealing of source becomes a primer for ferment-polymerase [1]. Ferment-

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polymerase produces two-chain DNA fragments that vary in size from few tens up to thousands of nucleotic pairs. Size of fragments depends on position of link areas of source DNA on polynucleotid. Reaction continues with duplication of first step products, i.e. DNA-fragments of fixed size. When quantity of DNA sources, polymerase and deoxynucleotidtriphosphates is enough, any part of polynucleotid (DNA or RNA) can be amplified. So even in situation when the only one polynucleotid molecule is available, it is possible to amplify it or it's part up to quantity that is easy to detected by standart methods. For example brome atidia in agar or polycrealamid geles. Test procedure can be greatly reduced in case of use of radioactive deoxynucleotidtriphosphates or their fluorescent analogous. According to this PCR is the most sensitive detection method for biological objects that contain polynucleotides (including viruses, bacteria, primitives, fungi et others). Certainly PCR can be used for detection of single nucleotides in any medium. PCR is widely used in agriculture for diagnostics of animal and plant pathogens. It's high precision and cheapness (comparing to other methods) made PCR the main method for diagnostics of infectional and inherited human diseases.

Last years PCR is used widely as the method for monitoring of biologic debris (including single nuclear acids) of the environment, food, medicines etc. Monitoring of pathogen microorganisms at their low concentration in soil, water and air become available only because of PCR. Moreover, PCR method significantly simplifies micro biological control. Now can be reduced such great work as laboratory incubation of microorganisms for following identification. There is an opportunity to extract stamm from specific DNA sources, not only to detect that there is precise type of microorganisms. An additional advance is that PCR method enables to test any type of microorganisms even in spore. But it is impossible to detect viability of detected microorganisms. Nevertheless PCR can be used as initial procedure of monitoring of polynucleotides and microorganisms in environment. Indeed PCR is outstanding method for this purposes.

This multiplication of DNA helps to receive large area around microorganism placed on surface of biosampler, filled with equal DNA molecules. This "colony" of DNA may be selected and measured by phase microscope. This device has an excellent resolution - 50 nm and best. Phase microscope investigations are safety for alive microorganisms. So this technology provides new directions for investigations - dynamical correlation spectroscopy. Time-space correlation vibrations and moving provides good information about source microorganisms. PCR method helps to enlarge area with important information. So phase microscope will find it more simple and with great speed. This method helps to go away from demand on careful collection of microorganisms from air. This direction of bioaerosol sampling is very perspective.

Authors appreciate Aerosol Technology Ltd firm for financial support of researches.

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ABSTRACTS
INTERNATIONAL AEROSOL SYMPOSIUM
IAS-4 (St.Petersbourgh 06-09 JULY 1998)

1045

PULSED LIGHT DEVICE FOR DEACTIVATION OF BIOAEROSOLS

Wick C.
ERDEC

(First received 22 December 1997; accepted for presentation during IAS-4)

The health care community has sought to reduce the hazardous bioaersol levels in hospitals, and operating theaters for many years. Historically, filters and other such devices have been used to some effect, but the problem persists frequently resulting in patients contacting serious infections as a result of the environment. A new device which utilizes high energy pulsed light to completely deactivate bioaerosols is presented. The Pulsed Light Device (PLD) uses high intensity, broad-band pulsed light as the mechanism for killing micro-organisms. Experimental results demonstrated high effectiveness for air streams having flow rates of 20-200 cfm containing Bacillus spores.

Other experiments demonstrated that the PLD could maintain a clean environment in a closed room for more than eight hours, during which high concentrations of Bacillus spores were continuously inoculated into the inlet air stream. Further, the PLD could rapidly decontaminate the air in a room after spores were dispersed inside it. Experiments indicate that the PLD is fully capable of both modes of operation.

1044.
УДК 541.18

THE METHODICAL APPROACHES TO BIOLOGICAL INDICATIONS OF AIR WASTES OF THE ENTERPRISES OD A MICROBIOLOGICAL INDUSTRY

Omeljanets T.G., Artyukh V.P., Ganeva S.L.

Ukrainian Scientific centre of hygiene, 50, Popudrenko str., Kiev-94, Ukraine,253660

(First received 23 September 1997; accepted for presentation during IAS-4)

When manufacturing the products with the help of microbial synthesis the pollution of industrial and environment by both viable microorganisms-producents and various protein substances by intermediate products of metabolism of microorganisms - ferments, antibiotics, vitamins and etc. is observed.; by impractical microorganisms and their conglomerates; by a dust of a ready product is observed. These biological pollutants can extremely adversely influence on the health of workers, and on the population, who is living in region of accommodation of such enterprises (diseases of a leather, respiratory ways, allergenic disease etc.).

In this connection a major moment at an estimation of biological action of either pollutants the careful its identification and effective method of determination its ingredients is necessary. Especially it has the important meaning at development of the hygienic rules of the allowable contents biological pollutants in industrial and environment objects.

From all methods of the control of biological pollution in air the most full methods of determination microorganisms-producents with use the various apparatus for the samples are developed. At an estimation of microbial pollution of the air in a working zone we used a number of devices - Krotov device, multicascade impactor MB-2, device PAB-1, device MD8 of

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firm "Sartorius". The device MD8 with the soluble gelatinous filters is the most convenient.

At determination of protein products, which formed in process of microbial synthesis a method of the immunochemical analysis is the most perspective, it characterised by a high sensibleness, selectivity, expressiveness, allowing determine specific individual albumins.

We used a method of the immunofermental analysis at determination polypeptid-proteins wastes in the air of a working zone and in atmospheric air. Thus we used immunity serum, which was received by immunisation of by a final product (fodder additive of a concentrate of lysine) with using Freund's adjuvant, for increase immunogenity of an antigen the methylated albumin was introduced into the animal.

The selection of samples of the air in a working zone and in zone of air wastes of the enterprises of a microbiological industry was made by aspirator "Krasnogvardeez" on the filter as FPP. Elution of the samples was made with the help of a buffer solution Tries-HCl 0,01M pH7,8. A concentrate of lyzine contained about 12 % albumin. The chromatographic analysis of a concentrate has revealed presence polypeptides and the protein fragments.

The quantitative determination of an antigen was carried out by a method ELIZA with application of fluorescent or ferment label (peroxidaze). In a case of ferment label the determination, besides, was made according to the intensity of the luminescence in a luminometer.

The results of researches testify, that a method allows to differentiate specific substances of a protein nature from the common protein pollution and to allocate them, even if their amount makes 0,5 -1,5 % from total protein.

The determination of the specific proteins is especially urgent for large microbiological manufactures, which make tens and more preparations using thus many producents and causing the rather complex - structured factors of pollution. Pollutants of a protein nature are rather diverse through the biological properties, and consequently, through the consequences of their influence on health of the persons, from complete tolerance up to provocation of rather heavy diseases. And, the quantitatively insignificant fractions can appear stronger allergens in comparison with other fractions. Therefore it is important to determine just this the most important by influence on organism) part of protein pollution, as the determination of total albumen can mask presence of the specific protein pollutants, to provoke arthefacts and to result to wrong conclusions.

1104.

SATELLITE ESTIMATION OF SPECTRAL SURFACE UV IRRADIANCE IN THE PRESENCE OF TROPOSPHERIC AEROSOLS 1: CLOUD-FREE CASE

Krotkov N.A.*, Bhartia P.K.**, Herman J.R.**, Fioletov V.***, Kerr J.***

*Raytheon STX Corporation, Lanham, MD 20706 U.S.A.

**Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, MD 20771

***Atmospheric Environmental Service, Downsview, Ontario, Canada

(First received 18 January 1998; accepted for presentation during IAS-4)

The satellite algorithm for determining the surface UVA(320-400nm) and UVB(290-320nm) flux in cloud-free conditions is discussed including the estimate of the various error sources (uncertainties in ground reflectivity, ozone amount, ozone profile shape, surface height, and aerosol attenuation). The presence of aerosols tends to reduce the logarithm of the UV flux linearly with aerosol optical depth. The slope increases with aerosol absorption and solar zenith angle. Using Brewer #14 measurements of UV flux and aerosol optical depth on clear days at Toronto the estimated slope falls in the range 0.2 to 0.3 (aerosol single scattering albedo about 0.95). It is shown that the Brewer measured spectral dependence of UVB (or UVB/UVA flux ratio) can be accurately reproduced using just total column ozone amount and the solar flux spectrum. The Brewer #14 measurements of absolute UVA flux can be reproduced with the

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aerosol model derived within uncertainties of the instrument calibration.

We have applied the algorithm to the data collected by the Total Ozone Mapping Spectrometer (TOMS) instruments that have been flown by NASA since Nov. 1978. It was demonstrated that in the absence of clouds and UV-absorbing aerosols, TOMS measurements of total column ozone and 380nm (or 360nm) radiances can provide estimates of surface spectral flux to accuracies comparable to that of typical ground based instruments. A newly-developed technique using TOMS aerosol index data also allows estimation of UV flux transmission by strongly-absorbing aerosols. The results indicate that over certain parts of the Earth, aerosols can reduce the UV flux at the surface by more than 50%. Therefore, the most important need for reducing errors in TOMS derived surface UVB spectra is to improve the understanding of UV aerosol attenuation.

Key words: measurement and monitoring of aerosols; tropospheric aerosols (dust, smoke); multiple scattering and absorption of ultraviolet radiation by aerosols.

More information: see the following NASA web pages:
http://jwocky.gsfc.nasa.gov http://skye.gsfc.nasa.gov
Corresponding author address: N.A.Krotkov,
Raytheon STX Corporation 4400 Forbes Blvd., Lanham, MD 20706-4392;
Phone: (301)-7945075; FAX: (301)-4411853,
EMail:krotkov@hoss.stx.com

1103

ULTRAVIOLET MODEL OF VOLCANIC CLOUDS FOR REMOTE SENSING OF ASH AND SULFUR DIOXIDE

Krotkov N.A.*, Krueger A.J.**, Bhartia P.K.**

*Raytheon STX Corporation, Lanham, MD 20706 U.S.A.;

**Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, MD 20771

(First received 18 January 1998; accepted for presentation during IAS-4)

The Total Ozone Mapping Spectrometer (TOMS) instruments have detected every significant volcanic eruption from November 1978 through December 1994 on the Nimbus 7 and Meteor-3 satellites and since July 1996 on the new satellites, TOMS-Earth Probe and ADEOS. We apply a radiative transfer model to simulate the albedos of these fresh eruption clouds to study the limitations of the present SO2 algorithm which assumes an absorbing cloud above a scattering atmosphere. The conditions are found to be approximated when the total absorption optical depth is less than 2 (i.e., 100 DU SO2 at 312 nm or 300 DU SO2 at 317 nm).

The spectral dependence of the albedo of a non-absorbing Rayleigh atmosphere can be specified by only two parameters which are uniquely different when ash or sulfate aerosols are present in the stratosphere. However, the interaction between ash scattering and SO2 absorption within a volcanic cloud produces a non-linear effect at strongly absorbing wavelengths that accounts for overestimation of sulfur dioxide in ash-laden volcanic clouds by the Krueger et al. (1995) algorithm. Correction of this error requires knowledge of the ash properties.

A method for determining two of the ash parameters from the longer TOMS wavelengths is described. Given the altitude of the cloud, surface reflectivity, and an estimate of effective variance of the ash size distribution, the optical thickness and either the effective radius or the

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index of refraction can be deduced. The ash retrievals are also needed to evaluate the tephra/gas ratio of eruptions and to compare the ash properties of different volcanoes.

Key words: measurement and monitoring of aerosols; stratospheric aerosols (sulfate and volcanic ash); multiple scattering and absorption of ultraviolet radiation by aerosols; non-spherical aerosols (volcanic ash); volcanic inputs to the atmosphere; volcanic hazards (ash avoidance by aircraft).

More information: see the following NASA web pages:
`http://jwocky.gsfc.nasa.gov http://skye.gsfc.nasa.gov`

1102

AEROSOL RESEARCH ISSUES RELATED TO HEALTH AND DEFENSE POLICY

Geernaert G.

National Environmental Research Institute, Denmark

(First received 13 January 1998; accepted for presentation during IAS-4)

Aerosols have been identified as one of the key atmospheric constituents which govern health policy, tactical defense operations, and climate. Aerosols originate from a number of natural and anthropogenic sources. Wind blown dust and sea spray are among the natural emission types, which are not easily governed by emissions controls. While also classified as a natural source, forest fires are, on the other hand, in most part controlled by human intervention.

The anthropogenic emissions are governed in most part by the industrial and traffic sectors. These sectors may be characterized with "controllable" emissions, where policies may be formulated to reduce or optimize emissions based on their impact across a variety of economic. In order to optimize labour output, health, tourism, defense, and other sectors, policymakers are obliged to select the appropriate environmental and economic instruments which satisfy a cost-benefit analysis. Such analyses are based on scenarios, options, and forecasts. This presentation summarizes the aerosol research issues which are necessary to carry out, in order to identify the type and extent of emissions control policies. The focus of the presentation will be on the health sector, and a secondary focus will be on defense. The discussion will highlight the experimental needs, quality of parameterizations and models, and the needs of the customers and stakeholders. The points will be illustrated with case studies from Europe, the USA, and southeast Asia.

1099

MICROPHYSICAL PROCESSES AFFECTING THE FORMATION OF THE BACKGROUND STRATOSPHERIC AEROSOL

Hamill P.

Physics Department San Jose State University San Jose, California, USA

(First received 13 January 1998; accepted for presentation during IAS-4)

We consider the characteristics of the background stratospheric sulfate aerosol layer and show how microphysical processes along with transport can lead to the observed properties of the layer.

It is generally believed that the source of the stratospheric sulfate particles is binary nucleation of sulfuric acid and water to form solution particles. This process would take place preferentially in the tropical upper troposphere and the particles would then be transported by updrafts into the lower stratosphere.

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We show results of nucleation studies based on the classical heteromolecular nucleation theory as adapted for the presence of hydrates. However, in the upper troposphere, environmental conditions are such that the critical nucleus is very small, containing just a few molecules of sulfuric acid. Under these conditions, a nucleation process may not be necessary, and the direct coagulation of hydrates may be the dominant mechanism for sulfate particle formation. We compare the two processes and show how they can affect the size distribution of the aerosol in the lower stratosphere.

The particles remain for most of their lifetime in the "tropical stratospheric reservoir" where they grow larger by means of condensation and coagulation. We show that these processes alone do not lead to the observed size distributions. To match the observed size distributions requires the mixing of older and newer air parcels.

That is, fresh aerosol particles will be much smaller than particles that have been in the stratosphere for long periods of time. However, a simple mixing of air masses still does not yield expected results. It is necessary to include the sedimentation of particles to get size distributions that are in agreement with measurements.

The transport of the aerosol particles to mid-latitudes can be studied using data from the SAGE II satellite system. We show that this process leads to a gradual lowering of the aerosol layer. The data also suggest a decrease in the particle number density. We suggest that this decrease is accomplished by several different mechanisms, such as sedimentation of larger particles and the removal of particles near the tropopause by cumulus clouds that pierce into the stratosphere. However, as suggested by recent studies in stratospheric dynamics, the most important removal process is probably non-isotropic transport through tropopause folds.

The aerosol particles that are carried to very high latitudes will be trapped in the polar vortex during the winter months. As the temperature decreases, these sulfate particles may serve as condensation nuclei for the formation of polar stratospheric cloud particles. We consider the formation of ternary system particles and show that modeled results agree with observations of the clouds by the SAM II satellite system during periods of time when ternary system particles are expected to exist.

In summary, we show how nucleation, condensation, coagulation, and sedimentation along with transport can account for the observed properties of the stratospheric aerosol layer.

1098

WET ELECTROSTATIC PRECIPITATION OF FINE PARTICLES

Siebenhofer M., Lorber K. E.

Institut fur Entsorgungs- und Deponietechnik Montanuniversitat Leoben, Austria

(First received 14 Jan 1998; accepted for presentation during IAS-4)

Particle precipitation has been an important role in off-gas purification since industrial activities have become an important factor in environmental issues. While precipitation by settling was the major dust separation process for a long period, a significant progress was made with the invention of particle precipitation by dry ESP. The treatment of large gas flow rates and the treatment of off-gas with high dust load has been possible since then.

But electrostatic precipitation has always had some specific limiting properties which affect its application negatively. Gas temperature, moisture of the gas and the specific electrical resistance must not deviate strongly from the design specification. A rapid loss in collection efficiency has to be accepted in case of out-of-specification operation. The particles to be precipitated must nearly have ideal adhesion properties since they must be collected at the precipitation electrode on one hand and they must be removed by rapping without redistributing in the off-gas on the other hand. The geometry of the precipitator does not

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permit deviation of electrode distances and the electrical insulation has to consider the application of high voltage under increased thermal, mechanical and electrical stress inside the ESP. As a matter of fact, particle precipitation is still a major challenge in modern off-gas purification. Many processes cause the formation of an increased amount of submicronic particles. On the other hand, air borne particles with low sedimentation properties are a significant health risk because of their respiratory properties, their high catalytic activity due to several photocatalytic gas phase reactions, and their adsorptive properties for gaseous pollutants.

Modern off-gas purification therefore has to pay increased attention to the efficient precipitation of submicronic particles. Filtration techniques can cover a wide range of efficient particle separation in industrial application. Dust collection by filtration is increasingly preferred over electrostatic precipitation. Even in the field of waste incineration filtration is state of the art meanwhile. Is therefore any application left for electro precipitation in modern off-gas purification? As demonstrated by several examples, it is. But application focusses on wet electro precipitation. This precipitation technique does not suffer from most of the above mentioned limits and disadvantages of dry ESP. Wet electro precipitation does not have to consider the specific electrical resistance of the particles to be removed. The adhesive properties of the dust do not limit the precipitation as the collecting electrode is formed by an aqueous film which can be renewed continuously.

The paper presents several results of industrial application of wet electrostatic precipitation The application considers the precipitation of quartzite aerosols as well as sodium chloride aerosols from off-gas of incineration processes and high temperature conversion processes. Soot particles, as well as paraffinic aerosols formed by condensation have been succesfully removed by wet electrostatic precipitation. Even mixed organic/inorganic aerosols are collected at aqueous precipitation electrodes. The examples demonstrate, that wet electrostatic precipitation does not have general applicability but may still prove advantageous or exclusive in specific application.

1092.
УДК 541.18

RADIATIVE FORCING BY VOLCANIC AEROSOLS FROM 1850 THROUGH 1994

Andronova N.G.[1], Rozanov E.V.[1], Yang F.[1], Schlesinger M.E.[1], Stenchikov G.L.[2]

[1] *Department of Atmospheric Sciences, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801*

[2] *Department of Meteorology, University of Maryland, College Park, MD 20742*

(First received 10 January 1998; accepted for presentation during IAS-4)

We use our detailed radiative transfer model and observations of the time evolution of the latitude-altitude distributions of zonal-mean optical properties for the Pinatubo aerosol to calculate the time evolution of its radiative forcing. We represent the zonal mean of this radiative forcing in terms of the zonal-mean optical depth of the Pinatubo aerosol, together with the solar insolation at the top of the earth's atmosphere, the planetary albedo in the absence of the aerosol, and the surface-air temperature. We use this representation, together with the volcano optical depths compiled by Sato et al. [1993] to calculate the radiative forcing by volcanic aerosols from 1850 through 1994.

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1038.

OPERATION OF HOT BENCH FILTRATION SYSTEM OF DUST REMOVAL FOR ADVANCED GOAL UTILIZING COMBINED SYSTEM

Choi J.-H.[1], Park G.-W.[1], Jeong H.[1], and Chung J.-H.[2]

[1]Dept. of (rem. Eng., Gyeongsang National University, Chinju 660-701, Korea,

[2]Korea Electric Power Research Institute, Taejon 305-380, Korea

(First received 6 September 1997; accepted for presentation during IAS-4)

Candle filter is one of the most promising system for a particulate removal et high temperature such as IGCC and PFBC. In order to develop the design technology of ceramic candle filter system, it is very important to optimise the pulse cleaning system and to understand the behaviour of pressure drop developing to depend much through the filter element during the operation. These characteristics i on the property of filter element, mounting of filter element, dust properties, a d operation conditions.

Our purposes: was to obtain the design data for a commercial filter system. For this aim, a dench scaled test facility mounted seven candle elements of 1m length was burned gas behavior and Jet cleaning ested. The hot gas stream was prepared by the mixing of an oil and fly ash from a conventional power plant. Pressure drop pressure development in the filter element inside during the pulse as observed in the several operation conditions.

The analysis of pulse nozzle system was also carried out by FLUENT program.

1046.

A PORTABLE HIGH-THROUGHPUT LIQUID-ABSORPTION AIR SAMPLER [PHTLAAS]

Dr. S. Zaromb, Dr. A. Birenzvige, R.W. Doherty

(First received 13 January 1998; accepted for presentation during IAS-4)

The portable high-throughput liquid-absorption air sampler [PHTLAAS] is an outgrowth of a high-volume vapour collector that was first developed at the Argonne National Laboratory [ANL] for the ultra-sensitive detection of trace concentrations of hazardous or illegal compounds whether in vapour or aerosol form. The sampler is characterized by its light weight (about 1 Kg) and low power consumption (less than 20 watts DC).

The PHTLAAS was evaluated as a sampler for aerosol particles in the size range of 2 - 10 micrometers (aerodynamic diameter) in a wind tunnel. The sampling efficiency was found to be between 20% - 85% (depending on aerosol particle size) at sampling rate of 230 - 250 litter / minute. The sampling efficiency was invariant to the orientation of the intake slit in respect to the wind direction, or the vertical inclination of the sampler up to 75 degrees off the vertical for aerosols of 3 microns diameters and wind speed below about 2.2 m/min (5 MPH). More recently an improved version of the sampler yielded a collection efficiency of about 20% at a sampling rate of 380 litter / minute.

The paper will describe the sampler and its characteristics in details. Also discussed will be test results using fluorescent particles as well as biological particles of Bacillus Subtilis (BG). performed in a wind tunnel and a static aerosol chamber. Potential uses for the sampler will be discussed as well.

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1178

NUMERICAL ANALYSIS OF FLOW FIELD IN THE CERAMIC CANDLE FILTER USED IN INTEGRATED GASIFICATION COMBINED CYCLE

Seo, Taewon

(Andong National University)

Choi, Joo-Hong

(Gyeongsang National University)

Chung, Jae-Hwa, Jeong, Hyun-Il

(Korea Electric Power Research Institute)

(First received 22 January 1998; accepted for presentation during IAS-4)

The regulation of the exhausted gases contained CO_2, SO_x, and NO_x becomes more and more stringent in the world and this regulation is forced to study the clean coal technology to minimize the environmental contamination. Because of the stringent regulation to protect the earth by the fully-developed countries the next generation of firing system to be constructed in the next century is either IGCC (Integrated Gasification Combined Cycle) or PFBC (Pressurized Fluidized-Bed Combustion).

The IGCC has increasing attention as the clean coal power plant system to minimize the environmental contamination and to increase the thermal performance. The removal of the particulate contained in the hot gas is important to protect the gas turbine. The particulate produced in the combustion process of IGCC have been gotten rid of by ceramic candle filter. To increase the performance of the filtering process is of importance to get uniform velocity profile in the candle filter. The objective of this study is to analyze the velocity and pressure distribution in the candle filter and to investigate the effect of the porosity and the length of the filter. It is assumed that the flow field in the candle filter is axi-symmetric and steady-state.

K-ε model in the flow field and Darcy's law in the porous region are adapted in the numerical calculation. It is found that the effect of the porosity in the flow field is negligibly small while the effect of the filter length is significant.

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IAS-4 *Saint-Petersburgh, July 6-9 1998*

>> Dates of IAS-4 - 6-9 July 1998

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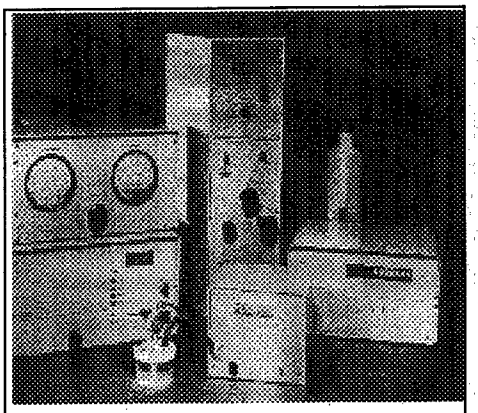
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1055.
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THE INFLUENCE OF AEROSOLS ON ATMOSPHERIC ABSORPTION OF SOLAR RADIATION

ARKING A.

Johns Hopkins University Baltimore, MD 21218 USA

(Received 16 December 1997; accepted for presentation during IAS-4)

There has been an ongoing debate over the last few years concerning the source of a discrepancy between observations and theoretical calculations of the amount of solar energy absorbed by the atmosphere. Based on a quasi-global, multi-year set of ground-based observations, combined with satellite measurements of top-of-the-atmosphere flux, absorption is 0.24 (expressed as a ratio with respect to incident flux at the top of the atmosphere). Models underestimate that absorption by 0.05 to 0.08. Some studies have attributed the discrepancy to clouds, while others have shown that the discrepancy is independent of clouds and, instead, correlated with column water vapour. At this point, the source of the discrepancy remains a mystery. Here, we examine the role of aerosols in atmospheric absorption, and test the possibility that aerosols account for some or all of the discrepancy. We use the output of chemical transport models to study the effects of three broad categories of aerosols: sulphates, mineral dust, and carbonaceous aerosols. We find that the discrepancy is not correlated with either sulphates or mineral dust, but there is a small but significant correlation with respect to carbonaceous aerosols.

However, based on their amount and distribution, the carbonaceous aerosols could only account for a small fraction of the discrepancy. To account for a major fraction, the total aerosol burden would have to be predominantly carbonaceous, with single scattering albedos ~0.75 or smaller, a highly unlikely situation at the vast majority of observation sites.

1066.

PUTTING METAL ATOMS INTO FULLERENES: ENDOHEDRAL METALLOFULLERENES

SHINOHARA H.

Department of Chemistry, Nagoya University, Nagoya 464-8602, Japan

(First receive 27 December 1997, accepted for presentation during IAS-4)

Endohedral metallofullerenes are novel fullerene-based materials and have attracted much attention in the last four years. In the last couple of years, some important progress have been made in direct structural analyses of metallofullerenes by using synchrotron X-ray diffraction and 13C-NMR studies. Recently, we have succeeded in determining the endohedral nature of the metallofullerene, Y@C82, and obtaining its total electron density via synchrotron X-ray powder diffraction(1). The results reveal that the yttrium atom is displaced from the center of the C82 molecule and is strongly bound to the carbon cage.

In the present study, both the isomer and the endohedral structures of a typical di-metallofullerene, Sc2@C84, have been determined for the first time by high-resolution 13C-NMR (2) and synchrotron X-ray diffraction studies, respectively. The results show that one of the major isomer of Sc2@C84, i.e., Sc2@C84 (III), has a D2d (23) symmetry and that some dynamical averaging of the Sc ions might be taking place around the optimum scandium position. This is a striking contrast to the Y@C82 case, where the yttrium atom is attached to the carbon cage even at room temperature.

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Some important features of the crystal structures of Y@C82 and Sc2@C84 will also be presented and discussed.

1185.

HOT PARTICLES OF CHERNOBYL ORIGIN IN ENVIRONMENTAL SAMPLES

TSCHIERSCH J., WAGENPFEIL F.

Institute of Radiation Protection GSF-National Research Center for Environment and Health

D-85764 Neuherberg Germany

(First received 31 January 1998; accepted for presentation during IAS-4)

Pure nuclear fuel particles were released into the atmosphere during the reactor accident in Chernobyl. These particles are connected with high concentrations of radionuclides and are called "hot particles". During resuspension experiments in the 30-km exclusion zone of Chernobyl, airborne hot particles were sampled and analysed. Detection methods for hot particles were (digital) autoradiography and gamma-spectrometry. In the size range larger 3 µm aerodynamic diameter approximately 36 hot particles per 1000 m^3 were measured during anthropogenic enhanced resuspension.

Hot particles in the environment cause samples which are not uniformly contaminated, especially if there are only few hot particles in the sample. Because of the inhomogene distribution of radionuclides in environmental samples a significant measurement uncertainty may result. In laboratory experiments the analytical uncertainty for various sample media (filter, soil) and measurement geometry were investigated. A single hot particle was analysed for instance in a sample without any other contamination in a frequently used 1000 cm^3 bottle by gamma-spectrometry. The measured ^{137}Cs activity may range between a factor 10 too high or a factor of 20 to low (related to the actual activity of the hot particle) depending on the position of the single hot particle in the sample. For most measurement geometries it was possible to formulate a procedure by which the relation between the measured and the actual activity concentration can be calculated in dependence on the position of the hot particle.

993.
УДК 541.18

BUILT - IN SENSORS (BIS) FOR DIAGNOSTICS OF LIQUID SYSTEMS ON PARAMETERS OF PARTICLES OF WEAR.

LOGVINOV L.M.

Samara state aerospace university named by acad. S.P. Korolev

(First received 26 December 1997; accepted for presentation during IAS-4)

In a structure of any liquid system of a product of an air engineering, machines and process equipment there are plenty of tribomechanical units (valves, plungers, bearings and etc.), the reliability of which significantly depends on a level of contamination and other parameters of a liquid /1,2,3,4/. It is known, that the imperfect control of a technical condition of tribomechanical units, included in structures of liquid systems, frequently causes failures and emergencies with products. Taking into account the fact, that the information on a history of development of wear process can be received from parameters of particles of wear, generated, it is possible to consider, that quantity and the size of particles, produced by the contacting pair, present the valuable information on a technical condition of whole unit of friction /2,3,4/. The travel of a liquid together with particles of wear in remote sites of a system permits to find out

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these particles in any place of hydraulic system, provided that built - in sensors (BiS) of technical condition of liquid systems of machines /3/, offered in 1984/5/ by the employees of ONIL-16 SSAU, will be used for this purpose.

Existing till now way of the control of a level of contamination of a liquid, based on the analysis (including automatic) of samples taken, does not permit to receive the information on a level of it's contamination in a real time scale /2,3/. Besides, for this method are inherent significant errors, stipulated by difficulties of maintenance and control of degree of cleanliness of sample containers and presence of "filter effect" of a small backlash in the sample valve, especially at sampling from highways of high pressure (up to 30 MPa). BiS of parameters of disperse phase (DP) offered /3,5/ do not require conventional sampling of a liquid and permit to increase objectivity and efficiency of the control.

In the report generalized functional and physical models, as well as principles of construction and feature of designs and characteristics of BiS of parameters of DP are considered in detail. In the report mathematical model of internal flowing part of photoelectric BiS and basis of their metrological maintenance are adduced.

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994.
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HARDWARE METHOD OF INCREASE CONCENTRATION LIMIT OF PHOTOELECTRIC ANALYZERS OF CONTAMINATION OF A LIQUID

KUDRIAVTCEV I.A.

Samara state aerospace university named by acad. S.P. Korolev

(First received 26 December 1997; accepted for presentation during IAS-4)

The concentration limit determines maximum accounting concentration of particles in a researched liquid, when the readout number of particles differs from valid not more, than on 10-15 %. This error is stipulated by coincidences of particles in sensitive volume of an analyzer, i.e. simultaneous presence in it more than one particle, that results in imposing of target electrical pulses of a photoelectric analyzer.

The existing photoelectric analyzers of contamination of a liquid register pulses only in case when the interval between them exceeds size of a duration of a pulse /3/. Thus the concentration limit is determined by the parameters of sensitive volume of a sensor.

The form and parameters of target pulses of a photoelectric analyzer are determined by

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distribution of light exposure in sensitive volume of a sensor, form of a particle and its speed, as well as passband of a electronic amplifier. Imposing of pulses results in formation of a signal of the complex form with local maxima and minima. The analysis of the form of such signals permits to recognize в¤Г«м-лГ pulses and, thus, to increase concentration limit /2/.

It can be executed by fixing of size of local maxima, even if the pulse was not finished. Necessary condition is suppression of false maxima, produced by noise, otherwise the concentration measured will be overestimated.

In photoelectric analyzers of a type AZJ-915 and POTOK-945 /3/ the analysis of amplitude of pulses from a output of a sensor is performed with the help of a row of comparators, the outputs of which are connected with the inputs of digital counters /2/. The thresholds of operation of comparators are chosen in order to execute the analysis of the sizes of particles pursuant to GOST 17216-71 (St.Standart). The amplitude of a target pulse of a sensor, determined by the size of a particle, is fixed in a moment when the comparator with a maximum threshold resets. Thus the analysis of a following pulse is made after reset of a comparator with a minimum threshold.

Change of logic of work of a analyzer in order to fix all local maxima of pulses, will allow to decrease "dead" time of a analyzer. For this purpose it is enough to register amplitude of a pulse in case of sequential set and reset of one of comparators, if between these events does not occur setting of any other comparators. The size of a hysteresis of comparators should not exceed level of noise /2/.

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995.
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PIEZOELECTRICAL CONVERTERS IN MONITORING SYSTEMS OF PARAMETERS OF METAL PARTICLES

POMINOV E.I.

(Samara state aerospace university)

(First received 26 December 1997; accepted for presentation during IAS-4)

The principle of action of piezoelectrical converters (PEP) for the control of size distribution of metal particles in liquid or gaseous dispersion fluids is based on the transformation of energy of impact of particles onto a sensitive surface of a piezoelectrical crystal to electrical signal. Signal of PEP is an radio-wave pulse with initial amplitude, which is proportional to mass and speed of particle at the moment of impact. The pulses from separate particles are being amplified, detected and sorted in dependence from magnitude for various channels of registration, according to certain sizes of particles.

Obviously, the sensitivity of a device is completely determined by the ratio of amplitude of a useful signal to peak value of a noise voltage on the output of an amplifier (SNR). A technique and results of calculation of the SNR for PEP and amplifiers with various parameters are

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discussed in the report . The analysis of the results obtained shows, that the sensitivity of PEP is limited by the noise of amplifier. Maximum of the SNR is attained at some optimum active resistance of a piezoelement's load and grows weakly with the reduction of capacity of a load. The amplifiers with various types of active elements do not permit to obtain significant gain. However, the application of the amplifiers, using bipolar transistors or OA is more preferable; for them the best accordance with output resistance of piezocrystal is provided, which is determined as by small resistance of piezocrystal near the antiresonant frequency, as by relatively small value of resistance of dielectic loss. The maximum of SNR is attained at Q-quality of a resonant contour of an amplifier 1.5 ...3 times smaller, than Q-quality of a piezocrystal; it corresponds to a threshold of sensitivity of PEP about 6.4 mm (at SNR equal 3) for bronze particles at speed of 15 m/sec. at the moment of impact (experimental value is equal 7 mm).

The process of the transformation in PEP is executed in some stages. On the first stage the initial distribution of particles in space in the PEP input is being transformed to a casual sequence of pulses; the intensity of pulse flow is proportional to the concentration of particles, and the amplitude distribution of pulses is correlated to initial size distribution of particles. On the second stage the reverse transformation to experimentally observed size distribution is being made. The discrepancy of the function restored of a distribution of particle size from the initial one is determined by the errors of the control of parameters of dispersion phase. The differences between speed and density of particles, conditions of impact of particles during the analysis, and values, used during experimental graduation of PEP, will result in occurrences of systematic errors, and their fluctuations during the analysis will cause casual errors. However, even during the control of particles of the same size and parameters in the same flow, deviation of signal's magnitudes is observed. It is caused by unevenness of the characteristics of a sensitive surface of the piezocrystal, speed of a flow in the cross-section of a channel and speed of particles driven on various trajectories.

In the report a technique and expressions obtained for density of probability of restored size distribution for monodispersed particles at various modes of flow of dispersion fluids in a channel of PEP are discussed.

Estimations of mean value and standard deviation for densities of probability have given values, correspondingly 1.08 and 0.124 for laminar mode and 1.006 and 0.051 for turbulent mode of the flow.

999.
УДК 541.18

INDICATOR OF QUALITY CONTROL OF JET FUELS OF A TYPE POTOK-RT

LOGVINOV L.M., MALYGIN N.A., SMAGIN W.À., COURDIN G.À.

Samara state aerospace university named by acad. S.P. Korolyov, Samara research institute "ECRAN"

(First received 26 December 1997; accepted for presentation during IAS-4)

It is known, that the reliability of fuel systems of products of a air engineering is significantly determined by a degree of their contamination (mechanical impurity and emulgated water) /1,2/. The developed indicator of the control of a degree of jet fuel's cleanliness permits to determine excess allowable and limiting levels of the contents of mechanical impurity and emulgated water during refuel of flying vehicles and executes switching of external executive devices (slide-valves) if a limiting level is exceeded.

The block diagram of an indicator of a type "POTOK-RT" consists of photoelectric built - in sensor (BiS), performed in explosion-proof variant and included in gap of fuel main with

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diameter of 100 mm, as well as electronics unit /2/. Photoelectric BiS works on a principle of measurement of light flows, scattered by particles (droplets) of insoluble water /2,3/. For use of a photoelectric sensor for the control of parameters of mechanical impurity and emulgated (insoluble) water in jet fuel were conducted experimental researches on valuation of a spectral structure of mechanical impurity and emulgated water, passed through the filter-separator if fuel flow changed /2,3/. Results of experimental researches have allowed to establish, that the particles of insoluble water have the sizes, more than two times exceeding average size of filter pores(~ 5 mm) in a wide range of the flows, and overwhelming number of particles of mechanical impurity have sizes in a range 5 ...10 mcm (i.e. less than 10 mcm) /2,3/. Thus, with the help of photoelectric BiS, if a filter with performance of 5 mcm is available in a hydraulic path, one can separately register the parameters of mechanical impurity and water, emulgated in jet fuel.

Main constructive and metrological characteristic of a developed indicator of a type "POTOK-RT" are informed in the report. Particularly, "POTOK-RT" can supervise a degree of cleanliness of fuels of a type TC-1, T-1, T-2, PT, T6 and other, when fuel flow is within the limits of 50...2500 (l/min) and pressure in a highway - 0.1 ..1.6 MPa.

Operation of a device in a range of temperature of a environment from -50 up to + 50| C is permitted. The range of particles size registered is 5...50 mcm, range of indication (in % of mass concentration): for mechanical impurity - 5.10^{-4}; for emulgated water - 5.10^{-3}. Mass of a sensor is not exceed 10 kg, and electronics unit - not more than 40 kg. Feed of an indicator is performed from a alternating current circuit 220 V / 50Hz and direct current source - 27 V. Consumed capacity: on an alternating current - 150 VA; on a direct current - 70 VA.

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APPLICATION OF MICROCOMPUTERS IN SYSTEMS OF RECOGNITION OF COMPLEX PULSES FROM PARTICLES ON THE OUTPUT OF PHOTOELECTRIC GAUGES.

KUDRIAVTCEV I.A., FADEEV V.V.

Samara State Aerospace University named by. Acad. S.P. Korolev (SSAU)

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The photoelectric analyzers of disperse phase (DP) parameters use a principle of registration of a light flow, scattered by the particle in sensitive volume of the gauge. /1/ As a result of simultaneous presence more than one particle in sensitive volume of the photoelectric gauge imposing of electrical pulses on its output occurs. Thus the multichannel peak analyzer, processing target signal of gauge, can not correctly interpete a pulse, being the result of imposing of two and more separate pulses. So the concentration measured is distorted.

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Concentration determination error value depends on a duration of target pulses and concentration of DP. In /2/ there is the formulation of the numerical approach to the calculation of value of this error.

The employees of research laboratory of SSAU ONIL-16 have developed the technique of processing of target pulses of a gauge, enabling to increase number of pulses, correctly registered by multichannel peak analyzer owing to analysis of pulse form.

The principle of work of the system offered leans on the allocation of local maxima and minima in the form of complex target pulses, produced as a result of concurrence of particles in sensitive volume.

The processing of a signal is conducted with the help of a system of comparators, separating such pulses into different ones the amplitude of which is determined by separate particles, participating in concurrence.

Necessary condition of correct division of pulses is exception of consideration local extremal values, stipulated by noise. It is made with the help of comparison of size of local minima with a level of a voltage, a little exceeding noise level.

The modern element base permits to organize high-speed digital processing of a target signal of a gauge and to make the analysis, proceeding from a duration local maxima and minima. Modeling of complex pulses with the help of a computer has shown, that local maxima and minima in complex pulses have a duration, essentially exceeding average duration of noise peaks, which can be accepted for separate pulses. Thus, using the sampling of a target signal of the gauge and carrying out the analysis of sample as values in a real time scale, it is possible to distinguish noise peaks and peaks, produced as a result of concurrences of pulses. The efficiency of such time recognition is more significant owing to the reduction of threshold value necessary for correct minima determination and, accordingly, increase of quantity of separated complex pulses.

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1025.
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ON SOME TURBULENCE MODEL OF FREE TWO-PHASE JETS

TSIPENKO A.V.

125871 Moscow, Volokolamskoe shosse, 4, MAI, NII NT MAI.

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For the theoretical determination of the parameter fields in two-phase jets, there exist a great number of approaches based on the different notion about the discrete fraction, the different approach to taking into account the turbulence. Besides, the engineering practice constantly requires - when modeling such factors as flow nonisotermicity, particle polydispersity, collision of one particle with another, phase transitions, etc. But these factors shade the peculiarities connected with different approaches used at constructing models, though the understanding of internal

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peculiarities of models is necessary at the selection of a concrete model for solving a concrete problem.

In this work an attempt to show the peculiarities of five different approaches to modeling the two-phase turbulent axisymmetric jet is made based on the detailed experiments /5,6/. The model 1 is the Prandtl-Abramovich model of first order. The model 2 is the model of Gavin at al. /3/, the model 3 is the model of Elghobashi at al. /4/. The model 4 is the model of Zaichik at al. /1/, the model 5 is the model of Mostafa at al. /5/ (this is so-called stochastic model). A detailed modelling of experiment was carried out according to the model of authors and also - according to the modified versions of models.

Based on the calculation performed, the following conclusions can be drawn: the best results can be expected from the stochastic model taking into account the interaction of particles but this model is not suitable for the realization on PC at this stage; for obtaining the minimax assessment, the model 1 is the most suitable; for carring out a more detailed calculation, the modification of model 3 is advisable as a most simple one.

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1036.

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AEROSOL EMISSION FROM CONTAMINATED STRIP OF SOIL DURING HARROWING AND TRUCK MOVING

GARGER E.K.

Institute of Radioecology UAAS Tolstoy St. 14 252033 Kiev, Ukraine

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Measurement of ^{237}Cs air concentration and "hot" particles for simulation of agricultural works (harrowing) and driving of vehicles along a dirt track into the exclusive Chernobyl zone allowed to estimate the emission flux and rate using solution of the turbulent diffusion equation for a dust strip[1]. Measurements were conducted by the gradient installation at the 1.0, 1.8, 2.5, 3.5 m heights and impactor with the aerodynamic cut off diameters 2.0, 4.0, 7.0, 12, 20, 30 μm [2]. Experiments were carried out from two strips with the density contamination by ^{237}Cs 0.31

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± 0.05 , 0.56 ± 0.06 [Mbq m^{-2}] and also the density of number "hot" particles 27.10^{-4} [m^{-2}], 60.5 x 10^{-4} [m^{-2}] respectively.

Vertical flux of ^{237}Cs for six experiments was varied from 22.2 ± 5.0 to 460 ± 90 [mBq m^{-2} s^{-1}] depending on a kind of vehicles and meteorological conditions. The emission rates have values from $0,07x10^{-6}s^{-1}$ to $1,5x10^{-6}$ s^{-1} and were by three-four orders of magnitude higher than for the wind resuspension conditions. "Hot" particles were measured in the third experiments that was given estimations of the emission rate (1.1-2.5)$x10^{-6}$ s^{-1}.

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1192.
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POINT IONS APPROXIMATION WITHIN THE MARCH MODEL FOR THE FULLERENE MOLECULE

DESPA F.

Department of Theoretical Physics Institute of Atomic Physics
Magurele - Bucharest, PO Box MG-6 Romania

(First received 26 January 1998; accepted for presentation during IAS-4)

Progress in the investigations of the Buckminsterfullerene has until recently been largely confined to the molecule model within which the positive ions are uniformly smeared over the surface of a sphere and the valence electrons constrained to move on the sphere surface.

The model has successfully been used in describing some electronic and optical properties of C60.[1-4]

Recent interest centers on new approach[5-8] of the continuum positive charge model which employ Thomas-Fermi theory in describing the electron distribution and the stability of the fullerene. The latter molecule model was inspired from the March's one-centre model[9] for heavy, almost spherical molecules. The results were decidedly encouraging, and led them to suggest possible improvements. One of them we attempt to present in this paper.

We shall use a point ions approximation within the March model for the fullerene molecule and, we shall self-consistently derive the electron distribution of a fullerene molecule by a systematic application of the well-known results of the many-body perturbation theory.

Previously,[9] the March's one-centre model was employed to investigate special molecules XY_n, like CH_4 or SF_6, and it has been provided with a sound theoretical basis.[10] Shortly, the positive charges of the Y nuclei are smoothed out uniformly over the surface of a sphere with the X atom at the centre and, then the essential problem being to apply self-consistent field methods for the delocalized electrons.

As a theory in its own right, the method developed by March has not been without its successes, and it seemed a natural step therefore to investigate whether the method could be extended to the fullerene molecule. The March model strictly corresponds to the endofullerene molecule and it has been explored recently by Clougherty.[8]

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For the fullerene case, there is no central atom and the boundary conditions imposed in the March model change at the origin.[6]

The molecule model assumes that the valence electrons cover the inner and the outer surfaces of the uniformly charged fullerene cage moving in a common potential generated both by the positive charges and by their distribution. One point need stressing here: Smearing the positive ions into a continuum surface charge distribution, as indicated above, it leads to electrons moving in a less rapidly varying spatial potential than for the point ions in the fullerene molecule. (Note that inside a sphere, the electrostatic potential due to a surface charge distribution is constant.) Mostly, the inside electron distribution seems to be affected by employing the continuum positive charge approximation; only lesser than half of all the valence electrons of the fullerene molecule are inside the shell.[6,7] Therefore, the fullerene molecule being too "rarefied" within its natural limits, some objections can be risen on its mechanical stability.[5-7]

This situation can be overcame in a case which we shall present here by employing a point ions approximation. In this case, the valence electrons are found to be confined, in majority, inside the shell as a consequence of the adequate changing of the internal electrostatic potential. Moreover, both the inside and the outside electron distributions show distinctive peaks near the fullerene cage,[11,12] fact which differs from the other results recorded in the field[5-7]

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1183.
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DETERMINATION OF EFFECTIVE ANNEALING TEMPERATURE RANGE IN THE FULLERENE FORMATION

OSAWA E., SLANINA Z., ZHOU X., MATSUMOTO T.

Computational Chemistry Group, Department of Knowledge-based Information Engineering, Faculty of Engineering, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempakucho, Toyohashi, Aichi 441-8122, Japan.

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Our knowledge on the events occurring in the course of fullerene formation is limited primarily because experimental techniques for high-temperature chemistry have not been well developed. For example, it is not yet clear if the distribution of configurational isomers in

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higher fullerenes fraction represents thermodynamic equilibrium or a snapshot of kinetic process. An well-known example favoring the kinetic view is the disagreements in the kinds and relative amounts of the isomers of [78] fullerene separated from the extract of soot produced by arc discharge of carbon electrodes: Diederich et al. first separated two isomers, D2v(I) and D3, in a ratio of ca 5:1, then Kikuchi et al. gave three, D2v(II), D2v(I) and D3, in a ratio 5:2:2, then Taylor et al. and we found ratios of 18:52:30 and 595: 1026:386, respectively, for the same three components as found by Kikuchi et al. This and other examples might appear to demonstrate experimental difficulties in controlling high-temperature processes.

However, we doubt the validity of these determinations for two reasons. First, all of the above analyses (HPLC) ignore possible variation of extinction coefficients among the isomers at the UV wavelength with which relative peak height was determined. We noticed considerable differences in the shape of spectra of the above three isomers around 312 nm. Second, structural assignments have been heavily assisted by the computed enthalpies at 0 K (for ab initio methods) or at room temperature (for semiempirical methods). This is doubly wrong because the annealing occurs at much higher temperature, and the effect of vibration must be explicitly taken into account by using free energies. Regarding the second point, recent progress in evaluating free energies of fullerene isomers over a wide range of temperatures (typically 0 to 10000°K) using higher levels of MO theories has provided reliable criteria to determine equilibrium compositions of isomers and straighten the past confusion.

Under this circumstance, if we assume thermodynamic equilibrium and have accurate experimental compositions of isomers, we will be in a position to estimate the temperature of annealing. For this purpose, we need accurate distributions of isomers in higher fullerenes. Fortunately, recently reported method of introducing helium atom into the inside of fullerenes under high pressure of helium (BC provides a convenient determination of isomeric compositions. Although the rate of He incorporation by this method does not exceed a few tenths of percent, highly sensitive 3He NMR allows analysis of the mixture without further purification. Applying the method to a sample of 'highly purified fullerene fraction containing mostly C78' and a similarly designated sample of C84, Saunders and his coworkers found that the purified samples contain five and nine isomers of [78]- and [84]fullerenes, respectively. In contrast, only three isomers of [78]- and two isomers of [84]fullerenes have been described previously.

Thus, temperature range of annealing process in the fullerene formation has been estimated to be 2300°K with standard deviation of a few hundred°K, by fitting the isomers distribution of [78]- and [84]fullerenes obtained by 3He NMR measurements to the computed free energies of isomers vs temperature relation. Stone-Wales rearrangements occur in this temperature range about 105 times per second, fast enough to reach complete thermal equilibrium among configurational isomers of IPR fullerenes.

1194.

FULLERENE MOLECULE AND ALKALI FULLERIDES

APOSTOL M.

Department of Theoretical Physics, Institute of Atomic Physics, Magurele-Bucharest MG-6, POBox MG-35, Romania email: apoma@theor1.ifa.ro fax: 40-1-423 17 01

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With the advent of the C60 fullerene molecule we are in the presence of a new microscopic object: a hollow, highly-symmetric, (quasi-) spherical molecule consisting of a large number of carbon atoms. Molecular physics can, therefore, borrow standard methods for treating such an object from solid-state and condensed matter physics.

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To the first approximation the fullerene molecule may be viewed as a spherical, elastic shell of atoms; having derived its elastic energy, one may obtain the corresponding vibration spectrum.

The linear elasticity of a spherical thin film has to be established from first principles.

The oscillation modes of this sphere can be classified into four classes, out of which a few particular modes only can be computed anallytically. The vibrations are coupled to rotations, the main effect of this coupling, however, being static deformations beyond the harmonic approximation. If such a molecule is being to blow up during rotation, this would happen for certain polar angles on the sphere; a situation never reached, however, for the fullerene molecule. The dynamical anharmonicities of such an elastic, hollow sphere are, nevertheless, an extremely intriguing subject.

Carbon is a life element (is our life carbonic?). We know it, mainly, as sp2-hybridizations in graphite layers, or sp3-hybridizations in diamond. Is the fullerene molecule a curved, spherically-shaped graphitic layer? The electron affinity of carbon is 1.26 eV, while the electron affinity of the C60 fullerene molecule is much higher, about 2.65 eV.

Any standard theory of chemical bonding would have principled difficulties in accounting for this discrepancy.

How does a fullerene molecule react to an electron moving in the vicinity of its surface? One may think that the molecule gets polarized, and bound states will appear for the moving electron.

The electronic spectrum of such a quantum system is a hydrogen-like spectrum, in agreement with the experimental indications of the single-charged fullerene anion.

Highly-charged anions could also be treated within such a simplified model, at least in principle.

Layered structures of graphite have been doped in the past with alkali cations, which are easily accommodated in-between the layers, with the hope, among others, to fabricate electric charge batteries. Solid-state fullerites accept easily alkali cations, too, and form stoichiometric compounds to various degrees. The best known among these alkali fullerides are A3C60, where A denotes Rb, K, Cs, or even Na and Li. These compounds have a fcc- structure, with two distinct coordination sites for the alkali cations, one tetrahedral, the other octahedral. These two types of sites look like fullerenic cages wherein alkali cations are accommodated. The tetrahedral coordination is rather tight, so that the relatively small-size alkali cations occupy central positions inside. On the contrary, the octahedral coordination is pretty wide, and, while large alkali cations like Cs are central in these coordination, small- and even medium-size alkali cations, like Li, Na, and, respectively, K are placed off centre, along the structural directions of high symmetry. For example, a K cation may ocupy one of the eight corners of a small cube centered on the octahedral coordination. Detailed computations using inter-ionic potentials confirmed this picture, leading to the conclusion that ocathedrally coordinated alkali cations in some fcc-alkali fullerides may acquire off-centre sites placed along the (111)-symmetry directions.These off-centre positions of the alkali cations in alkali fullerides give certainly birth to a certain disorder, though not a completely undetermined one, i.e. this disorder is only a partial one, preserving to a certain degree the original ordering of the host lattice. This circumstance is rather singular, in any case not very common in solids, and its effects on the transport phenomena, thermal properties, local electronic structure, etc remain to be investigated. In particular, diffusion of the interstitial impurities on off-centre sites may exhibit new, universal features, still unknown, to a large extent.

The off-centre sites may degenerate in highly-doped alkali fullerides into clusters of small-size alkali cations built inside the octahedral cages. Tetrahedral-, cubic-shaped and even cubic-centered Na clusters (i.e. Na_4, Na_8 and, respectively, Na9) have been reported in alkali-

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doped fullerites, and the questions of their stability, the nature of their chemical bonding, the degree of ionicity, the extent of their metallic behaviour, etc, have been rightly raised. These atomic systems are very complex to be approached by any specific theoretical method, even a numerical one. We are left, for the time being, with approximate models, able to give only a qualitative understanding of these micro-objects. Such an approach is the Thomas-Fermi model, where the electronic cloud moves in a self-consistent potential, usually of high symmetry. The Thomas-Fermi model for this situation tells us that the tetrahedral cages are too small to permit clusters building; that the alkali clusters in the octahedral cages are only formed in the presence of the cage walls which give rise to huge, repulsive electronic potentials; in other words, these clusters are actually groups of alkali cations strongly squeezed inside the fullerenic cages; this squeezing generate a high degree of collectivization of the alkali electrons, so that we may view these micro-objects as small metallic drops; whose ionicity is not very high, however: the Na_4 cluster, for instance, has a total charge of about +2.7 electronic charge, the Na9 cluster is almost neutral, while the Na8 cluster seems to be rather unstable. Alkali clusters in highly-doped fullerides may exhibit their own molecular dynamics, which is worth-testing by various spectroscopical methods.

There is no perfect solid, and the alkali fullerides are no exception. Usually, the defect concentration increases with increasing temperature. However, upon certain conditions of preparing the sample, when the preparation involves an equilibrum process, a slight defect concentration may appear, which is independent of temperature, and this seems to be the case for some alkali fullerides. In these compounds there seems to exist a small concentration of alkali vacancies in the tetrahedral coordination, which give rise to an additional line in the NMR spectra of 87Rb and 39K. This phenomenon is known as the T-T□ splitting of the NMR spectra of the alkali cations in Rb_3C_{60} and K_3C_{60}, and the mechanism of alkali vacancies migrating through the lattice seems to explain the occurrence of the additional T□-line, beside the T- and O-lines originating in the two distinct types of coordination (tetrahedral and octahedral) of a perfect compound.

The octahedral off-centre positions of the alkali cations in these compounds may also distort the shape of the alkali NMR lines originating in the tetrahedral cordination. Usually, the off-centre sites generate a quadrupolar coupling whose effect in the NMR spectrum is averaged out by the tunneling of the atoms between the highly-symmetric off-centre sites. However, in the case of K_3C_{60}, the alkali cations in the tetrahedral sites are polarized by the octahedral off-centre cations, in such a way that a net effect is obtained in the form of an assymmetric shape of the tetrahedral NMR line. This seems to be again a rather unique situation, pertaining to the fullerenic compounds.

1076.

LASER BEAM EVAPORATION OF ICE PLATE AEROSOL PARTICLE

KUCHEROV A.N.

Central Aerohydrodynamic Institute (TsAGI), Department of Fundamental Research, 140160 Zhukovsky, Moscow region, Russia

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When the investigating the destruction process and describing the mass and heat exchange of ice aerosol particles under laser beam radiation a large number of particles may be treated as plate disk, the thickness of which is less than its radius [1]. The physical evaluations show that energy demand and time necessary to heat an ice aerosol particle up to the melting temperature are significantly lower than those for the melting process. Similarly, energy

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expense and melting time are significantly lower than evaporation time and evaporation energy of a particle, transformed into a droplet. Studying the sublimation and evaporation process of a single ice disk is made at temperature T,K and heat release intensity q,W/m³ averaged over the volume of the aerosol particle. If the beam intensity is moderate, then the melting temperature is not reached. Let's call the maximum heat release intensity q, at which the particle is not melted, threshold of melting q_{melt}. In the first its value depends on ambient air temperature T_∞, pressure p_∞ and minimum particle size (half thickness of the disk). In Fig.1 the dependence of p_∞ value on the ambient temperature T_∞ is drawn at a pressure p_∞ =1bar and a disk half thickness r=d/2=1mkm. For comparison, the dependencies of qmelt value versus T_∞ are also drawn for a sphere and long thin cylinder of r=1mkm.

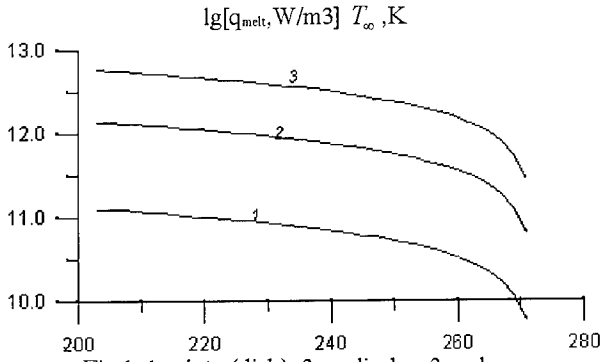


Fig.1. 1- plate (disk); 2 - cylinder; 3- sphere.

Thermal physical and optical properties of ice and water are insignificantly different ones from another [1-3], except thermal conductivity coefficient and vapour saturation pressure. In the same time the vapour mass flow from the disk surface is significantly less than that from the cylinder surface. The latter is less than vapour mass flow from the sphere surface if the cylinder and sphere radii are equal. Thus, the phase state of an aerosol particle (ice or water) influences on heating and evaporation process firstly through the ice aerosol particle form. When q< qmelt the particle slowly sublimates losing its mass. The dependencies of the ice particle evaporation efficiency on ambient physical parameters, incident radiation, particle size are investigated. The characteristics of plate (disk) and spherical ice particles sublimation and evaporation, as well as the super cooled water droplet evaporation are compared. This work is done under the financial support of the Russian Foundation of Fundamental Investigation (RFFI) and ISTC (Project 200).

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1213.
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RADIOACTIVE DISTRIBUTION OF SIZE PARTICLES FOR SIMULATION OF SOME ANTROPOGENIC ACTIVITIES

GARGER E.K., KASHPUR V.

Institute of Radioecology UAAS
Tolstoy St. 14, 252033 Kiev, Ukraine

PARETZKEH.G., TSCHIERSCH J.

Institute of Radiation Protection GSF-National Research Center for Environment and Health D-85764 Neuherberg, Germany

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Results for the antropogenic activities conducted in the frame of the Project ECP 1 "Contamination of surfaces by resuspended material" is presented. The accent is made on the describing of the radioactive distribution of size particles for the emission and transport processes simulated in the real field conditions into 30 km exclusive zone.

For tractor and truck experiments the character of the radioactivity distributions of size particles had the similar form with two maximums for the 2-4 μm range and the 12-20μm one. In all agricultural experiments it was a considerable part of activity distributed at the particles of 0.1 μm to 2.0 μm that is at the inhaleable range of size distribution. This part was equal 33% ± 6%.

From vertical profiles of Cs-137, Sr-90, Pu-239+240, Pu- 238 and Am-241 concentrations in two emission experiments with the high values of the emission rates and assuming that ratios between Cs-137 and other nuclides did not change with different ranges of size particles it was carried out the radioactivity size particle distributions for these nuclides by Cs-137 size distributions. The air concentrations of the plutonium sum was made up 36-40% from the total concentration for the inhaleable (0.1 - 2.0 μm) range and for giant particles (12.0 - 20.0 μm) - ~ 20%.

Ratios of the settling and friction velocities w_g / $u*$ were calculated for the estimation of the transport ability the large and giant particles. These ratios were 0.026-0.070 for different experiments . It means that particles with d = 12 - 20 μm may consider as light particles that is to neglect their settling velocity during the windy and unstable conditions preservation. So this supports a necessity to take into consideration this fact for the different tasks of dose assessments and radioactivity redistribution in the underlying layer of ground.

Measurement of the number concentrations to shown that the mean number concentration for large particles (3-10 μm and 10-30 μm) six times more the mean number concentration of fine particles (0.6-1.0 μm). The variation factor is more for giant particles (10-30 μm) and the ratio (N_{max} / N_{min}) has three order of magnitude for this range of particles compare with 7 times for the fine particles range.

Measuring were allowed to estimate the radioactive loading of size particles and to show the enrichment of resuspended particles compare with soil particles for the inhalation, respireable and large ranges of particles. The enhancement factor is increased from 4 to 29 times for (d < 2 μm) and (7 - 16 μm) ranges respectively.

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1057.
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MONODISPERSE LATEXES. MAKING, USING, CHARACTERISTICS.

CHECHIK O.S.

Scientific and production firm "VAPA", S-Petersburg, Russia.

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Monodisperse polystyrene latexes is especial group of latexes. Their main distinction is a narrow latexes particles distribution on size. It permit to employ these latexes for calibrating and checking of distinguish devices (electronic microscpes, particles counters and other), for checking of filters and filtering devices, for creation of modelling colloid systems with giving characteristics. Other specific region of their employing is a protein sorbtion on latex particles surface for making of medical diagnosticums.

We can make these latexes in laboratory scale by means emulsion polymerisation of styrene in presence of little strictly measuring amount of emulgator (sodium laurate or myristate as usually). We can receive by this way latexes with particles diameter in diapasone 0,05 microne. For making of latexes with larger particles we use usually seemed polymerisation.

An essential difficulty of these latexes receiving is their reliable attestation (determination of middle particle diameter and of degree their polydispersity. For their describing we use the average-number (S d/n) value of diameter and average-square deviation from average diameter. We use for measuring these characteristics two methods: electronic microscopy (miroscope Tesla BS-242E) and laser spectroscopy (Coultronix N4).

The characteristics of latexes we received are next:

Latex concentratio 10% (mass)

Particles dimensions diapason 0,05 - 4,0 microne

Particles dimensions measuring error 1-3%

Polydispersion extent 5% (for latexes with particles diameter 0,05-0,1 microne and 3,0-4,0 microne 10%).

It should be emphased, here are showed the guaranteed values of characteristics. Real values can be higher. Real measured polydispersity extent can be in diapason 2-3% and less.

Other characteristics of these latexes are next:

Dissoluble in water touch concentration less as 0,1%, it can be decreased, particularly with particles diameter more as 0,3 micrine, by dializing. Latexes particles material is polystyrene, its densityis 1,05 g/ml, refraction index is 1,59.

Depending on supplied latex volume we can sell it at a price 1000-3000 USD per litre. Analogous latexes supplied abroad at a price 6000-30000 USD per litre. Of course, these products are expensive, but a particles number in 1 ml of latex is 10^8 - 10^{13}. It is enough for reliable measuring to treat signals from 10^4 - 10^5 particles, so a value of one measuring is not so high. There are other methods of minimising of measuring value, now we work on one of them together with B.M.Zelicson ("Optica", SPb).

On inquiry of customer we can make modified latexes: painted, nonsedimented, carrying on particles surface carboxylic group, metal ions, metal atoms, including copper, silver e.o.

Other region of monodisperse latexes consuming is making on their basic of distinguish diagnosticums by sorbtion on their particles surface of distinguish proteins. The most interesting latexes are here on their particles surface are fixed functional groups: carboxylic, amino- et other, they allow strong to bind proteins macromolecules, excluding their desorbtion from particles surface. We can supply these latexes too.

Monodisperse latexes application here before "perestroika" became broadening, so it can

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expect to groww consuming of these latexes with renewal of home industry, especially based on high technologies.

1010.

УДК 541.18

SOME REGULARITIES OF A PRECIPITATION OF STOKE AEROSOL AND ITS ACCUMULATION ON A SOIL AND A VEGETATION

GRIGOR'EV A.I., SIDOROVA T.I.

Yaroslavl State University, 150040, Yaroslavl, av. October, house 17 "D", sq. 28,

Ph. (0852) 22 - 23 - 25 Grigor'ev A.I.

(First received 21 October 1997; accepted for presentation during IAS-4)

Smoke aerosols are known to be among the main sources of heavy-element soil pollution in urban areas. In connection with scheduled environmental studies, we measured the concentrations of various chemical elements Pb, Ni, Cu, Zn, Ba,and Co in the soil around a petroleum refinery. It is apparent that the positions of maximum concentration of different elements do not coincide. This result is in general quite unexpected, since indirectly through the relation describing the precipitation of smoke onto the soil it indicates that smoke particles of the same origin have different physicochemical properties.

It is not surprising that particles with different physicochemical properties appear in the smoke aerosol formed in the burning of combustible substances of complex chemical composition, since the chemical composition of a certain particle is determined by its entire history: the place at which it is nucleated in the flame and the chemical composition and temperature of the surrounding vapors and the products of combustion. Let us assume as an initial idealization that a smoke particle is formed as a result of condensation of vapors on a nucleus in accordance with the Maxwell equation, according to which the flux of condensing vapor of a substance onto a particle is proportional to the difference between the partial vapor pressure of this substance in the surrounding medium and that at the surface of the droplet, where the vapors can be assumed to be saturated. Since the pressure of the saturated vapor varies exponentially with temperature, it is easy to see that the temperature of the gaseous combustion products surrounding a smoke particle at the center of the flame and that of a smoke particle at the periphery of the flame will differ by hundreds of degrees. In this situation the mass fluxes of condensates onto the particles in the two situations will differ both in intensity and in chemical composition. As a result, the spread in the physicochemical properties of the material of different smoke particles can be extremely wide.

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1054.
УДК 541.18

MATHEMATICAL MODELLING OF DISTRIBUTION OF ECOLOGICAL RISK ZONES IN ATMOSPHERE AND ON THE UNDERLYING SURFACE FROM AIR ANTHROPOGENIC SOURCES

ARGUCHINTSEVA A.V.

Irkutsk State University, Russia

(First received 11 December 1997; accepted for presentation during IAS-4)

At present the standard methods of air pollution estimate are able to calculate absolute concentrations of ingredients for concrete meteorological situations. Usually the joint realization probability of all meteorological parameters of these situations is approximately equal 0. In contrast to such approach the mathematical models considered in this work take into account the probabilistic distribution function of the stable climatic characteristics of the region and all wind situations. These models are a special case of solution of boundary problem with the random coefficients for description of natural processes dynamics. In order to calculate a probability of realization for some solution it is evidently necessary to consider a set of solutions for various combinations of random values of coefficients, initial and boundary conditions.

The behaviour of these coefficients is determined by multi-dimensional function of probability density. A concrete form of theoretical density function may be established from a minimal discrepancy with an empirical distribution law (assigned on the base of external factors for the problem under consideration). The problem solving is considerably simplified when analytical solutions are used for the differential equations of transport and turbulent diffusion. The results will enable to perform a probabilistic evaluation of studied phenomenon, e.g. frequencies of the given criterion exceeding. Such the results may be following: probability of appearance of various climatic extrema, probability of exceeding indicated norms for the pollutants and for duration of living organisms stay (residence) in such dangerous zones. In addition a quantity of pollutants deposited on the surface (soil, water bodies) from sources can be evaluated for the studied time interval. Problems of the second pollution of surface can be solved.

1053.
УДК 541.18

MODELING OF MESOMETEOROLOGICAL PROCESSES AND POLLUTANTS TRANSPORT IN THE BOUNDARY LAYER

ARGUCHINTSEV V.K.

Irkutsk State University, Russia

(First received 11 December 1997; accepted for presentation during IAS-4)

Transport of atmospheric admixtures from their sources depends on meteorological conditions, orography and interaction of admixtures with the earth's surface.

For determination of admixtures motion velocities and coefficients of turbulent diffusion it is necessary to solve the equations of geophysical thermodynamics in combination with equations of admixtures transport.

We consider the statement and the method of solution of non-stationary three-dimensional nonlinear problem for mesoscale processes arising over thermal and orographic nonhomogeneities of the underlying surface on a background of time and space - variable large-

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scale meteorological fields. The model is constructed without the hypothesis on quasi-static and without the simplifications of the free convection theory.

The model takes into consideration all the components of Coriolis force and atmospheric compressibility. The model will enable to give an account of a broad spectrum of mesoscale phenomena: breeze, mountain and valley circulation with external wind, katabatic winds, dry winds, orographic waves, mesoscale structure of meteorological fronts, convection which is generated by anthropogenic factors etc.

Integration of the equation was realized for Cartesian coordinate system with the aid of the fictitious regions method. To solve the equation we use the methods of constructing of conservative finite difference schemes based on the conservation laws. The time approximation of the problem is constructed with the aid of two-cyclic full splitting. We use the nonmonotone factorisation for the numerical realization of the finite difference equations.

Numerical experiments were realized for study of mesometeorological processes and aerosols transport in the region of Lake Baikal.

1078
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OPTICAL DISTANCE PROBING OF EXTRACTIVE PULPS

TERENTIEV V.E.

All - Russian Scientific Centre "State Optical Institute name after S.J.Vavilov", Russia, 199034, St.-Petersburg, Birgevaya line, 12 Tel: (812)218-00-82, fax:(812)218-37-20, E-mail: Leader@soi.spb.su

(First received 30.10.1998; accepted for presentation during IAS-4)

The problem determination of small concentration of elements and combinations in the form of admixture with a mass portion ~ 0.1% and less in the extractive pulps (the dispersion systems of a fine - fragments solid substance with water) is solving at present by means of a laboratory method titration of samples, selected from the extractor with periodicity defined of the duration of analytic measuring (more 40 minutes). It's suggested the new probe of principle - optic-electronic analyser of admixtures, allowed to measure a concentrations of admixtures in extractive pulps continuous in process of production [1,2]. In given work the theoretical and methodical principles of optical distance probing of extractive pulps were examined, the results of the industrial probations of the analyser were presented.

It's supposed in theory, that pulps is describing by the strong stretched forward diagram of the light scattering, and theory, were developed in work [3], is spreading on pulps. Side by side with calculation of the scattering, determination of concentration SO_{3free}, P_2O_5 and other admixtures in pulps is founding on differences of optical spectrums between molecular interaction for different admixtures in the same condensed medium [4]. Influence of a pulp boundary on optical bunch is defining by refraction of radiation in the perturbed by boundary layer. Liner depending is supposed between indices absorption, scattering and correspond concentrations of admixture and of suspended substance.

With calculation the named assumption the formulae, established a communication of concentration of admixture as well as suspended substance in pulp with reading of the analyser, were defined. Methodic principles of foundation, colibration of analyser of admixtures in pulps were elaborated. Some results of measurements were presented.

At time the industrial probations of analyser the effect "Vanish of boundary division of pulp - air", consist in stabilization of the analyser reading by disturbance of stratification of pulp sample account for intensive mixing by the rest of the same conditions, were discovered. It's possible that effect is conditioned by optical pulp characteristics, namely, by great value of

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average quadratic scattering angle in one scattering act $<\vartheta^2>$ in comparison with diffraction angles Θ of radiation bunch in result refraction in perturbed by boundary layer.

In regime of continuous probing of extractive pulps the mistake of measurements of concentrations SO_{3free} isn't exceed $\pm$ 0,1÷0,15% mass for concentrations 1,0÷3,5% by a correlative coefficient no less 0,9 with data of control analytic measurements [2].

Author thanks to Mrs. M.N.Batova for participation in industrial probations and treatment of results, metrological certificate of optic-electronic analyser of admixture.

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EXOGENOUS SUPEROXIDE IS A VITAL NECESSARY COMPONENT OF THE ENVIRONMENT

GOLDSTEIN N.

Stahnsdorf, Germany

(First received 19 February 1998; accepted for presentation during IAS-4 Published by recommendation of Professor Korkina L.G.)

During the last nearly thirty years, a large body of experimental evidence has accumulated that suggests an important role for reactive oxygen species in numerous pathophysiological processes. The discovery by McCord and Fridovich in 1969 that an enzyme exists that has superoxide dismutase activity, suggesting the continuous formation of superoxide in mammalian cells in vivo as well as involvement of the superoxide in the inflammation and post-ischemic reperfusion syndrome consolidate the opinion about the "good" superoxide dismutase and the "bad" superoxide that they scavenge (1). However, the superoxide is not all bad effects how. Moreover, we have reported that gaseous superoxide (GS) is an inalienable part of the atmosphere, and is also essential for the terrestrial organisms (2). Uninterrupted deprivation of the atmospheric superoxide lead to the degeneration of the hypothalamic and pituitary nervous and secretory cells leading to numerous movement and autonomic disturbances and death of animals. Hypothalamus by means of the "periscope" from the diencephalon, vomeronasal system may monitor exogenous GS and is probably the first brain structure sensitive towards the GS changes in the ambient air. In this connection it is not unlikely that the partial lack of the GS could be the cause for the so called sick building syndrome and other complex vegetative disturbances, in human-beings.

Inhaled artificial GS provokes cascade of dramatic biochemical and physiological reactions. Thus, inhaled GS suppresses monoamine oxidase activity in the regions of hypothalamus and basal ganglia activating brain dopaminergic and serotoninergic mechanisms (3) as well as enhancing brain tissues superoxide dismutase activity. Catalase, glutathione peroxidase, glutathione reductase and glutathione are also involved in these reactions. In addition, inhaled GS suppress cytochrome P-450 activity in the liver causing changes in the metabolism of xenobiotics including various drugs. In the fore-part of pituitary, inhaled artificial GS activates

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both adrenocorticotropin and thyroid hormone producing adenocytes stimulating the cortisol production by the adrenal glands and activating the cell respiration, in vivo.

The biochemical changes observed underlie the numerous physiological and therapeutic effects caused by inhaled artificial GS. We have reported that the GS potentiates pain-relieving action of the opioid and non-opioid analgesics in animals and human-beings (4 - 6), weaken action of the narcotic and sedative drugs, improves disordered movement and autonomic functions in parkinsonian patients (3), and the respiratory function in asthmatics (7, 8). Exogenous GS abolishes toxic effects caused by the hyperbaric and normobaric oxygen, and enhances efficiency in the various experimental conditions, in animals. In addition, inhaled artificial GS modifies spontaneous activity in animals, and decreases temporal and spatial threshold of the smell (9) and gustatory, in human-beings.

Thus, all our data suggest that the gaseous superoxide found in nature a constructive use and is a vital necessary component of the environment.

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1351
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THE CHARACTERIZATION OF $SMCO_5$ POWDER

TALIJAN N., MILUTINOVIC-NIKOLIC A., JOVANOVIC Z.

Institute of Chemistry, Technology and Metallurgy, Njegoseva 12, Belgrade, Yugoslavia

(First received 19 March 1998; accepted for presentation during IAS-4)

In the course of studying the field of permanent magnetic materials of the Sm - Co type, it was noticed that although the properties of the final magnet strongly depend on the character and behaviour of the starting $SmCo_5$ powder, the methods for powder characterisation have

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not yet been systematised.

If the $SmCo_5$ powder is to be used in the production of sintered $SmCo_5$ magnets it should be of the following characteristics: the samarium content must be in the interval from 32 to 39 mass%; the minimal content of the $SmCo_5$ phase must be 95-97 mass %. [1] For achieving high magnetic performances it is necessary that the particle size of the starting powder be between 1 -10 μm. [1] It is very difficult to align particles larger than 10μm, and particles smaller than 1μm are easily oxidised. In both cases the magnetic properties decrease. The oxygen content in the starting powder is between 200 - 2000 ppm depending on the process of powder synthesis. The allowed oxygen content in the final sintered magnet is 0.6-0.8 mass %, and it requires continual oxygen analysis, not just of the starting powder but also of all the steps in the production of sintered $SmCo_5$ magnets, specially the milling of $SmCo_5$ powder. [1]
After considering all the experimental results obtained during the investigation of the synthesis of sintered $SmCo_5$ magnets, a selection of appropriate methods for the characterization of the starting $SmCo_5$ powder was made. [2]

The suggested methods were confirmed experimentally as being necessary for the reliable and adequate characterization of the $SmCo_5$ powder used as the starting powder for the production of sintered $SmCo_5$ magnets. The selected methods include: X-ray Micro Analysis using EDS for chemical analysis; Scanning Electron Microscopy with appropriate software for the quantification of the images for microstructure and morphological characterisation; X-ray diffraction analysis for the qualitative identification of the $SmCo_5$ phase and calculation of the crystalline lattice parameters and TGA for estimating the thermal stability of the $SmCo_5$ powder; oxygen content using a LECO device, as well as magnetic measurements. Some of the results of the characterization of the $SmCo_5$ powder obtained using the chosen methods are presented in this paper. [2]

It was confirmed by micro-X-ray spectral quantitative analysis using the corresponding energy dispersion spectra that the obtained samarium content (38 mass %) corresponds to the projected chemical composition enabling optimal magnetic properties.
The morphological characteristics of the starting and milled powders were investigated for different milling times using SEM analysis with appropriate software for the quantification of the visual information. By comparison of the observed particles size with the results of magnetic measurements it was possible to examine the influence of the milling time on the change of the particle dimensions and relative change of coercivity. It was found that for all the investigated milling times (up to 120 minutes) the decrease in particle size was followed by an increase in the coercivity. In the same time, increase in the oxygen content was acceptable up to a milling time of 60 minutes. [3]

X-Ray diffraction analysis was used to quantitatively determine the phases present in the starting and optimally milled powder. Only the $SmCo_5$ phase was identified by X-ray diffraction. In this way a minimal amount of 95 mass % of $SmCo_5$ was confirmed. [2,3]

The parameters a and c of the hexagonal crystalline lattice of the $SmCo_5$ phase were calculated on the basis of the obtained diffractograms for the initial and milled powder. The experimentally calculated values of the parameters a and c of the $SmCo_5$ hexagonal crystalline lattice of the starting powder and milled powder differ from the standard values by less than 0,2%. [2,4] Applied milling conditions did not induce defects in the crystalline lattice of the

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$SmCo_5$ powder.

The thermal stability of the $SmCo_5$ powder in a static air atmosphere was investigated by thermogravimetric analysis (TGA) using a DuPont Thermal Analyzer. Investigation of the behaviour of the $SmCo_5$ powder during heating was carried out using fresh samples of $SmCo_5$ powder for each of the investigated temperature cycles. It was found by TGA that oxidation of $SmCo_5$ was negligible below 200 ^{o}C. X-Ray diffraction of the residues remaining after thermogravimetric analysis of the $SmCo_5$ powder, heated at 240 ^{o}C, showed only the presence of the $SmCo_5$ phase. Different crystal forms were identified by X-ray diffraction depending on the maximal heating temperature. The following phases were identified: Sm_2O_3, Co, CoO, Co_3O_4 and $SmCoO_3$. According to the TG and X-ray results, for each of the investigated temperatures, the corresponding chemical reactions were established. [5]

Based on the obtained experimental results of testing the character and behaviour of powder of the intermetallic compound $SmCo_5$ and by processing of the experimental results, the most suitable technological parameters are designed for all steps in the procedure of obtaining the sintered $SmCo_5$ magnets.

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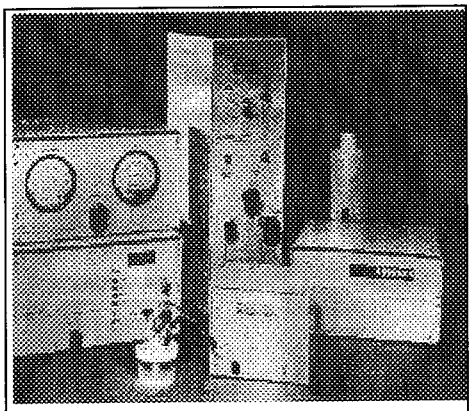
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6/July/98: Секции связанные и биоаэрозолем и переносом аэрозоля в атмосфере.

7/ July /98 Аэрозольные технологии (фильтрация, производство алмазоподобных материалов, ультрадиспесрсные порошки, горение диспергированного топлива, мембранные фильтры, чистые технологии ...)

В этот же день будут представлены работы по ФУЛЛЕРЕНАМ - синтез, экстракция, свойства, теория, применение, нанотрубки..

8/ July /98 АЭРОЗОЛЬ И КЛИМАТ, КОСМИЧЕСКИЙ МУСОР, АЭРОЗОЛЬ И ОКЕАН Радиоактивные аэрозоли, аэрозоли мегаполиса, вулканические аэрозоли, облака, эрозионные аэрозоли, ...

9/July/98 Последний день - АЭРОЗОЛИ И ЗДОРОВЬЕ - использование аэрозольных медикаментов, воздействие загрязнений воздуха на организм, Нормирование аэрозольной нагрузки для различных профессий, Проникновение частиц в легкие, Взаимодействие частиц с биологическими структурами...

АЭРОЗОЛЬНАЯ ТЕОРИЯ (1)- оптика аэрозолей, коагуляция, нуклеация, конденсация...ТЕОРИЯ АЭРОЗОЛЕЙ(2)-ДИФФУЗИОФОРЕЗ, ТЕРМОФОРЕЗ...Слушание докладов выдвинутых на соискание премий Российского аэрозольного общества (Две из этих премий поддержаны суммами $300 и $200 - спонсор - директор ERNAFT OIL Mr Mirlesse (Щвейцария)

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ВАЖНО! Выпуски журнала Аэрозоли за 1998 год являются экспресс публикацией тезисов, полученных по электронной почте для участия в Международном Аэрозольном Симпозиуме. Мы обращаемся к авторам с просьбой возможно скорее выслать лист замечаний по своим статьям по следующей форме: *на странице номер... строке номер* (сверху/снизу) *написано...* (указать ошибочное слово или выражение и одно - два слова до и после этой ошибки. Ошибку надо подчеркнуть) *должно быть написано* (привести правильное написание.) **Председателям секций** - просим указать названия и номера докладов, которые подходят по тематике в Вашу секцию. Просьба связаться с авторами и пригласить их сделать доклад в рамках Вашей секции.

Всех специалистов просим присылать свои отзывы по адресу 119285 Москва 2-Мосфильм 21-117 Белову Н.Н. Работы, которые Вы назовете особенно интересными , будут выдвинуты на премии Российского аэрозольного общества (ряд премий поддержан денежными суммами от 200 до 300 долларов).

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Это наука, приборы, вычислительные программы и технологии в России и странах СНГ.

Пришла пора передать спонсорам (Фонд Армии США, Американское и Российское физические общества ...) список секций, предварительную программу симпозиума и сборник тезисов докладов. Сейчас работа по подготовке этих материалов близится к концу. Принцип отбора докладов прост:

1. Рекомендации председателей секций и экспертов. Такие рекомендации получили работы, направленные для участия в IAS (кроме трех больших статей на русском и на англ языках Никитина Анатолия Ильича из Института энергетических проблем химической физики РАН. Его работы посвящены шаровой молнии, тел/ факс 9397501 - приглашаем заинтересованных в проблеме получить информацию о новых работах Никитина)
2. Наличие документов, разрешающих печать тезисов в трудах международной конференции.- Здесь ситуация сложная - половина полученных работ не подкреплена актами экспертизы и письмами о возможности опубликования в труха международной встречи. ВСЕ ЭТИ РАБОТЫ ОТЛОЖЕНЫ до момента получения указанных документов. Эти работы могут быть включены в одну из дополнительных книжек IAS как только эти документы будут представлены в оргкомитет
3. Наличие документов, подтверждающих оплату оргвзноса либо оплату публикации (достаточно заплатить 6 руб за страницу текста (и 6 руб за каждый рисунок и каждую таблицу, если они включены в Вашу статью), чтобы работа, удовлетворяющая первым двум критериям, была немедленно опубликована.) Если при этом Вы не забыли прислать четыре листа А4 с Вашим стендовым докладом - то можете быть уверены , что Ваша работа будет представлена на IAS-4. Таким образом в круг общения симпозиума вовлекаются те, кто не может принять участие в нашей встрече - проблема денег и /или времени. Так в нашей встрече будут опубликованы доклады из Бразилии, Мексики,... Однако авторы, которые не смогут приехать на нашу встречу, не будут включены в информационные списки симпозиума, с тем, чтобы эти списки показывали только тех, кого Вы можете встретить в Питере.

Прошу Вас проверить, получили ли Вы подтверждение о приеме тезисов, о получении актов экспертизы и документа об оплате. Если такие подтверждения Вами не были получены - не сочтите за труд переслать мне даты отправки этих документов и какую-нибудь дополнительную информацию, если она может помочь найти их побыстрее.
Будет весьма печально , если работа, по которой получены положительная рецензия и все документы, не будет опубликована по случайной ошибке оргкомитета.

Мы приглашаем председателей секций проверить - не забыли ли они оплатить свой оргвзнос. Минимальный вариант - 60 руб (регистрация одного дня). Практика показывает, что оплаченный оргвзнос является некоторой гарантией присутствия докладчика (да и председателя секции) на докладе.

Таким образом последний фильтр помогает выделить две группы возможных участников IAS-4: Теперь видны те, кто имеет возможность принять участие в нашей встрече и те, кто заинтересован только в публикации своих работ,

Мы сделаем все, чтобы поддержать последних (если они не забыли оплатить публикацию своих работ). Участники же симпозиума получат самую широкую информационную поддержку. Практически каждая работа будет опубликована трижды - в журнале для экспресс обсуждения и коррекции ошибок, в тематическом сборнике под редакцией председателя секции и в книжке тезисов докладов IAS-4. Первые два издания будут служить общественной экспертизой окончательного издания.

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INFLUENCE OF DIFFUSIVE LEAKAGE IN METHODS OF PARTICLE REJECTION FROM SURFACES

CASTILLO J.L.*, GARCIA-YBARRA P.L.**

**Dept. Fisica, UNED, Apdo. 60141, 28080 Madrid, Spain;*
***CIEMAT, Avda. Complutense 22, 28040 Madrid, Spain*

(First received 26 March 1998; accepted for presentation during IAS-4)

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In some industrial applications and material processing techniques, one tries to avoid the problems associated with the arrival and deposition of small particles on specific locations. For instance, in coal combustion processes, the deposition of soot particles and flying ashes on combustor walls and heat exchange tubes leads to slagging and fouling and provokes a reduction in the efficiency of the process. Also, in CVD growth techniques care should be taken to reduce the deposition of particles on the surface of the growing solid, to avoid the pollution of the resulting materials.

Several methods have been proposed to reduce particle deposition on the walls confining particle laden gases: such as thermophoresis, blowing, buoyancy effects, etc. The efficiency of these methods lies on the generation of a particle repulsion field near the wall. However, due to the unavoidable presence of Brownian diffusion some particles will diffuse against the repulsive force and reach the solid surface. This work deals with the analysis of the deposition flux due to Brownian diffusion under these constraints. The asymptotic limit of very large Schmidt numbers will be studied.

Heating the surface and imposing a thermal difference between the wall and the mainstream can reduce particle deposition rates. Then, thermophoresis (drift of particles down a temperature gradient, Rosner et al. 1992) pushes the particles away from the heated surface and a dust free region generates around the surface due to this thermally induced repulsion. Anyway, there exists a particle leakage towards the surface due to Brownian diffusion. Previous theoretical works, Gokoglu and Rosner, 1986, Friedlander et al. (1988), Garcia-Ybarra and Castillo (1996&1997), as well as recent experimental measurements, Wirzberger, et al. (1997), show the persistence of particle deposition rates which decrease exponentially with increasing wall-to-gas temperature differences.

Blowing is another mechanism commonly used to keep the particles away from walls. Here, the convective flow near the solid body opposes the transport of the aerosol particles to the wall. Also, buoyancy effects may be used to achieve this goal by locating the worthiest walls on the top. In any case, due to Brownian diffusion some particles are able to leakage against the flow field or buoyancy forces and deposit on the surface. The deposition rates of large particles will be analyzed in the limit of high Schmidt numbers.

As a model problem, the laminar (and self-similar) boundary layer around a wedge shaped solid will be considered. In the differential equation governing the particle mass fraction, the highest derivative (of the mass fraction with respect to the spatial similarity variable) is the term accounting for Brownian diffusion which is multiplied by the inverse of the particle Schmidt number.

In the limit of very large Schmidt numbers, the solution of this equation becomes singular. An approach in the same way as the analysis presented by Garcia-Ybarra and Castillo (1997) is always feasible.

Numerical evaluation of the asymptotic expression for the deposition rates will be presented and compared with the complete numerical solution.

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ON THE OPTICAL METHOD REGISTRATION OF THE AIR RADIOACTIVE EJECTION OF NUCLEAR POWER STATION

AVAKYAN S.V., VORONIN N.A., IL'IN V.V., SEROVA A.E., STARCHENKO A.N., TCHARUHCHEV A.V.

All-Russian Scientific Center "S.J. Vavilov State Optical Institute", 199034, St. Petersburg, Russia;
Scientific Research Institute of Complex Task of Optical-Electronic Devices,
188537, Leningrad region, Sosnovy Bor, Russia.

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In this paper the investigation of the possibilities of the registration by optical-electronic devices of the radioactive air ejection of nuclear objects with taking into account the optical air fluorescence mechanizm from [1] are carried out. It is known the radioactive gas and aerosol ejections during and after accident at the atomic power-station are very dangerous source of environmental pollution. These ejections are spread by meteorological air flows over considerable distances (up to several thousands km and more). Therefore the dissipation and settling of radioactive nuclides are occurred over very large area.

Existing remote sensing methods of the registration of radioactive clouds don't provide necessary information. The radar as and lidar methods detect the aerosol component of the ejection that often does not allow selecting the signal from the radioactive air ejection or a thunderstorm cloud and the aerosol (smoke) component which exists also above the thermal power-stations. The measurements of gamma-radiation from the radioactive nuclides are possible only at a distance ~ 100 m.

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The fact that Chernobyl ejection was detected in first time outside the former USSR (Sweden, Uppsala) by abnormal changes in the parameters of the atmospheric electricity in the radioactive cloud came from Chernobyl [2] confirms the importance of the registration of the ionizing ejection component for the purpose of identification of its radioactive origin. However discussion of the possibility of using this method for the nuclear ejection registration [3] has come to the conclusion that electrical data are not sufficient for determination of the cause of the observed abnormal spatial changes in the atmospheric electricity because there are too many physical processes which can provoke them.

In [1] the optical method of registration of radioactive air ejection by means of particular bands of atmospheric fluorescence with very high threshold of excitation was presented. There are three emission bands which are quite prominent and lie in the blue range of spectrum. It is important that they are absent in other events of natural and technological air emissions, besides short time lightning. It should be mentioned that just blue fluorescence of the air was observed above Chernobyl nuclear power plant.

The intensity of these emissions is much higher than background, especially at night. The transformation ratio from gamma-radiation flux to the visual one (for three bands) is 10^{-1} - 10^{-2} and for accident the intensity of optical emission (for radioactive cloud of 10^5 - 10^6 Ci) could be approximately 10^{13} - 10^{15} photons.s^{-1}.

The preliminary estimate can be made by making use of this data on the emission intensity. At the small size of a cloud (~100 m) the intensity of optical emission in the blue spectral range will be (1 - 100)(10^{-6} W, which at the distance R=1 km give the irradiance 10^{-12} - 10^{-10} W.m^{-2}. Measurements of these small intensities are difficult because there is a background radiation, especially during day-time.

For reduction of the background influence and for increase of the signal-to-noise ratio in the working spectral ranges the high performance spectroradiometric apparatus will be used. In the first experiments the spectroradiometer "Luch-1", which has been made before is supposed to be used. The characteristics of the apparatus "Luch-1" are: spectral range - 200 - 1100 nm, the entrance pupil - 0.06 - 0.07 m^2, the focal length of the objective lens - 1200 mm, the width of entrance slit - 0.1 - 4 mm, the viewfield angle - 0.1 - 3 mrad, dynamic range of photo-received devices - 10000, the spectral resolution - 0.5 - 10 nm, the scan speed - 5 nm/c, the range of the measured brightness (with 1 mm slit) - 10^3 - 10^8 W.$sr^{-1}m^{-3}$, the range of irradiances - 10^{-12} - 10^{-5} W.m^{-2}.

We are planning to develop special apparatus equipped with CCD TV camera (threshold flux is 10^{-14} - 10^{-13} W) for measurements of the energetic characteristics of the optical emission of the radioactive air ejection (cloud) in the night. This approach allows the standard apparatus to be used for longterm registration, measurements and information processing.

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MEASUREMENT CHARACTERISTICS OF RECEIVERS AND SOURCES OF RADIATION

MIKHAILOV O.M.

ARRC "S.I. Vavilov State Optical Institute (GOI)"

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The paper considers the problems of measurement of the active radiation and its conversion when having a contact with objects of the environment. A large number of receivers of optical radiation with different methods of performance are known, from selenium photo-element and thermo-element to photoelectronic multipliers and avalanche photo diodes. Their main purpose is to indicate the radiation or its modified state. The purpose of any measurements, however, is to obtain true, reproducible and stable results with preset error of measurements and selected confident probability. Such properties belong only to measuring photo receiving devices developed in cooperation with the State Optical Institute.

The paper shows the investigation results of boundary, specific and spectral power characteristics of the photoreceivers being widely used in industrial developments and in optophysical research and providing the unity of the radiation measurements. The measurement receivers of optical radiation, i.e. vacuum photo elements (F21, F28, F35, etc.) vacuum photo multipliers (FEU-142, FEU-154, FEU-100, FEU-84), phosphide-gallium, silicon and germanium photodiodes (FD-Fg, KFD-105A, FD288k, FD-9g, etc.), thermoelements and bolometers (e.g. RTN-30, PP-1). The latter are used as non-selective wavelength receivers in the wide spectral range with linearly-limited voltage and current characteristics and stability. Spectral operation range of measuring receivers is from 0.1 mkm to 11.0 mkm, the linearity of the power-current or light characteristic maintains with variation of radiation on their sensitive elements to 10^8 times (with photomultipliers to 1000 times), long-term reproducibility of power units storage within 10 years is ±5%, the non-stability error of measurement results does not exceed ±1%. the variation range of the incident measured flux is 10-100000 W.

The techniques of spectral correction of absolute and relative spectral sensitivity of receivers have been shown for solving the given photometric problem of measuring the efficient values. The above mentioned involves the use of measuring photoreceivers as standard means of measurements for carrying out equally spectral and light measurements. The property of self-calibration of silicon and germanium photo diodes eliminating the use of the expensive standards of power spectral measurements has been especially emphasized. Transfer and storage of the radiation power unit in different parts of spectrum in 450.....800 nm wavelength is done by the measured current value in Ampers with total error of power determination to 0.1%.

The measurement radiation sources in the traditional spectral region are well known, these are "light measuring" lamps and black body models. The paper emphasizes the broadening of operational possibilities of instruments and the universal character of research due to the development of new fields of science and an increase of dynamic and spectral ranges. The ordinary radiation sources are not able to operate as measuring devices. New standard grid-power sources have been created. Their operation takes into account the broadening of the spectral region into the UV part (gas discharge lamps DNK-90 and VMF-25), the possibility of measuring pulse radiation with up to 1 ms duration (pulsed standard lamps IShO, IPO, ISK, etc) and the necessity of modelling small size objects (stars imitators) and solar radiation. The common range of the confident radiation wavelengths is 0.1... 2.5 mkm, stability and reproducibility of radiation is, type of radiation is a linear or solid spectrum.

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The paper briefly considers the problems of spectral and integral attenuation, absorption and diffusion of the measured and active radiation. To conclude, it is noted that the developed methods and means of radiation measurement make it possible to create optoelectronic devices of high accuracy concerning the parameters of power variations of the coherent and non-coherent radiation.

984.
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THE EFFECT OF MAN FACTOR ON ATMOSPHERIC ECOLOGY (AEROSOL POLLUTION)

ANDREYEV E.

All-Russian Vavilov Scientific Centre SOI ; Birjevaya linia, 12, St-Petersburg, Russia

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The advantages in studies of the Earth atmosphere allow to understand clearer the effect of man factor on atmospheric processes which determine its state and radiative properties. Modern scientific knowledge at the Earth atmosphere may outline the four main negative effects of man factor on environment: stratospheric ozone depletion, acid rain , toxicity and global warming. The atmospheric aerosol takes active part in these processes due to its chemistry and optical characteristics. The presence of aerosol particulates in atmosphere stimulate different chemical reactions on their surfaces. So the chemical composition of atmosphere changes. The aerosol particulates effect also on radiation processes in atmosphere. Annual release of polluting chemicals in continental U.S. by industrial activity shows a scale of effect on environment [1].

Table 1.

Sourse	Quantity (kilotons)
Heating and power generation	33000
Transportation	9100
Industrial processes	6100
Rockets	3

The particulates contribute a significant part of this release. As an example, annual contributions (in kilotons) of the most important gases released in stratosphere by different sources are shown in the table 2.

Table 2.

Source	Cl	H_2O	H_2	Nox
Industrial	300			
Volcanoes	100-1000			
Natural	7.5	15600	340	280
Rockets	0.79	3.25	0.2	0.016

Note: chlorine data are global, other data for northern mid -latitudes. The properties of aerosol particulates as catalysts are known insufficiently. Studies indicate that the rate of the catalysis of ozone depletion by fine fraction of particulates depends on their surface area, and that the threshold surface area for ozone depletion is 5...10 mcm^2/cm^3. It should be noted that the lifetime of particulates in the stratosphere is on the order of 1...2 years. This phenomenon

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was seen during the eruption of volcanoes El-Chichon in 1981. Another problem of aerosol pollution is global actinometric measurements and its influence on optical characteristics of atmosphere [2]. The concentration of particulates can reach 10^{10} particles on cm^2 of vertical column in the atmosphere of industrial zones and megapolices. The spectrophotometric observations indicate that the atmosphere above such regions remains strongly turbid during a long time without natural purification. Under strong aerosol pollutions of air the radiation absorption by aerosols can reach values to be compared with those for molecular absorption by all atmosphere gases. So one should take into account aerosol atmospheric component when considering such phenomena as "green-house' effect and rainfall at forecasting a local weather. Analysis of different aspects of aerosol pollution shows the necessity for studies of optical and physical properties of aerosol particulates from different souses and operative optical monitoring of aerosol pollution of atmosphere above industrial regions.

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979.
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METROLOGICAL PROVISION OF AEROSOL MEASUREMENTS

MIKHAILOV O.M. , KANATENKO M.A.

ARRC "S.I. Vavilov's State Optical Institute (GOI)"

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Strictly speaking, the total complex of aerosol research, the corresponding temperature tests (including terrestrial ones), and technological processes of aerodispersion systems are not possible to be based on the developed national scheme of transfer and storage of physical units, i.e. calibration scheme, standards, test pieces and working means of measurement. The main reason is the lack of a single or a few physical values that would describe the state of aerosol measurements with a sufficient completeness. Therefore, the latter are of indirect or total character. However, basic research, physical (optical) experiments and the equipment for scientific and applied research can not do without measurements with the results expressed in legal units and the measurement value has a preset probability.

Metrological provision of any kind of research and developments is a special kind of activity which is finally aimed at the achievement of the unity of measurements being carried out. The development of optical aerosol devices, their units and elements, the unique measurement and test methods require experimental research to determine the degree of their correspondence to the established regulations and standards of metrology.

Carrying out optophysical research and tests is generally of a unique pre-informative character with regard to standard and even precision measurements. In such case metrological provision of aerosol research can be based on three techniques described in the paper and conditioned by the content, the method and the final aim of comprehensive tests of measuring aerosol devices, simulation of the external conditions effects and the performance of aerodispersion systems and optophysical aerosol research. The first provides a metrological certification of the set-up and is based on the direct measurements. The second involves the measurement of a few physical values and a by-element certification of the test complex. The third includes the research where new physical quantitative and qualitative relationships are

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established. In this case the metrological provision is based on certification of the procedures of carrying out the measurements and can also involve a partial metrological certification of separate elements of the scheme. This is the most inexpensive, reliable and universal technique. The three techniques require a deep analysis of the error of measurement results and an establishment of confident limits of their effect.

The paper shows that the basic measure of reliability of aerosol measurement results is the comparison of the measurement results and their mutual recognition on the inter-laboratory and international level. At the Vavilov's State Optical Institute there is a branched network of standard samples and specimens and a developed information automated system of optical measurement means. An operative data search of the instruments can be done both by name (or type) and by preset measurement parameters in correspondence with the measurement problem being solved. Standard samples and means of measurement can be placed prior to the local test schemes and provide the unity of measurements of such fields as dispersion media research, colorimetry, polarimetry, spectrophotometry, scattered radiation measurement, etc.

Standard samples of the Vavilov's GOI are used for measuring spectral coefficients of absorption, radiation, transmission and reflection (direct and diffuse), refractive index, gas mixtures, content, normalized characteristics of glass properties, colorimetric relationships. Standard optical measurement means include, in particular, models of black bodies, photoreceiving devices and radiation sources for 100...11000 nm spectral region.

The developed methods, standard means and measures for measuring coherent and non-coherent radiation and its modifications coefficients and the certified methods of carrying out optical, optotechnological, holograghy, fluorescent and spectrophotometrical measurements are aimed at providing reliability and unity of measurements in the research and and building of optoelectronic instruments including those for aerosol measurements.

980.
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TOOLS OF MEASURING VISIBILITY OF OBJECTS THROUGH AEROSOL MEDIA

YEVSIKOVA L.G., PUISHA A.E.

ARRC "S.I. Vavilov State Optical Institute (GOI)"

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

Observation through aerosol media (fog, rain, smoke, etc.) involves the problem of estimating the visibility of real (voluminous, relieved) objects against real backgrounds, since for such objects luminosity both over the surface of the object and over the surface of the background varies among different sections of the area, thus eliminating the possibility of using the concept of contrast.

At the Vavilov's GOI the method of estimating the visibility of real objects in full-scale conditions with observation through aerosol media has been developed basing on measuring the value of the degree of the object visibility [1]. For this purpose, the notions of conventional contrast, conventional threshold contrasts of visual perception of real objects and their limiting range of visibility have been introduced [2].

Test samples of non-adaptive visibility meters IF-173, IF-173M [3] have been created, with improved optotechnological, accuracy and ergonomical characteristics with the following

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technical parameters:

Magnification, x	1.5... 10
Field of view angle, deg	40... 5.7
Size of the exit pupil, mm	2 x 2
Dioptry focusing, dptr	4
Angle of turn of the line of sight, deg.:	
by the horizon	360
by the vertical	10
Overall dimensions, mm	870x290x160

The serviceability of the developed methods has been confirmed by full-scale and laboratory tests [4]. It has been shown that the use of IF-173 and IF-173M equipment makes it possible to measure true, visible threshold contrasts of any objects and their limiting visibility ranges to an accuracy of 8-12% against any backgrounds, in any conditions of observation with no long distant tracing being required.

For estimating the visibility of real objects in the near IR spectral range, the structural and principal circuits of the IR visibility meter in 0.7...0.9 mkm spectral range have been for the first time developed at the Vavilov's, the calculations of the overall dimensions and aberrations of the optical system have been carried out and a laboratory model has been made with the following technical parameters:

Visible magnification, x	4
Field of view angle, deg	11
Focal distance of the lens, mm	120
Exit pupil diameter, mm	5.7
Diameter of photocatode of EOC, mm	25
Electronic-optical magnification, x	1
Dioptry focusing of the eye-piece, dptr.	4
Focusing adjustment of the lens with object distances being, m	15 and 500

A software product of the calibration of the model and experimental data processing has been developed.

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986.
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UV, VISIBLE AND IR HIGH-QUALITY SMALL-SIZED OBJECTIVES FOR RESEARCH OF ATMOSPHERE OPTICAL PARAMETERS

KAMESHKOV G.B., MIRZOEVA L.A., GRAMMATIN A.P., LUSTBERG E.A., MAKOVTSOV G.A.

All-Russian scientific center "S.I. Vavilov State Optical Institute"

Russia, St Petersburg, 199034, Birzhevaya line, 12.

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Standard small-sized and light-weight high-quality objectives operating at wide spectral range from UV (0.3 μm) to middle IR (6.0 μm) for aerospace purposes have been produced and tested in All-Russian research center "S.I. Vavilov State Optical Institute" in 1996.

UV objective, 130 g mass, holds high image quality in wide temperature range. Petzval's scheme is used as base element of the objective. Galilee's system with angle magnification less than one is placed before it. Concave- plane Smith's lens is put behind Petzval's objective near image plane in order to correct image curvature. It allowed to reduce general length of the objective to 35 mm. Objective includes 7 lenses, three of them are of lithium fluoride and other four of silica glass. Focal length of the objective is 21 mm, diaphragm ratio is 3.5, angle field of view is 30^0. Total transmission in operating range 0.3-0.4 μm is 75%, energy concentration in circle dia 27 mm is 80%, relative radial distortion at edges of filed of view does not exceed 4%. When heating up to $+50^0$C image plane is shifted by minus 0.016 mm, when cooling to -20^0C by 0.019 mm correspondingly.

Lens IR objective, 210 g mass, is meant to operate at temperature 90^0K. Objective includes 4 lenses, two of them are of silica, two other of fluorite. Four-layer AR-coating on silica lenses provides high transmission (more than 70%) at spectral range 2.6 - 5.0 μ. Focal length of the objective is 18 mm, diaphragm ratio is 1.6, angle field of view is 28.4^0 at temperature $+20^0$C as well as at -170^0C, energy concentration is more than 80% both in the circle dia 20 μ (at the spectral range 2.6 - 3.0 μ) and in the circle 35 mm (at the range 2.6-5.0 μ).

Five-lens objective, 240 g mass, is meant to be used in optical assembly of spacecraft astro-measuring system. When being developed, we paid special attention to provision for following requirements: - small chromatic aberrations at spectral range 0.5 μ wide (operation spectral range is both at visible and near IR ranges); - high-stable image scale within the temperature range 20^0C 30^0C; - efficient attenuation of side illumination from Sun radiation coming to the objective from blind, lighted by the Sun; - low level of light scattering from intensive point sources of radiation (bright stars) within field of view; - decrease of light size of front optical component by matching its first surface with aperture diaphragm, in order to have minimum length and mass of anti-sun blind.

Focal length of the objective is 60 mm, diaphragm ratio is 3.8, angle field of view - 8^0. Total transmission is 90% at spectral range 0,5 - 1.0 μ. Perfect combination of optical materials used for the lenses allowed to achieve high level of achromatization at the working spectral range. Level of scattering was decreased not only by reduce of number of working surfaces bordered on air (three middle lenses were combined into unit by cementing) but the use of five-layer achromatic AR-coatings.

All samples of above described objectives were manufactured and executed tests confirmed that specified characteristics were obtained and they are in agreement with computation.

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APPLICATION OF TIKHONOV REGULARIZATION METHOD TO OBTAIN SIZE DISTRIBUTIONS

ALVAREZ, M. L.[1], CANALS, A., MORA, J., TODOLÍ, J.L.

Department of Analytical Chemistry, Alicante University Box 99, 03080, Alicante, Spain

(1) On leave from Institute of Materials and Reactive for Electronics, Department of Research on Electronics for Solid State (DIEES-IMRE). Havana University, Cuba.

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Keywords: Particle/aerosol size distributions, laser diffraction particle sizing, aerosol characterisation, ill-posed problems, inversion.

Laser Diffraction Spectrometry is a powerful non-intrusive technique for size analysis of aerosols and suspensions. This optical technique do not require single particles to be measured successively and the interaction between light and the ensemble of all illuminated particles is analyzed. This technique is useful for studying dispersion phenomena, aerosol characterization, powders, etc.

The determination of size distribution by light scattering involves a inverse scattering problem, that is associated with the obtention of the size distribution from energy data. The inversion by numerical quadrature is one method to solve this problem. We have applied the Tikhonov Regularization Method (TRM) with the L-curve criterion[1] in order to obtain the regularization parameter. Liquid aerosol and powder of paint are the samples characterized in this work. For theses samples, deviations of particle size measurement for statistical parameters are more important than in the case of the representative parameters. The TRM has been proved to be suitable for certified distributions and has provided successful results.[2]

Pneumatically generated aerosols have been widely studied in Atomic Spectrometry techniques, since their drop size distribution influences the analytical signal.[3] In the present work, the nebulizer employed was the Single Bore High Pressure Pneumatic Nebulizer (SBHPPN). The liquid aerosol was generated from lubricating oil diluted with MIBK (60% in oil). The powder sample was POLIPOX 6 FR gray PR-7004 SMMT and the solvent used to stabilize the slurry was sodium hexametaphosphate in water (HMP, 1.8 g/l). Such a particles are used in paint manufacture.

The scattered energy was measured by means of a Commercial Instrument (CI) (Malvern, mod. 2600c). Figure 1 shows the volume undersize distributions for the samples tested. Two plots appear in this figure: (a) volume undersize (%) measured by the CI and calculated from the same light scattering data using TRM, for liquid aerosols; and, (b) volume undersize (%) measured by the CI and calculated from the same light scattering data using TRM, for slurry.

The matrix used to solve the inverse scattering problem by TRM for the aerosol and the slurry was obtained applying the Fraunhofer diffraction theory and the Mie scattering theory, respectively. In both cases (aerosols and slurries) the inversion method TRM offers always 0 % of volume for minimum limit of measurement with this instrument. For the remaining diameter ranges the results obtained with TRM (L-curve criterion) are close to CI.

Parameter characteristics obtained for drop/particle distributions are shown in Table I. In this table the representative diameters (i.e., median volume, $D_{50\%}$) as well as some statistical parameters (i.e., Sauter mean diameter, $D_{3,2}$, volume mean diameter, $D_{4,3}$ and relative spread, span) are compared for the algorithms used.

The Tikhonov regularization method gives both, representative and statistical, diameters within 5% of those obtained for Commercial Instrument. The distribution spans are virtually

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the same for the two algorithms, however, in all the cases, the representative diameters are slightly lower when TRM is used. This is due to the fact that TRM generates volume fractions for smaller diameters. As a result, the averages variables ($D_{3,2}$ and $D_{4,3}$) are shifted to lower diameters.

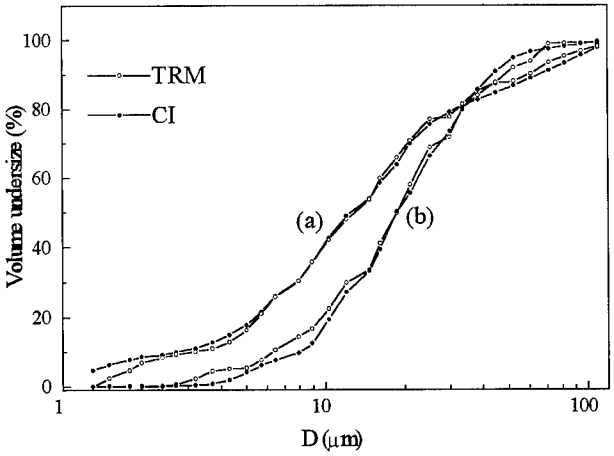


Fig. 1. Cumulative volume fraction vs. diameter for: (a) liquid aerosol and (b) slurry.

Table I. Results obtained with TRM application.

	Aerosol*		Slurry**	
parameter	TRM	CI	TRM	CI
$D_{50\%}$ (μm)	11.4	11.6	18.2	18.5
$D_{3,2}$ (μm)	4.9	5.1	12.4	13.7
$D_{4,3}$ (μm)	20.6	21.4	21.1	22.1
Span	4.9	5.1	2.2	1.8

* the matrix used is obtained applying the Fraunhofer diffraction theory.

** the matrix used is obtained applying the Mie scattering theory.

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NUCLEATION PROCESSES IN ANALYTICAL HOT LIQUID AEROSOLS

MORA J., TODOLÍ J.L., CANALS A.

Departamento de Quнmica Analнtica. Facultad de Ciencias. Universidad de Alicante. P.O. Box, 99. E-03080 Alicante, Spain.

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Keywords: Thermospray Nebulizer, Nucleation, Aerosol Characterization, Lase Fraunhofer Difraction, Solvent Nature

Studies on heterogeneous nucleation are of crucial importance in techniques such as Atomic Spectrometry since samples are usually introduced as liquid aerosols. In these techniques, the aerosol should be as fine and monodisperse as possible. Nucleation processes should be avoided in order to prevent the deterioration of the analytical results. The present survey deals with the nucleation processes taking place when the hot aerosol generated by a thermospray nebulizer1,2 passes through a cold environment. To this end the effect of surrounding temperatures and liquid nature on the aerosol characteristics have been studied.

Two different devices coupled to a thermospray nebulizer have been employed. In the first system (A), the hot aerosol was directly introduced into a cooled environment (i.e., a cooled Scott-type spray chamber3). In the second system (B), once the aerosol was generated, it was heated and further cooled (i.e., two step desolvation system4). Drop size distributions were measured by means of a model 2600c laser Fraunhofer diffraction system (Malvern Instruments, Worcestershire, UK) as stated elsewhere.4,5

System A

Figure 1 shows the median of the volume-based drop size distribution (D50) and the volume concentration (VC) of the aerosol as a function of the temperature of the spray chamber (Tsc) for the solvents studied. From Figure 1 it can be seen that Tsc hardly affects D50 values. Nevertheless, an increase in Tsc causes the VC to decrease. These behaviours can be explained in terms of droplets growth by nucleation.6 In a simplistic way, nucleation makes the total liquid volume of the aerosol to increase and the drop size distribution curves to shift to larger diameters. Nevertheless, nucleation will not change D50 values since the largest droplets are always removed. This is the behaviour observed in Figure 1. On the other hand, when Tsc is decreased a fraction of the solvent condensed on the nuclei (i.e., droplets or dry particles) could be carried by the gas exiting to the spray chamber and giving rise to VC values greater than the expected.

As regards the solvent nature, Figure 1 shows that water gives rise to the finest aerosols followed by ethanol and butan-1-ol. On the other hand, butan-1-ol is the solvent with the highest VC all along the Tsc range. This fact can be accounted for by its higher vapour pressure (Pv) that causes an increase in saturation ratio (rs) and, hence, in the intensity of the nucleation process.6

System B

Figure 2 shows the effect of the heating unit temperature (Th) on D50 and VC for water at several temperatures of the condensation unit (Tc). For a given Th value, D50 and VC values decrease when Tc is increased. This effect is more important as higher Th is. These results can be explained as follows: firstly, increasing Th causes the evaporation of the solvent and the

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amount of vapour to increase, and hence, D50 to decrease. Therefore, rs raises, making the nucleation processes more severe. In second place, the lower Tc and the higher Th (i.e., higher the solvent vapour amount), the higher rs is and, hence, the greater the extent of the nucleation process.6 Thus, for instance, at Tc < 0 eC, increasing Th hardly modifies D50 values, since the increase in droplet evaporation is counterbalanced by the concomitant increase in the nucleation process. At Tc > 0 eC evaporation is more intense than nucleation, with the result of a reduction in D50 when Th is increased.

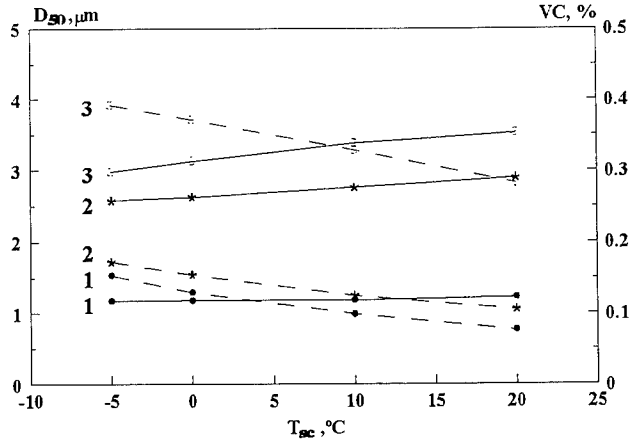


Figure1. Effect of the temperature of the spray chamber on D50 (solid lines) and VC (dotted lines), for all the solvents studied: (1) water, (2) ethanol; (3) butan-1-ol.

As regards the solvent nature, Figure 3 shows that butan-1-ol affords the highest values of D50 and VC. These results can be explained by considering that butan-1-ol generates the coarsest aerosols5 and shows the lowest Pv values (i.e., high rs values and, so, strong nucleation process). Figure 3 also reveals that aqueous aerosol are coarser than those obtained with ethanol. This unexpected behaviour can be assigned to the higher volatility of the latter.

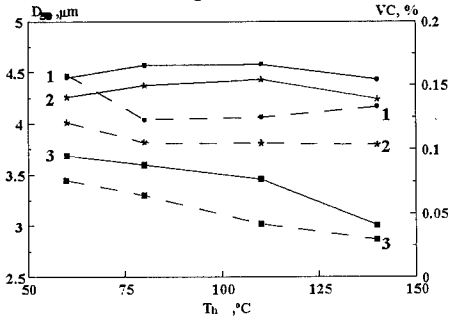


Figure 2. Effect of Th on D50 (solid line) and VC (dotted line) for different Tc: (1) -5 eC; (2) 0 eC; (3) 20 eC. Solvent: water.

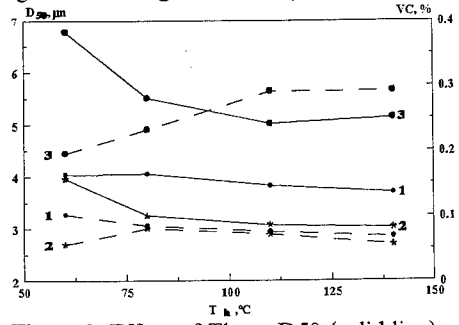


Figure 3. Effect of Th on D50 (solid line) and on VC (dotted line) for the different solvents tested: (1) water; (2) ethanol; (3) butan-1-ol. Tc = 10 eC.

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1424.
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KINETICS OF ISOTHERMAL CHANGES IN ELECTRIC RESISTIVITY AND LINEAR EXPANSION OF THE FAST COOLED AlSi10Mg ALLOY

SIMEUNOVIC R., MITROVIC N., JORDOVIC B.

Technical Faculty, , Yugoslavia

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Lately, interest has increased in glassy metals (MG) as an especially attractive category of metallic materials, due to their exemplary physical, chemical and technical properties. Several methods have been developed for obtaining amorphous alloys in different forms (ribbons, wires, powders). In each case the obtained structure is not ordered or it is ordered at short distances [1]. Electrical properties which change with temperature, following structural changes stand out among physical and physico-chemical properties of metallic glass [2].

In this paper the process of structural stabilization with changes in the relative specific electric resistivity and the thermal coefficient of linear expansion in dependence on temperature has been observed.

A commercial composition of the AlSi10Mg alloy in the form of ribbons 35-70 μm thick and 1-3 mm wide was investigated. The ribbons were obtained by fast cooling of the alloy melt using the melt-spinning method [3] in the Department for Amorphous Systems of the Joint Laboratory for Advanced Materials of SASA at the Technical Faculty. Measurements of the specific electric resistivity were performed using the four-point method. The same method was used for measuring isothermal changes of resistivity in regions of the exo-energy system stabilization. The coefficient of thermal expansion was measured using a dilatometer with a sensitivity of 10^{-5} m.

All measurements were performed in hydrogen flow in the temperature interval starting with the room temperature up to temperatures 50 K higher than the temperature of system stabilization.

Results of measurements of the electrical resistivity and coefficient of thermal expansion in dependence on the temperature show that structural organization takes place in the temperature interval of 450-500 K. Structural organization is accompanied by a rapid decrease of specific electric resistivity and increase of the temperature coefficient of linear expansion. An expressed correlation exists between the electrical resistivity and thermal coefficient of linear expansion.

Measurements of changes of electrical resistivity in isothermal conditions at temperatures of 473 and 498 K show that the dependence $\rho(\tau)$ has an exponential form:

$$\rho(\tau) = \rho_0 \exp(-k\tau)$$

where: ρ_0 - is the starting specific resistivity at the temperature of isotherm recording.

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Constants k_1 and k_2 of the process rate were determined from the slope of $(\Delta \ln \rho)/(\Delta \tau)$, indicating that structure stabilization takes place in two stages.

Process activation energies were determined from the known relation:

$$E = R\left[\frac{\Delta \ln k}{\Delta(1/T)}\right].$$

Obtained values for the activation energy of the first and second stage of structural stabilization are E_1=36.52 kJ/mol and E_2=24.9 kJ/mol, respectively. Corresponding rate constants were also determined. Results of investigations show that due to the high cooling rate an unstable structure with a certain organization degree of atoms at short distances and saturation of the Al solid melt is obtained. Thus, the stabilization process of the obtained structure is complex, which is shown by corresponding changes in electric resistivity and the thermal coefficient of linear expansion.

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1197.
УДК 541.18

THE TRACE GASES IN ATMOSPHERE OVER LAKE BAIKAL.

POTEMKIN OF V., KHODHZER T.

Limnological Institute, Siberian Division of RAS, Irkutsk, Russia 664033 Ulan-Batorskaja St. 3

(First received 26 January 1998; accepted for presentation during IAS-4)

Key words: gases, atmosphere, sulphur dioxide, nitrogen dioxide, ozone.

During 1993-1996 there were conducted natural measurements of concentrations of sulphur and nitrogen dioxide and ozone in near-water layer of atmosphere. Measurements were done with the help of correlative mass-spectrometer and ozonometer M-124. The operation principle of the spectrometer is based on the measurement of relative difference of intensity of optical radiation in two sets of narrow spectral ranges which correspond to maxima and minima of absorption of investigated gas. The device calibration was regularly done by the setting of optical quartz cuvette with the certain amount of gas on the way of received radiation. The observations were carried out with simultaneous registration of meteodata and visibility distance.

Background content of gases in atmosphere over Lake Baikal in summer time is average 1-7 mkm/m*3 for sulphur dioxide and 0.5-2.5 mkm/m*3 for nitrogen dioxide.

Increased values of concentrations of sulphur and nitrogen dioxide are observed close to industrial and agricultural sources (Baikalsk, Severobaikalsk, Ust-Barguzin). High concentration of gases was observed in train and chimney of discharges of Baikalsk town with the fast decrease towards the lake which was due to wind direction along the coast. Increased values of nitrogen dioxide were observed in the region of river Selenga and Barguzin Bay (to 10 mkm/m*3).Along river Angara from Lake Baikal to Irkutsk city the concentrations of nitrogen dioxide increase, but these values are lower than accepted ones for settlements (20

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ppb). In Central Baikal these values were not registered at all.

There were observed daily concentrations during sunny days with maximum of 13-18 hours.

1431.
УДК 541.18

EXPERIMENTAL INVESTIGATION OF DRIFT MOTION IN AEROSOLS AND HYDROSOLS UNDER PROPAGATING ACOUSTIC WAVE

YU.REDCOBORODY, S.GRINSHPUN, V.ZADOROZHNII

(First received 04 April 1998; accepted for presentation during IAS-4)

Experimental setup has been developed and mounted for obtaining of one-dimensional propagating acoustic wave in a glass waveguides filled with highdispersed water suspension (polystyrene latex (PSL) particles) or with aerosol (cigarette smoke) . It has been shown that small foreign particles (PSL particles 0.17 mcm in size), which are suspended in water, because of unidirectional drift phenomenon move at a constant rate in the wake of the acoustic wave. Laboratory experiments with water suspensions under propagating acoustic wave were executed which made it possible to calculate the foreign particles drift rate in relation to wave intensity. The experimental results are in good agreement with analytical relations for small particles entraintment effect under propagating acoustic wave at the expense of viscous forces that has been predicted and calculated by one of the authors in 1995.

It has been shown that, if wave intensity in aerosol is the same as one in the case of water hydrosol , the drift rate in aerosol is several orders greater than in hydrosol. Drift effect investigated provides the basis of vibrational method for purification of any liquids and gases from foreign inclusions of any nature with size more than 0.01 mcm (including viruses, bacteria etc.). For wave intensity of 20 W/cm2 the drift rate in water suspension is of the order of 0.01 cm/s (it is far beyond that the gravity precipitation rate, which is markedly less than 10-4 cm/s for such particles).

Since any individual microparticle follows the unidirectional drift laws, such a method is applicable for initial impurity concentrations that can be made as small as one likes. Besides, this method is comparatively energysaved (energy consumption does not exceed (0.01-0.1) kWh per litre of purificated liquid and 1 kWh per cub. m of purificated gas) and allows, conceptually, to achieve absolute purification of medium. Results obtained may be of interest for purification of air and other gases , for motor car industry (petroleum and diesel fuel purification, refining of oil in engines, etc.), and for medical and pharmaceutical industry (settling of blood red cells, purification of water etc.). The drift method may be used in order to design acoustic levitators (devices for prevention of particle sedimentation), and acoustic separators (by size), and acoustic concentrators for very small particles. It should be noted that these devices will be able to operate at high temperatures, under hostile conditions as well.

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1196.
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MATHEMATICAL MODEL OF AEROSOL ASPIRATION IN CALM AIR

KISELEV O.M., ZARIPOV SH.KH., ZIGANGAREEVA L.M.

Kazan State University Chebotarev Institute of Mathematics and Mechanics, Universitetskaya St., 17, Kazan, Republic of Tatarstan, Russia 420008 e-mail:shamil.zaripov@ksu.ru

(First received 30 January 1998; accepted 4.03.98 in final form for presentation during IAS-4)

It is known that an accurate measurement of the concentration of the airborne dust in the atmosphere is often complicated by nonideality of the aspiration process. Aspiration efficiency is defined as the ratio of a measured concentration to the true one. Determination of the aspiration coefficient for a given kind of aerosol sampler is the problem of great practical interest. The review of theoretical and experimental studies on determination of the aspiration coefficient is done in [1]. The problem of aerosol aspiration by thin-walled tubular inlet in calm air is theoretically solved. For small concentrations of dispersed phase a mathematical modeling of aerosol flows reduces to the solution of two problems: determining the gas flow velocity field and then calculating the trajectories of the aerosol particles in the velocity field obtained. A case is investigated when the gas flow is steady potential axially simmetric flow of an incompressible fluid. For determining velocity distribution of the gas in the vicinity of the sampling inlet the effective numerical method is used. It is based on the boundary value problem for the streamline function in the hodograph plane. The streamline function is represented as the sum of the singular and regular components. For determining the singular component the method of small parameter is used. It allows to reduce the problem to the solution of ordinary differential equations. The regular component is found from the sequence of linear boundary value problems. The equations of a motion of particles are also integrated in the hodograph plane. The limiting trajectory was found by the iterations method. This trajectory divides the particles that enter into the tube from those that do not and allows to calculate the aspiration efficiency. The dependencies of aspiration coefficient on Stokes number and settling velocity are constructed. The comparison of calculated data with the experimental formula from [2] is given. This work was supported by Russian Basic Research Foundation, Grant number: 96-01-00111.

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1215.

RADIATIVE FORCING AND CLIMATE RESPONSE FROM THE 1991 MT. PINATUBO AEROSOL CLOUD

STENCHIKOV G.*, KIRCHNER I., ROBOCK A.***, GRAF H-F.****

**University of Maryland, College Park, MD, US*

***Max Planck Institute for Meteorology, Hamburg, Germany*

****Rutgers University, New Brunswick, NJ, US*

(First received 05 February 1998; accepted for presentation during IAS-4)

We developed a zonal mean, monthly mean data set of stratospheric aerosol radiative characteristics for two years after the Mt. Pinatubo eruption. To calculate the aerosol parameters for the entire radiative spectrum, we combined SAGE II aerosol extinctions for 1.02 microns, provided by Larry Thomason, and CLAES/ISAMS retrieved effective radii provided by Don Grainger. This is the first global data set with vertically dependent effective radius. Using this data we calculated aerosol radiative forcing and climate response with ECHAM-4 general circulation model. We found more small aerosol particles above the 10 mb than expected for the first year after the eruption. The solar NIR heating appears to be more significant than it was found previously especially at the top of the aerosol layer, because small particles are relatively more absorbing. Ozone depletion and the QBO significantly modify the observed stratospheric temperatures. The changes in stratospheric temperature and dynamics force the tropospheric circulation from the top. The tropospheric dynamic response produces a significant portion of the climate variation especially in the winter. This dynamic response is sensitive to the stratospheric heating and sea surface temperature.

1423.
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OPTICAL PROPERTIES OF NON-SPHERICAL AEROSOL PARTICLES IN RANDOM ORIENTATIONS

SUTHERLAND R.A., KLETT J.D.

US Army Research Laboratory, Atmospheric Effects Branch, White Sands Missile Range, New Mexico, USA

(First received 02 March 1998; accepted for presentation during IAS-4)

Several approximate methods for modeling the electromagnetic (em) scattering and extinction properties of non-spherical aerosol particles are presented and applied to the practical problem of modeling the composite properties of ensembles of random orientations. The random orientation distributions are themselves modeled using semi-empirical methods approximating the effects of atmospheric turbulence. Although some of the methods are applicable to arbitrary shapes we confine our attention to homogeneous cylinders, discs, and spheres for which there are some exact solutions available for comparison. Methods include the classical approaches such as the Rayleigh-Gans (RG), Anomalous Diffraction (AD), Wentzel-Kramers-Brillouin (WKB) methods (Klett& Sutherland, 1992; Lopatin & Shepelevich, 1995), and various exact and approximate solutions in the "IPHASE" collection of Evans (1996).

Most of the methods include the full vector (polarimetric) propagation and include extinction, absorption, and scattering in all directions denoted as the differential cross-section, the equivalent of the classical phase function used in optics. The particle orientation model is based upon semi-empirical relationships valid for the inertial subrange of turbulence often used to approximate the real atmosphere. Results for thin cylinders show a tendency for particles to orient in the stable fall mode (long axis horizontal) for low levels of turbulence as long as the

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particle lengths are on the order of the inner scale (ie. a few millimeters), otherwise the more usual uniform random approximation applies. The paper reaffirms our earlier assessment of the WKB method which offers a viable alternative to the more widely used RG and AD approximations and provides a significant improvement in accuracy with only a slight increase in mathematical complexity.

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1210.

GENERATION OF AEROSOLS BY THE ELECTRICAL EXPLOSION OF WIRES AT REDUCED AIR PRESSURES

SEDOI V.S.*, VALEVICH V.V.*, KATZ J.D.**

**High Current Electronics Institute, Tomsk, Russia*

***Los Alamos National Laboratory, Los Alamos, NM, USA*

(First received 10 January 1998; in final form 5/2/98, accepted for presentation during IAS-4)

The exploding wire method of particle production, allows us to model the high speed formation of aerosols because of the fast heating and evaporation rates inherent to this technique. The method is also of interest from the viewpoint of controlling the production of aerosols of a particular material with a specific particle size distribution at a specific efficiency.

The electrical explosion of iron, aluminum, titanium, and copper wire has been investigated in air at pressures of from 0.01 to 1 atm. In these experiments the energy density introduced into the material, w, normalized to the sublimation energy of the material, s, and the heating rate were controlled. Particle and agglomerate sizes were determined using transmission electron microscopy and laser scattering methods. The specific surface of the powder was measured by low-temperature adsorption. The phase composition was determined by X-ray diffraction.

The specific energy introduced into a material, w/s, the pressure (density) of the surrounding medium, and the exothermic effect due to oxidation reactions are controlling parameters in particle
formation.

Increasing the energy density increases the internal energy of the material, the expansion velocity and the number of condensation centers, while the final particle size decreases. With an exothermic oxidation reaction, the optimum energy density can be less than the sublimation energy of the material. As a result, metal oxides are formed. As the density of the surrounding medium is increased, the particle size decreases because of an increase in the frequency of collisions and more rapid cooling of the particles.

Electrical explosions of wires, at reduced air pressures, allows for the production of ultra-fine powders of oxides of various metals with particle sizes of less than 50 nm. The method is environmentally safe and does not require excess energy expenditures. The electrical explosion of wire at reduced pressure allows for new possibilities in the production ultra-fine powders.

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982.
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BALLOON - BORNE STUDIES OF AEROSOL OPTICAL PROPERTIES OF FREE ATMOSPHERE AT ALTITUDES UP TO 30 KM IN VISIBLE AND NEAR IR SPECTRAL RANGES

LOBANOVA G.I., MIRSOEVA L.A., POPOV O.I.

All- Russian scientific centre "SOI named after S.I.Vavilov"; Birjevaya linia, 12, St-Petersburg, Russia.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

During long period the balloon-borne experiments were fulfilled by SOI to measure spectral radiances of cloudless day sky at altitudes up to the 30 km and in the spectral region 0.4-3.2 mcm. The authors made also the balloon-borne investigations of radiance phase functions for day sky [1] and atmospheric transparency [2]. These studies allowed to get the information about altitudial and spectral dependencies of aerosol scattering factor in free atmosphere. Measuring instruments (grating spectrometers with tracking system) were calibrated absolutely in units of spectral radiance. The experiments were carried out in middle latitude region of Russia in summer. The measured values of altitude and spectral dependencies of atmospheric aerosol scattering factor were compared with literature data.

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983.
УДК 541.18

METHODS AND COMPUTATION CODES FOR CALCULATION OF BACKGROUND OBJECT RADIANCES WITH ACCOUNT OF AEROSOL SCATTERING

GRIPOST S.B., MIRSOEVA L.A., POPOV O.I., SEMENOVA V.I., VESELOV D.P., LOBANOVA G.I.

All-Russian scientific center "SOI named after S.I.Vavilov";
Birjevaya linia, 12, St-Petersburg, Russia.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

In SOI during some years the methods and computation codes for calculation of radiative characteristics of the system the Earth-atmosphere were developed in ultra violet, visible and infrared spectral ranges. The code was developed to calculate background radiances with an approach of single scattering of solar radiation for different combination of aerosol models and wide range of illumination and observation conditions in the spectral interval 1...3.0 mcm with spectral resolution 0.025 mcm. The software operates with data base including altitude (up to 100 km with a step 1 km) and spectral profiles of aerosol attenuation and scattering factors for nearground, tropospheric, stratospheric and mesospheric aerosols in different regions. The software uses C-language and operational systems Windows 3.1, Windows 95, Windows NT. The requirements to hardware are following: processor 486-DX2- 66, operative memory >4 Mb, the data base storage of hard disk - 10 Mb.

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985.
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ALTITUDINAL AND SPECTRAL PROFILES OF ATMOSPHERIC AEROSOL EXTINCTION IN 0.4-12.0 μM REGION: STRATOSPHERIC BALLOON EXPERIMENTS

KISELEVA M., RESHETNIKOVA I., KAZBANOV W.

S. J. Vavilov State Optical Institute, Birjevaya 12, 199034, St.-Peterburg, Russia

(First received 10 January 1998; accepted for presentation during IAS-4)

Spectral atmospheric transmittance in the region 0.4-12.0 μm based on balloon experiments has been analysed and generalized. These experiments have been carried out up to 35 km height by authors of this report during of last ten-twelve years in different geographical regions (Russian, Kazakhstan , France) and different periods of volcanic activity. Altitudinal and spectral dependencies of atmospheric aerosol extinction in region of two atmospheric windows (0.4-0.8 μm and 8.0-12.0 μm) was considered. The influence of volcanic activity on atmospheric aerosol extinction spectra was noted. The approximate method of effective aerosol parameters and concentrations of aerosols has been developed. This method was used for the approximation of effective radius and concentrations of atmospheric aerosol particles. The comparison of data obtained in this work with modern publication ones was carried out. The influence of volcanic stratospheric aerosols on the stratospheric ozone concentration was discussed. The anticorrelation dependence ozone concentration versus aerosol extinction for level of H = 20 km was discovered.

1214.

THE IMPACT OF AEROSOLS ON SOLAR UV ACTINIC FLUX AND PHOTOLYSIS RATES

STENCHIKOV G., DICKERSON R., KONDRAGUNTA S., PARK R.

University of Maryland, College Park

(First received 04 February 1998; accepted for presentation during IAS-4)

A high mixing ratio of photochemically produced ground level ozone (photochemical smog) is the most typical characteristic of air pollution in highly populated urban regions. At the same time, the optical depth of fine aerosol particles on smoggy days can reach 2 in the near UV spectral bands. Sulfate and some organic aerosol particles scatter solar radiation back into space and cool the surface, but can increase the UV actinic flux, which is proportional to photon number-density in the atmosphere. This means that with the same number of photons arriving at the top of the boundary layer, aerosols simultaneously increase the number of reflected photons and the number of photons in the boundary layer.

Observations and theoretical calculations with MIE code and Discrete Ordinate radiative transport (DISORT) model based on observed aerosol size-number distributions show that UV-scattering particles in the boundary layer accelerate photochemical reactions and ozone production, but UV-absorbing aerosols, such as mineral dust and soot, inhibit photochemical processes.

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981.
УДК 541.18

ON INFLUENCE OF ATMOSPHERIC AEROSOL OPTICAL PROPERTIES ON RADIANCE CHARACTERISTICS OF THE EARTH IN NEAR IR SPECTRAL RANGE AT OBSERVING FROM SPACE.

VESELOV D.P., LOBANOVA G.I., MIRSOEVA L.A., POPOV O.I., SEMENOVA V.I.

All-Russian scientific centre "SOJ named after S.J.Vavilov"; Birjevaya linia, 12, St-Petersburg, Russia.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

The method and software are developed to calculate radiative characteristics of the system the Earth- Atmosphere due to reflection by underlying surface and singly scattering by atmosphere of sun radiation in the spectral range 1-3.0 mcm at observing from space. The software uses the data-base of optical characteristics of earth surface, tropospheric clouds and atmosphere. A special attention was paid to atmospheric aerosol which is the most changeable components of atmosphere. In calculations the different combinations of models for nearground, atmospheric, stratospheric and mesospheric aerosols were used. The choice of aerosol models is found to control substantially a radiance level of the system the Earth-atmosphere.

1195.

COLLECTION OF EMISSION FROM OSCILLATING DIPOLES INSIDE AN ILLUMINATED MICROSPHERE: ANALYTICAL INTEGRATION OVER A CIRCULAR APERTURE

PENDLETON J.D., HILL S.C.

US Army Research Laboratory ATTN: AMSRL-IS-EE

2800 Powder Mill Road, Adelphi, Maryland 20783-1197; dpendlet@arl.mil shill@arl.mil

(First received 29 January 1998; accepted for presentation during IAS-4)

We describe a method for analytically integrating, over a circular aperture, the emission from an illuminated microsphere containing a uniform distribution of molecules. Each molecule is modeled as an oscillating dipole with polarizability proportional to the internal (Mie) electric field at its location. The model is useful for investigating fluorescence, Raman, or other emission from excited molecules inside of small spherical droplets.

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	Novosibirsk	Institute of Catalysis of RAS
	Novosibirsk	Russian State Scientific Biological Center VECTOR
	Obninsk	Institute of Experimental Meteorology SPA Typhoon LLNL
	Samara	Aerospace University of Samara Samara Branch of P.N.Lebedev Physical Institute
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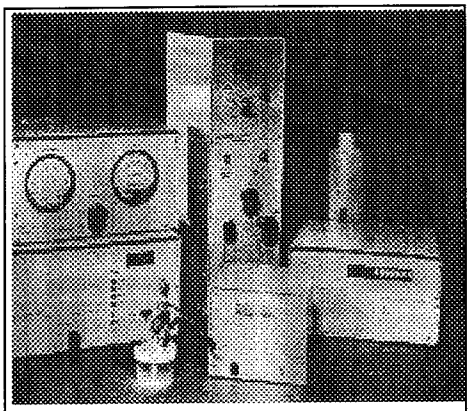
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THERMODYNAMIC INVESTIGATION OF THE ALTERNATIVE FREONS R-122 AND R-122A

VARUSHCHENKO R.M., DRUZHININA A.I., PASHCHENKO L.L.

Thermochemical Laboratory, Department of Chemistry, Moscow State University, 119899 Moscow, Russia.

(First receive 31 December 1998, accepted for presentation during IAS-4)

Keywords: Freons, Thermodynamics, vapour pressure, heat capacity.

This work was carried out under the program of the complex investigation of the alternative Freons by experimental and estimation methods in the wide temperature range from helium up to critical temperatures. The hydrogen containing Freons $CF_2ClCHCl_2$ (R-122) and $CFCl_2CHFCl$ (R-122a) are used as solvents and starting materials for fluoroorganic synthesis instead of environmentally unacceptable chlorofluoroethane $CFCl_2CF_2Cl$ (R-113), that destroys ozone layer in the stratosphere. The literature data on the thermodynamic properties of the hydrogen containing Freons are scarce and need to be refined.

The next properties of Freons were studied by experimental methods:
- the low-temperature heat capacities, the temperatures, the enthalpies and entropies of the phase transitions,
- the saturated vapour pressures and the enthalpies of vaporization over the moderate ("atmospheric") range of pressure,
- the densities of liquids at the room temperatures,
- IK and KP spectra of the molecules [1].

The experimental data were used as a basis for estimation of the set of properties in wide temperature range using the Clausius-Clapeyron equation and the corresponding states law.

The heat capacities were measured by adiabatic calorimetry. The apparatus consists of the automatic vacuum calorimeter, data acquisition and control system, and PC. The volume of the substance under study is about 1 cm^3. The temperature of the calorimeter is measured with the accuracy ± 0.01°K by rhodium-iron resistance thermometer [2]. The heat capacities were measured over the temperature range from 5°K to 325°K with mean accuracy ± 0.2 percent. It was found that both Freons were in the forms of glasses, supercooled liquids, partially crystalline, and liquid states. For the first time, the melting temperatures of these Freons have been determined. The thermodynamic functions $\{S°(T)-S°(0)\}$, $\{H°(T)-H°(0)\}$ and $\{G°(T)-H°(T)\}$ have been estimated at T = 298.15°K. The contributions to the residual entropies at T = 0 caused by disorder of configurational and conformational nature have been found on the basis of calorimetric and spectroscopic data for the both Freons. The values S°(298.15°K) for the R-122a determined by both methods are agreed in the error limits, that showed their reliability.

The saturated vapour pressures in dependence of temperature were determined by comparative ebulliometric technique over the pressure range from 11 kPa to 102 kPa. The apparatus consists of a differential ebulliometer and the manometric system [3]. The temperature of the (liquid + vapour) equilibrium was measured by means of platinum resistance thermometer at 20 fixed pressures maintained automatically by means of a mercury-contact manometer. The values of the fixed pressures were obtained by calibration of the manometer with standard substances (water and decane) for which the vapour pressures are well known. The accuracy of the temperature and pressure measurements ($\pm<0.01$°K and $\pm<2\leq6$ Pa) keeps pace with the present-day advances. The values-(pT) were treated by least-square method (LSM) using orthogonal functions. The next equations were obtained:

$$\ln(p) = A + B/T + C\ln(T) + DT, \quad (1)$$

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$$\Delta vH = R(-B+CT+DT^2)\,\Delta Z \pm \{s(\Delta_v H)+\Delta(\Delta Z)\Delta_v H\}, \quad (2)$$

$$\Delta C_p = C_p^o - C_p\,(liq) = R(C+2DT) \pm \{s(C_p)\}, \quad (3)$$

where ΔZ is the difference of the compression factors of gas and liquid (the value ΔZ takes into account vapour deviation from ideality). Equations (1)-(3) were employed for calculation of the normal boiling temperatures Tn.b., enthalpies of vaporization at T = 298.15°K and Tn.b., and the differences ΔC_p.

If it was possible, the enthalpies of vaporization were determined by both calorimetric and estimation methods with the accuracy ±(≤0.5 and ≤1.5) percent, respectively. The values ΔvH found by two independent methods agree within error limits, which proves their reliability. The ΔC_p differences are negative in agreement with the physical meaning of these values.

Experimental data of Freons were used for estimation of the saturation vapour pressure for the whole temperature ranges of liquid phases. To extrapolate safely the pT-values towards the triple point, they were treated simultaneously with the low temperature differences $\Delta C_p = C_p^o - C_p\,(liq)$ found by spectroscopic and calorimetric methods:

$$\ln\{p/p(m)\} = A + B/T + C\ln(T) + DT \quad (4)$$

$$\Delta C_p/2R = \{C_p^o - C_p\,(liq)\}/2R = C/2 + DT$$

where p(m) is the mean pressure within the range of pT-data. The errors of extrapolation in the temperature interval $T_{ext} \leq 100$°K are within (1 to 10) percent. The correlation of the vapour pressure and densities of liquids according to the corresponding state law (CSL) allowed us to estimate the critical parameters T_c, P_c, and V_c and to extrapolate pT-values to critical region with uncertainties (from 1 to 5) percent. The critical parameters can be used for estimation of many thermodynamic properties by the (CSL).

The thermodynamic properties of Freons and their fluorinated and hydrogen- substituted analogues were analyzed depending on the some structural parameters of the liquid phase. The conclusion was drawn that the values $\Delta_v H$, Tn.b., and T_c vary regularly in accordance with the dipole moments and the coefficients of molecular packing, that is, the parameters determining the intermolecular interaction energy and short-range order in the liquid phase, which proves consistency and reliability of the considered thermodynamic data in the series of halogenated ethanes.

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VARIABILITY FACTORS OF AEROSOLS AND AEROIONS IN POLAR ATMOSPHERES

SMIRNOV V.V.*, RADIONOV V.F. , SHEVCHENKO V.P.*****

**Institute of Experimental Meteorology, 82 Lenin str., Obninsk, Russia 249020*

***The Arctic and Antarctic Research Inst., 38 Bering str., St. Petersburg, Russia 199397*

****Institute Oceanology, 36 Nachimov str., Moscow, Russia 117851*

(First received 01 February 1998; accepted for presentation during IAS-4)

1. The complex regular measurements of the aerosol dispersity and air ion spectra mobility were proceed in the Western (Franz-Joseph Archipelago, Zigler Island, March - April 1994), Central (Laptev Sea, summer 1995) and Eastern (Wrangel Island, March - April 1985) Arctic and the Antarctic (Molodezhnaya station, January-May 1983). Aerosol size range is from 0.004 to 10 (m, as well as aeroion mobility from 0.00032 to 5 cm^2 / V. s.

2. In contrast with the Antarctic, the Arctic atmosphere is distinguished high concentrations of small size particles (D<0.1 (m). But in contrast with ecological satisfactory little cities at the Central Russia (Zvenigorod, Obninsk) the Arctic air is much cleaner, although the counting N and mass M concentration of the particles D> 0.5 (m turn out to be equal: N = 4 - 8 cm^{-3}, M = 30 - 50 (g/ m^3. For reference: at the surface air of arid zones N = 20 - 100 cm^{-3}, M = 100 - 300 (g / m^3 [1].

3. The size spectra of the polar aerosols above a snow surface is conservative with regard to the changes in relative humidity, solar and gamma-beta radiation and wind direction variations. The moderate and strong wind (U = 8 - 30 m/s) stimulates a concentration growth for coarse (D = 0,5 -1 (m) and large (D> 3 (m) particles. Fine particles (D<0.1 (m) are conservative to wind speed but the strong frost (T = -20...-35 °C) stimulates a increasing its concentration.

4. Practically independently from the weather situation and local time the size modes of D = 0.025, 0.15 and 1.5 (m are well-pronounced. Only at the strongly cooled and windless air one more mode appears between D = 0.5 and 0.9 (m. It is important to note that in the generalized size spectra of aerosols measured at the high-latitudinal Canadian Observatory Alert, the Moscow` suburb and Tadjikistan semi-deserts there are also present modes in the size area D = 0.01, 0.1 and 2-3 (m [2]. This allows us to speak about a possible similarity in the mechanisms of the formation and evolution of polar and continental aerosols in spite of significant differences in the character of the underlying surface: the continual snow cover in the Arctic, vegetation cover on the soils in middle latitudes, eroding soils on the arid zones.

5. The previous conclusion is made more convincing by the results of the measured relative spectral variations F(D) = MSD(D)/N(D), where MSD (D) is the mean square deviation of the aerosol concentration from the mean value N(D). So, the function F(D) depends very little on the wind direction. Thus, in most continental regions the aerosol concentration for cumulative fraction D = 0.1-0.3 (m fluctuates very little but for the very fine and very coarse continental aerosols the concentration fluctuations are about an order of magnitude larger [2, 3]. However, for the spring Arctic at weak winds (less than 5 m/s) the variability function F(D) for coarse particles are also small. This provides some key to the understanding the possible general mechanism of the polar-born aerosol formation - wind erosion of the snow cover and gas-aerosol conversion in very cold air.

6. As the exist presentations [4] possible to identify three mobility groups of polar ions: heavy 0.00032 - 0.001, intermediate 0. 02 - 0.2 and light 0.5 - 2.5 cm^2 / V.s. Correlation between

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concentrations of ions within the groups approximately such, either as for continents. In general event concentrations of negative and positive aeroions approximately correspond to the quasineutral atmosphere model. The main factors of variability in the concentration of aeroions are air temperature, wind speed and intensity of inversions above snow surface. Probably, it is the increase in wind speed that stimulates the known effect of contact electrization of aerosol particles at collisions with each other and the snow surface with the shift of the equilibrium toward negative charges. The largest effect on heavy aeroions is produced by stratification of the surface troposphere layer at anticyclones.

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AIRBORNE DEVICES FOR STUDY OF SUPERFINE ATMOSPHERIC AEROSOLS

SMIRNOV V.V., SAVCHENKO A.V., PRONIN A.A.

Institute of Experimental Meteorology, 82 Lenin str, Obninsk, 249020, Russia

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Set of portable instruments for functioning in the car and aircraft laboratories for complex and operative studying the characteristics of superfine aerosols of natural and manmade origins is considered. The electrical aerosol analyser DAES-3, thermo-diffusion spectrometer of nuclei condensation Omega-3 and portable sampler PAS-3 allows to get information on concentration and dispersity, as well as on hygroscopic, electrical and chemical characteristics of aerosol particles by diameter from 0,003 to 10 (m. Total weight of set is 15 kg, power consumption is 100 w from network 220/110 V or +27 V. Commercial analogues of instruments unknown.

Separate instruments and set itself were used in the aerosol car - laboratory for control of toxic dust emissions from the Owens Lake dry bed (USA, East California, Owens Valley, springtime 1993, international project LODE [1-3]), stationary polar station for study of background aerosols (Zigler Island, Franz-Joseph Archipelago, springtime 1994, russian-austrian project Polar Spring [4]), airborne laboratory for studying a long-distant transportation of dust from the Kalmykia deserts (summer 1996 and 1997) and others [5].

The portable electric aerosol analyser DAES-3.

Principle of action: the functional unipolar charging the aerosol particles by small aeroions, charged particle selection and ion current measurement. Recommended for the concentration and size spectrum measurement of finely divided aerosols, as well as for control of weakly dusty

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atmosphere and clear rooms of purity classes 100 and 1 000.

Measured interval by the diameter D = 0,003 - 1 (m in 11 dimensioned gradations. High level of the measured concentration of particles with sizes less D = 0,1 (m is consist N = 7.10^7 $1/cm^3$. Resulting measurement error of concentration and size in interval D = 0,01-0,5 (m does not exceed 40 and 30%, respectively. Volume sampling flow is 100 - 250 cm^3/s, linear sampling speed is 10 m/s. Weight of the remote gauge up to 7 kg. Power consumption + 27 V, 0.7 A. Removing of sensor not less than 25 m.

In contrast with the famous electrical analyser model 3030 (Thermo - Systems Inc., USA) given instrument has the tenfold lower mass and power consumption, as well as more high sensitivity.

2. Portable aerosol sampler PAS-3.

Is kept a rotary high pressure pump, controller and electric power supply 220/110/+12 V, anemometer, barbell by the length 1 m, removable fiber and nucleapore filters, two cascade impactor for large particles (d>2 micrometer). Recommended for continuos sampling of aerosols by sizes from 0,01 to 20 (m for an evaluation of mass concentration and dispersity as well as microelement, radionuclide and PAH - analysis.

Volume sampling flow is 1000 cm^3/s. Efficiency of precipitating of particles by sizes D = 0,01 - 10 (m upon substrates more then 90 %. Total sampling error does not exceed 15%. Power consumption 220/110/+12 V, 1.7 A. Removing of sensor not less than 25 m. Total weight of sampler up to 6 kg.

Condensation activity aerosol spectrometer OMEGA-3.

Principles of action is the flow condensation rising of nuclei within the thermo-diffusion chamber and automatic sizing of water droplets by photoelectric counter. Supersaturation interval over a water 0.01-1%. An interval of measurement from of droplet sizes D = 3 - 200 (m on 8 size gradation. The concentration and size measurement error does not exceed 30 and 40%, accordingly. Optical accounting volume is equal 1 mm3. Linear speed of sampling is 6 m/s. Lighter is laser diode, wave length 0,85 (m. Weight of the remote sensor 5 kg. Power consumption + 27 V, 0,5 A.

All remote sensors runnable at the air temperature 0-40 °C, pressure 70 -100 kPa, relative humidity up 90%, as well as under the linear vibration and shock 10 g and 15 g, jolting (bumpiness) 4g during one hour.

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REGULARITIES OF LONG DISTANT TRANSPORT OF SOIL DUST

SMIRNOV V.V. *, GILLETTE D.A., NOVITSKI M.A.*, GRANBERG I.G.*****

**Institute of Experimental Meteorology, Obninsk, Russia*
***ARL/SMDL, NOOA, Research Triangle Park, N.C., USA*
****Institute of atmospheric physics RAN, Moscow, Russia*

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Main source of air contamination on terrain, removed from the desert, is wind erosion of loess similar soil. These soil most often folded by sedimentary rocks and so their distinguishes good dispersivity and high contents of different salts. Corresponding dust emission can be initiated by the moderate wind (mean speed 7-12 m/s) within many hours. In total even the moderate flows of dust materials possible to watch a significant contamination an atmosphere after removing from the dust source of the order hundred km [1].

Situation is aggravated, when wind erosion of dry and drying large pools is occurs. Aerosol products of similar emissions are characterized by the high dispersity, condensation activity, electrization and significant contents of toxic substances [2, 3]. In the available literature practically are absent quantitative data about kinetics of aerosol particle concentration and size spectra during a transportation of the dust cloud and stream. Accordingly were unclearly an possibility of theoretical description on evolution and forecasting of similar dust emissions.

In the report are analyzed results of the stationary, car and airplane measurements of dust particle spectrum and concentrations, optical depth and atmospheric electrical field along dust stream on distance to 150 km from the erosion center. Investigations were conducted in the Owens Valley, East California, USA within the framework of the international project LODE-1993, as well as in 1994 -1997 at deserts near Aral Sea, Kasakhstan and Kalmykia, Russia [1]. Areas of an wind erosion at dust source is 60 - 80 km^2. Averaged dust storm at these regions lasted approximately 3 hours, generating into atmosphere from 10000 to 50000 ton finely divided dust [4].

Optical transparency of atmosphere were measured in the wavelengths (= 0.45 - 0.65 (m by means of the photometer "Sirius-2" with Se - photosensor. Electric aerosol analyzer DAES-2 was used for the concentration and size spectrum measurement of dust particles by the diameter from 0,0032 to 1 (m. Battery -operated rotary fluxmeter was used for the measurement of electrical field tension in atmosphere in vicinity of dust stream. Possible note the following interesting results of experiments.:

On removal X = 2 - 3 km from the dust source an atmospheric electrical field E achieves values +400 - 800 V/cm, exceeding the corona threshold for sharpened objects on land surfaces (people, bestial, trees, shrubs, antenna and the like). On removal 8 - 15 km field E decreased before the zero and changed a sign. Negative field value also has a maximum E = 100 - 200 V/cm on X = 30 - 80 km. Hereinafter removals X = 120 - 150 km field falls to background value E = +(0.1 - 0.2) V/cm;

On removals from the dust source X = 30 - 40 km spectrums of dust are powerfully enriched (by factors of 20 - 100) by dust particles of respirable size fractions (D>0,5 (m).
Very high concentration of superfine dust particles (D<0.1 (m) distinguishes the dust from the bottom dry pools from sandy desert. So be basis to suppose that for the appearance at atmosphere the superfine aerosols of the mineral, saline and biological nature can be

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responsible not extensive sandy deserts, but arid wind - erosion provinces with loess - similar soil (Central and Middle - West Asia, China, Caspian Sea shore, the South - East states of USA and others);

After removals greater X = 30 - 40 km a spectrum of speck sizes is gradually transformed: total dust concentration is reduced but a contribution of middle size fractions D = 0,075 - 0,25 (m grows, i.e. natural monodisperisation of dust spectrum is occurs. Approaching a dust spectrum to the background atmospheric spectrum is observed on removal an order 100 km and more;

Before small removals X = 3-5 km the basic factor of dust stream (or cloud) dissipation is coagulation of superfine particles (D<0,05 (m) and sedimentation coarse particles, over X = 5-10 km is turbulent diffusion.

The proposed mathematical model for contaminant transport is based on the three-dimensional semiempirical equation of turbulent diffusion and the model for mesometeorological atmospheric boundary layer and adequately describes the experiment within 150 km of the seat of the dust storm. Offered asked semiempirical formulas for the estimation of the dusting and electric power of a dust source and for prediction a degrees of atmospheric contamination at region using separate photometric measurements an dust stream [5, 6].

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1218.

POSSIBILITY OF ORIENTATIONAL MELTING OF TWO-SHELL CARBON NANOPARTICLE

LOZOVIK YU. E., POPOV A. M.

Institute of Spectroscopy, Russian Academy of Science 142092, Troitsk, Moscow region, Russia

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The discovery of fullerenes gives rise the interest to other carbon nanostructures included the nanoparticles with shell structure. It is known that a melting of single cluster essentially

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differs from phase transitions in macroscopic systems.

The melting of a cluster may manifest itself as an hierarchy of transformation in shells or breaking the order between them. E.g., in 2D microclusters with Coulomb, dipole and logarithmic interaction between particles the rotational melting (i.e. rotation of "solid" shells) preceedes to melting inside the shells [1]. However, the rotational melting had not been discovered in 3D clusters.

Van der Waals interaction between atoms of neighbor shells in carbon nanoparticles is considerably weaker than valent interaction between atoms inside the shell. Therefore these nanoparticles seems to be possible candidates for rotational melting. To investigate the possibility of this phenomenon we consider the two-shell carbon nanoparticle with fullerene C_{60} as inner shell and fullerene C_{240} with icosahedral symmetry as outer shell (four different shapes of this fullerene are considered). The fullerene C_{60} is the smallest fullerene without adjacent pentagons in its structure, therefore the absence of chemical bonds between shells in this case is very probable. We describe the interaction between atoms of neighbor shells by Lennard-Jones potential. The energies of shell deformation is described in terms of deviations of bond lengths and angles between bonds from their equilibrium values.

The global and local minima of total potential energy of nanoparticle are found by optimization of three angles of relative shell orientation. The high I_h symmetry of shells leads to great number of equivalent global minima. The energies of shell deformation are also calculated. The barriers for relative rotation of shells in the nanoparticles under consideration are calculated for relative orientations corresponding to global minima of total potential energy. It is found that the obtained values of barriers for rotation are surprisingly small and shell deformation during intershell rotation does not considerably influence on the magnitudes of barriers. Moreover, these barriers are only several times greater than barriers dE_a, the differences between minimum and maximum in dependencies on angle of rotation for energy of interaction between one atom of the second shell and the whole first shell.

For example, for the nanoparticle with close to icosahedron shape of second shell C_{240} the barrier for rotation around fifth order axis is dE_r = 159 K. Simultaneously the maximal barrier among the barriers dE_a for individual atoms of the second shell are 22 K, i.e. dE_r \ll 240 \dE_a.

The detailed analysis shows that in the case of relative shell orientations with coincident symmetry axis of shells the second shell have several tens groups of atoms with different orientation relative the first shell. The maxima of dependencies E_a for individual atoms from different group correspond to different angles of rotation and so the dependence of total energy on angle of rotation is essentially smoothed. In the case of relative shell orientations with noncoincident symmetry axis barriers for relative rotation are very small due to incommensurability of atom positions in two shells.

The orientational melting may be considered in a sense as a two stage phenomenon. At low temperatures the relative reorientations of shells are frozen. Initially, the jump-like rotational diffusion begins with increasing of temperature. For greater temperature free rotation of shells take place.

The temperature T_1 of crossover from frozen state of nanoparticle to rotational diffusion of shells is estimated to be several Kelvin degrees. The temperatures T_2 of crossover from jump rotational diffusion to free rotation of shell is identified as the point where the two free energies of these states are equal. These temperatures are about tens Kelvin degrees. Both temperatures T_1 and T_2 are determined by the shape of second shell.

The molecular dynamics simulation of the process of nanoparticle orientational melting is performed.

The obtained very small temperatures T_1 and T_2 in the two-shell nanoparticle allow us to proposed that rotation melting may occur also in many-shell nanoparticles.

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THE NONLINEAR LIDAR-EQUATION - AN INVERSE ILL-POSED PROBLEM

BOCKMANN C., BERNUTAT C., FISCHER S.

Universitqt Potsdam Institut fur Mathematik Am Neuen Palais 10 Postfach 60 15 53 144 15 Potsdam
Phone: (0331) 9771743/1500 Fax: (0331) 9771578 bockmann@rz.uni-potsdam.de

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Multispectral lidar measurements, tropospheric aerosol, multimodal aerosol size distribution, inverse ill-posed problem, regularization method, mollifier-method

The knowledge of the size distribution of atmospheric particles is of interest in many areas of aerosol research, e.g. for understanding the radiation budget of the atmosphere and for the explanation of heterogeneous chemical processes that occur in the atmosphere. The problem of determining the aerosol size distribution function n(r), by multispectral lidar measurements, belongs to the class of problems in mathematics called nonlinear inverse ill-posed problems. The best and tricky techniques of nonlinear optimization do not work there. Consequently, we have to look for a suitable regularization method to obtain reasonable approximations to n(r).

We consider two linear ill-posed subproblems, i.e. two linear first kind Fredholm integral equations, $\beta^{Aer} = K_{\pi} \cdot n$ and $\alpha^{Aer} = K_{ext} \cdot n$.

Small changes in the data function can produce very large changes in the solution, i.e. the solution n, if a solution exists, does not depend continuously on the right-hand side data functions β^{Aer} and α^{Aer} , respectively.

Since the tropospheric aerosol contains a large number of species, the model process is much more complicated as in the stratosphere. There occur aerosols with different particles, i.e. with different refractive index m. The aerosol size distribution is a multimodal one. In general the number of different particles and their refractive indices are unknown. Now we choose a suitable method to solve the two-dimensional ill-posed problem of integral equations. We propose a mollifier method. We start form the fact that in practice only a finite number of observations are possible. We choose among all n solving the equation the one with minimal norm. We select a smoothing operator $E_\gamma : X \to X$ with $w - \lim_{\gamma \to 0} E_\gamma n = n$ and determine $n_\gamma = E_\gamma n$.

If X is a function space, e.g. L^2 or Sobolev spaces $H^{-s}, s > \frac{1}{2}$, we represent E_γ by $E_\gamma n(r) = \langle e_\gamma(r,\cdot), n \rangle_X$ with a suitable mollifier e_γ , e.g. wavelet functions. The value s depends on the degree of ill-posedness, i.e. on the smoothness of the kernels.

The algorithm for reconstruction n at a specified point r from the given data proceeds in two

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steps:

1) solve the normal equation

2) calculate n, by parallel processing for different β^{Aer} and α^{Aer}, respectively

The ill-posed part of the algorithm, step 1, is independent of the data. Moreover the matrix of the linear system is independent of r and γ. The regularization parameter γ appears only on the right-hand side. The right-hand side can be compute exactly, avoiding in that way any influence of the noise in the data.
No additional or artificial discretization of the solution n is needed.We may freely select the points r where n_γ is evaluated.

1243.
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LIGHT-INDUCED EVAPORATION AND GROWTH OF AEROSOL PARTICLES

CHERNYAK V., KLITENIK O.

Department of Physics, Ural State University, Ekaterinburg 620083, Russia

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The purpose of this work is the elaboration of a kinetic theory for the evaporation and condensational growth of the particle under the effect of resonant optical radiation.

Consider a spherical nonabsorbing and non-heating particle suspended in a mixture of its own vapour and a non-condensed gas.

Could the evaporation or especially the condensational growth of the nonabsorbing particle be possible? The microscopic analysis answers in the affirmative on this question.

Let the frequency of the travelling light wave is close to the absorption line of the electronic or vibrational-rotational transition of vapour molecules. Due to the Doppler effect, only the vapour molecules whose velocity projection on the radiation
direction lies within a certain velocity range can be excited. The excited molecules change their transport properties - in particular, the collision cross section. If excited and nonexcited vapour molecules interact with molecules of the buffer gas
differently, the distribution function for the vapour molecules becomes nonequilibrium.

As a result the temperatures of the vapour and the vapour-gas mixture are different (resonant heating or cooling of the vapour). When the vapour temperature is
higher than the equilibrium temperature of the system, the droplet is evaporated. In the opposite case the condensational growth of the particle takes place.

The next reason for a perturbation of phase equilibrium is a dependence of the collision frequency of vapour molecules on quantum state. The absorbing molecules change their collision frequency. In this case the number of vapour molecules sticking
the surface of the particle per time unit is changed. As a result the dynamic equilibrium between evaporation and condensation is upset. The difference in the condensation coefficients for excited and nonexcited vapour molecules is the reason of evaporation or growth of the particle too. If the condensation coefficient of excited molecules increases then the condensation process is predominant, i.e. the growth of the particle takes place.

It has been assumed:

* The particle is exposed to the monochromatic optical radiation. A travelling light wave is absorbed by the vapour molecules in the electronic or vibrational-rotational transition from the

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ground state to an excited state. The radiation frequency is slightly detained from the centre of absorption line.

* The distribution functions of the excited and nonexcited vapour molecules and the distribution of the buffer gas molecules satisfy the Boltzmann kinetic equations.
* The evaporation coefficients for excited and nonexcited molecules are different and the effective cross sections are different too.
* Let the particle size is much smaller then the mean free path of molecules in a gaseous phase, i.e. free-molecule regime.
* The particle does not absorb the radiation; it does not change its temperature during evaporation or condensational growth.

It has been obtained:

* The expressions for kinetic coefficients, which characterise the surface and bulk mechanisms of evaporation (condensation) rate.
* The dependence of kinetic coefficients on the detuning between the radiation frequency and the centre of the absorbing line has been studied. The evaporation (condensation) rate has a maximum at exact resonance.
* The direction of the process, i.e. evaporation or growth of the aerosol particle takes place, is determined by the differences in the effective diameters of the excited and unexcited vapour molecules, in the evaporation coefficients of the excited
and unexcited molecules and by the detuning magnitude.

1253.
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NATURAL AND COSMOGENIC RADIONUCLIDES AT MT. CIMONE-ITALY

TOSITTI L., TUBERTINI O., BETTOLI M.G., BONASONI P.

Environmental Radiochemistry Lab., Dept. Chemistry, Univ. Bologna, V. Selmi 2, 40126 Bologna, Italy
Institute of Physics & Chemistry of the Lower and Upper Atmosphere with CNR - FISBAT, Bologna, Italy

(First received 25 February 1998; accepted for presentation during IAS-4)

In this work, an overview of radioactivity measurements at a mountain site (2165 m a.s.l.) representative of the free troposphere of Mediterranean basin located in the Italian northern Apennines, together with some preliminary results are presented. This area is of great interest for at least two main reasons: 1) high frequency of cyclogenetic phenomena in connection with intense stratosphere-to troposphere exchange processes; 2) the location is not directly affected by anthropic emissions, providing the opportunity of observing and identifying the drift of air masses both of European and Saharan origin. Current work includes high-volume aerosol samplings followed by gamma spectrometry of particled radionuclides, mainly Pb-210 at 47 keV and of Be-7 at 478 keV. Stratospheric intrusions have been at times detected and diagnosed by cross-check of activity values of both radionuclides and of their activity ratio with ozone and meteorological parameters which are simultaneously measured at Mt. Cimone observatory. In addition, the setup of a radiochemical procedure for the determination of cosmogenic P-32 in the same samples is in progress in order to better distinguishing between transports from the upper troposphere from those from the lower stratosphere when compared to corresponding Be-7 activity. Noble gas Rn-222 is continuously measured on a hourly basis by means of a modified lucas cell. Time series of radon activity are presented and discussed in the light of local climatology including the occurrence and description of some peculiar events observed.

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SOOT AEROSOL AND FULLERENE FORMATION IN CARBON VAPOUR CONDENSATION PROCESS

KRESTININ A.V., MORAVSKY A.P., TESNER P.A., FURSIKOV P.V.

Institute of Chemical Physics, Russian Academy of Sciences,
142432, Chernogolovka, Moscow Region, Russia

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The very discovery of fullerenes and further studies on their formation process implied that kinetic mechanism of carbon vapour condensation has little in common with studied earlier processes of other simple substances condensation. In fact, the variation of the conditions of fullerene synthesis in an arc reactor leads to obtaining of 0 to 24wt.% of fullerenes C60+C70 in the product of carbon vapour condensation (fullerene soot).

Analysis of carbon vapour condensation process indicates that the following factors determine the kinetics: a) growth and decay reactions of carbon clusters under non-isothermic conditions, b) soot aerosol formation and growth, c) heat and mass transfer processes essentially influencing the temperature and gas phase composition. A kinetic model allowing for these factors is presented in the work. To test the model two sets of experimental data were used. These are kinetic data on fullerenes thermodecay in a shock tube [1] and on fullerenes synthesis in a carbon arc reactor [2].

The numerical analysis of the kinetic model of carbon vapour condensation lead to the following general conclusion. Under close to optimum conditions for the synthesis of fullerenes strict constraints on the kinetic scheme of vapour condensation are imposed by two factors: the high value of fullerene yield and constancy of molar ratio C70/C60 in the products of arc synthesis. In particular, the following is valid:

1) Coagulation of large clusters, for example, coalescence of cycles and polycycles, cannot be the main route to fullerenes C60 and C70. The inevitable high contribution of clusters coagulation to the soot particle nucleation would lead in that event to catastrophic fall in fullerene yield because of prevailing condensation of carbon vapour on readily formed soot particles.

2) The growth of fullerene structures ranged between C60 and C70 should proceed through insertion of C1, C2 or C5 fragments to get the main reaction route passed exactly both through C60 and C70 clusters. There slightly exists an alternative to this condition since it furnishes under mild additional restrictions both the high yield of fullerenes and constancy of the C70/C60 ratio in the products. The model employes the insertion of C2 - fragment as the main reaction route for fullerene structures growth. The decay of fullerene structures is well known to produce mainly the C2 fragment as well.

Two probable routes to perfect fullerene structures are compared in the model.
The first includes original formation of defect C60 and C70 clusters followed by monomolecular Stone-Wales type annealing into perfect molecules. The second one goes through the regular channel of fullerene growth by addition of C2 - fragment. Under some natural assumptions the value of the C70/C60 ratio obtained in calculations is almost constant and pressure dependence of fullerene yield coincides with experimental one for both routes.

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Наименование товара	Ед. изм.	Количество	Цена руб.	Сумма руб.	Ставка НДС	Сумма НДС, руб	Всего с НДС, руб.
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1257.
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MECHANISM OF SOOT FORMATION IN PYROLYSIS AND COMBUSTION OF HYDROCARBONS

KRESTININ A.V.

Institute of Chemical Physics, Russian Academy of Sciences, Chernogolovka, Moscow Region, 142432, Russia

(First received 26 February 1998; accepted for presentation during IAS-4)

Two existing approaches to quantitative description of soot formation mechanism through <aromatic> and <polyyne> models are critically reviewed. Aromatic model considers the soot particle inception process as coagulation of polycyclic aromatic hydrocarbons (PAH). Polyyne model assumes that primary soot particles originate from fast polymerization of "supersaturated polyyne vapor". Certain experiments disagree with "aromatic" hypothesis. D'Alessio and co-workers recently discovered 3-6 nm sized transparent in visible particles in the soot zone of a premixed hydrocarbon flame. The concomitant conclusion states that primary soot particles are not giant aggregates of large condensed PAH, and the process of their formation may be faster than predicted by quantitative kinetic schemes of PAH growth and coagulation. Second, Tesner and co-workers in the studies of hydrocarbon pyrolysis discovered that admixture of acetylene to PAH decreases the soot particle number density. The opposite trend could be expected from the viewpoint of aromatic model since acetylene promotes PAH growth.

An essentially improved version of the polyyne model which details the acetylene pathway to soot particles is presented. The model is based on the idea that the fast polymerization process of polyynes C2nH2 , n=2,3,..produces primary soot particles in the form of polymeric globules. Soot nuclei arise in the model as radical centers of the polymerization process. Their irreversible growth is conditioned by the occurrence of supersaturation of a "polyyne vapor" in the reactive atmosphere. The carbonization process of primary soot particles is presented in the model as well. Its duration determines how long soot particles coalesce in the coagulation process. The computer code of the model comprises a detailed description of gas-phase and heterogeneous reactions, soot particle nucleation, surface growth and coalescence of soot particles. The principal quantities of soot formation process in hydrocarbon pyrolysis, namely, induction time, soot particle number density and soot volume fraction are available in the model. Calculations performed earlier for methane, acetylene, ethylene and benzene well agree with experiments [1-3]. The quantitative explanation of both high efficacy of PAH-molecules in soot particle nucleation and the "inhibition" of this effect by admixture of acetylene is presented in the report. Experimental results on those mixtures are crucial for understanding the main kinetic regularities of soot formation in pyrolysis and combustion of hydrocarbons.

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AEROSOL-OPTICAL CHARACTERISTICS OF THE ATMOSPHERE IN HIGH AND TEMPERATE LATITUDES OF RUSSIA

RADIONOV V.F., RUSINA YE. N.

The Arctic and Antarctic Research Institute 199397, St. Petersburg, Bering St.,38

(First received 13 February 1998; accepted for presentation during IAS-4)

The features of the space and time variability of the aerosol extinction characteristics in the atmosphere of high and temperate latitudes of Russia were investigated in the regions that are not directly exposed to the influence of industrial sources. For this purpose the series of monthly means of the aerosol optical depth at a wavelength of 500 nm (AOD) and a selectivity indicator of aerosol extinction (wavelength exponent - WE) were analyzed at 13 Arctic and 6 mid-latitude stations of background atmospheric monitoring over 1972 to 1995 period.

The monthly means of aerosol optical depth in polar and background conditions of mid-latitudes of Russia are close by value and do not exceed AOD=0.25.

The variability of the aerosol optical depth within a year depends on latitude and is governed by different factors. The spring maximum of aerosol pollution recorded everywhere at the Arctic stations is a result of the increased aerosol export from the continent due to a pronounced meridian transfer in the wintertime. By the summer the Arctic atmosphere is purified and the minimum optical aerosol depth is observed in September. On the contrary, at mid-latitudes "normal" annual variations occur with AOD maximum during the spring-summer period.

At most stations under consideration there was no pronounced trend of the aerosol optical depth. A significant increase in AOD was recorded only at the mountainous North-Caucasian station Pyatigorsk-1 and at three Arctic stations (Dikson, Uyedineniya and Kotel'ny Islands).

At all background stations without exception, AOD increases with appearance of aerosol of volcanic origin in the atmosphere. The relative response value increases from South to North. Up to the present time the contribution of natural sources to aerosol pollution of the atmosphere still remains decisive.

During the period under study mean values of the wavelength exponent varied within 1.0-1.2, i.e. were by 15-23% below WE=1.3 assumed by Angstrom for average conditions. This indicates some displacement in aerosol size distribution to coarse-dispersed particles, probably, under the influence of antropogenic factors.

Like AOD, the wavelength exponent responses to large volcanic eruptions (such as El-Chichon and Pinatubo). The WE value decreases.

It was unexpected that unlike AOD, the tendencies in the change of the WE at mid-latitudinal stations turned out to be different. In particular, at two of them (Pyatigorsk-1 and Turukhansk), more clean of a special interest. However performing such experimental be related to the increased aerosol pollution in the observation regions. At most background stations in the late 1980s-early 1990s there was a transfer of the anomalies of annual means of WE to negative values. To determine the causes of this phenomenon additional studies are required.

Due to high sensibility to random errors of measurements the wavelength exponent is still badly studied and because of that it is of a special interest. However perfoming such experimental investigations will demand for high-precision spectral measurements of solar radiation.

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ABOUT DETERMINATION OF COEFFICIENTS OF ABSORPTION AND REFLECTIVITY OF MATERIAL PARTICLES FROM THE UNDERLYING SURFACE

VOZZHENNIKOV O.I., NIKONOV S.A.

Scientific Production Association 'Typhoon' Obninsk, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

As powerful computation means have become available we see reviving interest to using methods of random wanderings (Monte-Carlo), both for research problems on turbulent diffusion in complex meteorological processes and for applied problems related to calculation of material dispersion in case of regional and long-range transport. This method has been put to use by many research institutions and prognostic centres, among them Livermore National Laboratory (USA), RSMC "Obninsk" and others.

When applying this method, researchers encounter the "chronic" difficulty, namely parametrization of particles interaction with the underlying surface. To our knowledge, there is no solid research on the topic in the literature. Each research team uses its own developments in transport models which, as a rule, have not been discussed by the scientific community.

The present report describes one of possible approaches to determination of coefficients of reflectivity and absorption of material particles by the underlying surface. The approach is based on using traditional characteristics of near-surface and near-ground atmospheric layers. The sought values are determined for logarithmic near-ground layer, both for weightless and settling material. The simplest is the expression for the absorption coefficient for weightless material dispersing in the neutral atmosphere:

$$K_- = \frac{V_{g0}}{K_L + V_{g0}}, \qquad (1)$$

where V_{g0} is the velocity of dry settlement in the near-surface layer,

$K_L = \frac{\aleph U_*}{\ln h/z_0}$ is the exchange coefficient in the near-surface atmospheric layer, $\aleph \approx 0.4$ is the Karman constant, U_* is the dynamic velocity, z_0 is the roughness parameter, h is height at which the limiting conditions for the vertical flow are set.

The reflectivity coefficient can be simply calculated as:

$$K_+ = 1 - K_- = \frac{K_L}{K_L + V_{g0}}. \qquad (2)$$

In the case of settling material the reflectivity coefficient is found from the balance flow equation at the border with the surface.

For a simple logarithmic vertical wind profile characteristic of neutral stratification the reflectivity coefficient takes the form

$$K_- = \frac{W}{W + V_{g0}\left[\left(h/z_0\right)^m - 1\right]}, \qquad (3)$$

where $m = W/(\aleph U_*)$

For verification of the proposed approach we used the Monte-Carlo method of random wanderings in the velocity space. A series of experiments with the logarithmic wind profile were

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conducted. The report describes the results of comparison of modelled concentration profiles using the above defined absorption and reflectivity coefficients with exact solutions of diffusion equations for the simplest cases. The analysis suggests that this approach holds much promise in specifying the interaction of wandering particles with the underlying surface.

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ALIGNMENT EFFECTS IN NA*(3P) - C60 CHARGE TRANSFER REACTIONS

HEUSLER G., CAMPBELL E.E.B.

Max-Born-Institut fur Nichtlineare Optik und Kurzzeitspektroskopie,

Rudower Chaussee 6, 12489 Berlin, Germany

(First received 03 March 1998; accepted for presentation during IAS-4)

In a crossed beam experiment of neutral C_{60} and neutral Na charge transfer is observed when the sodium atom is excited to its 3p state. To investigate this reaction, we used an effusive sodium source and collimators to get a sodium beam. The fullerene beam was obtained from a small-sized oven. The fullerenes leave the oven through a 15 mm long tube of 1.5 mm inner diameter leading to a non-Maxwellian-Boltzmann velocity distribution.

The sodium in the interaction zone was excited to its first excited state (sodium D_2-line) using a two-mode laser. This laser is a cw dye laser emitting light at two wavelengths at 589 nm [1].

The laser was focussed to approx. 1 mm in the interaction region. The sodium atoms therefore pass through about 50-100 pumping cycles. The fluorescence light emitted by the sodium atoms was detected by a photodiode.

The interaction zone was completely surrounded by a box made from m-metal. This served as a shield to the earth's magnetic field.

The charge transfer was observed by detecting the emerging negatively charged C_{60} ions. They were accelerated from the interaction zone by an electric field. A lens allowed to focus the ions into the entrance hole of a quadrupole. In front of the quadrupole an ionizer is provided which allows electron impact ionization at variable energy. The ionizer could also be used to produce C_{60} - by electron attachment.

To investigate alignment effects, the polarization plane of the laser light was rotated continuously by a polarization rotator driven by a stepper motor. The fluorescence light and the C_{60} anion signal were registered simultaneously. A clear alignment effect could be observed and will be discussed in detail.

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1276
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COMPLEX MODEL FOR EVALUATION OF ECOLOGICAL SITUATION IN THE VICINITY OF NUCLEAR FACILITY

VOZSZENNIKOV O.I.*, MOROZ'KO E.N.*, SEMYONOVA E.V.**

**Scientific Production Association "Typhoon", Obninsk*

***Moscow State University, Moscow*

(First received 08 February 1998; accepted for presentation during IAS-4)

Evaluation of the influence of Nuclear Power PlantTs (NPP) releases including accidental ones is the important part of projecting organizationT work. In Russian practice, such an evaluation are performed by the different organizations, on the base of their own techniques

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and methodologies. As results, the non comparable estimation of NPP environmental impact appear.

The distinguishing feature of a model described is using of the whole complex of data available for the territory around nuclear facility(data on relief vegetation, land use, orography demographic data , etc.,),. A set of physico-mathematical submodels is proposed to perform the evaluation of the radioecological situation.

The present version of the complex model:
- is based on GIS technologies to operate with distributed data on territory;
- includes the atmospheric dispersion model capable to take into account deposition onto various surfaces;
- includes the runoff model to take into account the radionuclides washoff from the watersheds;
- is able to simulate wind resuspension of pollutants for different accidental stages.

All model parameters based on demographic , land and contamination data distribution are used average values for each cell of a rectangular grid. Diffusion fluxes between the adjacent cells could depend on the grid resolution.

RadionuclidesT transport by is described by with system of ordinary differential equations for each cell.

The complex model described was applied in the 30-km zone Novovoronezhskaya NPP to evaluate the possible environmental consequences of the accidental releases .

The evaluation results and model analysis are submitted in the paper.

1278.
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EXPERIMENTAL AND THEORETICAL STUDYING OF LANGEVIN SCHEME OF STOCHASTIC WANDERING.

ZHUKOV G.P., NIKONOV S.A.

Scientific Production Association 'Typhoon' Obninsk, Russia

(First received 12 DFebruary 1998; accepted for presentation during IAS-4)

The Langevin equation, initially derived for describing the Brownian motion in the velocity space, is now successfully used for accounting for random wandering of liquid particles in modelling turbulent dispersion of material. The advantage of this approach is a possibility to adequately represent both relative and absolute diffusion. This is because the process of random wandering of particles in the coordinate space is non-Markovian, which allows going beyond the traditional K-Theory of diffusion.

The proposed work uses the numerical Langevin model of stochastic wandering to analyse results of the experiments on material dispersion from an instantaneous source in the atmospheric boundary layer (testing site of the meteorological tower, Obninsk, Russia). In these experiments, a plume was simulated by release of chaff with a low sedimentation rate (<30mm/sec). The chaff cloud was tracked using the meteorological radar, which made possible determination of relative distribution of the concentration in the cloud and calculation of the variance in chaff concentration by three directions. First results of these experiments were published in [1]. The meteorological conditions of these experiments were such that the stratification of the atmospheric boundary layer ranged from almost neutral to moderately unstable. In the experiments, the conditions of cloud expansion were: $S^2 \sim t^3$ (at $t \le \tau_L$, τ_L is the Lagrangian time scale, L is the effective cloud width with the Gaussian approximation of concentration in it) $S^2 \sim t$ (at $t > \tau_L$). This permitted estimation of τ_L and diffusion coefficients for the meteorological conditions of the experiment. All experiments provided for

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measurements of main meteorological parameters using instruments located at the meteorological tower.

The used stochastic model was validated against the theoretical dependencies derived in [2]. Then, using the values τ_L and σ_u determined in the experiments the conditions of relative and absolute diffusion were reconstructed. Setting the initial distribution of the velocity of liquid particles to be Gaussian resulted in the absolute diffusion regime equivalent to a continuous source. It was found that the variance in distribution should be equal to the Eulerian dispersion of the medium in the release point. In this case, we get satisfactory agreement between the curves of growth of lateral dispersion of continuous jet in the IAEA methodology [3]. Given the delta-shape distribution, by the initial velocities the model simulates relative diffusion, i.e. increase in the size of the instantaneously released cloud. At large times, as follows from the theory, both regimes coincide.

For determination of the variance in meandering of the cloud in the model and in experiment the following formula was used

$$M_y = \sigma_y - S_y, \qquad (1)$$

where M_y is the variance in cloud meandering, σ_y is the absolute dispersion (which was taken from the IAEA methodology as lateral dispersion of continuous jet for experimental determination of meandering), S_y is the relative diffusion of expansion of an instantaneous cloud. For distances less than 10 km the experimental and model characteristics of meandering showed good agreement. At considerable distances, the meandering obtained by the combination method (experiment + IAEA methodology) shows higher values than the model. For example, at 30 km the variance in meandering is as large as 1 km. In our view, the obtained values are indicative of overestimation of variances in [3].

Based on the experimental data, we estimated a simple scheme to account for the vertical gradient of velocity in the model, namely

$$du/dt = -(u-\overline{u})/\tau_L + f_u(t) + G\cdot\omega, \qquad (2)$$

where u is the horizontal velocity, $\overline{u}$ is the mean horizontal velocity, f_u is the random force of the pressure gradient, G_T is the vertical gradient of velocity, ω is the pulsation of vertical velocity. It was concluded that such an account leads to overestimation of the longitudinal diffusion of the cloud. This fact can be interpreted as violation of the turbulence uniformity condition which was one of the main assumptions of the model.

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1279.
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PRODUCTION AND CHARACTERIZATION OF ENDOHEDRAL LI@C_{60}

KRAWEZ N., GROMOV A., HEUSLER G., PRAXEDES A., HERTEL I.V., CAMPBELL E.E.B.

Max-Born-Institut fur Nichtlineare Optik und Kurzzeitspektroskopie, Rudower Chaussee 6, 12489 Berlin, Germany

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A method to produce Li@C_{60}, which has a much higher efficiency than any other available method for producing endohedral fullerene, will be presented [1]. In this method monolayers of C_{60} are continuously exposed to an intense beam of alkali ions at an energy chosen such that the ions can penetrate the carbon cage but cannot destroy it. In this way it is possible to build up a film of fullerenes of many nanometres thickness which contains a substantial percentage of Li@C_{60}. The ratio of Li^+ to C_{60} during the deposition was estimated to be 6:1 (for which the the best capture rate was found). As determined from laser desorption mass spectroscopy, this capture rate was up to 50% (i.e. equal intensity of the C_{60} and Li@C_{60} mass peak).

However, to purify the endohedral species, it was found that the best solubility was obtained for films produced at the lower Li+ to C60 ratio of 1:1 (and hence a lower content of the endohedral species). Results of the purification process using HPLC will be presented.

To characterize the endohedral species, mass spectrometry, infrared, Raman and X-ray spectroscopy investigations have been performed. Some of the results will be presented.

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1284.
УДК 541.18

THE INVESTIGATIONS OF SPATIAL VARIABILITY FOR WIND FIELD AND ITS EFFECT ON POLLUTION CONCENTRATION NEAR THE GROUND FOR A LOCAL SYSTEM OF RADIATION MONITORING

BESCHASTNOV S.P., NAIDENOV A.V.

Scientific Production Association 'Typhoon' Obninsk, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

The results of field measurements and of numerical simulation of wind field are considered along with the calculations of pollution concentration distribution from an elevated source over a heterogeneous surface in the re-gion of a local system of radiation monitoring for Obninsk, which being designated in conditions typical of middle regions of Russia. The wind spatial distributions was stu-died during simultaneous basic balloon observations and with a mesoscale nonhydrostatic model of the atmospheric boundary layer (ABL) incorporating a microrelief, a penetrable region of obstacles (a forest, bushes, a settlement, a town), albedo and roughness variations. The extent of the wind field spatial heterogeneity effect on the pollution concentration distribution from an elevated source was estimated with a numerical model of pollution diffusion.

It has been found that considerable variations in wind velocity and direction caused mainly by the influence of the obstacles region and albedo variations were observed at weak winds and convective conditions. A comparison performed has demonstrated that there exists a

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satisfactory agreement in the tendencies of wind velocity and direction spatial variations in field measurements and numerical simulation.

An analysis of numerical results of the lower atmosphere pollution has shown that the wind spatial variability influences strongly the pollution dispersion. But more crucial for the pollution concentration is the choice of a representative site for aerometeorological observations as the wind direction in the ground surface layer in the vicinity of the source may vary by $70\text{-}120^0$.

The investigation results obtained have shown that even under the conditions typical of the middle regions of Russia wind field natural variability is so high that its does not allow one to use unambiguously the data of the national meteorological network in local system of radiation monitoring. For the latter subsystems of meteorological support should be created including at least a meteorological mast near the source term.

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NUCLEATION IN THE VICINITY OF CRITICAL PARAMETERS OF THE 1,3-PROPANDIOL - CO2 BINARY SYSTEM

ANISIMOV M.P., NASIBULIN A.G., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

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Studies of a vapor nucleation have a significant interest. The reason of such interest is a fundamentally important problem of the kinetics description of the first-order phase formation. The next reason is the necessity to create the engineering computational methods for processes during homogeneous formation of a new phase takes place. The current level of research techniques for study an aerosol formation is fairly high, but there is no theory that would be suitable for the quantitative prediction of experimental results.

For the theory development it is necessary to have additional experimental facts which could be received under conditions differ from traditional nucleation studies. One of the possible direction of kinetic studies of new phase embryos formation is an experimental determination of isothermal nucleation rate in the vicinity of critical parameters of system under investigation.

The present work is devoted to investigation of 1,3-propandiol vapor nucleation in CO_2 atmosphere in a vicinity of critical temperature of the system. The particle formation by homogeneous nucleation has been experimentally studied using a laminar flow diffusion chamber technique [1].

Nucleation of this system has been investigated under the pressure range from 0.10 MPa to 0.30 MPa and in the broad interval of temperatures. The nucleation rate was measured in the range of 6 orders.

During our studies it was established the influences of critical temperature of gas-carrier (critical parameters of CO_2: T_{cr} = 304.2 K, P_{cr} = 7.39 MPa) on the vapor nucleation rate. The analysis of critical activities, a, at the constant vapor nucleation rate, J, on nucleation temperatures showed that the CO_2 mole fraction increase (CO_2 partial pressure) entails the drop of the critical temperature. The mole fraction increase of CO_2 skews of the critical temperature of the system to the critical temperature of the pure carbon dioxide. These experimental results do not have the explanation from the standpoint nor one of existing

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nucleation theories. The same behavior in the vicinities of critical point of nucleated system it was earlier found by us in other systems [2,3].

Using experimental nucleation rates versus 1,3-propandiol vapor activities, the number of molecules in embryos was evaluated [4]. It was established the influence of critical parameters on a size of critical embryos.

The influence of gas-carrier pressure on the nucleation rate was detected.

The experimental results were compared with the classical nucleation theory [5] and self-consistent theory [6]. It was found essential deflection from the theoretical models of description of nucleation process.

Thus, the formation of a new phase in the 1,3-propanol - CO_2 system under investigation should be interpreted as binary vapor nucleation.

Acknowledgment

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1,3-PROPANDIOL - SULFUR HEXAFLUORIDE VAPOR NUCLEATION IN THE VICINITY OF CRITICAL TEMPERATURE

ANISIMOV M.P., NASIBULIN A.G., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

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The history of the nucleation theory began about a hundred years ago. As a result of its rapid development, the classical theory of nucleation was created [1,2] in 1940's. However, it may hardly be considered as universal theory, because of it's coincidence with experimental results only within a narrow range of temperatures and supersaturations for definite classes of substances. The theory of phase transitions includes a number of unjustified assumptions, which do not make allow to describe of such small clusters. Although researchers tries to describe properties of embryos by using the microscopic approach the development of the new phase formation knowledge necessitated rejection of the use of the different thermodynamic corrections within the framework of the classical model. When the size dependencies of the surface tension and density of nuclei was taken into account [3,4] and the inherent degrees of freedom were considered in the statistical sum for a nascent cluster [5], agreement between theoretical predictions and experimental results became even worse.

In order to make the theory consistent, we must revise all its foundations. The role of the gas-carrier during nucleation should be analyzed, too. From the standpoint of the existing

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theory, this gas does not participate in the formation of critical embryos but only serves as a medium that maintains isothermicity of the nucleation processes. To create a more accurate theory and gain a better understanding of the processes that take part during aerosol formation, qualitatively new experimental results are required.

The present work is devoted to investigation of the critical temperature influence on nucleation phenomena. It is known, a chemical potential of a condensed phase has some peculiarities at a temperature of second-order phase transitions. The Gibbs's free energy of a critical embryo of a condensed phase and therefore vapor nucleation rate must feel temperature behavior of the chemical potential near the phase transition.

For this purpose, we selected experimental conditions in the vicinity of critical temperature, because they are suitable for exerting an inactive influence on the nucleating system at the level of intermolecular interaction and for studying the results of this influence.

As the object of our study, we selected 1,3-propandiol and as the carrier gas, we used sulfur hexafluoride (T_{cr} = 318.7 K. P_{cr}= 3.76 MPa).

The particle formation by homogeneous nucleation has been experimentally studied using a laminar flow diffusion chamber technique [6].

During our studies the following results were received:

1. Experimental dependencies of the nucleation rate on the activity of the investigated substance vapors under different pressures of the gas-carrier are measured;
2. Influence of critical parameters on the nucleation rate, size and composition of critical nucleus are found;
3. Dependency of critical system temperature and nucleation rate on the pressure of gas-carrier are detected.

The received experimental results point that the formation of new phase from vapors of the substance under investigation in the atmosphere of gas-carrier should be interpreted as binary nucleation.

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CONTRIBUTION OF SOIL BACTERIA IN AIR-PLANKTON OF URBAN ENVIRONMENT

L.V. LYSAK, N.N. SIDORENKO

Moscow State University, Department of Soil Science

Vorobyevy Gory, 119899, Moscow, Russia tel./fax +7 095 / 939 0989 E-mail: klofo@glasnet.ru

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Thanks of its heterogenesis soil provides the existence of different microorganisms, some of them is absorbed on soil particles and other are in water film, capillaries and soil solution. In this connection it should be noted as "the bank of microorganisms or a gene pool of microworld" (Zvyagintsev *et al.*, 1992). This property is a principal biospherical function of soil. Soil bacteria get to the atmosphere and transfer by air to great distances. This is a principal way of its moving all over the earth.

The aim of our work was the investigation of bacterial complex (BC) of soil and connected substrates (litter, leaf fall and phillosphere) contribution in formation of air-plankton of urban environment (Pushchino, Moscow region). The samples were analyzed by sedimentation on the surface of special nutrient medium which allows to count more than 40 genera of soil bacteria. The studies were carried out on three areas with different human impact: in the centre of town (CT), inside an urban public bus and in a suburban forest plot in 1994-96 in different seasons. The quantity and diversity of BC of soil and connected substrates were investigated simultaneously.

Obtained results were processed by modern approaches of synecology. The following regularities were revealed:

— more than 20 genera of soil bacteria were detected in air-plankton composition; the strains of genus Streptomyces, Bacillus, Arthrobacter, Rhodococcus, Cellulomonas, Micrococcus, Pseudomonas, Xanthomonas and family Enterobacteriaceae and the gliding bacteria are predominated;

— the maximum quantity and diversity of BC of air-plankton were revealed in the samples of CT and urban public bus; the minimum quantity were in the samples of forest plot;

— considerable changes of quantity of air-plankton by seasons were observed; the maximum index was registrated during spring and summer and the minimum one was in winter;

— the high degree of connection between frequency of some genera from upper lay of soil, litter and leaf fall and genera from the lowest lay of air was emerged;

— the maximum frequency of dominance in BC of air-plankton were determined for such genera of bacteria: Bacillus, Arthrobacter, Rhodococcus, the gliding bacteria (the center of the town); Rhodococcus, family Enterobacteriaceae (the urban public bus); Streptomyces, Arthrobacter, the gilding bacteria (the forest plot)

— fast-growing species of bacteria with short lag-phase were dominated in CT and urban public bus.

The increasing of quantity of genus Rhodococcus and family Enterobacteriaceae in the samples of air from CT and urban public transport are worthy of notice because of their pathogenic, toxigenic and allergenic properties.

Obtained results suggest that contribution of soil bacteria and litter in formation of air-plankton is considerable. The bacteria connected with man are important for composition of air-plankton of anthropogenic habitats.

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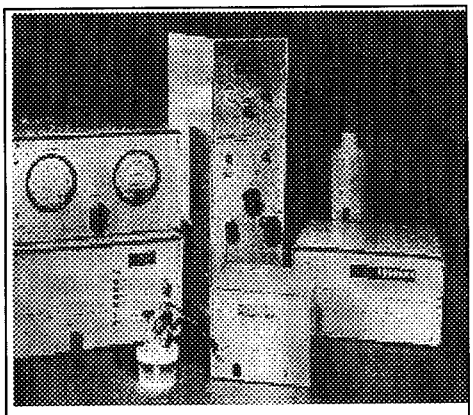
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tel+fax :+7-095-1474361 belov@blackrat.cs.msu.su pnbelov@mail.orc.ru

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Специалист-аэрозольщик (ученый, технолог, приборист, бизнесмен) решит многие свои проблемы, работая с ТОО Аэрозоль Технология Лтд !

«Международный Аэрозольный Симпозиум»

IAS-4 *Санкт Петербург 6-9 июля 1998*

Предлагаем Вам выбрать один из трех вариантов участия в Симпозиуме.

Первый - **полная регистрация** участия в работе симпозиума.

Оргвзнос составляет 300 руб. Для Вас будут приготовлены труды симпозиума на русском и на английском языках., визитные карточки, бэдж, данные обо всех участниках нашей встречи. При этом перед Вами встанет проблема гостиницы. Наиболее дешевый вариант гостиницы - комната на четверых 100 руб в день. Оргкомитет поможет Вам связаться с другими участниками -4 , которые заинтересованы в дешевом жилье.

Второй вариант - регистрация участия в течение одного дня - 60 руб. Симпозиум строится так, чтобы близкие по направлению секции прошли в один день.

6/July/98: Секции связанные и биоаэрозолем и переносом аэрозоля в атмосфере.

7/ July /98 Аэрозольные технологии (фильтрация, производство алмазоподобных материалов, ультрадисперсные порошки, горение диспергированного топлива, мембранные фильтры, чистые технологии ...)

В этот же день будут представлены работы по ФУЛЛЕРЕНАМ - синтез, экстракция, свойства, теория, применение, нанотрубки..

8/ July /98 АЭРОЗОЛЬ И КЛИМАТ, КОСМИЧЕСКИЙ МУСОР, АЭРОЗОЛЬ И ОКЕАН Радиоактивные аэрозоли, аэрозоли мегаполиса, вулканические аэрозоли, облака, эрозионные аэрозоли, ...

9/July/98 Последний день - АЭРОЗОЛИ И ЗДОРОВЬЕ - использование аэрозольных медикаментов, воздействие загрязнений воздуха на организм, Нормирование аэрозольной нагрузки для различных профессий, Проникновение частиц в легкие, Взаимодействие частиц с биологическими структурами...

АЭРОЗОЛЬНАЯ ТЕОРИЯ (1)- оптика аэрозолей, коагуляция, нуклеация, конденсация...ТЕОРИЯ АЭРОЗОЛЕЙ(2)- ДИФФУЗИОФОРЕЗ, ТЕРМОФОРЕЗ...Слушание докладов выдвинутых на соискание премий Российского аэрозольного общества (Две из этих премий поддержаны суммами $300 и $200 - спонсор - директор ERNAFT OIL Mr Mirlesse (Щвейцария)

Выбрав для посещения только один из дней, вы сэкономите время и деньги. Вам будут предоставлены материалы по выбранной Вами секции. Например, ночная поездка на поезде в Санкт-Петербугр и обратно позволит Вам не заказывать гостиницу.

И наконец - Вы можете передать четыре страницы А4 Вашего **стендового доклада** в оргкомитет: оплатить публикацию Ваших тезисов из расчета по 6 рублей за каждую страницу текста (через два интервала 12 кеглем), каждый рисунок и каждую таблицу. В этом случае оргкомитет разместит Ваш доклад во время симпозиума на стенде, опубликует Ваши тезисы в трудах симпозиума. Прошу Вас переслать эти деньги на счет ТОО"Аэрозоль Технология" ИНН 7714095748 ОКПО 26121540 ОКОНХ 95120 Расчетный счет р/с 40702810600010000820 в ОАО АБ Промрадтехбанк г. Москва к/с 30101810000000000366 БИК 044 525 366

Подписывайтесь на журнал АЭРОЗОЛИ - 200 рублей годовая подписка .

ВАЖНО! Выпуски журнала Аэрозоли за 1998 год являются экспресс публикацией тезисов, полученных по электронной почте для участия в Международном Аэрозольном Симпозиуме. Мы обращаемся к авторам с просьбой возможно скорее выслать лист замечаний по своим статьям по следующей форме: *на странице номер... строке номер* (сверху/снизу) *написано...* (указать ошибочное слово или выражение и одно - два слова до и после этой ошибки. Ошибку надо подчеркнуть) *должно быть написано* (привести правильное написание.) **Председателям секций** - просим указать названия и номера докладов, которые подходят по тематике в Вашу секцию. Просьба связаться с авторами и пригласить их сделать доклад в рамках Вашей секции.

Всех специалистов просим присылать свои отзывы по адресу 119285 Москва 2-Мосфильм 21-117 Белову Н.Н. Работы, которые Вы назовете особенно интересными , будут выдвинуты на премии Российского аэрозольного общества (ряд премий поддержан денежными суммами от 200 до 300 долларов).

В то же время Ваши замечания помогут оргкомитету снять доклады тех работ, в которых Вы найдете ошибки, по поводу которых Вы выскажете серьезные замечания...

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Это наука, приборы, вычислительные программы и технологии в России и странах СНГ.

Пришла пора передать спонсорам (Фонд Армии США, Американское и Российское физические общества ...) список секций, предварительную программу симпозиума и сборник тезисов докладов. Сейчас работа по подготовке этих материалов близится к концу. Принцип отбора докладов прост:

1. Рекомендации председателей секций и экспертов. Такие рекомендации получили работы, направленные для участия в IAS (кроме трех больших статей на русском и на англ языках Никитина Анатолия Ильича из Института энергетических проблем химической физики РАН. Его работы посвящены шаровой молнии, тел/ факс 9397501 - приглашаем заинтересованных в проблеме получить информацию о новых работах Никитина)
2. Наличие документов, разрешающих печать тезисов в трудах международной конференции.- Здесь ситуация сложная - половина полученных работ не подкреплена актами экспертизы и письмами о возможности опубликования в труха международной встречи. ВСЕ ЭТИ РАБОТЫ ОТЛОЖЕНЫ до момента получения указанных документов. Эти работы могут быть включены в одну из дополнительных книжек IAS как только эти документы будут представлены в оргкомитет
3. Наличие документов, подтверждающих оплату оргвзноса либо оплату публикации (достаточно заплатить 6 руб за страницу текста (и 6 руб за каждый рисунок и каждую таблицу, если они включены в Вашу статью), чтобы работа, удовлетворяющая первым двум критериям, была немедленно опубликована.) Если при этом Вы не забыли прислать четыре листа А4 с Вашим стендовым докладом - то можете быть уверены , что Ваша работа будет представлена на IAS-4. Таким образом в круг общения симпозиума вовлекаются те, кто не может принять участие в нашей встрече - проблема денег и /или времени. Так в нашей встрече будут опубликованы доклады из Бразилии, Мексики,... Однако авторы, которые не смогут приехать на нашу встречу, не будут включены в информационные списки симпозиума, с тем, чтобы эти списки показывали только тех, кого Вы можете встретить в Питере.

Прошу Вас проверить, получили ли Вы подтверждение о приеме тезисов, о получении актов экспертизы и документа об оплате. Если такие подтверждения Вами не были получены - не сочтите за труд переслать мне даты отправки этих документов и какую-нибудь дополнительную информацию, если она может помочь найти их побыстрее.
Будет весьма печально , если работа, по которой получены положительная рецензия и все документы, не будет опубликована по случайной ошибке оргкомитета.

Мы приглашаем председателей секций проверить - не забыли ли они оплатить свой оргвзнос. Минимальный вариант - 60 руб (регистрация одного дня). Практика показывает, что оплаченный оргвзнос является некоторой гарантией присутствия докладчика (да и председателя секции) на докладе.

Таким образом последний фильтр помогает выделить две группы возможных участников IAS-4: Теперь видны те, кто имеет возможность принять участие в нашей встрече и те, кто заинтересован только в публикации своих работ,

Мы сделаем все, чтобы поддержать последних (если они не забыли оплатить публикацию своих работ). Участники же симпозиума получат самую широкую информационную поддержку. Практически каждая работа будет опубликована трижды - в журнале для экспресс обсуждения и коррекции ошибок, в тематическом сборнике под редакцией председателя секции и в книжке тезисов докладов IAS-4. Первые два издания будут служить общественной экспертизой окончательного издания.

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1346.
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ULTRA-FINE POWDERS OF METALS, PRODUCED BY EVAPORATION-IN-FLOW TECHNIQUE.

JIGATCH A.N., LEYPUNSKY I.O., KUSKOV M.L, VERZHBITSKAYA T.M.

Institute of Energy Problems of Chemical Physics RAS.

117829 Russia Moscow B-334, Leninsky pr-t, 38, bd.2 E-mail ajigatch@chph.ras.ru

(First received 18 March 1998; accepted for presentation during IAS-4)

A generator to produce the plum of ultra fine powders of metals and/or metal oxide with concentration as great as 10^{10}:10^{13} 1/cm^3 is proposed. Ultra fine powders of metals and metal oxides were produced, using evaporation-in-flow technique from the free-levitating drop, suspended between the coils of HF-inductor (this technique is a further improvement of Gen-Miller technology [1]). The powders of Ag, Cu, Ni, Al, either Al_2O_3 and NiO with juvenile particle surfaces and particle sizes within the range 5:200 nm were generated in inert gases (He, Ar) or in a mixture of inert gas with oxygen.

Particle samples were trapped directly from the gas flow by electron microscope grids (for TEM evaluations), by silicon plate (for electronography investigations) or by perforated stainless foil boats -- for adsorption and TPD/MS (temperature programmed desorption with mass-spectrometric analysis of desorbed products) experiments.

Electron microscopy investigation of particles size and shape were carried out using Philips EM 430 ST microscope to evaluate the dependence of particles array structure parameters on particle size. The analysis of structure characteristics for particles of different sizes were carried out by means of electronographic techniques too.

Probe gas technique with further TPD-MS analysis were used to investigate the dependence of active surface sites concentration and energy characteristics on particle sizes.

The dependencies of average particle sizes on gas flow parameters (the flow speed, inert gas pressure and gas type) and the drop temperature and size were evaluated. It was found, that the average particle size decreases with the decrease of the drop temperature (the drop temperature increases sharply with the increase of its size under the device conditions being constant), the flow speed increase and the gas pressure decrease. Helium as the carrying gas generates less particles, than argon. The nucleation kinetics in particle formation was investigated. Naturally, characteristics of all these dependencies are determined by a character of the evaporated metal.

The particles of the following minimal size parameters were generated and investigated:

Pair: "carrying gas - metal"	Average particle size <R>
Al – He	2.8
Al – Ar	7.0
Ag – He	4.7
Ag – Ar	10
Ni – Ar	3.7
Cu – Ar	14

Particle size distribution was found to obey logarithmically normal law with ?R/<R>=1. The shape of particles was near the spherical one, but the less particles was edged and had the shape with the fifth order of symmetry. Twins and more complex particles assembles were observed too.

The experiments on adsorption such probe gases as carbon dioxide and water vapour were carried out. It was found, that energy characteristics of adsorption active sites on the surface of ultra fine (<r><10 nm) and relatively "rough" (<r>~100 nm) differs from each other

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significantly. E.G., maximum of TPD curve splits to "two-headed" shape and moves towards higher temperatures for "ultra fine" particles both for water and for carbon dioxide on the surface of silver.

These probe gas adsorption showed less reactionability of cold metal particles surface, than it might be expected.

This work was supported by grants: DNA001-96-C-0051, DSWA001-C-98-0002 (Defence Special Weapons Agency, USA) and RFBR 96-15-97318 (Russian Foundation for Base Research).

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1349.
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NANOSTRUCTURE CERAMIC OXIDE SYNTHESIS FROM THE AEROSOL

MILOSEVIC O.*, MANCIC L.*, NIKOLIC N.*, RISTIC M.M.**

**Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Yugoslavia*

***Center for Multidisciplinary Study, University of Belgrade, Yugoslavia*

(First received 20 March 1998; accepted for presentation during IAS-4)

The aerosol spray pyrolysis method was applied for submicrometar to nanosized ceramic oxide powder synthesis using a wide range of compositions. Particles formed by homogeneous or heterogeneous nucleation from aerosol generated by twin fluid and ultrasonic atomizers, the later operating at 1.7 and 2.5 MHz. Recent research has focused on controlled powder synthesis, with the purpose of ensuring control over particle purity, shape and size distribution. X-ray diffraction, infrared spectroscopy, differential scanning calorimetry, particle size analysis, scanning and transmission electron microscopy were used for particle characterization. Tailoring of the powder size, morphology, chemical and phase composition was possible by controlling the solution and process parameters. Control of the mechanisms of droplet generation, coagulation and evaporation/drying stages enabled the production of different particle morphologies. In the case of twin fluid derived powders the appearance of hollow spheres with a complex surface structure composed from primary crystallites is dominant. Nanosized and submicronic dense spherical particles are obtained ultrasonically. Control over the particle size and shape uniformity as well as structural homogeneity in multicomponent systems is established by maintaining the aerosol density below 10^8 droplets/cm^3. The phenomenon of funicular agglomeration in submicronic multicomponent powders was explained by the mechanisms of particle formation and interparticle sintering in the presence of a liquid phase. Assuming that a certain particle morphology forms during the first stage of spray pyrolysis, the empirically obtained particle size and morphologies were discussed in the context of the modeling of evaporation stage. The developed model gives a good description of phenomenon of mass and heat transfer and is in agreement with the obtained experimental results and numerical prediction.

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1350.
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CONSOLIDATION OF ULTRADISPERSED POWDERS SYNTHESIZED FROM AEROSOLS

NIKOLIC N., MILOSEVIC O., MANCIC L.

Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Yugoslavia

SRECKOVIC T., MARINKOVIC B., RISTIC M.M.

Centre for Multidisciplinary Studies, University of Belgrade, Yugoslavia

(First received 20 March 1998; accepted for presentation during IAS-4)

The development of novel materials eventually leads to an expansion of new methods for the synthesis of powders with the desired properties. A rising increase of research for the applications of materials with the characteristics of the ultradispersed structures is evident. Polycrystalline ultradispersed oxide powders were synthesised from aerosols by the spray pyrolysis and freeze-drying method. X-ray diffraction, differential scanning calorimetry, infrared spectroscopy and scanning electron microscopy were used for particle characterisation. The obtained submicronic and nanostructured powders were reactive, homogeneous, high-purity and with a narrow particle size distribution. Consolidations of powders up to high densities were performed through the compacting of dispersed powders and sintering of the obtained compacts in order to achieve materials with the improved properties. Nonisothermal sintering process was analysed using dilatometric data. The sintered pellets were characterised with XRPD, SEM and BET method. The obtained results were discussed in terms of particle morphology.

1353.
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CALCULATION OF ANISOTROPIC SCATTERING OF SOLAR RADIATION IN ATMOSPHERE (MONOENERGETIC CASE).

ÀRISTOVA E.N., GOLDIN V.YA.

Institute for Mathematical Modelling of RAS

(First received 01 January 1998; accepted for presentation during IAS-4)

The strong anisotropic scattering, including scattering with forward-peaked indicatrix (small angle scattering), is very important at the solar radiation transport in atmosphere containing aerosols. In the paper, a method of radiation transport calculation at strong scattering anisotropy is developed. And scattering indicatrix is used without approximation, directly, for example according the data from [1].

Radiation intensity in the method is represented as a sum of three components: 1) non-scattered solar radiation, including specularly reflected from the Earth surface one (analytical solution), 2) small angles scattered direct solar radiation and its specularly reflected part (with multiple scattering); (high-accuracy representation of this component with real indicatrix is obtained), 3) all the rest radiation, the method of calculation of which is based on our papers [2,3].

The method makes it possible to consider also real anisotropy of reflection from the Earth surface [2]; because of lack of data ,we restricted ourselves by linear combination of specular and diffusive reflection.

The results of calculation of several problems in monoenergetic case for plane approximation of atmosphere are presented.

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Problems for different angles of incidence of solar radiation in cloudless atmosphere as well as at presence of cloudiness are considered. An appearance of "inner boundary conditions" for radiation intensity at inner and outer cloud boundaries as natural consequences of complete solving the problem in non-homogeneous medium is interesting.

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1356.
УДК 541.18

REMOTE SENSING OF FOREST FIRES AND THE DIRECT RADIATIVE FORCING OF FIRE SMOKE

LI Z.

Canada Centre for Remote Sensing, Ottawa, Canada

(First received 10 March 1998; accepted for presentation during IAS-4)

Smoke aerosols produced by fires modify the earth's radiation budget. The direct impact is referred to as direct radiative forcing (DRF). Until now, studies dealing with the DRF of fire smokes have focused on the top of the atmosphere in tropical regions. This study investigates atmospheric DRF due to smoke from boreal forest fires. The presentation include two parts. Part I deals with the detection of forest fires by satellite. Part II is concerned with the determination of DRF by fire smoke.

A fire detection algorithm was designed to monitor active fires using individual AVHRR images across the Canadian boreal forest zone. It takes advantage of information from multi-channel AVHRR measurements to determine the locations of active fires on satellite pixels of about 1 km^2 under clear sky or thin cloud conditions. Daily fire maps were obtained showing all fires across Canada except for those obscured by thick clouds. This was achieved by first composting all the AVHRR scenes acquired over Canada and then apply the fire detection algorithm. 480 Canada-wide NOAA/AVHRR daily mosaics from 1994 to 1996 during the fire seasons were processed. Composting the daily fire spots permits a nation-wide view of the total burned area in a month, season or any specified period, in addition to providing information on the timing and development of fires. The total area of burning across Canada is estimated to be approximately 4.9, 7.1 and 1.6 million hectares in 1994, 1995 and 1996 respectively. The peak of burning also varies considerably from one year to another ranging from June to August, and so does the spatial distribution of fires. In general, conifer forests appear to be more vulnerable to burning and tend to grow bigger than deciduous forests.

By virtue of a satellite retrieving algorithm for estimating surface absorbed photosynthetically active radiation (APAR) over the visible wavelengths (400-700 nm), the DRF caused by smoke can be distinguished from the radiative effects of other agents. The algorithm was first validated under a range of sky conditions: clear, smoky and cloudy days. It was found that the estimated fluxes are in good agreement with surface observations for both

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clear and cloudy days. For smoky days, the estimates are generally greater than the observations. With aerosol corrections, the two fall again into a good agreement. This finding suggests that smoke DRF can be determined simply as the difference between observed and estimated APAR without correction for aerosol. Following this method, instantaneous, daily and monthly mean DRF values due to smoke were calculated. At the peak of the burning season, in July 1994, monthly mean atmospheric DRF was as high as 26.0 Wm^{-2}. This is quite a significant amount in comparison to the total forcing of -76.7 Wm^{-2} at the surface by both clouds and smoke, and to the monthly mean APAR flux of 132.6 Wm^{-2}.

1357.
УДК 541.18

URBAN-MARINE AND MINERAL-DUST AEROSOL PROPERTIES, RADIATIVE EFFECTS AND CLOSURE STUDIES OVER THE ATLANTIC OCEAN: AN OVERVIEW AND SELECTED RESULTS FROM TARFOX AND ACE-2

RUSSELL P. B.[1],LIVINGSTON J. M.[2],SCHMID B.[3],HIGNETT P.[4],DURKEE P. A.[5],HOBBS P. V.[6], GASSO S.[6], HEGG D.[6],STOWE L. L.[7],BATES T. S.[8], QUINN P. K.[8],HAMILL P.[9],

[1] NASA Ames Research Center, Moffett Field, CA 94035-1000 USA

[2] SRI International, Menlo Park, CA 94025 USA

[3] Bay Area Environmental Research Institute, San Francisco, CA 94122 USA

[4] United Kingdom Meteorological Office, Meteorological Research Flight, DRA Farnborough, Hampshire, GU146TD, UK

[5] Naval Postgraduate School, Monterey, CA 93943-5114 USA

[6] University of Washington, Seattle, WA 98195 USA

[7] NOAA/NESDIS, Office of Research and Applications, NSC, Washington, DC

[8] NOAA-Pacific Marine Environmental Laboratory, Seattle, WA 98115 USA

[9] Physics Department, San Jose State University, San Jose, CA 95192 USA

(First received 23 March 1998; accepted for presentation during IAS-4)

Aerosol effects on atmospheric radiation are a major source of uncertainty in understanding the past climate and predicting climate change. To help reduce this uncertainty, the 1996 Tropospheric Aerosol Radiative Forcing Observational Experiment (TARFOX) and the 1997 second Aerosol Characterization Experiment (ACE-2) measured the properties and radiative effects of anthropogenic aerosols over the Atlantic Ocean. TARFOX focused on the urban-industrial haze plume flowing from the eastern United States over the western Atlantic, whereas ACE-2 studied aerosols carried over the eastern Atlantic from both European urban/industrial and African mineral sources. These aerosols often have a marked influence on the top-of-atmosphere radiances measured by satellites. However, the accurate derivation of both optical depths and radiative flux changes, or radiative forcing, from the satellite-measured radiances remains a difficult challenge for the wide range of aerosol types and properties present.

In TARFOX, sensors and samplers on four aircraft, land sites, and ships measured optical depth spectra, aerosol composition, microphysics and optical properties, and radiative fluxes during many overpasses by different satellites. Closure studies show that the aircraft-measured flux changes agree with those derived from the aerosol measurements using several modeling approaches. Essential to obtaining this agreement is modeling the aerosols as moderately absorbing--i.e., having midvisible single-scattering albedo between about 0.90 and 0.95. These values are in accord with the aircraft measurements of (1) aerosol absorption and scattering

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coefficients, (2) unexpectedly large carbonaceous fractions of aerosol composition, and (3) unexpectedly large aerosol humidification factors.

In ACE-2, European urban-marine and African mineral-dust aerosols were measured by sunphotometers on the Pelican aircraft and the Research Vessel Vodyanitskiy, and by sensors on NOAA satellites. We present a comparison of the optical depths derived from the NOAA-14 satellite data with those measured by our fourteen- and six-channel sunphotometers. We find that the excellent agreement for urban-marine aerosols is degraded when African dust is present. Using the sunphotometer data during ascent and descent of the aircraft, we also obtain extinction profiles for separated layers dominated by African dust and urban-marine aerosols, respectively. The extinction profiles allow us to obtain size distributions for both these aerosol types, showing the distinctive differences between them. These optical depth and size spectra are combined with model complex refractive index spectra to calculate radiative flux changes induced by the different aerosol layers. By combining solar beam transmission measurements in the 0.94-micron band with those at neighboring wavelengths, we also determine water vapor columns and profiles, which are shown to agree well with aircraft in situ measurements.

1362.
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MODE ANALYSIS OF OSCILLATORY NUCLEATION IN VAPORS

FISENKO S.P.

A.V. Luikov Heat & Mass Transfer Institute , National Academy of Sciences 15 P. Brovka St.,220072, Minsk, Belarus E-mail: fsp@hmti.ac.by

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The simulations of heat and mass transfer processes related with kinetics of the phase transitions received new impact from applied research related with novel material production based on a nanoparticles [1]. The homogeneous nucleation is the first stage of nanoparticles creation at vapors mixture.

High rates of a nucleation and nanoparticles growth lead to a depletion effect of vapor density at nucleation zone. In some cases this effect brings to stop of the nucleation process which is extremely sensitive to the supersaturation value. The diffusion mechanism restores the vapor density at nucleation zone in some time if new phase particles have been removed from nucleation zone. Finally, nucleation and particles growth is repeated. Such process is called oscillatory nucleation. It's clear that oscillatory nucleation impacts greatly on the productivity of a devices for nanoparticle production.

The physical and mathematical model of oscillatory nucleation is developed to simulate some parameters of an this process . The mathematical model includes integro-differential equation of the mass transfer processes with source related with growth and motion of a nanoparticles. It have been shown that heat processes have small influence on oscillatory nucleation if pressure carrier gas is much larger the partial vapor pressure. The evolution of the moving source are described by the systems of ODE.

$$\partial_t n(x,t) = \partial_x (D(x)\partial_x n(x,t) - I(R(z(t)), < n(z(t)) >, t) \qquad (1)$$

where n(x,t) is the vapor density, <n(x,t)> is the average vapor density in a spatial domain occupied by nanoparticles, D(x) is a vapor diffusion coefficient, I is general form of moving source, z is the position of the center of mass of a nanoparticles clouds, R(z(t)) is the average radius of nanoparticles. The value of I is directly proportional the number density of nanoparticles.

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$$\frac{dz}{dt} = v(R, < n(z(t)) >) \qquad (2)$$

where v is the velocity of nanoparticles. The drag force, gravitational force and thermophoretic force influent on the velocity value.

$$\frac{dR(t)}{dt} = L(R)[< n(z(t)) > - n_e(z(t)) >] \qquad (3)$$

where $n_e(z(t)$ is the saturated vapor density, L is the known function of Knudsen number.

The theory is illustrated by an example of oscillatory nucleation in diffusion cloud chamber. The spectral variant of Galerkin's method is used for investigation this mathematical model. Results of numerical simulation of oscillatory nucleation are presented. The mass transfer processes are calculated in one-dimensional approximation. In particularly, for oscillatory nucleation at microgravity environment are considered. The comparison of experimental results (Fourier spectra of nanoparticles production rate) and theoretical calculation of the frequencies of oscillatory nucleation are discussed.

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1363
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CHARACTERISTICS OF AEROSOL AT THE NORTHERN OKLAHOMA

KATO S.[1], CHARLOCK TH.P.[2], CLOTHIAUX E.E.[3], LONG C.L.[4], CHARLES N.[5] MACE C.N.[5], ACKERMAN T.P.[3]

[1]. Hampton University, Hampton, Virginia, U.S.A.

[2]. NASA Langley Research Center, Hampton Virginia, U.S.A.

[3]. The Pennsylvania State University, University Park, Pennsylvania, U.S.A.

[4]. NOAA/ARL/SRRB, Boulder, Colorado, U.S.A.

[5]. University of Utah, Salt Lake City, Utah, U.S.A.

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Recent studies indicate that theoretical computations of the diffuse component of downward shortwave irradiance significantly exceed measurements at the surface under clear-sky conditions. This discrepancy leads to the uncertainty in estimating the total surface irradiance under clear sky condition. Because aerosol optical properties are temporally and spatially variable, uncertainties in the optical properties of aerosols contribute to uncertainties in irradiance computations.

To investigate the possible role of aerosols in this discrepancy at the Atmospheric Radiation Measurement site in northern Oklahoma, U.S., we relate ground-based measurements of direct and diffuse broadband irradiance, as well as aerosol spectral optical thickness, to meteorological parameters such as relative humidity, wind speed, and wind direction. When available, we analyze lidar backscattering returns for information about the aerosol profile.

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1373.
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CONCEPT OF POLARIZED LIGHT SCATTERING MATRIX CORRECTNESS

GERMOGENOVA T.A., KONOVALOV N.V., PAVELYEVA E.B.

Keldysh Institute of Applied Mathematics, Russian Academy of Sciences,
Miusskaya Sq. 4, Moscow, Russia, 125047

(First received 26 February 1998; accepted for presentation during IAS-4)

The polarization effects play an essential role in the radiative transfer in oceans, in atmospheres of the Earth and of planets, in astrophysical objects. The contemporary experimental facilities are able to fix the polarization value beginning with the thousandth fraction of percent. The polarization effects registration results in the sharp increase contents and size of an accessible information. It permits to interprete and understand more deeply the physical processes in real objects, to obtain qualitative and quantitative characteristics of the scattering substance nature.

In our report some aspects of transfer theory and numerical methods relating to the polarized light transfer in scattering and absorbing media are considered. The conception of the non-negativity of polarized scattering matrices is the base of developed theory.

The key moment of this theory is the Stokes cone introducing. This cone is the set of Stokes vectors satisfying some inequalities in four-dimensional real vector space. Those inequalities imply from a physical analysis of Stokes parameters, characterizing the polarized light. The matrix, transforming linearly the Stokes vectors is named nonnegative, if any Stokes vector is transformed also into Stokes vector.

Almost complete absence of the information on scattering matrices for real physical objects is the obstacle to the successful solution of the polarized transfer problems. The scattering matrices, which are measured experimentally or obtained numerically, are always determined with errors and are not nonnegative. Thus, the main problem of the polarized transfer theory is a problem to develop a physical correctness (non-negativity) criterion for scattering matrices, to check and correct the known scattering matrices.

We formulate in report the necessary and sufficient conditions of the non-negativity of polarized scattering matrices in the form convenient for practical use.

The correction algorithm for polarized scattering matrices which are not non-negative is proposed and discussed. It is based on the combination of the well-known methods for extremal problems: methods of the steepest gradient descent, Gelfand-Cetlin method of "ravines" and local step search. Our correction algorithm has been developed and realized in FORTRAN codes. The experimental matrices of radiative scattering by the natural ocean waters have been studied. We found them to be incorrect at the scattering angles near 0 or 180 degrees, where the measurement accuracy is low. These matrices have been corrected.

Numerical transport methods and Monte-Carlo methods require a very large calculation time in problems for optically thick media. It is naturally to use in those problems the asymptotic approaches developed in traditional (scalar) transfer theory. Our investigations in this direction are based on the analysis of characteristic equation taking into account the polarization effects. In general suppositions we have investigated the structure of the characteristic equation spectrum and establish base properties of the main eigenvalue and corresponding eigenfunction, determining radiative regime far from irradiated boundaries.

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1379.
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TIME DYNAMYCS OF THE DISPERSE COMPONENT OF THE BIPHASE LASER ACTIVE MEDIUM

LETFULLIN R.R., MELIKHOV K.G., IGOSHIN V.I.

Lebedev Physics Institute of Russian Academy of Sciences (Samara Branch), Novo-Sadovaya St. 221, Samara 443011, Russia, Tel:+7(846 2)347481, Fax:+7(846 2)355600, E-mail: fian@ssu.samara.ru

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Heterogenius chemical active systems, consisting from disperse particles of metal or their compounds suspend in gas mixtures, present a significant interest for getting the high concentrations of free atoms (active chemical reaction centres) in the quantum electronics for making the active medium of lasers. So, for instance, disperse phase forms a base of the active medium variety of lasers on metal vapours [1], as well as in under development the pulsed chemical oxygen-iodine [2] and fluorine-hydrogen [3,4] lasers.

Main defect of lasers on the biphase active medium is a quick degradation of the disperse component and, consequently, small lifetime of the active medium with given characteristics. Ever changing with time of the disperse phase properties lead to worsening the output features of laser, or to breakdown of laser generations in general. Regrettably, in the laser studies on disperse medium was not conducted analysis of degradation processes of the biphase active medium, and not determined possible limits of changing the aerosol parameters, for which laser generation on such scheme impossible. In particular, small lifetime existence of given working mixture of a HF-laser with disperse phase insufficient for preparing of master generator and initiating a laser in the experiment, can be one of the possible reasons that hitherto experimentally not received its generation.

This work is devoted to detailed studying the processes of disperse component degradations of the active medium of pulsed chemical oxygen-iodine and HF-lasers, considered with provision for coagulation [5] particles, their gravitation precipitation and electrostatic scattering.

The range at most-possible parameters of the disperse component, under which possible generation of pulsed chemical oxygen-iodine and HF-lasers, is determined from laser-chemical kinetics and the aerosol optics analysis, calculated by diffraction Mie theory [6]. For a HF-laser a radius of aluminium particles must falls within $r_0 = 0.09 \div 0.4$ μm, but their concentration, accordingly, $N_0 = 10^9 \div 10^7$ cm^{-3}. In the case of a pulsed chemical oxygen-iodine laser on biphase active medium must satisfy parameters: radius of iodine particles $r_0 \le 0.04$ μm at concentrations $N_0 \ge 10^6$ cm^{-3}, or radius of iodine particles $r_0 = 1 \div 5$ μm under their concentrations, accordingly, $N_0 = 4 \cdot 10^4 \div 8 \cdot 10^3$ cm^{-3}.

It's shown that main contribution to disperse component degradation of the active medium of lasers contributes a process of Brownian coagulation, changing by precipitation for big particles.

Take as a criterion of active medium optical transparency for laser radiation a condition $I_{sca}/I_0 << 1$, where I_{sca} and I_0 - intensities of scattering and incident radiation, most possible value of time of existence of the biphase active medium of said lasers was evaluated. So, for instance, for a HF-laser the maximum scattering of radiation on $\lambda = 3.3$ μm correspond to the size of the aluminium particles $r = 0.6$ μm, consequently, chosen by us criterion will be executed, if in result distribution on sizes N(r) practically particles of specified radius are absent. Coming from this, and considering all processes, which is leading to the diligence of

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aluminium aerosol in the active medium of a HF-laser, it was determined that condition $N(r = 0.6\ \mu m)/N_0 << 1$ is good executed only for a time $t \leq 250$ seconds ($r_0 = 0.05\ \mu m$, $N_0 = 2 \cdot 10^9\ cm^{-3}$). For pulsed chemical oxygen-iodine laser a time of existence large iodine aerosol within said restrictions is equal $t \approx 180 \div 260$ seconds and defined by high precipitation the particles.

Obtained results in the article allow to give concrete recommendations on a time of preparations and of the biphase active medium of pulsed chemical oxygen-iodine and HF-lasers with given parameters.

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1391.
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MODELING THE ATMOSPHERIC CYCLE AND THE RADIATIVE EFFECT OF SAHARAN DUST

BALKANSKI Y.[1], GUELLE W.[1], SCHULZ M.[2], CLAQUIN T.[2,1], MARTICORENA B.[3], BERGAMETTI G.[3], CHAZETTE P.[1], PELON J.[4]

[1] *Laboratoire des Sciences du Climat et de l'Environnement, Unite mixte CEA-CNRS, CE Saclay Bat 709, F-91191 Gif-sur-Yvette, France.*

[2] *Institut fÐr Anorganische und Angewandte Chemie, Universitat Hamburg, Germany*

[3] *Laboratoire Interuniversitaire des SystXmes Atmospheriques, Universite Paris XII, Creteil, France.*

[4] *Service d'Aeronomie du CNRS, 4 Pl. Jussieu, F-75252 Paris, France balkansk@lsce.saclay.cea.fr*

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Recent advances in the physical description of the source of mineral aerosol together with global aerosol transport model that describe the size distribution of aerosols have allowed for a considerable improvement in the description of the atmospheric cycle of dust. Here, we present several years of simulation of Saharan dust transport using analyzed winds from the European Center from Medium Range Forecasts (ECMWF). We compare the results of the model with several types of observations:

* Meteosat geostationnary satellite
* Ground measurements of aerosol concentration
* Lidar profile obtained during the Sofia-Astex-Mage experiment near the Azores

The agreement found between the seasonal variations of mineral concentrations at 3 sites: Barbados Island (13°10'N, 59°30'W), Sal Island (16°40'N, 22°55'W) and IzaЯa (28°20'N, 16°29'W), suggests that the transport and principal removal processes are well represented in the model. Furthermore, on a shorter time scale, most of the episodic events of dust transport from the Sahara are captured by the model. We also examine the Lidar profiles that give us precise information about the vertical distribution of this aerosol which main features are captured in the simulation. Concurrently to the Lidar measurements, radiative measurements estimated the flux at the top of the atmosphere. These encouraging results have lead us to estimate the direct radiative impact of the mineral aerosol over Northern Africa and the

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Northern Atlantic. The top of the atmosphere net radiative effect over the region averages less than 1 Wm-2 over the region of study but the distribution of the forcing shows a very large contrast between warming exceeding 20 Wm-2 over Africa and cooling exceeding 10 Wm-2 over the Eastern Equatorial Atlantic Ocean.

1399.
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GAS-DISPERSED SYNTHESIS OF THE METAL OXIDES NANOPOWDERS

POLETAYEV N.I., ZOLOTKO A. N., VOVCHUK J.I., FLORKO A.V., ALTMAN I. S.

Institute Combustion, Odessa State University, Odessa, Ukraine

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At this work the possibilities of obtaining the metal oxides nanopowders are considered by the combustion methods. The gas-dispersed synthesis (GDS) method is based on combustion of dust clouds of metal particles in a laminar plume (it can be premixed plume - like Bunzen's burner or nonpremixed two-phase plume - like Burke-Shuman's diffusion burner). The obtained powders are well desagregated, have the spherical morphology, narrow gradation, average size of particles - 0.04 -0.1 microns. To obtain pure oxide powders of Al, Zr, Ti, Fe, Mg etc. by GDS method it is necessary to use not less pure microdisperse metal powders which are frequently obtained from the appropriate oxides. However, unique properties of obtained nanopowders, and also the technological virtues of the method GDS (very low expenditure of energy, has one stage, ecological cleanness) do a line-up an oxide - metal-oxide quite acceptable for a commercial production. The method GDS allows also to obtain multicomponent oxides by burning mechanical mixtures of powders of metals and their alloys.

The influence of basic macroparameters of a plume (fuel and oxidizer concentration, metal particles dispersion) and also thermal structure of the combustion zone on disperse and phase characteristics of the combustion products have been investigated by experiment for aluminum. For the definition of temperatures of condensed and gas phases in combustion zone the spectral methods were employed and for the analysis of the combustion products the disperse and x-ray- methods were used. It is shown, that nanopowder of alumina (average size of particles 0.04-0.07 microns, y-crystal phase), which properties depend little on variation of parameters of synthesis, accounted for no less than 99.5 mass persents of the products. The rest (- 0.5 %) compose the oxide particles, which sizes are about fuel sizes.

For powders of the high-boiling metals, such as Fe, Zr, Ti it is proved the possibility of their gas-phase combustion (under the temperatures of gas and condensed phase in combustion zone, which is lower than temperature of the metal boiling) with formation of oxide nanopowders of these metals (average size of particles - 0.02-0.05 microns). Zr, Fe, Ti particles burn heterogenetically in two-phase plumes with a low content of oxygen in carrying gas flow with generation oxide particles, which sizes are of the order of particles sizes of the initial fuel. Increase of oxygen concentration in particles dust clouds of these metals (more than 40-50 %) result in sharp increase of yield nanopowder fraction of the combustion products, i.e. intensification of gas-phase reactions.

On the bases of the obtaining results it is initiated an attempt to mechanism of formation and growth of particles of a condensed phase in combustion, with the supposition about the heterogeneous mechanism of condensation. Calculated value of an average size of oxide particles and its dependence on dust clouds parameters are obtained. The comparison of experimental and theoretical outcomes is produced which has confirmed a validity of the accepted supposition.

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DETAIL APPROACH TO DESCRIPTION OF NANOOXIDES CONDENSATION GROWTH DURING METALS COMBUSTION

ALTMAN I.S.

Institute of Combustion, Odessa State University, Odessa, Ukraine

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As it is known the nanooxides are the main part of the products of the metals gas phase combustion. Description of the processes of the condensation growth of oxides has great applied (for the gas-dispersed synthesis) and general theoretic importance. Existing now condensation models describe nucleation and don't pay enough attention to kinetics of the nucleus condensation growth. As a rule it's considered that condensation is proceeded in quasi-equilibrium regime. But the recent author's experimental investigations (with Yu.L.Shoshin) show the essential non-equilibrium of nanooxides optical characteristics during their condensation growth. This causes interest to consideration of detail mechanism of processes accompanying condensation growth.

In this work the growing oxide particle is considered as the aggregate of two non isothermal subsystems - system of electrons and system of phonons. It is shown that the processes of the gas molecules adsorption and desorption are nonreversible during condensation growth of particle. The energy of these processes is transferred through two different channels. The system of kinetic equations describing the heat transfer between electrons and phonons subsystems and the evolution of the adsorption and desorption energy is formulated. The analysis of probable solutions of this system shows that in the oxide particles having some size the electrons system becomes cool. This leads to decrease of adsorption rate and therefore to the stopping of the oxides condensation growth. The obtained result apparently explains the absence of large oxide particles at the products of metals combustion (when there is the gas-phase combustion).

This work was sponsored by the Ukraine Ministry of Education and partially by INTAS (grant 96-2334).

1401.
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ULTRAFINE TIO2 PARTICLES SYNTHESIS BY COMBUSTION OF TITANIUM DUST IN O2+N2 (PREMIXED AND SEPARATED REAGENTS JETS)

SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

(First received 01 April 1998; accepted for presentation during IAS-4)

The experiments with laminar premixed flame of titanium dust / (oxygen+nitrogen) mixtures stabilized on 2.5cm diameter Bunzen-type burner was carried out. These experiments have demonstrated for the first time that at high oxygen concentrations the titanium particles' burning can be partly in gas phase regime with formation of considerable quantity of utrafine oxide. When oxygen volume concentration in dust/gas mixture was 40% the part of ultrafine titanium oxide was about 30% from the whole oxide quantity. The increase of oxygen volume concentration above 40% lad to flame slipping into dust feeding system.

To settle the problem of safe titanium dust burning with pmpose of ultrafine titanium dust

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production the combustion of thin titanium dust jet with separate reagent and oxidizer flows was experimentally studied. Vertical titanium dust / nitrogen laminar jet was formed using electrodynamical dust dispersing system. Dust jet diameter was 1-2mm. The outlet hole of dust supplying system was surrounded by concentric tube with diameter 15mm trough which oxygen was supplied. Oxygen volume spending was much more than nitrogen volume spending. In case of low dust flow velocities the flame stabilized in outlet hole. When dust flow velocity was gradually increased suddenly flame out took place and flame stabilized in distance 10-50mm from outlet hole, depending on dust flame velocity. By wariating of dust flow velocity it was possible to establish stable distanced flame at dust mass concentrations 0.3-10kg/m . The ratio of distance between flame and outlet hole to dust jet diameter reached 0 times at dust jet diameter 1mm. It is believed that the main reason of distanced flame stabilization is diffusional dissipation of nitrogen from a dust jet, which lead to increase of flame propagation velocity along the dust jet when retiring from outlet hole. Estimated oxygen volume concentrations in the axis of dust jet near the flame front was 20-90% depending on experimental parameters. Therefore, inspite of separate reagents feeding, the flame in fact was premixed or, at high dust concentrations, of intermediate premixed-diffusion type. The part of ultrafine titanium oxide was more than 80% from the whole oxide quantity.

The proposed method of ultrafine titanium oxide synthesis is safe and eliminates the problems of conductive heating of a burner and thermophoretic storage of ultrafine oxide on parts of the burner. Probably this method can be used also for ultrafine zirconium oxide synthesis as the parameters of zirconium and titanium burning are close.

1402.
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SYNTHESIS OF ULTRAFINE ZnO PARTICLES IN DIFFUSION (ZnO DUST+ PROPANE)/O_2 FLAME

SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

(First received 01 April 1998; accepted for presentation during IAS-4)

In the present work the method of ultrafine zinc oxide synthesis by burning zinc dust/propane mixture is proposed. The concentric burner with separated fuel and oxidizer flows was used to obtain a laminar flame. The zinc dust / propane mixture was created by electrodynamical dust dispersing system which provided laminar flow with dust concentrations 0.1-10 kg/m3 . The pure oxygen as an oxidizer was used. The structre of obtained diffusion flame was studied experimentally. Two brightly luminous zones formed during combustion: yellow inner zone and distanced on 0.5-1.5 cm outer zone which color changed from blue to green and yellow by gradual increasing of dust concentration. Experiments with focused He-Ne laser beam scattering have shoved the presence of condensed phase only behind the inner luminous zone (initial zinc particles) and in- and beyond outer zone (zinc oxide particles). When a small water droplet was inserted between luminous zones a bright radiance appeared near and under the droplet which looked like "flame" of the same color as outer zone. The radiance evidently was caused by zinc oxide vapor condensation due to cooling by water evaporation. Analogous radiance appeared when thin jet of cool nitrogen was blown between zones. The results recounted above lead to the next conclusions about the flame structure. Zinc particles completely evaporated and zinc vapor oxidized in common diffusion front with propane (inner luminous zone). The outer luminous zone is the zone of zinc oxide vapor condensation.

The increase of dust concentration in zinc/propane jet led to the increase of zinc oxide particles mean diameter. The changirig of color of zinc oxide condensation zone can be

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explained by disproportional growth of radiance' self-absorption by oxide particles for different wavelengths. Because of specific spectral dependence of zinc oxide emissivity this effect must lead to nonuniform increase of radiation towards the short wavelength end of the spectrum.

The zinc oxide powders obtained at low dust concentrations haven't shown luminescence when UV irradiation, but powders obtained at high dust concentrations have shown yellow luminescence. It is believed that high heat release in condensation zone in second case provides long residence time of zinc oxide particles at high temperatures. The excess oxygen introduced into zinc oxide particles in high-temperature post-condensation zone is responsible for the luminescence.

The proposed method of ultrafine zinc oxide synthesis doesn't require external energy sources. The laminar regime of burning provides approximately uniform conditions of oxide particles growth. The method provides a simple way to regulate the mean diameter of oxide particles by regulation of zinc dust concentration.

1403.
УДК 541.18

REGIONAL AEROSOL MODELLING WITH A EULERIAN MODEL

INGMAR J ACKERMANN, HEINZ HASS

FORD RESEARCH CENTRE AACHEN

DENNEWARTSTR.25 D-52068 AACHEN GERMANY ph.:49 241 9421 205 e-mail: iackerma@ford.com

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The particulate matter suspended in the troposphere is strongly linked to numerous air pollution problems. Aerosol particles serve as cloud condensation nuclei and therefore influence the chemistry and spatial distribution of precipitation. In case of evaporating clouds the cycling of aerosol particles through clouds leads to a physically and chemically modified aerosol system. Heterogeneous processes within as well as on the surface of particles have the potential to modify the concentration levels and the spatial distribution of most acidic and photochemical air pollutants found in the atmosphere. Due to their light scattering properties aerosol particles have a strong impact on the radiative budget of the atmosphere. This in turn might effect the photochemistry by changing the photolysis rates of important reactions. Additionally submicrometer particles can be inhaled and therefore might be a cause for adverse health effects.

Hence, a more accurate modelling of air pollution has to consider atmospheric aerosol processes. In contrast to gas phase substances it is not sufficient for an aerosol to predict the chemistry of the system to capture the effects mentioned above, since these are additionally influenced by the physical characteristics of the particle population, e.g. number and size of the particles or mixing degree and phase state. Therefore this paper describes an approach to model particle formation, transport and deposition with respect to aerosol chemistry as well as aerosol dynamics for the use in regional chemistry transport models.

The Modal Aerosol Dynamics Model MADE for Europe has been developed from the Regional Particulate Model (RPM, Binkowski and Shankar, 1995), adapted for European conditions and implemented into the Eulerian chemistry transport model EURAD (EURopean Air pollution Dispersion model, Hass et al., 1995; Ackermann et al., 1995). The size distribution of the submicrometer aerosol is represented by two overlapping intervalls (modes) assuming a lognormal distribution within each mode. Coagulation is treated within each mode as well as between the modes. Aerosol mass can be increased by direct emission of particles, the formation of new particles from the gas phase (nucleation) and by growth due to condensation.

In previous versions aerosol chemistry was restricted to the sulfate-nitrateammonia and

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water system. Since secondary organics comprise a major portion of the atmospheric aerosol we will describe the extension of MADE to organic substances in the aerosol phase. This allows to study the formation of secondary organic particles, their impact on the size distribution of the aerosol population and the response of the gas phase chemistry to the formation of particles on a regional scale over Europe.

Addtionally we will describe the extension of the model towards a more complete coverage of particle chemistry -by adding elemental carbon, primary organics and PM2.5- and particle size range -by adding the coarse mode aerosol particles. New developments to incorporate aerosol-cloud interactions in the model will also be presented.

The simulations will be performed with a prototype version of the aerosol code from the USEPA-Models3 system, thus providing a test case for this new community model platform. Results will be presented for an episode in July 1994 for an European domain and subdomains nested into this grid with a finer resolution.

1416
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THE MODIFICATED PETRYANOV'S FILTER FOR DIRECT RADIOMETRY OF ALPHA-RADIONUCLIDES IN AEROSOLS

NEKRASOV V.V.*, OGORODNYKOV B.I.*, SURIN N.M.**

** Karpov's Physical-Chemistry Insto, 103064,Russia, Moscow, Vorontcovo pole, 10 nekrasov@cc.nifhi.ac.ru*

*** Institute of Oceanology, RAS, 117218, Russia, Moscow, Nachimovskiy prospect, 36*

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Polymeric fiber materials - Petryanov's filters (PF) - are frequently used at the quantitave analysis of radionuclide contents in aerosol. These filters have high effeciency of catching of aerosol particles of any sizes [1,2]. The average thickness of filtering materials at all analytical filters does not surpass 3-3.5 mg/cm2, i.e. does not exceed rundown of alpha-particles with energy 5MeV. This circumstance eases the factor of absorption of alpha-particles in volume of filter, though and it is not enough. The decision of the problem is some simplified by use of specially developed many-layer filters, containing layers from superthin fibre. In this layer the absorption of alpha-radiation is relatively not large and occurs under known law, enabling to calculation quantity of radionuclides, accumulated by the filtering material [3]. However and in this case the direct reception of energy spectrum of sample is rather problematic. Frequently analytical PF are used for enrichment of sample with its subsequent analysis by traditional radiometric methods in a combination with preliminary chemical allocation and concentrating . Thus significant errors connected with correct account of losses at chemical allocation are appeared. At radiometry of samples with low-activities the liquid scintillators are usually applied (to realize of spherical-geometry experiment). In this case the error called by the account of solubility of sample in used scintillator is added. Moreover, the similar method is practically not aplicable for control of concentration of short-living radioactive isotopes. New type of filtering material, enabling to conduct accumulation of sample and radiometry of alpha-active aerosol without processing of sample and practically in spherical-geometry, are developed on the basis of PF by the authors of the present message. The proposed approach consists in transfer of radioactive emission of sample in optical emission directly in the filter material. The optical emission (radioluminescence, excited by alpha-particles) is not weakened by polymeric material and can be registered by standard photoelectronic devices.

The proposed material can be used in the complex analysis of radioisotope composition of accumulated sample by methods of alpha- beta- gamma-coincidence spectrometry. Record sensitivity can be obtained in this case. For example, the accounts show, that at selection of

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sample in course of 1000 seconds with pumping rate 3 cm/s the sensitivity on 241Am will be 2x10-15 Ci/m^3.

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1425.
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SEASONAL VARIATION OF AEROSOL DEPOSITION FROM BIOGENIC SULFUR GASES IN REMOTE MARINE ATMOSPHERE AT AMSTERDAM ISLAND IN THE SOUTHERN INDIAN OCEAN

NGUYEN B. C.*, MIHALOPOULOS N., SCIARE J.*, BABOUKAS E.****

**Laboratoire des Sciences du Climat et de l'Environnement DSM/LSCE Unit Mixte de Recherche CEA-CNRS. BEt 709 - Orme des Merisiers 91191 - Gif-sur-Yvette Cedex. France.*

***Department of Chemistry, University of Crete, P.O. Box 1470, GR- 71409 Heraklion, Greece.*

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Biological activity of phytoplankton and zooplankton in surface seawater, over 3/4 of the Earth's surface, releases about 15 to 40 Tg S/year (1 Tg=10^{12}g) of DMS into the atmosphere . This gas rapidly oxidizes in the atmosphere to give methane sulfonic acid (MSA), dimethylsulfoxide (DMSO) and sulfur dioxide (SO^2) which subsequently reacts to form non sea-salt-sulfate (nss-SO_4^{2-}) . These aerosols (MSA, DMSO and nss-SO42-) can act as cloud condensation nuclei (CCN), influencing albedo and therefore the Earth's climate.

Due to its importance in atmospheric chemistry, considerable effort has been made in the last few years to better understand the seasonal variation in DMS and its oxidation products. We present results of simultaneous measurements taken over a 2 to 4 year period in order to assess whether there is a link between oceanic and atmospheric DMS, atmospheric SO_2, and wet deposition of MSA, DMSO and nss-SO_4^{2-} .

A continuous record of SO_2 in the atmosphere (1989-1990) and of MSA and non-sea-salt-sulfate (nss-SO_4^{2-}) in rainwater and DMS at the ocean surface and in the atmosphere (1987-1990) were performed at Amsterdam Island (37+S 77+E) . Covariations are observed between the oceanic and atmospheric DMS concentrations, atmospheric SO2 concentrations, wet deposition of MSA, nss-SO_4^{2-}. A comparable summer to winter ratio of DMS and SO_2 in the atmosphere and MSA in precipitation were also observed. During the last 2 years from December 1995 to February 1997, measurements of MSA and DMSO in rainwater were also performed. DMSO concentrations ranged from 7.0 to 369 nM, with a distinct seasonal variation. The mean concentrations during the summer and the winter periods were 90 nM and 25.6 nM respectively. The observed DMSO seasonal cycle is in line with the observations of DMS in the atmosphere and MSA in rainwater, measured simultaneously during the reported period.

However, the summer to winter ratio of DMSO is significantly lower than that observed for DMS and MSA. The DMSO to MSA ratio and its observed seasonal variability are also presented. The implications on the biogenic sulfur cycle are discussed.

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1426.
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INFLUENCE OF DYNAMIC ATMOSPHERIC CONDITIONS ON THE CONCENTRATIONS AND PARTICLE SIZE DISTRIBUTION OF THE MARINE AEROSOL

ZIELINSKI T., ZIELINSKI A., PISKOZUB J.

Institute of Oceanology, Polish Academy of Sciences

ul. Powst. Warszawy 55, 81-712 Sopot tymon@iopan.gda.pl

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Keywords: Aerosol, Size distribution, Concentration, Coastal area, Breaker zone.

This paper presents the results of research, which started in 1992, and has been dedicated to determination of aerosol dynamics in the marine boundary layer over coastal areas of the southern Baltic under various hydrometeorological conditions by means of the lidar method. In the marine boundary layer over the breaker zones of the southern Baltic aerosol size distribution function and aerosol concentration depend on wind speed, direction and duration. The results obtained indicate that for northerly winds it can be assumed that the particles which occur in the marine boundary layer above the breaker zones of the southern Baltic are marine aerosols. In the other cases, especially with southerly winds the particles are a mixture of marine aerosols and particles of the land origin. With southerly winds the aerosol concentrations, masses and fluxes in the marine boundary layer above the breaker zones are significantly higher than in the case of northerly winds and also they do not differ substantially with offshore distance, even though the wind speeds are lower than the southerly winds. It was revealed that in the case of northerly winds the breaker zone could be easily distinguished from aerosol concentrations, masses or fluxes which were higher when compared with these of the open sea. In the case of southerly winds it is not as easy to determine the range of the breaker zone because the mean concentration of aerosols is constant along the sounding path. Also, the aerosol concentrations are higher in the case of southerly winds even though the wind speeds are lower for theses winds.

The lidar method allows for determination of variations of aerosol size distribution function, aerosol fluxes and their residence times as a function of two different formulae for roughness length coefficient including developing roughness and fully developed roughness, diverse sea bottom types with various slopes and different weather conditions with changing wind velocity, direction and duration.

The procedure has been verified experimentally on several types of Baltic Sea bottoms and it allows for the good estimation of aerosol dynamics in the coastal zone provided that wind conditions and the sea bottom type are known.

1428.
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PLUTONIUM RELEASE FRACTIONS FROM ACCIDENTAL FIRES

VLADIMIR KOGAN AND PHIL M. SCHUMACHER

Battelle Memorial Institute Columbus, Ohio, USA

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Open literature and technical reports covering airborne releases of plutonium and plutonium-simulating contaminants during combustion of radioactive metals themselves and during fires in processing and waste storage facilities were reviewed.

Examination of the literature has identified three major sources of contamination which

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may be released during a severe accident at nuclear facilities:
1) Release by oxidation of plutonium metal,
2) Release by combustion of contaminated solid waste materials stored in the facility, and
3) Release by combustion of contaminated flammable process liquids, or evaporation of contaminated non-flammable liquids.

Based on the information gathered in this study, airborne releases from oxidation of metallic plutonium were grouped into three general categories. These categories include plutonium oxidation at a range of temperatures not exceeding plutonium ignition point, exothermic combustion of plutonium leading to its melting, and an explosive-like dissemination of plutonium resulting in formation of airborne plutonium particles and their subsequent violent combustion.

Combustion of contaminated solid waste materials appears to present a significant contamination hazard, because of the quantity of contaminated wastes stored in nuclear facilities, and because of the large fraction of contamination that can be released during a solid waste fire. Experiments have shown that up to 50 percent of the radioactive contamination can become airborne during combustion of a typical waste material, if the material is burning in the convective plume of the fire. A large fire may also cause bursting of waste storage drums exposed to direct flames.

Airborne release parameters are presented in terms of airborne release fractions (ARF) and respirable fractions (RF) for various contaminated combustible solid materials involved in a fire:
1) Rubber (polychloroprene or latex)
2) Polystyrene resin
3) Polymethylmethacrylate
4) Paper (cellulose) and mixed waste
5) Mixed waste in 55-gal drums

All releases from burning contaminated solid materials are conservatively assumed to be in the respirable size range. However, since plutonium oxide contaminant is a refractory material unaffected by fire, its original RF, if known, should be used.

Potential releases from flammable liquids are less significant, because of the lower releases expected. Nevertheless, the risk of contaminant releases associated with combustion of kerosene-like flammable liquids, such as during a jet-fuel fire caused by a crash of an airplane, will continue to be of significant concern.

With the potential for high release fractions, uncertainties associated with any release parameter needed for the environmental impact calculations become also extremely important. It is shown that major uncertainties are associated with the considerable amount of scatter among the reported ARF and RF data. Much of this scatter is due to the experimenters' desire to investigate a variety of test conditions in a limited-scope study. These variables include use of plutonium or a simulant, chemical form of the contaminant, its size distribution, its amount and application procedure, type of combustible material, flow conditions, and many others. Even when experimenters took great care to achieve reproducible fire conditions, order of magnitude variations in contaminant release were observed. The physical arrangement of the contamination and combustible material can also affect test results.

The health effects of the released contamination are strongly dependent on the size distribution and composition of the aerosol. Respirable contaminated particles present the greatest hazard to the surrounding population. Aerosol from solution tends to be mostly respirable, and a conservative estimate requires a relatively large respirable fraction for this contamination form. In many experiments involving combustible materials, the total mass distribution of the released aerosol was measured, which may not provide correct information

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regarding the size distribution of the contaminant aerosol.

1429.
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SOOT AEROSOL IN THE LOWER STRATOSPHERE: ABUNDANCE AND CLIMATIC IMPLICATIONS

PUESCHEL R.F., STRAWA A.W.

NASA Ames Research Center, Moffett Field, CA 94035-1000. Phone:650.604.5254. Fax:650.604.3625. Email: rpueschel@mail.arc.nasa.gov

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Soot aerosol has been of interest in connection with a proposed commercial supersonic fleet that would more than double the direct injection of aircraft emissions into the lower stratosphere. We determined an average surface area of soot aerosol of (4.6+2.7)e-3 μm^2 cm^{-3} in the northern hemisphere when approximating soot particles by equivalent spheres. Accounting for the fractal nature of soot increased this value 20-fold. The abundances in the southern hemisphere were lower by one order of magnitude. The data were compiled from fourty Ames wire impactor aircraft samples from pole to pole, between 0 and -200 degrees western latitude, and between the tropopause and 20 km altitude

A "decadal" average value of (2-5) μm^2 cm^{-3} for the total aerosol was derived from the 1979-1981 and late 1984-1990 SAM/SAGE satellite data sets [1] which exclude the major El Chichon effects but include at least seven other volcanic injections. That's why this "decadal" average exceeds by one order of magnitude a "background" value that we derived from our in situ samples in agreement with satellite observations [1] in 1979.

In order to compute the optical properties of the stratospheric aerosol, we applied the Maxwell-Gannett function to determine a "gray" refractive index of 99% by mass of sulfuric acid/water droplets that are mixed externally with 1% by mass soot particles. The single scatter albedo of this mixture is close to 0.98 at mid-visible, and about 0.94 at near-infrared wavelengths. In contrast, a pure sulfuric acid/water aerosol has a single scatter albedo of one at mid-visible, and of 0.98 at near-infrared wavelengths. Pollack [2] concluded that impurities reducing the single scatter albedo to 0.98 or less at solar wavelengths would change the sign of climate forcing from cooling to heating. Thus it appears that increased emission of soot aerosol into the stratosphere by a proposed supersonic or enlarged subsonic commercial fleet could prove problematic.

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1436.
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A COMPUTER CODE SYSTEM ATRAD FOR EFFICIENT PRECISE CALCULATIONS OF ATMOSPHERIC RADIATION.

SHILKOV A.V., SHILKOVA S.V.

Institute for Mathematical Modelling of the Russian Academy of Science, Moscow

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The report is devoted to computer code system ATRAD (ATmospheric RADiation) for numerical calculations of atmospheric radiation transfer in climate studies. Mathematical methods for numerical modelling are submitted. Calculation results are presented.

A specificity of the Earth atmosphere and connected problems are the following: A)Heterogeneity of altitude profiles of optically active gases. B)Very large number of molecular absorption lines (resonances) (10E4 - 10E5). C)Presence of cloud layers where the optical thickness with respect to absorption and scattering at particles changes sharply and temporal varying of cloudiness and aerosols.

The existing computer codes, solving these problems, are divided on poles apart:

1) "Line - by - Line" calculations of radiation spectra. These codes provide precision control at all stages of transport equation solving and use real microscopic cross-sections of radiation scattering and absorption as a data. Their disadvantages are large calculation time and difficulties at change of calculation variants.

2) "Semi empirical methods and codes" applying in climate studies. These methods are economical and permit the fast change of variants. Their disadvantages are the using of roughened model optical constants for wide spectrum parts as a data and precision uncontrollability.

The System ATRAD, being developed by the authors, has "Line - by - Line" calculation precision (1) and "Semi empirical methods and codes" efficiency (2). The data are microscopic cross-sections of radiation scattering and absorption (HITRAN - 92). The integration of these two qualities is achieved by application of a number of mathematical methods.

For the molecular absorption heterogeneity problem (A) solving, a procedure of energy scale division at resonance carriers is proposed. We call a pooling of spectrum intervals, at which absorption lines of gas "t" lie, a resonance carrier of gas "t". For the Earth atmosphere, it is enough to divide the energy scale at three carriers: H20, C02 and 03. The radiation transfer calculations are made independently inside the boundaries of each carrier.

For the problem (B) solving, method of Lebesque averaging of radiation microscopic cross-sections and intensity with respect to photon energies is used. The averaging is performed over energy points with equal absorption. So there are practically no precision losses. As a result, instead of transport equation calculations in 10E5 - 10E6 spectrum points, we solve the averaged transport equation in 10 - 10E2 conventional spectrum units.

For the problem (C) solving, quasi diffusion schemes and schemes with quasi analytical interpolation with respect to space variable were developed. Quasi diffusion schemes have given the fast and precise solution of transport equation with prevailing scattering and strong temporal varying of particle concentrations. Schemes with quasi analytical interpolation with respect to space variable have given the fast and precise solution of transport equation with presence of cloud and aerosol layers where the optical thickness of cells changes sharply. These schemes don't require space mesh retirement and/or model consideration of cloud layers. Schemes are constructed on the base of analytical solving transport equation inside uniform cells, then connection of conditions at cell boundaries and reconstruction of the solution in the whole region.

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The numerical calculation results, showing the efficiency of ATRAD Code System in comparison with "Line - by - Line" calculations are presented.

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1443
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PHOTOINDUCED GENERATION OF H_2O_2 IN WATER/HYDROCARBON EMULSIONS CONTAINING C_{60}

NADTOCHENKO V.A.*, KIWI J. **

**Institute of Chemical Physics in Chernogolovka, Russian Academy of Sciences Chernogolovka, Moscow region, Russia, 142432.*

*** Institute of Physical Chemistry II, EPFL. Lausanne II, Switzerland, 1015.*

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Photoexcitation of natural or artificial pigments in the air saturated water solution could lead to the formation of H_2O_2. This process plays important role in the mechanism of the pigment bleaching under the light and in the redox oxidation of organic compounds in the contaminant or natural waters. The main goal of this study is to test the photoinduced generation of H_2O_2 sensitized by C_{60}. C_{60} is not dissolved in the water therefore the hydrocarbon/ water emulsions were tested. Basic photophysical and photochemical properties of C_{60} are well studied. Triplet excited C_{60} is quenched by air oxygen with the efficient production of the singlet excited oxygen. In the presence of the electron donor molecules the quenching of the triplet excited C_{60} by donor with the formation of the C_{60} anion radical is possible. The following oxidation of C_{60} by air oxygen should produce the O_2 radical. The formation of H_2O_2 should be expected due to the following redox processes involving reactions of singlet oxygen or O_2 radical.

There were studied the water/thoulene and water/hexane emulsions. There was used solutions of hydrocarbon saturated by C_{60}. The Sun-test lamp was used for the excitation. The concentration of H_2O_2 was measured by iodometric titration technique. Aniline, triethanolamine, phenol, oxalate were tested as electron donor quenchers. As control experiments were performed the measurements of H_2O_2 formation in: a) complete emulsion solution containing C_{60}, donor, oxygen in dark; b) emulsion solution containing donor, oxygen without C_{60} under the light; c) emulsion solution containing C_{60}, oxygen without donor under the light; d) emulsion solution containing C_{60}, donor without oxygen under the light.

The results can be summarized as following:

a) there is observed photoinduced generation of H_2O_2 in the complete emulsion solution containing C_{60}, donor, oxygen under the light.

b) there is no or negligible small formation of H_2O_2 in the control experiments;

c) there is observed the growth of H_2O_2 concentration during 4 hours. After that the growth is stopped. Long time excitation during 24 hours leads to the H_2O_2 degradation.

d) there is observed the degradation of C_{60} after 3-5 hours.

e) maximum of H_2O_2 concentration depends on the donor. This value achieves to 10 M.

Qualitatively the properties of C_{60} as a photosensitizer of H_2O_2 is close t the properties such most efficient sensitzer as dye methelene blue. The optimization of the efficiency the H_2O_2 formation relative the absorbed light energy is possible.

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1014.
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ON SECONDARY RESUSPENSION RADIONUCLIDES INCOME INTO ATMOSPHERE AFTER

VASILYEVA K.I., VOSZHENNIKOV O.I., NIKONOV S.A., FOSTER K. (*), BURKOV A.I., MOROZKO E.A.

Tayifun (*), LLNL

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The parametrizations for a resuspension factor and a resuspension rate as functions of the time after an accident, wind velocity and roughness parameter are developed based on existing experimental and theoretical data. For taking into account the dependence of resuspension process on moisture content of soil and on anthropogenic activity it is introduced the empirical factors. The comparison of resuspension factor and resuspension rate calculated with use parametrizations shows good coincidence with experimental data. The correlation coefficient for them is equal 0.9.

1293.
УДК 541.18

NON DESTRUCTIVE EXAMINATION BY TXRF (TOTAL REFLECTION X-RAY FLUORESCENCE) OF AIR NUCLEOPORE FILTERS

CICARDI C., GALLI A., MILAZZO M.

Instituto di Fisica Generale Applicata Via Celoria 16, Milano 20133

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Some multielement analysis of airborne particulate on nucleopore filters have been performed using the method of TXRF which allows non destructive examination as well as PIXE analysis, but is obtained in much more simple and economic way.

Quantitative analysis is based on comparison with Fly Ash Standard BCR CRM 038 and we found agreement with PIXE results.

Possible influence of aerosol particle diameter in quantitative analysis is been investigated at present.

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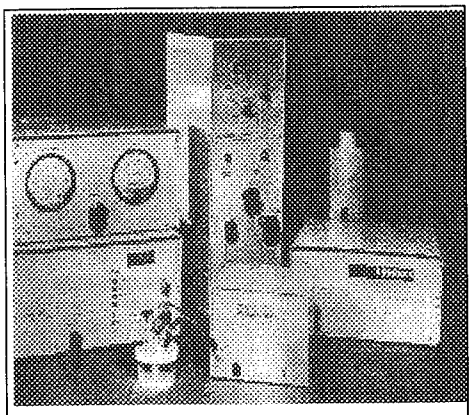
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В этот же день будут представлены работы по ФУЛЛЕРЕНАМ - синтез, экстракция, свойства, теория, применение, нанотрубки..

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Всех специалистов просим присылать свои отзывы по адресу 119285 Москва 2-Мосфильм 21-117 Белову Н.Н. Работы, которые Вы назовете особенно интересными , будут выдвинуты на премии Российского аэрозольного общества (ряд премий поддержан денежными суммами от 200 до 300 долларов).

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Это наука, приборы, вычислительные программы и технологии в России и странах СНГ.
Пришла пора передать спонсорам (Фонд Армии США, Американское и Российское физические общества ...) список секций, предварительную программу симпозиума и сборник тезисов докладов. Сейчас работа по подготовке этих материалов близится к концу. Принцип отбора докладов прост:

1. Рекомендации председателей секций и экспертов. Такие рекомендации получили работы, направленные для участия в IAS (кроме трех больших статей на русском и на англ языках Никитина Анатолия Ильича из Института энергетических проблем химической физики РАН. Его работы посвящены шаровой молнии, тел/ факс 9397501 - приглашаем заинтересованных в проблеме получить информацию о новых работах Никитина)
2. Наличие документов, разрешающих печать тезисов в трудах международной конференции.- Здесь ситуация сложная - половина полученных работ не подкреплена актами экспертизы и письмами о возможности опубликования в труха международной встречи. ВСЕ ЭТИ РАБОТЫ ОТЛОЖЕНЫ до момента получения указанных документов. Эти работы могут быть включены в одну из дополнительных книжек IAS как только эти документы будут представлены в оргкомитет
3. Наличие документов, подтверждающих оплату оргвзноса либо оплату публикации (достаточно заплатить 6 руб за страницу текста (и 6 руб за каждый рисунок и каждую таблицу, если они включены в Вашу статью), чтобы работа, удовлетворяющая первым двум критериям, была немедленно опубликована.) Если при этом Вы не забыли прислать четыре листа А4 с Вашим стендовым докладом - то можете быть уверены , что Ваша работа будет представлена на IAS-4. Таким образом в круг общения симпозиума вовлекаются те, кто не может принять участие в нашей встрече - проблема денег и /или времени. Так в нашей встрече будут опубликованы доклады из Бразилии, Мексики,... Однако авторы, которые не смогут приехать на нашу встречу, не будут включены в информационные списки симпозиума, с тем, чтобы эти списки показывали только тех, кого Вы можете встретить в Питере.

Прошу Вас проверить, получили ли Вы подтверждение о приеме тезисов, о получении актов экспертизы и документа об оплате. Если такие подтверждения Вами не были получены - не сочтите за труд переслать мне даты отправки этих документов и какую-нибудь дополнительную информацию, если она может помочь найти их побыстрее.
Будет весьма печально , если работа, по которой получены положительная рецензия и все документы, не будет опубликована по случайной ошибке оргкомитета.

Мы приглашаем председателей секций проверить - не забыли ли они оплатить свой оргвзнос. Минимальный вариант - 60 руб (регистрация одного дня). Практика показывает, что оплаченный оргвзнос является некоторой гарантией присутствия докладчика (да и председателя секции) на докладе.

Таким образом последний фильтр помогает выделить две группы возможных участников IAS-4: Теперь видны те, кто имеет возможность принять участие в нашей встрече и те, кто заинтересован только в публикации своих работ,

Мы сделаем все, чтобы поддержать последних (если они не забыли оплатить публикацию своих работ). Участники же симпозиума получат самую широкую информационную поддержку. Практически каждая работа будет опубликована трижды - в журнале для экспресс обсуждения и коррекции ошибок, в тематическом сборнике под редакцией председателя секции и в книжке тезисов докладов IAS-4. Первые два издания будут служить общественной экспертизой окончательного издания.

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THE RESULTS OF EXPERIMENTAL RESEARCH OF THE FOREST FIRES INFLUENCE ON THE RADIOACTIVE CONTAMINATION OF ENVIRONMENT AND THE ASSESSMENT OF DOSES TO FIRE FIGHTERS

KADYGRIB A.M.*, KASHPAROV V.A.*, LUNDIN S.M.*, PRISTER B.S.*, PROTSAK V.P.*, LEVCHUK S.E.*, YOSCHENKO V.I.*, GARGER E.K., KASHPUR V.A.**, TALERKO N.N.****

** Ukrainian Institute of Agricultural Radiology, Kiev, Ukraine*

*** Institute of Radioecology of UAAS, Kiev, Ukraine*

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The experimental researches of the resuspension and the transfer of radioactive substances during the dry grass and forest fires were carried out in Polessje district of Kiev region at the experimental sites 50x150 m and 100x200 m respectively. The concentration of radionuclides in the elements of meadow and forest biocaenosis as well as the total contents of radionuclides were measured for both sites. The density of contamination with Cs-137 of the meadow biocaenosis was 4.8 MBq/m^2 with the part of radioactivity localised in plants 0.01%. The density of contamination with Cs-137 of forest biocaenosis was 0.9MBq/m^2 with the part of radioactivity localised at the ground surface about 96%. The values of airborne concentration, dispersal composition and deposition intensity of radioactive aerosol (RA) at the different distances had been obtained at the different phases of fire. The main meteorological parameters had been measured.

The experiments in laboratory were carried out in order to assess the parameters of wind resuspension. The dependence of resuspension intensity on the wind velocity was investigated using the aerodynamic pipe. The ash of samples collected in 30-km zone and burned at the temperature 600 C was used to model the fire products. The dispersal composition of RA and the release of radionuclides during the burning of the samples of forest biocaenosis in a chamber were measured. It was shown that after the burning of pine-needles (the most important flammable material in pine forest) the main part of Cs-137 activity in aerosol is associated with the particles of aerodynamic diameter less than 1.8 mm which are much less than the ash particles (>5 mm). Visual analysis of impactor cascades shown that this activity is associated with the tar particles evaporated as a result of pineneedles burning.

Such parameters of RA transfer in atmosphere as the resuspension coefficient, resuspension and deposition velocity at the different distances (15-270 m) from the source had been calculated using the data obtained in experiments on dry grass and pine forest fires.

Using the obtained data a mathematical model of RA transfer in atmosphere was verified. The calculations for the different scenario of fire were performed. It was shown that the wind transfer of radionuclides is not significant even for the hardest scenario of fire - it produces the contribution to the density of contamination of surrounding areas about 10^{-6} of its background values.

The spatial distribution of average RA concentration during the fire shown that the RA transfer in atmosphere was caused both by the convective and the unconvective transfers. The superposition of these transfers results the formation of an ununiform aerosol concentration field with a sharp minimum of concentration at the distance about 100 m from the source and with two maximums of concentration - in close vicinity of the source and at the distance several kilometres.

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Both the dynamics of RA concentration and the dispersal composition depend on the distance from the source and the phase of fire. For instance, at the distances 10-300 m and the wind velocity 1-2 m/s the concentration of Cs-137 at the phase of active fire is two orders of magnitude higher than its background value, one order of magnitude higher at the smoulder phase and several times higher at the post-fire phase.

Human respiratory tract dosimetric model recommended by ICRP (Publication 66) was used for the assessments of doses caused by the inhalation intake of RA by fire-fighters. Using the data on RA dispersal composition it was shown that its variability during the fire does not cause the significant changes of 137Cs dose coefficient. Its median value calculated for the 1-year effective equivalent dose (EED) caused by acute intake is $1.53*10^{-8}$ Sv/(Bq*hour/m^3). Due the estimated high solubility of RA the 1-year EED from acute intake reaches up to 90% of 50-years EED. For the wide range of scenario of the forest fires outside the 30-km zone the estimated contribution of inhalation dose into total dose does not exceed several percents. The presence of radionuclides of transuranium elements in the forest fire radioactive release (which is possible for the fires inside the exclusion zone) can result an increasing of the inhalation dose up to the values higher than an external irradiation dose.

1292.
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PHOTOSTIMULATED CONVERSIONS OF METHANE ADMIXTURES IN THE AIR MEDIUM

MUSTAFAEV I. *, MAMMADOVA I. **

**Ecological Society of "RUZGAR", 124/128 G.Garayev ave. 370179 Baku, Azerbaijan*

*** Sector of Radiation Researches, Azerbaijan Academy of Sciences ,*
31-a H.Javid ave 370143 Baku, Azerbaijan

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Methane emissions into the atmosphere as a results of natural and industrial processes constitute about 50 mln tonnes in a year. Owing to high diffusion abilities methane easily spreads to the middle and upper layers of the atmosphere and takes part in photostimulated physico-chemical reactions. Under certain conditions the participation of methane in this processes may considerably influence on the rate and direction of chemical reactions, and at the end make contribution to decomposition of ozone layer, "greenhause effect", formation photochemical smog and etc.

The results of investigation of kinetics and mechanism of vacuum-ultraviolete photostimulated conversions of methane in the air medium are conducted in this paper. Obtaining of informations on kinetics in this reactions allows to predict the influence of methane admixture on chemical processes in the atmosphere.

Experiments were carried out at ranges of changes concentration of methane in the air 0.01 -99,5 % , total pressure of gasephase mixture are 0,04 - 100 kPa and irradiation time 10 - 300 minutes. As a sources of VUV -radiation the Kr and Xe rezonanse lamps were used.The wave lenght of VUV- radiation were 123 nm and 147 nm and the radiation flow was 4-4,5 10^{15} quant/s. As a index of processes are determined rate and quantum yields of formation H_2, CO, C_2H_4, C_2H_6, O_3, also decomposition of methane admixture. It is established, that at the dependence on wavelength and methane concentration in the air medium, methane is decomposed to direct and indirect processes:

$$C_4H + \text{radiation} \longrightarrow CH_2 + H_2 \text{ (or } CH_3 + H) \quad (1)$$

$$C_4H + O(D) \longrightarrow CH_2O + H_2 \text{ (or } CH_3O + H) \quad (2)$$

Such as under radiation with wave length 123 nm and [CH_4] more than 0,1 % reaction (1)

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dominate from (2), being at the 147 nm and [CH_4] less than 99,5 % atoms O(D), formed at the photochemical decay oxygen are of vitial importance in photochemical methane decomposition processes. It has been shown, that at the methane concentrations [CH_4] more than 0.05 % in the air medium occurs sharply decrease of photolitical ozone concentration at the expense of decrease of its generation rate at the presences of methane in processes of radiation absorption and in the reaction with precursors of ozone. At the changes of methane concentration in the irradiation mixture 0.1-51 % the quantum yields of ozone are changed at limits 0,35- 10^{-4} molec/quant at the 123 nm wave length radiation and 0,4- 10^{-3} molec/quant at the 147 nm.

As results of analysis are obtained ratio of constants rates of reactions:

$O(P) + CH_4$ _____ $CH_3 + OH$ (a)

$O(P) + O_2$ _____ $O_3 + M$ (b)

Finding that K_a/K_b = 942.8 .These results satisfactorly correspond with changes literature datas.

Given kinetical scheme of happened reactions of methane mixture with air under VUV-radiation.The kinetical schemes include 161 reactions of 41 particles. At the basis this kinetical scheme are calculated kinetics for formation stable products (H_2, CO, O_3, C_2H_4, C_2H_6, NO_x, aldehydes, alcohols, organic acids and etc) and the activity intermediate particles (O, H, CH_3, CH_2, OH, X* and etc). The calculation dependence of yields these products at the wide changes ratio components and irradiation time are obtained.Comparisons of calculation and experimental results on formation O_3, CO, H_2 were carried out.The satisfactorly (to 20 %) agreement among these results is observed.

The discussion of experimental and calculation results are adduced.

1296.
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MODEL OF OPTICAL WEATHER IN THE SURFACE ATMOSPHERIC LAYER AND ITS AEROSOL SECTION

PHILIPPOV V.L., MAKAROV A.S., IVANOV V.P.

The Federal Research & Production Centre The State Institute of Applied Optics Kazan, TR 420075 RU

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Keywords: Atmospheric attenuation, optical weather, optoelectronic systems

The paper concerns one of the important aspects of usage and development of IR optoelectronic systems for remote geophysical measurements, namely the problems of optical atmospheric radiation attenuation modelling with allowance for considerable daily, seasonal and regional features of its aerosol component. The material originality is stipulated by a provided opportunity to present quantitatively spectral values of radiation attenuation components under any weather conditions in the most variable part of the atmosphere, i.e., in the lower troposphere at a height up to 5 km. The authors have determined an interrelation (to be predicted and expressed in terms of mathematical relations) between meteorological situation parameters, i.e., weather conditions in the agreed-upon sense, and optical atmospheric properties. It enabled to use the term "optical weather" in the paper title.

The model structure consists of sections determining the environmental properties under the conditions of clear cloudless atmosphere, in different aerosol states (haze, fog, dust, smoke) and in falling the hydrometeors (rain, snow, drizzle).

Some results are compared with measurements known from European OPAQUE Programme publications.

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Reference

Philippov V.L., Makarov A.S., and Ivanov V.P. Optical Weather in the Lower Troposphere (Empirical Method of Calculating the IR Radiation Attenuation). Kazan. Press House. 1997, p.230.

1306
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SYSTHESIS OF HIGHLY DISPERSED PRECURSORS FOR C60 PHOTOPOLYMERIZATION

LAVROV V.V., ARKHANGEL'SKII I.V., SKOKAN E.V.

Moscow State University, Department of Chemistry,

Moscow, 119899 Fax: (095) 939-0198, E-mail: skokan@thermo.chem.msu.su

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Since the polymerization of fullerene molecules was observed, this phenomenon was intensively studied. The most efficient and studied types of polymerization are photochemical and pressure-induced. However, only the quenching technique, applying high-temperature and high- pressure treatment allow to obtain bulk quantities of polymerized fullerenes.

As the polymerization mechanisms are not enough studied, it was proposed that the products of photopolymerization and pressure-induced polymerization are the same. But according to Woodword- Hoffmann theory of 2+2 cycloaddition reactions photochemical process, representing photoexcitation and pressure-induced process at elevated temperature, representing thermal excitation have different mechanisms and should result in different products.

In the current paper some techniques for photochemical polymerization of small C_{60} particles are described. These techniques make possible to produce macroscopic amounts of polyfullerene C_{60} by UV-irradiating of water suspensions, soles and powders. Therefore methods for solid state analysis, i.e. XRD, NMR and DSC can be used to characterize samples. Precursor samples were prepared using several methods: grinding in a ball mill, lyophylisational drying of frozen solution, precipitation from saturated solutions and joint condensation of C_{60} and liquid media vapor. Every type of dispersed precursor consist of small particles, less then 0.5 -7 in diameter and are actually free of oxygen, which photochemically react with C60 molecules. Fullerite, used for preparation of precursors, was carefully purified of solvent admixture. Polymerized samples appear to be insoluble in toluene and after heating revert to pristine C_{60}.

Preliminary experiments were performed to study how oxygen affect polymerization process.

Samples of polyfullerene C_{60} were studied by means of IR, Raman and UV - spectroscopy, X- rays diffraction, ^{13}C NMR, differential scanning calorimetry, HPLC, tunneling electron microscopy and mass-spectrometry. New spectral features consistent with the change in bonding due to polymerization are reported. Thermal behavior of polymerized samples was studied and enthalpies of depolimerization were determined.

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1309.
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MECHANICAL PHENOMENA AT SHOCK AND DESTRUCTION OF METAALLIC NANOPARTICLES STUDIED BY MOLECULAR DYNAMICS SIMULATION

POKROPIVNY V.V.*, SKOROKHOD V.V.*, POKROPIVNY A.V., KRASNIKOV Y.G.****

** Institute for Problems of Materials Science, 252142 Ukraine, Kiev, Krzhyzhanovsky str.3*

***Moscow Institute of Physics and Technology, 141700 Russia, Dolgoprudny, Institutsky str.3*

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The processes of iron nanoparticles shock are computer simulated at the atomic level by molecular dynamics technique. The correlation between the structure transformation and variations of energy and force of adhesion, adhesive bond number, viscosity of contact is analysed. The adhesive-vibratory effect is observed. Acoustic and optical phonon spectra for vibrations of mass centres and single atoms are calculated.

Velocity dependent change of atomic mechanisms of shock interactions is discussed. During a shock with small velocity the joint action both the adhesive forces and impact pressure leads to joint dynamically steady vibratory and translation movement. At higher velocity, when the atomic processes of relaxation and shock occur simultaneously, vibrations are shown to transform into inelastic flow, amorphization and fracture of nanoparticles. At a near-sound velocity the particles are shown to smash into splinters.

The concept of new devices is proposed based on the resonance principle of powders compacting and coating activation by means of ultrasound treatment synchronized with shock influence.

The problems of interatomic potentials design and development of this technique for nitride and boride (TiN-TiB2) nanoparticles are discussed.

1311
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MICROBIAL BIOMASS AS FACTOR OF STABILITY OF EARTH ATMOSPHERE COMPOSITION

POLYANSKAYA L.

Moscow State University, Departament of Soil Science, Tel+fax +7(095)9390989

Vorobyevy Gory, 119899, Moscow, Russia; E-mail: pol@soil.msu.ru

(First received 06 March 1998; accepted for presentation during IAS-4)

Soil and atmosphere gas change plays a part in the determining atmosphere composition along with volcanic activity, photosynthesis and human impact. Conservation of reduced carbon in soil carries contribution in oxygen component stability of atmosphere. Activity of soil microorganisms has influence on contents combinations N, P, S in atmosphere. Living and dead microorganisms get constantly in atmosphere as result of wind erosion from the upper layer of soil. The number of microorganisms is the important factor of microbiological activity of soil.

Model and field studies of microbial communities allowed to describe seasonal dynamic of number and biomass of soil microorganisms as a whole and different systematic groups and populations. The vertical distribution of microorganisms along the whole profile in the main soil types is studied for the first time. It is shown by the method of epiluminiscent microscopy that the soil microorganisms are widely distributed over the soil profile. The observed results are contradictory to the previous concept about sharp decrease of microbial number at the depth of the profiles. The maximum microbe number and biodiversity in all soil types are

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proper to forest litters. The total amount of microbial biomass by luminescent microscopy studing are considerably above in soil horizons and measured by tens of tons per ha.

The method for account of the microbial biomass in soils was devised. According to this method was conducted the assessment of microbial boimass in the profile of the main soil types. The biomass of soil microorganisms was found to be very sizable. Microbial biomass composes from some units (grey forest soil) to several tens of tons per ha (soddy podsolic soil, chernozem, chestnut soil).

The biomass of mycelium and spores of fungi predominates in the investigated soils and reaches of 88-99 per cent of total microbial biomass. The proportion of procaryotic microorganisms ranges from 1 to 12 per cent depending on the soil type. The predominance of fungi biomass over the bacterial biomass leads to conclusion that the fungi play a main role in destruction of plant debris. The scarce of binding nitrogen commonly occuring in soils becomes clear in spite of sufficient quantity of nitrogen-fixing bacteria. The fungi perform the destruction of main part of plant debris, but they cannot fix nitrogen.

The soils are distinguished by number of microbial biomass and the character of its distribution along the soil profile and in time. The seasonal and interyears dynamic of number of procaryotic and eucaryotic microorganisms in soils was demonstrated. The moisture of soil is one of the main factor which is responsable for these changes. The proportion of microbial biomass carbon is very significant in reserves of organic matter carbon in soil as a whole. The most part of fungi biomass in all soil horizons is viable. Is was revealed that the viable cells of fungi are more in forest litters.

Every soil is characterized by a specific indices of microbial number and quality. The reserves of organic matter connects with favourable conditions for microbial activity and are not determined by deficiency of microorganisms in soil. The indices of microbial biomass and diversity may be used as a criteria for evaluation of ecosystem capability to support the resistance. The large values of these indices are indicative of the stability of the soil-microorganisms-phithocenosis system and is one of the factors of stability of earth atmosphere.

1291.
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MODELLING OF GAS PHASE REACTIONS IN POLLUTED AIR, INITIATED BY IONIZING IRRADIATION

GURBANOV.M.A.

Sector of Radiation Research of Sciences , Azerbaijan , Baku

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The comparative simulation and experimental kinetic stydy of products forming was carried out under the impact of ionizing irradiation on air (System 1) and air containing admixtires SO_2 , H_2 , CO_2 , NO_x , CH_4 , C_2H_2 (System 2). The kinetic scheme including 124 elementary reactions was taken into consideration.

– It's established that in the kinetic curves of azone and nitrogen oxide maximums are observed , their yields make up - 1 mol.\100 ev. In presence of humidity (-2%) the formation of nitrogen acid takes plase with yield of 0,5 mol.\100 ev (System 1).

– The comparison of kinetic ozone formation curves indicate maximum gliding of O_3 conrentrations in presence of admixed molecules and decrease of radiation yield of O_3 formation in this case (System 2).

– Nitrogen and sulpur acid yields are defined by presence and content of humidity , as well as oyher admixed molecules in irradiated mixtures.

The presented scheme includes variety of reactions ability of nitroge atoms N , N (D) and

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N (P) in relation to the molecules of components and molecular interactions of end products - N0x , O_3 , SO_2 , as well as clusterization of ions N_2 + , H_2O + , O_2 + and others.

The role of irradiated gas phase reaction on the formation of aerosols in atmosphere is discussed.

1341.
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THE METHODICAL APPROACHES TO BIOLOGICAL INDICATIONS OF AIR WASTES OF THE ENTERPRISES OF A MICROBIOLOGICAL INDUSTRY

OMELJANETS T.G., ARTUCH V.P., GANEVA S.L.

Ukrainian Scientific centre of hygiene, 50, Popudrenko str., Kiev-94, Ukraine, 253660

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The enterprises of a microbiological industry are a source of biological pollution of air. The biological factors of pollution, which offer danger to health of the person, are: viable microorganisms-producents, dead microorganisms, substance of a protein nature, which include enzymes, protein fragments of microbial structures. The whole this complex of biological wastes have the potential danger for the health of the workers of the microbiological industry and for the population, living in a zone of an location of the enterprises.

The products of microbial synthesis can cause the diseases of the skin, respiratory tract, allergic diseases etc. [Omelyanets T.G., 1994; Omeljanets T.G., 1997; Nemurya V.I., Nikitina Yu.N., Spazhakina G.N., 1986; Bruevich T.S., Zaharov G.A. ., 1978].

Qualitative variety biological pollution of air at the enterprises of a microbiological industry and in adjoin territories defines originality of the approaches to the control of biological pollution. The widest application was receive the methods of determination of microorganisms-producents. Is developed a number of samplers with subsequent sowing of the samples of air on a suitable agar culture medium and incubation. At an estimation of microbial pollution of air in a working zone of the enterprises we used samplers - Krotov, multicascade impactor "MB-2", sampler "PAB -1", MD8 (firm "Sartorius").

The most convenient and informative at these researches is air- sampler MD8 with use of gelatin filters of Sartorius AG. The application of gelatin membrane filters of a large diameter (80mm) enables realizations of isokinetic pick out the samples and possibility to work at large speeds throughput of air, not breaking of laminar flow. Due to this the periods of a sampling are reduced, that promotes preservation of viability of microorganisms and germination them when adhere the filters to the agar surface with nutritious media. An adjustable air flow ricte allows to determine quantity of microorganisms in various rooms at both large and minimum pollution.

However, mentioned methods allow to determine only live microorganisms, for identification them a lot of time is required. During period, which necessary for determination of microbial pollution, the situation in a factory can by a radical image change, especially at supernumerary (emergency) situation. Therefore, not underestimating importance of such estimation, to the present time well fulfilled, it is necessary to note necessity of application express and complete (with due regard for all biological factors) characteristic of a condition of pollution in any necessary interval of time.

To the protein substances are believed just as pure protein, and the substances, in structure of which, in this or that form, enter protein. Despite an improbable variety, inherent in this class of combination, determination of they usual in most of cases is based on peculiarities of structure, which is typical for proteins in general. At existing practice a method

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is applied, in a basis of which is combined biuretic colour reaction and Folin's reaction on aromatic aminoacids. By other words, is determined not individual protein combination, but total protein. Thus, basic problem - determination of specific protein connection which can be the reason of a various sort of diseases is not carried out. Taking into account the fact, that great bulk of biological wastes can be tolerant in relation to organism of the person, the traditional method of determination of the total protein cannot be used at the hygienic control. Especially it concerns to the enterprises, where a plenty of various products of microbial synthesis is made, which include enzymes, antibiotics, vitamins, aminoacids etc.

The absence of methods of determination in air of specific protein combination promoted that the hygienic rules for many potentially dangerous wastes of a protein nature were established on total protein.

It is natural, the urgent need for methods differentiatial of determination of the protein combinations for the purposes of hygienic reglamentation and control will inevitably change an existing situation, as it becomes a brake in development of certain directions of biotechnology. The decision of these problems can be supplied by methods of the immunochemical analysis (IFA) [Braun T., Klein A., Zsindely S.,1992; Zherdev A.V., Dzantiev B.B.,1996]. To the present of time bases of the immunoenzyme analysis are developed. The brief list of advantages of use of a method of the immunoenzyme analysis for determination of the protein contain substances in air includes unique specificity in a combination to high sensitivity, high stability of reagents, simplicity of methods of registration, variety of objects of research - from the lowmolecular combination up to bacteria and viruses. Extraordinary the wide sections of problems, connected to variety of conditions of application IFA, causes development of an extremely plenty of variants of this method [PP.Tijssen, 1985 Yu Hao,1996; Burkin M.A., Sviridov V.V., Yakovleva I.V.,1996]. It enables to develop methods, which can be used as for the simple answer to a question "yes" or "not" there is no whether exceeds required substance a level of extreme allowable concentration (EAK)(dot-varsion of ELISE), and for the exact determination its quantity with high sensitivity and accuracy.

Large experience in creation reagents for IFA is at the moment saved, criteria which they should satisfy to reach necessary sensitivity are known, basic laws of reaction antigen-antibody in a solution and in a firm phase are investigated, that allows to purpuse-full optimize conditions of realization of the analysis [R.A.Mariuzza, V. Phillips, R.J. Poljak, 1987].

The high sensitivity IFA is reached also due to use of various physical methods of registration of enzyme activity: photometric, fluorometric, and also bio- and luminescent methods.

The reaction of interaction antigen-antibody can be considered as a particular case of linkage of lygands with macromolecular receptors. In a basis of interaction common principles any of biomolecular reaction lay. A product of biomolecular reaction, in this case, is a complex antigen-antibody. The immunity reaction is described the same kinetic and thermodynamic parameters, as any process of the formation of combination [H.M.Geysem, J.A.Tainer, S.J.Rodda, T.J.Mason, H.A.Alexander, E.D. Getzoff, R.A. Lesner,1987].

We offer to consideration a particular case of application of technology IFA for development of a method of determination the wastes of a protein nature at the production of the fodder additive, enriched by lisin. As producent at the production of the fodder additive bacteria Brevibacterium were used. To peculiarities of industrial conditions at microbial synthesis, as well as in this case, it is necessary to relate the circumstance, that at the enterprise in parallel come true of a several technological processes, and many of them are also sources of protein pollution of a working zone. Hence, the application of traditional methods of determination of total protein in these conditions is not expedient. By the basic requirement to a method of determination fodder protein in air in conditions of enterprise is strong specificity

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and selectivity on a background rather expressed pollution by diverse protein combinations. Practically unique, known for a today's day, the method of specific determination of individual protein combinations or of a complex of protein combinations, caused by use certain producents and conditions of it's inoculation and processing can be only a method, which based on use of the immunoenzyme analysis.

For reception of specific serum the immunization of rabbits was made, basically, by standard methods [G.S. Bailey, 1984]. As immunogen was used an extract of a final product - powder-like substation, which is hydrolisat of producents. The fodder additive, dressing by lysin, contained up to 12 % protein. An initial solution of immunogen contained 100-150 mg/ml protein of the fodder additive. For immunisation consecutive used complete and incomplete Freid's adjuvant (CFA). On a final stage of immunisation in a solution of immunogen entered methyebumin. It is known, that polipeptides and proteins with molecular weight more than 5000 is effective immunogen. The chromatographic analysis of the fodder additive has shown, that the large part of protein substances is large polipeptides.

For relative increase of concentration of antibodies used gamma-globulin or Ig G - fractions of immunity serum. The titre of antiserum was established by a method of immunoprecipitation.

Determination the antigene made by a competitive method with use of labelled antispecific of antibodies [Neizotopnue metodu immunoanaliza, VINITI, 1987]. We used enzyme-like immunosorbent (ELISA).

Estimation the concentration of an antigene carried out by using the calibrate diagram. The definition of the total protein in a working zone and adjacent to a zone made by a traditional method and has shown pollution 25-45 mg/ml^3.

Results of determination of the lisin-containing fodder additive have shown, that the contents it in air makes 3-5 % from common protein pollution of air of a working zone. Traditional methods of determination of protein would not allow to define such quantity individual specific protein product, which is the lisin-keeping fodder additive.

The method of the immunofermental analysis can be used also as express for determination in air of quantity of microorganisms-producents, not dependent from that live it is or dead. Thus the determination take a few minutes, while the microbiological method requires a few days (from 1 up to 14 depending on a sort of microorganisms).

To lacks of this approach it is necessary to relate the fact, that in each particular case reception of specific antibodies is required and the developed method can be applied, at the best, only in conditions of realization of the particular production.

The certain difficulties exist also and at a choice and standartisation of antigenes of protein compound, which are used for development of a method.

In the last years the attention of the researchers is involved the methods with use of biosensors.

Attempts of development of biosensors devices for determination of protein, based on use proteinases and field transistors are made [Biloivan O.A., Dzyadevich S.V., Soldatkin O.P.,1997].. One of advantages of biosensors is their high expressivety of determination. But the mentioned type of biosensors have a lack of tradicional methods - nonspecificity. The combination high specificity, selectivity, sensitivity and expressivety is possible only, on our sight, to embody in development of the biosensore device on the basis the field transistor in a combination with specific antibodies [Kalab T.,1995].. With the help of such devices the continuous control wastes is basically possible. These possibility, as a whole, determine a common direction of methodical development, which should ensure hygienic reglamentation and control of biopollution in the near future.

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1226
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AEROSOL CEMENT PARTICLES NUMBER CONCENTRATION LIDAR STUDIES

LAKTYUSHKIN G.V., PRIVALOV V.E., SHEMANIN V.G.

Kuban State Technological University, Novorossiysk Department, Novorossiysk, Russia

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Cement particles back scattered Mie radiation intensity dependence on particles number concentration in range of 10 - 1000 cm^{-3} at YAG-Nd second harmonic laser wavelength of 532 nm has been experimentally studied on laboratory bistatical aerosol lidar type [1]. Back scattered radiation was collected by 0.12 m diameter mirror receiving telescope and recorded through 532 nm interferential filter with peak transmission of 64 % and halfwidth of 2.4 nm on PMT FEU - 79. PMT signal was inputed by special controller to IBM PC Pentium 100 RS-232 port. The cement particle air flow was created by particles generator [1] and its concentration and velocity continuously controlled by laser Doppler anemometer [2]. It is getting that back scattered Mie radiation intensity has linear growth with particles number concentration. Measured results treatment allowed to determine by known lidar constant [1] back scattered cross section for concentration unit is equal to $(3.2 + 0.5)\ 10^{-6}\ m^{-4}$. For these results testing lidar equation as in [3] computer simulation has been fulfilled with our experimental conditions. This lidar equation parameters for our case had the next values: h, R = 7.5 m for recording time duration of t_d = 50 nc, A_2= 0.008 m, K_2 = 0.495 at 532 nm wavelength (measurement result), laser pulse energy E_0 = 10 mJ, laser pulse duration t_L = 10 ns, ranging distances R = 7.5 - 15 m, PMT type FEU-79 photocathode spectral sensitivity values at wavelength of 532 nm have been taken from [4] and it is equal to 0.92, atmospheric transmission values have been calculated as in [3] with extinction coefficient k value from [4] and for wavelength of our interest is 160 m^{-1}.

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Back scattering Mie radiation power computer simulation have been made with above described data for the ranging distances from 7.5 to 15 m as aerosol particles back scattering coefficient function. The determined power values P(7.5) have been used for particles back scattering coefficient concentration dependence calculation with FEU-79 sensitivity experimental data. All the results both measured and calculated are exhibited in Table 1.

N, cm $^{-3}$	E(7.5), mJ	$(\frac{\partial\sigma}{\partial N})\ 10^6$ m^{-4} sr. C	P(7.5), W C	σ, m^{-1} C	$(\frac{\partial\sigma}{\partial N})\ 10^6$ m^{-4} C	$(\frac{\partial\sigma}{\partial N})10^6$, m^{-4} sr.
100	15.5	3.7 +-0.5	0.523	296	2.96	2.1 +-0.6
150	21. 7			415	2.77	
270	24.8			474	1.76	
350	31.0			593	1.69	
500	37.2			711	1.42	

Calculated results were pointed by C in this Table 1, all the other were experimental results. These calculation results confirm the cement aerosol particles number concentration vesus back scattering coefficient linear dependence. Therefore, the such a type aerosol lidar can serve as an instrument for cement aerosol particles number concentration ranging measurement.

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MULTIPARAMETRIC OPTICAL STUDY OF BIOLOGICAL AND OTHERS DISPERSE SYSTEMS

BEZRUKOVA A.G.

St. Petersburg State Technical University, St. Petersburg, 195251 RUSSIA bezr@psb.usr.pu.ru

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Multiparametric optical assay (MOA) can provide further progress in studies of complex disperse systems such as our water and air.

MOA includes the nondistructive analysis of dispersions by different optical methods such as refractometry , absorbance, fluorescence, light scattering (integral and differential, static and dynamic, unpolarised and polarised). Taking into account optical theory and results of study can help to elaborate methods for on-line optical control of complex systems.

Our research has investigated different disperse systems : proteins, nucleoproteins, liposomes, lipoproteids, viruses, lipid emulsions, bloodsubstitutes, latexes, liquid crystals, cells with various form and size, metal powders, barytes, kaolin, kimberlite clay, zeolites and mixtures - liquid crystals with surfactants, liposomes and viruses, mixtures of clay with cells and others, samples of different waters and air sediments, etc., by various optical methods.

One of the most vital problems is development of MOA for on-line environmental control for dangerous impurities - metals, oil, viruses, bacteria.

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THE PULSE CLEANING BEHABIOURS OF GROUP CANDLE FILTER IN A HOT BENCH UNIT

Choi J.-H.*, Seo Y.-G.*, Jeong H.**, Chung J.**

*Dept. Chem. Eng. Gyeongsang National University, 900, Gazwa dong, Chinju 660-701, Korea

**Korea Electric Power Research Institute, Taejon 305-380, Korea

(First received 03 April 1998; accepted for presentation during IAS-4)

Ceramic candle filters have been widely studied for the application in the advanced coal power plant because of their high filtering efficiency. High collection efficiency is especially important to control the micron particulates which causes the erosion and abrasion of gas turbine in the IGCC and PFBC. Because the filtering volume decreases as the face velocity increases, the operation at high face velocity is very beneficial for any filtering system, while keeping pressure drop low, maintaining collection efficiency high, and sustaining candle life. Pulse jet cleaning is one of the methods to improve the performance of the candle filter. A reliable cake removal and keeping the constant residual pressure drop are essential for the long term operation of the pulse jet cleaning filter. Several factors affect on the reliability of candle filter, including operation conditions, dust properties and the conditions of candle. Some experimental aspects on the pulse operation of candle filter were investigated in this study.

Hot gas stream was prepared with an oil burned exhaust gas in which fly ash from a conventional coal power plant was fed. The aerodynamic mean average size of the particulate was 23 micrometer. And the accumulative volume fraction less than 10 micrometer was 45.9%. Careful attention has to be paid during the mounting of filter element because of the element failure from the thermal and mechanical stress, while preventing the dust leak through the gaskets. The disc typed-spring was used to absorb those stresses. There were no dust leak through tube sheet and on mechanical troubles. The collection efficiency was maintained above 99.9%. The pressure drop through the temporary dust cake can be estimated by the measurement of the pressure drop developed after the pulse cleaning at each stage. Under the steady state operation at the constant in temperature, pressure, and face velocity the pressure drop across the dust cake was linear with the change of time because the concentration increases linearly from the constant accumulation. The pressure drop rate was linear with the change of dust concentration and showed a quadratic increase with the change of face velocity. So the pressure drop across the temporary dust cake could be understood well by Lippert's equation. And overall pressure drop across the filter element was well expressed by Darcy's law. Usually, stable value of dimensionless permeability lies between 0.4 and 0.45 for commercial filter element, which reaches after more than 100 hours. So the data we obtained shows only its trend in the short term of experiment. The determination of the suitable conditions for the pulse cleaning is very important for the long term operation. The forces between particles and the filter element is key factors of cake stickiness. The shock pressure difference during pulse jet is the main force to destroy the stickiness. And the cake detachability depends on the pulse amount. Experimental variables which can control the pulse amount are the pulse reservoir capacity, pulse nozzle size, pulse duration, and nozzle design.

The durable base line pressure drop is allowed up to about 1000mmH2O in commercial application. So the pressure drop rate should be lower than 0.002. More than 1 sec was suitable at this condition. We could expect much more pulse effect after a certain duration. The effect of cycle duration at given pulse pressure and pulse duration. The state at which the pulse cleaning is impossible after all when the cycle duration was extended step by step. The fail in cleaning occurred within 1 hr if rR is more than 0.3. The maximum cycle duration decreased sharply as

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Счет 15 **от** **1998**

Наименование товара	Ед. изм.	Количество	Цена руб.	Сумма руб.	Ставка НДС	Сумма НДС, руб	Всего с НДС, руб.
Оргвзнос за участие в Симпозиуме IAS-4, 6-9 июля 1998 г.	взнос	1	250	250	20 %	50	300

Счет 16 **от** **1998**

Наименование товара	Ед. изм.	Количество	Цена руб.	Сумма руб.	Ставка НДС	Сумма НДС, руб	Всего с НДС, руб.
Оргвзнос за участие в Симпозиуме IAS-4 на 1 день	взнос 1 дня	1	50	50	20%	10	60

Счет 17 **от** **1998**

Наименование товара	Ед. изм.	Количество	Цена руб.	Сумма руб.	Ставка НДС	Сумма НДС, руб	Всего с НДС, руб.
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the face velocity increased. In the case the face velocity was more than 4 cm/sec, pulse cleaning was impossible even though the cycle time was less than 2 min. The cleaning effect of two different pulse modes, the collection and the dispersion one were compared. There was not significant different between them. The sequential pulse cleaning with the pulse cycle of 5 seconds after 15 min of long interval was carried out in the collection pulse mode. But the effect was almost similar with that from the regular cycle duration of 5 min was applied in the dispersion mode.

In summary, bench scaled high temperature ceramic candle filter was operated to observe the pulse events. The total pressure drop across the tube sheet was monitored during the pulse jet. The cleaning behaviors were explained well by Darcy's law and the equation proposed by Lippert, et al. The prediction of long term durability of the filter element could be estimated by the pattern of the increase in the base line pressure drop. The pulse duration has a minimum value at a certain condition. The maximum cycle duration was affected much by the face velocity. The operation results at unsteady state shows that the pulse mode was not important on the cleaning effect.

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COMPOSITION OF AEROSOLS IN THE MARINE BOUNDARY LAYER IN THE RUSSIAN ARCTIC

V.P. SHEVCHENKO*, A.P.LISITZIN*, R.STEIN, A.A.VINOGRADOVA***, V.V.SMIRNOV****, V.N.LUKASHIN***

** P.P.Shirshov Institute of Oceanology of RAS, Moscow, Russia; e-mail: vshevch@geo.sio.rssi.ru*

*** Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany*

**** Institute of Atmospheric Physics of RAS, Moscow, Russia*

***** Institute of Experimental Meteorology, Obninsk, Russia*

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Traditionally riverine input was assumed to be the main geochemical pathway of terrestrially and anthropogenically derived compounds from their sources top the aquatic environment, but there is much evidence that atmospheric inputs contribute significantly to marine areas. Numerous studies have shown that aerosols in the Arctic are of importance for atmospheric chemistry and climate. But up to now aerosols of the Russian Arctic were studied little.

In 1991-1997 during 10 expeditions 126 samples of aerosols have been collected by nylon meshes and by filtration of air through Whatman-41 and AFA-HA in the Laptev, Kara, Barents and Norwegian Seas. Aerosol size distribution has been measured by PC-218 photoelectrical particle counter.

In general, there is a much greater number of small particles (with sizes from 0.5 μm to 2 μm) in comparison to large particles. Over the open water an increase of the wind velocity stimulates the concentration growth of coarse (>5 μm) particles in the spectrum. This could testify the input of sea salt particles from the sea surface microlayer by wind and the importance of these particles for the chemical composition of marine aerosols. In ice-covered areas we find an increase of concentrations of fine particles (from 0.5 μm to 2 μm), especially at low temperature. It can be explained by formation of ice microcristals.

In August-October 1993, the mass concentration of the coarse fraction of the Kara and Barents aerosols which are not soluble in water, varied from 0.02 to 0.48 $\mu g/m^3$ (0.15 $\mu g/m^3$ in

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average); in the Laptev Sea concentration of insoluble aerosol particles was 0.04-0.09 μg/m^3 at the end of July 1995. These values are similar to those measured in the North Atlantic (Duce et al., 1991). In most of samples organic matter (fibers of vegetation, pollens, diatoms) and mineral particles are the main component. Content of organic carbon varies from 7.54 to 26.9 % (17.6 % in average).

The mean concentrations of most of the chemical elements are within limits known from literature for other Arctic regions. Concentrations of heavy metals in our samples are higher than in the Antarctic and the remote ocean regions, but they are much lower than those from seas in highly industrialized regions. Temporal variations of the element concentrations are caused by various air masses coming to the studied area. The increase of concentrations of some elements in remote areas covered by ice could be explained by resuspension of particles from sediment-laden sea ice.

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THE INFLUENCE OF AEROSOL ON THE FLUXES OF SOLAR RADIATION IN THE ATMOSPHERE, CLOUDS AND ON THE EARTH SURFACE.

E.M. FEIGELSON, I.A. GORCHAKOVA, O.A. SHILOVTSEVA.

Obukhov Institute of Atmospheric Physics, Russian Academy of Atmospheric Physics, Russian Academy of Sciences. Moscow State University. Address: 3, Pyzhevsky, Moscow, 109017, Russia. Tel: 7-095-9511347; Fax: 7-095-9531652 e-mail: Gor@omega.ifaran.ru

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AIR QUALITY AND ITS HEALTH CONSEQUENCES IN CENTRAL BALIKESYR TOWN

TALAT KOC

Department of Geography Education, Balykesir University, Necatibey Education Faculty. Balykesir, TURKEY.

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INTRODUCTION: Air pollution is one of the important problems specifically of towns. Recently, the problem of air pollution is rapidly growing in the central Balykesir town.

One of the important negative effects of air pollution is the increase in health problems. For example, upper respiratory diseases are the most common related to the low levels of air quality. This study takes this problem into consideration and investigates the relationship between the air quality and the number of patients who register for upper respiratory problems

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in the period of 1990 and 1995. The aim of this study is to draw attention to the relationship between the two mentioned above and relate deaths.

DATA: Among the elements of air quality only sulphur dioxide (SO_2) and particule matters (PM) are measured in the central town. This measurement is done by the Laboratory of Public Health and the Directorate of Environment. For the air quality research, the average values of SO_2 and PM are taken into consideration. These values were weekly and yearly between 1990 and 1995. For the problems of health research, weekly number of patients who were applicant to the health units in the central town and suffer from upper respiratory diseases were investigated. Nevertheless, the problem of not being able to determine the number of patients who lived in the central town was emerged. Therefore, this problem needs to be considered in mind.

METHOD: In Balykesir central town, air quality and Number of Patient Applicants (NPA) values are investigated in the six year period of 1990-1995. Changes related to time in the air quality and NPA values and relationships between the two are attempted to find out with the help of correlation coefficient.

RESULTS: There have been found obvious fluctuations in the air quality and NPA values in Balykesir central town (Figure: 1: NPA values and linear trend; 2: SO_2 values and linear trend and 3: PM values and linear trend). While in the warm period, air quality increases and NPA values decrease; in the cold period air quality decreases and NPA values increases. Table show the relationship of 59% and 78% between the NPA values and SO_2 and PM values.

There is a tendency to increase in the SO_2 and PM values in the period of 1990-1995. While the average SO_2 value of 70 $\mu g/m^3$ in 1990 increased 86% in 1995 and reached to 130 $\mu g/m^3$; the value of 44 $\mu g/m^3$ PM increased 61% and reached to 71 $\mu g/m^3$. With parallel to the changes in air quality, while the weekly total of NPA was in 819 in 1990, it reached to 1718 with a 110% increase rate. Zaim's work (1997) which reported better air quality standards in big cities of Turkey in the period of 1990-1993 is invalid for the Balykesir central town. Figure shows the changes in air pollution and NPA values with regard to time and tendency lines. While the tendency of increase for the NPA is $y= 3.3 x + 739.4$, for SO_2 is $y= 0.2 x + 79.7$ and for PM is $y= 0.1 x + 47.6$. The correlation coefficient for NPA and SO_2 is 70%; for NPA and PM is 65% in the 1990-1995 period (see table).

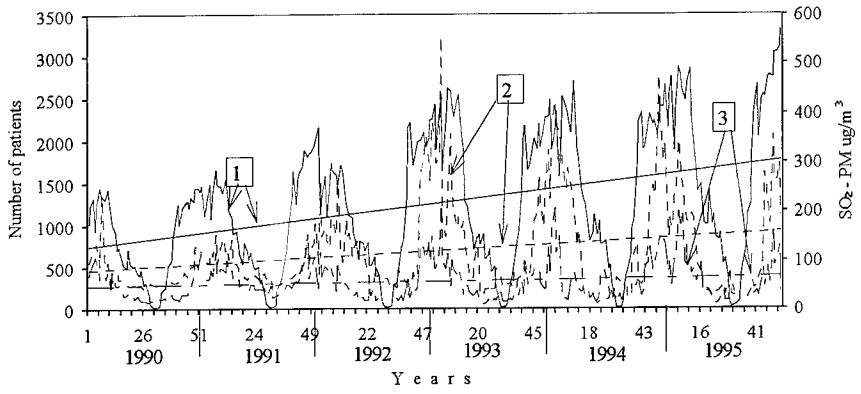
DISCUSSION: As well as other studies this research also showed that there is a close relationship between the air quality and human health. It was noted earlier that in many cities in Turkey as well as in Balykesir only SO_2 and PM values are measured. However, in addition to these values, other air quality parameters should be measured in order to prepare a base for the more detailed research.

The effects of air quality on health come out in short or long term. Upper respiratory problems may be due to air quality as well as other factors. The results of SO_2 and PM values and relationship with the NPA values which reach 78% in a year is a confirmation of this effect. As well as yearly changes in the air quality the changes in the period of a year also show the close relationship between the air quality and NPA values (see table).

EVALUATION: Balykesir central town is one of the settlements which have low levels of air quality due to the effects of physical environment (Koc, 1997). There is more negative tendency in the air quality when the 1990-1995 period is taken in to consideration. Therefore, there is need to prevent the negative effects of air pollution.

One of the most important consequences of air pollution is its negative effects on human health. Particularly, upper respiratory system and the patients who suffer from related diseases are the most effected in the short run. In Balykesir, there have been found that there is a close

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relationship between SO_2 and PM values and the number of patient applicants (NPA). There might be deaths in the continuation of decrease in the air quality and in the case of strong reverse movements of air. It should be noted here that there is a need to study the reasons detail behind the deaths.

Although there is the need for cities to allow a good environment to live in, Balykesir, is difficult to say, has a good air quality environment. If the increase in air pollution continues, Balykesir like many cities which have this problem, disasters related to the air pollution should be expected. Therefore, it is suggested that detailed studies should be on the way for a better environment in Balykesir.

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Correlation coefficient (%) between number of patients and SO_2 - PM

Years	SO_2	PM
1990	67	73
1991	71	73
1992	63	70
1993	75	74
1994	71	59
1995	78	60
1990-1995	70	65

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PORTABLE CORRELATED OPTICAL DETECTOR FOR EXPRESS REMOTE ANALYSIS OF POLLUTING SUBSTANCES IN ATMOSPHERE

V.V.NEKRASOV*, D.R.GASANOV*, A.T.PORTYAN*, N.V.RYJAKOVA*, N.M.SURIN**

** Karpov's Physical-Chemistry Research Institute, 103064, Russia, Moscow, Vorontcovo pole, 10*

nekrasov@cc.nifhi.ac.ru

*** Institute of Oceanology, Russian Academy of Sciences, 117218, Russia, Moscow, Nachimovskiy prospect, 36*

(First received 31 March 1998; accepted for presentation during IAS-4)

One of the global problems of environment protection is anthropodenic polluting of atmosphere. Effect of polluting of atmosphere is a destruction of ozone layer of the Earth that leads to change of climate and to worsenning of an ambience of dwelling.

Practically in polluting of atmosphere two formind components participate - aerosol and gas. These components base in the dynamic balance. In the different layers of atmosphere chemical and photochemical reactions with their participation constantly run. For getting complete information on occurring in atmosphere processes, it is necessary to be able to measure chemical composition of gas and aerosol components.

In this reporting prospects of using portable correlated optical detectors for express remote analysis of gas composition of different layers of atmosphere are discussed. Correlated optical detectors are capable to find in atmosphere vapours of different chemical compounds - ozone, oxide of nitrogen, sulphur, carbon and others. These instruments ensure a finding of polluting on distances before several tens of kilometers. Correlated optical detectors possess high selectivity to analyse components, as far as they exclude an influence of any admixture on results of measurements, spectra of which weakly correlate on the structure with the analysed component. As sources of sounding radiating it is possible to use both artificials sources of the light, and natural sunshine, diffused by the celestial sphere or reflected from the surface. This is particularly important for problems of ecological monitoring. Correlated detectors are perspective for using in the composition of apparatus complexes unceasing monitoring of atmosphere in real-time and express making of the large-scale distribution cards and vertical stratifications of analysed components.

Perspective of using of correlated optical detectors is demonstrated on the example of measurements of distribution of dioxide of nitrogen in atmosphere. In the course of studying of distribution of oxides of nitrogen in different regions it is installed that alongside with industrial objects and motor transport, sources of arrivals of nitrogen oxides in atmosphere are agricultural regions. This effect is stipulated by the decomposition nitratecontained fertilizers, not adopted by plants [1]. Contribution of this source is weakly taken account into evaluations of general background p olluting of atmosphere. The situations, when such sources can contribute an essential contribution to polluting of atmosphere and destruction of ozone layers of the planet, are presented wholly real [2].

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ON A CONTRIBUTION OF WIND SHEARS INTO HORIZONTAL DISPERSION OF POLLUTION PLUME FROM A CONTINUOUS POINT SOURCE

BESCHASTNOV S.P., NAIDENOV A.V.

Scientific Production Association 'Typhoon' Obninsk, Russia

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Pollution dispersion in the vicinity of a point source is governed, as is known, by turbulent diffusion, at average distances it is controlled by diffusion and wind shears. According to this empirical formulae for calculating horizontal dispersions depending on an pollution source in its vicinity involve only the terms considering turbulent diffusion, at large distances shear components are added. Empirical formulae [1] can be mentioned for a remote zone as an example. This and other formulae obtained by other authors have not been yet widely verified experimentally. Therefore, the goal of this work is to estimate with a diffusion numerical model an effect of wind shears on the magnitude of horizontal dispersions under different conditions and to validate the parametrization shear components used now practically.

In limited case at long diffusion times one may reduce from the empirical formulae and semiempirical diffusion equation the following relations:

$$\sigma_x^2 \approx a_x \left(\frac{\partial V}{\partial z}\right)^2 \sigma_z^2 t^2 \quad \text{and} \quad \sigma_y^2 \sim a_y V^2 \left(\frac{\partial \varphi}{\partial z}\right)^2 \sigma_z^2 t^2, \tag{1}$$

where V is the velocity module, φ is the wind direction, t is time. In [1], as in most other works, $a_x = a_y$ =1/3. Pasquill [2] propose to use the coefficient by the order of magnitude less: $a_y \sim 0{,}03$. In a limited case of a horizontally homogeneous atmosphere the model equations for dispersions are reduced for large distances from source to: $\frac{\partial \sigma_\alpha^2}{\partial t} \approx 2 K_z \left(\frac{\partial p_\alpha}{\partial z}\right)^2$, (2)

where $p_\alpha = \bar{x}, \bar{y}$ are the co-ordinates of the cloud gravity centers; $\sigma_\alpha^2 = \sigma_x^2, \sigma_y^2$ are dispersions. Using the relation $d\,p_\alpha = d\left(t\,u_\alpha\right)$ describing a variation of the cloud gravity center with time, one may obtained (1) from (2). An analysis of the numerical results obtained has shown that at large distances from a pollutant source comparable estimates of dispersions can be obtained only when the coefficient a_x and a_y are decreased, as in [2]. The model estimates of dispersion σ_y^2 appeared to be in satisfactory agreement with the Gifford dependence [3] generalising different experimental data. An analysis of the data available and their comparison with the model estimates of dispersions made it possible to refine the range of possible values of a_x, a_y depending on the diffusion conditions with the account of simplifications of (1) in practice.

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PROBLEMS OF THE DIESEL PARTICULATES ASSESSMENT AND REDUCTION

KUTENEV V.F., ZVONOW V.A., KORNILOV G.S.

Russian Diesel Institute, phone 7-095-1541301 fax 94430030

(First received 23 March 1998; accepted for presentation during IAS-4)

The diesel engines are being largely applied as power units for various vehicles since they have the highest thermal efficiency in comparison with the other heat engines and are capable to provide a wide range of power output. However, in re cent times air pollution caused by the diesel exhaust gases of the motor vehicles has created a serious problem in the developed countries.

The major toxic pollutants of the diesel exhaust include nitrogen oxides and particulates. The diesel particulates consist of solid and liquid particles of various composition. The solid particles of soot formed during the fuel combustion have also an electric charge. To assess the emission of the diesel particulates the following methods at present are widely used:

— measurement of smoke of the diesel exhaust;

— measurement of specific mass emission of the particulates per a unit of work done.

The most widespread smokemeter is of a light extinction type (opacimeter). The opacity of the exhaust gas in a measuring chamber of the device is determined by means of the loss of intensity of a light emitting source. In the actual operating conditions smoke measurements are made at increased revolutions of the idle mode of an engine and at free accelerations.

The mass emission of the automobile diesel particulates is determined on the basis of bench tests results carried out under the 13-mode test cycle that corresponds to actual operating conditions. The particulates are collected by means of a filter from the exhaust gas that has been preliminary diluted with air and cooled (to the temperature lower that 52oC) in a special tunnel.

In the Russian State Research Centre NAMI a set of devices has been developed to measure a smoke level of the diesel exhaust mass emission of diesel particulates. The portable microprocessor smokemeter IDP-2 is designed for smoke measurements of diesel powered automobiles under actual operating conditions. A power supply of the device is from an accumulator of 12V. The stationary microprocessor smokemeter IDS-3 is intended for smoke measurements during bench tests of a diesel engine and has a remote control.

Both of the mentioned smokemeters have microprocessors, software of those ensures the following: statistical processing of smoke measurements data; an automatic adjustment of the device; a self mulfunction diagnosis.

Metrological features of the smokemeters comply with the international standards. The portable smokemeter IDP-2 has been undergone the state acceptance tests and has been certificated for application in Russia. The stationary smokemeter IDS-3 is being prepared for the acceptance tests and certification. A prototype of the minitunnel for mass assessment of the diesel particulates is passing various types of laboratory tests. In comparison with minitunnels being in use it has the following distinctive features:

— an advanced system of the isokinetic gas sampling from an exhaust pipe of diesel engines designed on the basis of a swirl valve;

— advanced designs of gas flow meters and pressure measurement devices.

The minitunnel as a whole and its separate systems are designed to comply with the international standards. To reduce diesel particulate emission measures to modify the combustion in side the cylinder or to trap particles by means of special filters incorporated in the engine exhaust system are applied.

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A prototype of the electromechanical filter based on combination of mechanisms of electrostatic precipitation of the particles and their trapping by filtration has been developed in NAMI centre. Preliminary tests of the filter have confirmed it's high trapping efficiency (over 80%) at very low pressure drop.

At present thorough investigations of the filter are being carried out.

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SOLID PARTICLES CONCENTRATION OPTICAL MEASURING INSTRUMENTS ON THE BASIS OF INTEGRATED LIGHT SCATTERING METHOD APPLICATION FEATURES

PAVEL V.CHARTY, VALERY G. SHEMANIN

SPA "Stromecology", Novorossisk, Russia

(First received 15 February 1998; accepted for presentation during IAS-4)

Integrated light scattering on particles method is one of optimum methods due to a number of the characteristics sold in solid particles concentration in technological gases automatic measuring instruments. IVA-3M concentration automatic measuring instrument realizing this method [1] was developed and is made at SPA "Stromecology" in Novorossiysk. Actual task is the place for control choice at gaspipe because the particles concentration measurement by this device is carried out practically in one point (measuring volume is about 30 cm^3), instead of the whole gaspipe cross section. In cases, when it is possible to suggest distribution of particles concentration is more or lesser constantly, satisfactory recalculation of the whole section concentration have to make by results of one-point measurement [2].Ideal for the particles control are the vertical lines gaspipe, which lengths as the minimum on the order exceed their cross sizes [2].

In real operation conditions it frequently fails to choose close to an ideal condition for this instrument installation. Therefore the experimental work on influences of the various factors on IVA-3M instrument calibration characteristics is necessary for adequate results of measurement getting with this automatic device.

Comparative measurements results of concentration of solid particles in technological gases in the industrial enterprise conditions in a wide range variation of the basic technological parameters are given in the present work. IVA-3M instrument calibration characteristics have been received for various installation sites and the recommendations for concentration of firm particles in technological gases optical measuring instruments constructed on the basis of integrated light scattering method practical application have been formulated.

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BERILLIUM AEROSOL: HIGH DANGER YET POSSIBLE PREVENTION OF HARMFUL EFFECTS

N. KHELKOVSKIY - SERGEEV

RAMS Institute of Occupational Health, Moscow, Russia

(First received 20 February 1998; accepted for presentation during IAS-4)

Beryllium (Be), its oxides and alloys are applied in power and space technologies, aviation, and other branches of industry In Russia more then 300 plants were primary consumers of Be during the most favourable period of economic development.

Be aerosols are inflammable and explosive, they are extremely toxic (1 class of danger, 0.001 mg/m is the MAC value for the air of working zone, 0.0001 mg/m is the MAC value for the ambient air, they are allergenic and carcinogenic). Acute and chronic respiratory pathologies may develop when Be aerosol penetrate to the body. The most severe and difficult to be cured is berylliosis that may progress long after the ceise of the contact.

Toxicity of Be was found in the middle of the 30 - s in Russia, Germany and Italy. The peak morbidity level fell on the 50 - s and the 60 s when production sharply increased, safety measures were not developed at that moment. About 1500 cases of the disease were registered in Russia and the USA, however, the figure should be considered as a diminished one because the register impairments due to berylliosis was developed in Russia only in the 80 - s, besides, actually no cases of non - occupational berylliosis were found in Russia (while in the USA up to 11% of cases were registered in the highest levels of morbidity). At present acute cases were eliminated though single chronic cases can be revealed, however, potential danger still exists.

Be human effects were most thoroughly studied in the RAINS Institute of Occupational Health. Cytotoxicity and allergenic manifestations that cause immune impairment lay the basis of Be human effects. When in the organism, Be may cause local macrophage - neutrophyl response, it impairs cell membranes, penetrates to the cells, leads to hydrolyst and hematoxic factors. It also breaks in cell nucleus the synthesis of protein and provokes the synthesis of autoantigens. As a strong chemical allergen, Be may cause specific reaction. Cytotoxic, allergic and immune processes develop simultaneously, prevalence of any of them depends on the level of exposure and the type of compounds. Of particular importance is the genetic predisposition, or increased sensitivity to Be, as an allergen, on a genetic level, acquired pre disposition developed due to severe endocrine shifts because of chronic pathologies, injuries, surgery, deliveries, etc., is also important.

According to the classification of the IARC Be is referred to 2 A carcinogens.

Safety measures have been well developed. In Russia the greatest number of maximum adminittable levels and concentrations have been established for Be: they are for the air of working zone, ambient air, water basins, for skin surface of hands, equipment, tools, and production, for individual protective clothing, etc. Engineering, construction ventilation measures on work hygiene and environmental protection have been developed including specific fine diagnosis methods. The main criterion of safety is strict observance of hygienic requirements.

Big Be processing enterprises have been built with regard to helpful consultations of experts of the Institute, long-term follow - up periods of working conditions, environmental protection showed that Be in the concentration in the air could be lower then the standard values. No diagnosis of berylliosis have been put during two decades of follow - up periods using immunological, physiological, roentgenological and clinical methods.

Along with all the mentioned facts, many problems concerning Be are still unsolved:

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1. Long - term follow - up periods with regard to the health are to be continued concerning long - term Be effects, both of active contingents, and those whose contacts have been ceized, at MAC level and lower which will complete the work on hygienic MAC approbation;
2. Necessary is the research of Be carcinogenic effects in cohorts exposed to it at MAC level and lower;
3. Regarding individual sensitivity in the development of berylliosis, adequate seems improvement of tests for medical examinations, pre work identification of risk groups, development of recommendations on ceisure of Be contacts;
4. System of Be monitoring in industry is necessary including the wastes; development of hygienic requirements is necessary to eliminate Be branches;
5. As more then 93% of Be goes to the atmosphere with coal burning at thermal power stations, advisable with be health study of workers, environment, and nearby residents if coal with high Be content is used,.

This question has not been studied so far in full.

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PRODUCTION OF SUBMICRON AEROSOLS BY THE EXPIRING WIRE METHOD

V.S. SEDOI, V.V. VALEVICH, AND L.I. CHEMESOVA

High Current Electronics Institute RAS, 4 Akademichesky Ave., Tomsk 634055, Russia.

(First received 15 February 1998; accepted for presentation during IAS-4)

The major characteristic in production of aerosols is the thermal energy Introduced Into the material. Depending on the energy density, the state of the explosion products can vary from liquid to plasma, and the sizes and properties of' the particles formed depend on their states.

The distribution of the energy density over the sample Is also important. The uniformity of heating is provided in the fast electrical explosion mode. The fast explosion is characterized by the following conditions: the energy introduced into the material exceeds its heat of vaporization, and the heating time is shorter than both the time of the action of the capillary forces and the time required for development of magnetobydrodynam ic sausage-type Instabilities. Comparing the characteristic time for a given process with the heating time, one can write the corresponding similarity criteria. From these criteria the conditions for uniform heating have been obtained.

The uniform heating conditions impose restrictions on the heating rate. The heating rate is a significant factor in the production of submicron metal aerosols.

Under the uniform heating conditions, the production and properties of powders based on copper, aluminum, titanium, iron, tungsten, indium, and other metals were investigated. The specific surface area of powders was measured by the low- temperature adsorption method. The shape and size distributions of particles were determined with electron microscopes. The phase composition was determined using X-ray diffraction and electron diffraction methods. Analytical chemistry methods were also used to determine the chemical composition of samples.

With rather low energy consuraptibns, under the conditions of uniform Joule heating, ultra-fine powders having narrow size distributions and a count median diameter of 4-SO nm have been produced.

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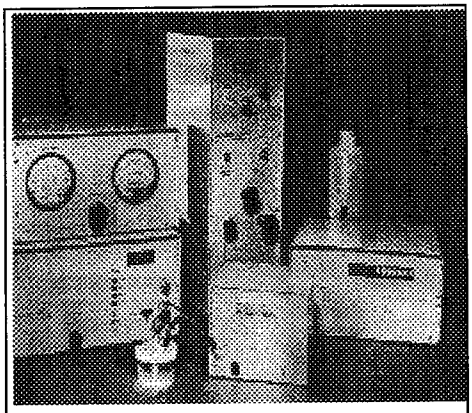
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Saint-Petersburg 6-9 July 1998

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This meeting supported by US Army science foundation, Russian Aerosol Society, American Physical Society, Moscow Department of Russian Aerosol Society... IAS-4 gathers aerosol scientists from Europe, Asia, Africa and America.

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1265.
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FORMATION OF FULLERENES AND THEIR ISOMERS

YU. E. LOZOVIK, A. M. POPOV

Institute of Spectroscopy, Russian Academy of Science, 142092, Troitsk, Moscow region, Russia

(First received 13 February 1998; accepted for presentation during IAS-4)

Since the discovery of fullerenes the explanation of their formation mechanism is one of the most interesting and puzzling problems in fullerene science. In our review report we consider various models for fullerene formation: assembling from graphite sheets, assembling of other clusters, models of 'nautilus' and 'fullerene road' and different ways of annealing from clusters with other structure (See also [1]). Two contradictory facts should be explained.

A set of experimental data shows than fullerenes easily form from hot carbon clusters of arbitrary structure and size during their annealing. Nevertheless, only few fullerenes (C60, C60, and several other) are abundant.

It was proposed that in typical conditions of are discharge or during laser ablation for mation of fullerenes takes place through following stages: firstly carbon clusters form in hot unequilibrium plasma and after that these clusters anneal in cooler regions of plasma and transform to fullerenes. However, this model explains only the first of two mentioned above facts and therefore needs in further assumptions to develop corresponding scenario.

The only assumption which is in agreement with the mentioned theory was suggested: the selection of abundant fullerenes takes place after the fullerene formation. Here we carry out the detailed analysis of experimental facts concerning this problem. We propose that abundant fullerenes selection is mainly due to reactions of molecule C2 insertion into fullerene and molecule C2 emission by fullerene [1]. Therefore the relationship of rates of these two channels of fullerenes interconvertion determines a set of abundant fullerenes. Namely, for fullerenes C28, C32, and C84, the constant of reaction of molecule C2 insertion is small; for fullerenes C36, C44, and C76, the constant of reaction of molecule C2 emission is small; and for the most abundant fullerenes C50, C60 and C70 both constants of reactions are small in comparison with that for fullerenes of neighbour size. The experimental conditions where microcluster insertion or emission by fullerenes or both processes take place are discussed.

The constants of reactions of molecule C2 insertion and emission are determined by local structure of fullerene area where the reaction take place. Therefore these constants may be different for fullerene isomers with different local structure. Thus we believe that observation only one isomer of fullerenes C60 and C70 and a few number of isomers of some other abundant fullerenes may be explained by selection with the help of these reactions.

This work was supported by the grants of Russian Foundation of Basic Research, Pro grams "Fullerenes and atomic clusters", "Surface atomic structures" and "Physics of nanos tructures".

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1319
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AEROSOLS ELECTRODYNAMIC PARAMETERS INVESTIGATION: IMPORTANCE FOR A NUMBER PHENOMENON

SERGEY BERESNEV AND ALEXANDER STARINOV

Department of General and Molecular Physics, Ural State University, Ekaterinburg, 620083, Russia E-mail: sergey.beresnev@usu.ru, alexander.starinov@usu.ru

(First received 02 March 1998; accepted for presentation during IAS-4)

The rapt of attention is now given to questions connected with dynamics of heating, evaporation, destruction and movement of aerosol particles under the influence of directed electromagnetic radiation, both solar radiation and powerful laser radiation. The theory of the droplet evaporation in the field of directed radiation is now known to solve three interconnected essential problems. First, it is necessary to determine heat sources distribution of the electromagnetic origin within a particle. Second, the solution of the heat-conduction equation (considering conditions of heat exchange with environmental gas of course) allows finding out temperature distribution within the drop volume. And third, it is necessary to analyze processes a heat- and mass-transfer in gas environment using the kinetic theory. The problem of aerosol particle movement under photophoretic force action seems to partition similarly. Thus complex character of aerosol problems does not allow ignoring either electrodynamical or kinetic part of the solution.

The droplet evaporation time in a radiation field is well-known to depend on absorption factor J0 which can be obtained as a function of the particle parameters, such as complex refraction index, size and form.

Following two approximations restrict most of all recently published theoretical investigations of droplet evaporation (their review is given in the monograph [1]). According to the first one the heat sources distribution within particle is considered to be homogeneous. One of the other restrictions is the usage of hydrodynamic approximation at the description of process heat- and mass-transfer in a gaseous phase. Such theories are applicable only for small Knudsen numbers, where it is enough to consider the steam diffusion and thermal conductivity of gaseous mixture processes only. So it is clear, to avoid the first restriction in numerical solution we ought to give a main attention to the precision of the electrodynamical parameters. That is not trivial task, due the complexities of theory even for spherical homogeneous particles. Recently, certain progress has been achieved in kinetic part of evaporation problem solution [2,3] also. These newly appeared theories allow to use them to analyze kinetics of evaporation aerosol particles in the whole range of Kn, taking into account optical, heat and kinetic properties of a particle and a gaseous phase.

The electrodynamical part of problem can be solved on the basis of the Lorenz-Mie theory [4] for scattering and absorption of electromagnetic radiation by a spherical or elliptical particle (one or some layers). Though problem of scattering and absorption is known to be solved for a long ago, numerical results and therefore possibilities for analyzing have been received recently because of development of computer facilities [5,6,7]. Calculation complexities make it difficult to achieve exact numerical results thus the represented results are the most often incorrect or reflect qualitative view only. The main results of an electromagnetic part of aerosol problems are following: the factor of absorption Jo, asymmetry factor of the temperature distribution on a surface of a particle J1 (it is for the first time appeared in [8]), in general, J-L factors, and a source function of radiation B. So the precise values of J0 are very important in problems of droplet evaporation because quantitatively determine evaporation time of a drop as shown above. Value J1 specifies the angular non-uniformity of the heat sources at particle surface and

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appears in a photophoretic problem [8] and determines both a direction and magnitude of photophoretic force and the particle movement velocity. Thereby it is necessary to calculate J1 as exactly as possible, but its precision limits with evaluation time. Our algorithm allows to get 18 decimal signs and guaranteed correct values for the whole range of diffraction parameter and complex refractive index. It is known, the main difficulty of such calculation is getting so-called Mie coefficients which define magnitudes of J1. Because of Mie series for these electrodynamic parameters converge too slowly so the maximal precision of Mie coefficients is necessary. Precision of our method is approached by combination of the best sides of Lenz and Bohren-Huffman algorithms taking ito account possibilities to evaluate some types of non-spherical particles. Logarithmic derivation and basic mathematical functions was calculated with continued fractions method, besides the criterion of the number items in series was modified too. In detail this theory of photophoresis for the whole range Kn is written in [9].

The analysis of mentioned electrodynamic parameters have been already carried out [7], but the most of the investigations concern the abstract dependence of B on dimensionless radius R and non-existing refraction index n and the absorption index k. Probably these dependencies are not related to reality, at least because values n and k for really substances are interconnected with Kramers-Kronig equation. We've carried out the systematic analysis of values J0 for aerosols of various substances types [10] taking into account the aerosol classification given at [11]. Rather simple half-empirical formula describing average (the factor of absorption for small particles is known to have a so-called ripple structure at its dependence on R) behavior of values J0 offered for various types of substances. For the first time the similar formula was offered by Shifrin [12]. But, due to the method of its construction it is suitable only for water-containing aerosols and describes only bottom bound of true values J0 [10]. The Shifrin's formula upgraded by us is now suitable for solid aerosol particles also. The systematic analysis of factors of next orders J2 , J3 (which apparently make more exact of values mentioned above J0 and J1) is now being conducted.

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1013.
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INSTABILITY OF A CHARGED DROP FREELY FALLING IN THE ATMOSPHERE

KOROMYSLOV V.A., SHIRYAEVA S.O.

Yaroslavl State University, Physical Faculty,
Sovetskaya 14, Yaroslavl, 150000, Russian, Ph. (0852) 22 - 23 - 25 Shiryaeva S.O.

(First received 21 October 1997; accepted for presentation during IAS-4)

The problem of dispersion of a charged drop which is freely falling in surrounding media presents significant interest in connection with the numerous applications in various sections of physics of aerosol systems. The instability of a large charged drop freely falling in media resulting from joint action of a sheer flow on the drop - media interface and its own charge results in deformation of aerosols distribution function of the sizes and charges of drops. In this connection the problem of finding the critical conditions of instability of a charged liquid drop, moving with constant speed in a dielectric media presents interest.

Solving the system of the electrohydrodynamic equations we received, that the charged drop is capable to undergo instability in a flow of a liquid or gas. It is accompanied by emission of heavily charged daughter micro droplets. The parents drop have a subcritical charge due to instability to self own charge. It is possible due to a superposition of two above listed instabilities. The drop can undergo instabilities of two types: aperiodic and oscillatory, depending on the relation of a drop and media density, the quantity of charge and velocity of a media flow. The aperiodic instability can be realized by deformation to extended spheroid, then a drop break up on two parts of the comparable sizes (at small velocity of a flow) or deforms to the parachute form which break up on set of fine and a several large drops (at high velocity of a flow).

1037.
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SIZE DISTRIBUTION OF RADIOACTIVE PARTICLES RESUSPENDED IN THE CHERNOBYL AREA

GARGER E.K.*, TSCHIERSCH J.**

** Institute of Radioecology UAAS, Tolstoy St. 14252033 Kiev, Ukraine,*
*** Institute of Radiation Protection GSF-National Research Center for Environment and Health D-85764 Neuherberg, Germany*

(First received 4 November 1997; accepted for presentation during IAS-4)

Size distribution measurements of particulate radionuclides were performed at two sites in the Chernobyl 30 km zone using several cascade impactors. The results obtained in the period September 1986 till June 1993 were discussed in regard to the general assumption in inhalation dose assessment of a log-normal activity size distribution. At Zapolie (a site 14 km far from the Chernobyl reactor) in 91 % of all measured distributions a bimodal distribution was observed. In most cases the medians were in the ranges 4 μm and 20 μm - 30 μm. According to soil

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granulometric data this finding was explained by superimposing two processes: local resuspension and advective transport of radioactive aerosol from highly contaminated territories. The mean air concentration showed an increasing part of inhalable particles with the years since the accident. In 1993 the inhalable fraction was about 48 % of the total concentration. At Pripyat, a site situated within a highly contaminated area, unimodal types of size distributions were predominant with the median diameters in the range 5 μm - 10 μm for ^{137}Cs. For the three nuclides ^{137}Cs, ^{144}Ce and ^{106}Ru very similar types of distributions were observed. Apparently the radioactive aerosol was of fuel origin. During a forest fire at a distance of 17 km, the main part of radioactivity was measured to be associated with to submicrometer particles with median diameters in the range 0.28 μm - 0.50 μm.

1087.
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COLLECTIVE ELECTROMAGNETIC AND HEAT EFFECTS IN AEROSOL SYSTEMS TWO AEROSOL INTERACTED PARTICLES–CONTINUOUS MEDIUM

UVAROVA L.A.*, KRIVENKO I.V., SMIRNOVA M.A.****

** Moscow State Technological University "Stankin", 101104, Moscow, Vadkovsky str., 3a,*

*** Tver State Technical University, 170026, Tver, Af. Nikitin emb., 22*

(First received 10.10.97; accepted for presentation during IAS-4)

In this paper we investigated collective effects, conditioned by the electromagnetic and heat interaction in placed in continuous medium two aerosol particles system. There were solved the system of stationary Maxwell equations for two spherical absorptive particles and heat equation with heat source, initiated by electromagnetic radiation:

$$\nabla^2\mathbf{E}_j + k^2\varepsilon_j\,\mathbf{E}_j = 0, \quad \nabla^2\mathbf{H} + k^2\,\varepsilon_j\mathbf{H}_j = 0,$$

$$\nabla\mathbf{D}_j = 0, \quad \nabla\mathbf{B}_j = 0,$$

$$\nabla(\chi_j\,T_j) + q_j = 0,$$

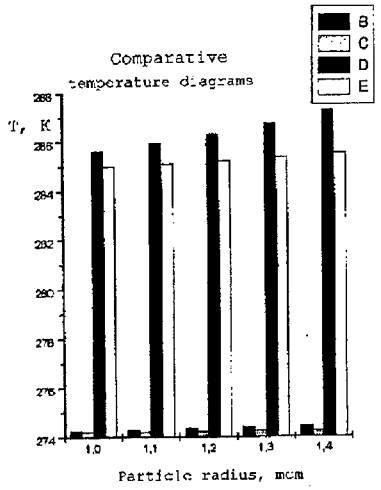
$$q_j = 4\pi n_j\,m_j|\mathbf{E}|^2 I/\,(n_3\lambda), \quad j = 1, 2.$$

Here are: $k = 2\pi/\lambda$, λ - electromagnetic wavelength, $\varepsilon = \varepsilon^{*} + i\varepsilon^{**}$ - complex dielectric permittivity, T - temperature, χ - coefficient of the heat conductivity, χ = (T), q - the density of the heat source, n - refractive parameter, m - adsorption coefficient, I - intensity of the initiative radiation, the indexes j = 1, 2 are related to the first and the second particles accordingly, the index j = 3 - to the surrounding medium, $\varepsilon_3^{**} = 0$, $q_3 = 0$. Using the received analytic solutions for the electric and magnetic vectors in the form of the infinite system of linear algebraic equations [1] there were received a program for the calculation of the densities q_j in the each particle and the temperatures T_j. By means of carrying out computations there were varied the radii of the particles r_j, the interparticle distance, the intensity of radiation I, wavelength, optical and heat characteristics. In the picture there are presented as a primer the diagrams, received on the basis of the carrying out computations for water drops. There were assumed, that =10.6 mcm, r_1=1 mcm, r_2=1 — 1.4 mcm, the temperature of the undistorted by the presence of the particles atmosphere T_0 =273 °K, the intensity of initiative radiation I_1, I_2 , $I_1=10^6$ W/m², $I_2=10^7$ W/m².

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The rectangles are shaded at the pattern and accords the following cases: 1) B, C for $I=I_1$ и $I=I_2$, accordingly, there were there were taken into consideration the electromagnetic and heat interactions; 2) D и E, $I= I_1$ и $I= I_2$ accordingly, there were taken into consideration only electromagnetic interactions of the particles (the computation of the temperature was carrying out for single particles on the basis of the found from the electrodynamics problem heat sources densities) was hold haw for the single particles. At the ordinate axis there are put the values of the temperature at the surface of the first particle. Since, in general, the surface temperature of the particles T_{sj} depends on the surface point $M^{(i)}$, then there was computed T_{s1} in the point $M_o^{(i)}$ with the coordinates $\xi = r_1$, $\eta = \pi$ in bispherical coordinate system for the clarity. The valueT_{s1} was determined with the consideration of Knudsen layer influence.

The represented diagrams are illustrated the increase of the heat interaction caused contribution with the rise of the second particle radius (it goes to 13% for r_2=1.4 mcm, if $I= I_2$, and to 28%, if $I=I_1$).



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1062.
УДК 541.18

A PROGRAM TO STUDY THE EFFECT OF AEROSOLS ON ATTENUATING THE SOLAR RADIATION IN TAIWAN (1994)

CHUNG-MING LIU ET AL.

Department of Atmospheric Sciences, National Taiwan University, Taipei, Taiwan, R.O.C. liucm@ccms.ntu.edu.tw

(Received 8 February 1997)

Aerosols are effective on scattering the solar radiation. The surface aerosols would hence affect the local visibility and attenuate the solar flux. This project intends to gradually set up observation program in Taiwan to analyze the effect of surface aerosols on the solar radiation field. In the first few years, we have selected the Tainan area for study. It is because that the

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area is flat and with a uniform distribution of air pollutants. Climatological data show that during September - April, Tainan was dry and clear, with a prevailing northerly, poor visibility and high levels of PM10, i.e. aerosols with diameter < 10mm; whereas during May-October, this area was wet and cloudy, with a variable wind, good visibility and low PM10 levels. Hence, we have selected the autumn, winter and spring seasons as the target period for the future intensive study period.

During February - March 1995, instruments were set up at Tainan-Yukang Meteorological Station to measure the surface solar flux, the aerosol composition and the aerosol optical properties. The Solar Spectrum System set up by the Yankee Environmental Systems, Inc., was used, which contains a automated multifilter rotating shadow-band radiometer (MFR-6) to measure the solar intensity in 415, 500, 600, 665, 862 and 940nm with an interval of 10nm each. Meanwhile, a TSP (Total Solar Pyrheliometer) was set up to provide a standard total solar flux dataset to be intercompared with those estimated by MFR-6. The data acquisition system is YESDAS-2. Meanwhile, a sky video-taping system was set up in along with a ceilometer, to assist in the determination of the clear-sky condition. Only the data collected during a clear-sky condition, will be used to study the effect of local aerosols on the attenuation of the solar flux. Otherwise, the scattering effect by cloud particles on the solar radiation is far more important than that by aerosols.

A Scanning Mobility Particle Sizer (SMPS), TSI model 3934, was set up to determine the number spectrum of aerosols with diameter between 0.025 -Ц 0.5mm, which was then compared with the number spectrum data collected simultaneously by a PMS probe for aerosols with diameter of 0.1 -Ц 10 mm. Meanwhile, an Integrating Nephelometer, TSI model 3563, was set up to determine the light scattering coefficient (m-1) of aerosols. The instrument is sensitive enough to measure the scattering coefficient as low as to 10-7m-1, and can provide the total and the backward scattering coefficient of aerosols in the band of the red, green and blue color, respectively.

In order to determine the composition of aerosols, a GBM-2000H high volume sampling system was set up to collect the aerosol samples. The filter used was Whatman 41 (20x25 cm). Since only a Hitachi Z-8100 polarized Zeeman AAS was available during the experimental period, only the concentration of the elements of Al, Fe, Mn, Na, Mg, Zn, and Pb were determined. The data of Pb, Na and Al were used as an indicator of the anthropogenic, marine and crustal influence.

Currently, the datasets collected during February-March 1995 are still under detailed analyses. A preliminary report to the National Science Council with a project ID no. NSC84-2621-M002-037 is available form the author. The whole research team contains: Chung-Ming Liu, Fei-Jan Lin (Institute of Oceanography, National Taiwan University), Chung-Teng Lee (Graduate Institute of Environmental Engineering, National Central University) and Hsiu-Wu Chang (central Weather Bureau).

1264.
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PHASE EVOLUTION OF ATMOSPHERIC CLOUDS." NEW CONCEPTION BASED ON EXPERIMENTAL DATA

ANATOLY N. NEVZOROV

Central Aerological Observatory, Dolgoprudny, Moscow Reg., 141700 Russia cloud@adonis.iasnet.ru

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The present knowledge of two-phase microstructure and phase evolution of clouds at negative temperatures being basically a priori, is in poor general agreement with the factual

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evidence and is only weakly progressing under limited possibilities of field experiment. Representative comprehensive measurements performed in the late 80s with the CAO aircraft instrumentation have revealed a. series of new unexpected peculiarities of phase and disperse composition of such cold clouds:

I. In clouds consisting of only supercooled water drops as commonly accepted, actually ice fraction is usually detected with particles less than 20 to 30 mkm in size and up to tens of thousands per a litre in concentration.

2. Bath purely ice and mixed, by definition, clouds integrated here as ice-containing clouds (ICC), equally practically always carry liquid droplets up to tens and hundreds micrometers in size. The liquid phase in ICC persists at temperatures down to at least - 55°C. As to mass and numerical content, the droplet 5 action is comparable' with ice one and exhibits positive spatial correlation with this.

3. Just listed represents the complete set of' signs of. condensation equilibrium between both condensed phases in mixed clouds which include almost without exception all ICC. As this takes place, in all ICC the relative air humidity proves to be lower than saturated relative to liquid water.

4. It is found from the comparison of magnitudes of microphysical parameters determined through the use of different physical methods, that the substance of ICC liquid droplets has the refractive index between 1.8 and 1.9 and hence the density 2.1-2.2 $g.cm^{-3}$, and the evaporation heat about 550 J/g at - 30'C. It is important to add thereto that the known phenomenon of coloured gloria on a mixed cloud top can be elementarily interpreted as the first-order bow formed on big enough spheres having the refracting index close to 1.83.

The conclusion is justified from all sides that the liquid droplets in ICC are comprised not of usual supercooled water, as it is generally agreed, but of a specific amorphous phase of water, or A water. This water state is distinguished by the absence of intemolecular hydrogen bonds, and is known from laboratory experiments as both solid and melted amorphous ice. The amorphous water has the vitrification/softrening temperature 135 K and the flowability limit at about 150 K (-120'C). In melted state, this is capable of spontaneous crystallization with transforming to usual ice I.

The analysis of great totality of both known and newly obtained experimental facts, based on the fundamentals of the physical chemistry, leads to the following conclusions.

Having the lowest condensation enthalpy of all condensed phases of water, the A-water can nucleate only though direct condensation from vapour. At the same time, A-water plays the genetic role of an intermediate phase, or polymorphous substance of two-step phase change in ice deposition processes by the Ostwalds rule. This statement is confirmed by the existence of quasi-liquid transition layer on the surface of ice particles, responsible as such for the condensation equilibrium between ice and A-water particles. At the absence of active crystallization centre in a nucleus of condensation of A-water, it stays in metastable form of liquid droplet.

The permanent coexistence in ICC of droplets of A-water and ice particle;. in comparable concentrations being by orders different from these of the known ice-forming nuclei, suggests the universal dominant role of the mechanisms of condensation and partial ciystallization of A-water in formation of ICC. Essential independence of average concentrations of both ice and liquid particles of temperature, including lower than -40oC (gives the indication of' uniformity of microphysical processes forming ICC microstructure.

It was found in recent years that the icing of water clouds can be resulted from not only commonly accepted freezing of supercooled droplets, but also from their evaporation accompanied by regeneration of former nuclei of condensation of ordinary water into the secondary ice forming nuclei. As follows from our data this evaporation-reactivation

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mechanism forms the nuclei of both condensation and subsequent crystallization of A-water and is far more productive in ice generation than the freezing mechanism. The abundance in the atmosphere of cloudiness layers with vapour supersaturation relatively to ice implies that the A-water condensation nuclei are usually absent in dry air, and possible obligatory condition for their natural generation is the intermediate condensation of ordinary water.

In a water cloud, the secondary nuclei are capable to be collectively generated under the lowering of environmental humidity, sufficient for though the smallest droplets to evaporate. The originated thereon particles of A-water and ice are first very slowly growing to sizes of order of 20 mkm. This just gives the most real explanation of many-hours lifetime, as observed, of supercooled water clouds which are in fact in unstable "latent-mixed" state. As the gravitational fall of growing particles accelerates, the slowest molecular diffusion mode of Bergeron phase re-condensation converts to increasingly fast convective mode, completed by the avalanche-type process of full evaporation of ordinary water with vapour deposited on A-water and ice particles (Bergeron -Fiodeiseo process in extended sense).

The terminal stage of the phase evolution of a cloud, called above ICC, is the equilibrium three phase system. The utilitarien definition of ICC may be either or both colloidally stable mixed cloud and "quasi-ice" cloud in which a part of disperse ice stays in the metastable form of intermediate liquid condensate.

The content of A-water in ICC averages between 60% and 80% of total water content at all temperatures down to -55oC. The droplet effective diameters vary in most cases within the limits 20 mkm and 100mkm. The droplets of A-water have as a whale a dominant impact on diverse optical properties of ICC, far from excluding cirrus clouds even at temperatures lower than - 40'C.

The conclusions suggested are deduced solely from the analysis of wide totality of reproducible observational evidence and experimental data as well as of scientific fundamentals. These not only refine the basic conceptions of the physics of cold clouds but also put forward comprehensive explanations for numerous poorly understandible phenomena involved.

1065.
УДК 541.18

ON SPRAYING OF ELECTRIFIED CAPILLARY JETS

GERTSENSHTEIN S.YA., LYAKHOV A.G., NEKRASOV I.V.

Institute of Mechanics, MSU 119899 Moscow, Michurindki prospekt, 1

(Received 16 December 1997)

Main attention in this work will be given to experimental study of features spraying of a charged aerosol near the unexposed surface. The charged aerosol produced on initiation of corona discharge and subsequent deposition of ions generated in the corona discharge on independently formed drops of aerosol.

The experimental setup consisted of a corona electrode, a high-voltage (10 - 30 kV) power supply, an aerosol generator, a grounded electrode, a grid, and an object for spraying (a rectangular plate and so on). The aerosol generator was constructed according to the model of an atomizer and produced an aerosol jet whose speed considerably exceeded that of the ion wind near the corona point.

The studied object comprised two Getinaks plates covered on one side by copper foil with dimensions 300 mm * 50 mm. The plates were installed so that the foil was on the outer (relative to each other) surface of the plates. The plate-to-plate clearance (2 mm) prevented electrical contact between the plates when they were wetted. Charges collected by the plates leaked out

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through the resistors, and the voltage across them was measured by an electronic voltmeter. The water collected by the plates drained down and was directed to the measuring vessels.

In particular, the experiments were carried out when the water consumption q=1.6 cm³/s, the spraying, period was 30 s, the air consumption was equal to 1.4 l/s, and the voltage was varied in the range 0 - 26 kV.

We also carried out quantitative measurements of the current feeding the needle, the currents through both plates, and the water flows falling on these plates.

The currents run off the unexposed I1 and front I2 surfaces is relation to the water consumption q and needle voltage E are given.

Exchange of Getinaks plates for a fine-mesh wire netting, which intersected the entire cross section of the jet, led to a similar decrease of the charge carrying away by the jet when the water consumption was increased from 0.8 to 1.6 cm³/s. The amount of water draining off he plates was determined using the measuring vessels. The ratio of water amount fallen on the unexposed surface to that on the front surface Q_1/Q_2 is shown there as a function of the needle voltage.

One of the significant results of this work is that the spraying efficiency is independent of water consumption (within the limits of experimental accuracy). As mentioned above, with an increase of q the needle's feeding current does not change, and the current flowing off the plate actually slightly decreases.

A relationship was also studied between the ratio Q_1/Q_2 and angle of the jet incidence on the plate surface. It is shown that at angle < 45 grad. the ratio Q_1/Q_2 does not change significantly, and at angle = 60 grad. this ratio noticeably increases.

One of the most interesting investigations of this work concerns a study of the distribution of sprayed substance over the unexposed surface of a plate.

It is easy to see that the interests of spraying falls to the center approximately exponentially.

Also the results of new effective way of charged aerosol generating are presented. Aerosol is generated on oscillating string with small drops of liquid exposed in high voltage field.

1315
УДК 541.18

KINETIC THEORY OF DIFFUSIOPHORESIS OF AEROSOL PARTICLES IN A BINARY GAS MIXTURE

V.G.CHERNYAK, S.A.SERESNEV, S.A.STARIKOV

Department of Molecular Physics, Ural State University, Ekaterinburg, 620083, Russia

(First received 02 March 1998; accepted for presentation during IAS-4)

Concentration gradients of the chemical species in a gas mixture are known to cause movement of aerosol particles. The particle motion is commonly termed "diffusiophoresis", and the force producing this motion is known as "diffusion force" [1]. This phenomenon, which cannot be described within the ordinary continuum theory, may find various technological applications, one of which will be the separation and collection of small particles (micron- and submicron-sized).

The theory of diffusiophoresis has been developed previously' only for particles whose radius was either much smaller or much larger than the mean-free path of the gas molecules. The analysis covering the regime of an intermediate Knudsen number, i.e. the transition regime, is an important but difficult problem in aerosol microphysics. A few studies have been made in the transition regime based on kinetic theory treatments (one of these theories is the method of giant molecules [2]). The aim of this work is the elaboration of a consistent gas-kinetic theory for the diffusion force, friction force, diffusiophoretic velocity and the study of

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their dependencies on the properties of an aerosol particle and binary gas mixture. Consider a spherical particle placed in an infinite expanse of binary gas mixture with a low concentration gradients along OZ axis. As the concentration gradients are very low, the velocity distribution functions for the binary gas mixture can be linearized. This allows to split the problem (the diffusion force problem and the friction force problem). The particle surface temperature and the temperature of a gas mixture are the same (and constant). Let us use the Lorentz's and the Rayleigh's vapour-gas mixture approximations when the vapour concentration is small, and the molecular mass of the vapour is much less or much larger than the molecular mass of background gas.

The problem is solved in a steady-state formulation on the basis of the linearized McCormack model kinetic equation [3] under the boundary conditions of Maxwell's type (diffuse reflection type). The integral-moment method of solution for arbitrary values of Knudsen number is employed. The set of integral moment equations for macroparameters was solved by the Bubnov-Galerkin method. Numerical calculations of the diffusion force, friction force and diffusiophoretic velocity for the extensive range of Knudsen numbers are carried out. The results obtained are compared to the known theoretical [2,3] and experimental [4,5] data.

This work was supported by the Grant for Scientific Research (No. 96-01-00756) from the Russian Foundation for Basic Research (RFBR).

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1317
УДК 541.18

DIFFUSIOPHORESIS OF AEROSOL PARTICLES AT ARBITRARY KNUDSEN NUMBERS: APPLICATION OF THE SHERMAN'S METHOD

S.A.BERESNEV, A.S.PASECHNICK

Department of Molecular Physics, Ural State University, Ekaterinburg, 620083, Russia

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Concentration gradients of the chemical species in a gas mixture are known to cause movement of aerosol particles. The particle motion is commonly termed "diffusiophoresis", and the force producing this motion is known as "diffusion force" [1], This phenomenon, which cannot be described within the ordinary continuum theory, may find various technological applications, one of which will be the separation and collection of small particles (micron- and submicron-sized).

The theory of diffusiophoresis has been developed previously only for particles whose radius was either much smaller or much larger than the mean-free path of gas molecules. The analysis covering the regime of an intermediate Knudsen number, i.e. transition regime, is an important but difficult problem in aerosol microphysics. A few studies have been made in the

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transition regime based on kinetic theory treatment (one of these theories is the method of giant molecules [2]).

The strict and consequent approach to the problem should be based on the decision of the Boltzmann equation (or appropriate model kinetic equation of rather high order) with adequate boundary conditions for the distribution function on a particle surface. The first stage of the problem decision at such level is presented in the report of V.Chernyak, S.Beresnev and S.Starikov "Kinetic theory of diffusiophoresis of aerosol particles in a binary gas mixture" (where the results for the small concentration of one species are obtained). The solution of the problem for arbitrary concentration of species encounters a number of serious difficulties of computing character (one of them necessity for accounts every time to set parameters of a specific binary mixture).

The aim of this report is the attempt of reception of estimated results (with an error no more than 10 %) for the friction force, diffusion force and difFusiophoretic velocity for the arbitrary concentration of species in a binary gas mixture in the whole range of Knudsen numbers on the basis of a so-called Sherman's method [3] (interpolation method allowing on the known decisions in free-molecular and hydrodynamical limits to receive results in the intermediate regime).

Note, that the Sherman's method for phoretic problems in case of gas mixtures is used, apparently, for the first time.

The received results are compared with known theoretical and experimental data. The high efficiency of the developed technique is shown. The received expressions can be useful for the practical estimations of diffusiophoretic behaviour of aerosols in binary gas mixtures.

This work was supported by the Grant for Scientific Research (No. 96-01-00756) from the Russian Foundation for Basic Research (RFBR).

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1448.
УДК 541.18

GLOBAL CHANGES OF COMPOSITION AND TEMPERATURE OF THE ATMOSPHERE CAUSED BY SULFUR DIOXIDE DISCHARGES INTO ENVIRONMENT

DYOMINOV I.G.[1], ZADOROZHNY A.M.[1], ELANSKY N.F.[2]

[1] Novosibirsk State University, Novosibirsk, 630090, Russia;
[2] Institute of Atmospheric Physics, RAS, Moscow, 109017, Russia

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A two-dimensional zonally averaged model is used to examine global changes of composition and temperature of the troposphere and stratosphere caused by sulfur dioxide discharges into environment, which are due to the mount Pinatubo eruption and regular flights of supersonic aviation in the period of 1990 - 2015. The model self-consistently calculates diabatic circulation, temperature, and distribution of 45 gas constituents and distribution of condensed particles in a sulfate aerosol layer. To adequately represent the main features of

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Счет 15 **от** **1998**

Наименование товара	Ед. изм.	Коли-чество	Цена руб.	Сумма руб.	Ставка НДС	Сумма НДС, руб	Всего с НДС, руб.
Оргвзнос за участие в Симпозиуме IAS-4, 6-9 июля 1998 г.	взнос	1	250	250	20 %	50	300

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Наименование товара	Ед. изм.	Коли-чество	Цена руб.	Сумма руб.	Ставка НДС	Сумма НДС, руб	Всего с НДС, руб.
Оргвзнос за участие в Симпозиуме IAS-4 на 1 день	взнос 1 дня	1	50	50	20%	10	60

Счет 17 **от** **1998**

Наименование товара	Ед. изм.	Коли-чество	Цена руб.	Сумма руб.	Ставка НДС	Сумма НДС, руб	Всего с НДС, руб.
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sulfate aerosols of the atmosphere with sizes in an interval $0.0064 < r < 5.2$ microns, a rather complete scheme of photochemical changes of sulfur compounds has been used along with the most important microphysical processes including nucleation, condensation, evaporation, and sedimentation. To take into account gas component sinking on aerosol particles surface, six heterogeneous chemical reactions are used. The calculations are made for the latitudes from the North to South poles at altitudes from 0 to 50 km. It is shown that megaton discharges of sulfur dioxide in the atmosphere during the Pinatubo eruption result in significant changes of temperature, gaseous and aerosol composition of the troposphere and stratosphere. For example, by the end 1991 we have in tropics (30°N - 20°S) at altitudes of 22 - 24 km a -2.5-3.5K increase in temperature, while at altitudes of 5 - 8 km a -0.8-1.0K decrease in temperature. It is caused by the intense absorption of solar radiation by aerosol particles from powerful eruptive stratospheric clouds. These clouds play a role identical to that of polar stratospheric clouds leading to form the ozone hole. At the surfaces of particles forming these clouds comparatively inactive HCl and $ClONO_2$ transform itself into more active chlorine components. In -100 days after eruption this results in a 5-7% decrease in total ozone at latitude of 35°N-25°S. An autumn transport of eruptive aerosols to higher latitudes brings about a significant variation of ozone in the polar region. This effect is most pronounced over Antarctic where the spring 1992 decrease in total ozone receives a 15 - 18% addition in comparison with 1991. It is the result of the sharp decrease of the ozone at the heights of 11 - 13 km and 17 - 28 km. Powerful discharges of sulfur dioxide from the Pinatubo eruption significantly increase the aerosol optical thickness of the stratosphere. This leads to a -0.28K decrease in monthly mean global temperature at the Earth's surface by the end of 1992.

Calculations of global impact by regular flights of 500 supersonic aircraft on gaseous and aerosol composition of the troposphere and stratosphere are carried out with the two values of nitrogen oxide emission index ($EI(NO_x)$), 15 g and 5 kg of NO_2 equivalent per 1 kg of fuel. Emission index for SO_2,H_2O, CO, CO_2 and CH_4 are adopted to 0.4; 1230; 1.5; 3160 and 0.2 g per 1 kg of fuel. Averaged global fuel consumption is 80 megaton a year. The ratio of a mean speed of flights to the sound velocity (Mach number) is 2.4. Calculations are carried out with account taken for SO, injection into the atmosphere from aircraft engines as well as without this injection at all. Three kinds of sulfur compounds emission are used: as gas (100% SO_2), as gas/particles mix (90% SO_2 Grid 10% SO_2 converts into aerosol particles), and as 100% particles. The size of sulfate particles is taken to be 0.01 microns.

It is shown that it is necessary to take into account the processes involving atmospheric aerosol particles in order to be able to adequately estimate global change gaseous composition of the atmosphere by regular flights of supersonic aviation. Thus, consideration of heterogeneous surface processes on particles of background ($EI(SO_2)=0$) sulfate aerosol layer leads, in the entire region, to a significantly lower ozone destruction than consideration of only gas-phase reactions. It is the result of heterogeneous conversion of NO_x($NO+NO_2$) into HNO_3 leading drastic weakening of destructive effects of the nitrogen cycle on ozone.

Thus aerosol sulfate particles are a buffer in the atmosphere, that is, weaken the effects of aviation on the ozone layer. When sulfur dioxide injection by supersonic aviation is present, such a buffer characteristic of sulfate aerosols significantly depends on the kind of sulfur compounds emissions, NO_x emission index value, and odd chlorine background content. The kind of emission of sulfur compounds defines a character of changes of effective surfaces of sulfate aerosols.

The results of self-consistent model calculations show that without SO, emission ($EI(SO_2)=0$) the impact of aircraft exhausts on a background value of sulfate aerosol surface density is hardly noticeable. This fact allows us to take into account only sulfur compounds emission for estimation of supersonic aviation impact on the sulfate aerosol layer of the

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atmosphere. This estimation gives a significant (about 35%-50%) increase of aerosol surface density in the lower Northern stratosphere following sulfur compounds injection in the gaseous form (100% SO,). Gas/particle (90% SO_2/10% particles) mix gives a still more significant increase (up to 75%). When all SO, converts into sulfate particles, the latter causes a catastrophically great (-100% - 200%) increase in aerosol surface density in a wide range of latitudes (90°N - 20°S). All these effects are caused mainly by increased H_2SO_4 content and nucleation, condensation, and coagulation.

In light of all the above results, estimates of global ozone changes by 2015 due to regular flights of supersonic aviation show that for the two examined chlorine background contents (3 ppbv and 2 ppbv) sulfur injections accompanying those of nitrogen oxides lead to a decrease of prognostic depletion of total ozone in the Northern Hemisphere. Thus, for NO_2 and SO_2, emissions from aircraft engines anticipated in near future (that is, with $EI(NO_x) = 15$ and with $EI(SO_2) = 0.4$) sulfate aerosol layer is a buffer in the atmosphere of the Northern Hemisphere for every kind of sulfur compounds emission, that is, it leads (due to heterogeneous and microphysical processes) to the weakening of impact of regular flights of supersonic aviation on the ozone layer of the atmosphere.

1377.
УДК 541.18

DEVELOPMENT AND METROLOGICAL QUALIFICATION OF THE RADIOACTIVE ISOTOPE DUST-METER IKAR

BALAKHANOV M.V., BOLSHAKOV V.A., KUDRJASHOV V.V., PETROV A.A., SEVASTJANOV V.D., SOLNYKOV V.V.

GP "VNIIFTRI", IPKON RAS, SKB IRE RAS, Moscow

(First received 30 March 1998; accepted for presentation during IAS-4)

An operative and exact checking of the air dustiness level are necessary for the raising of air disdusting efficiency on factories, where technological processes are accompanied to the generation of dust. Herewith follow to use such concentration's measurement method, which is less subjected to influence of material and dispersity dust's composition, since stuff and technology of its processing on the concrete factory are not known beforehand and can change over a wide range. Only a radioactive isotope measurement method possesses specified characteristics from known indirect methods of a dust concentration's evaluation in midair. It is based on the measurement of the beta-particle attenuation in a layer of dust, precipitated on the filter from the given volume of dusted air. This circumstance does the radioactive isotope dust-meter preferred not only at the measurement of dust concentrations in midair of a working area, as well as at an environmental ecological monitoring on dust factor.

One of the important conditions of undertaking the responsible measurements is a possibility to metrological qualifications (type approval tests) and to checks of instruments, realizing chosen method. Herewith two approaches are used. In first, master samples of material are used for the check and qualifications. In the event of the measurement of dust concentrations it is practically impossible to create a sample of the standard polluting air because of instability of an aerodispersive air-dust system. In the second approach, simulators or so named equivalent measures are used, which are objects that are distinguish from a measure, but have alike or equivalent influence on measuring instrument elements. However under such approach it is necessary strictly to prove those attenuation laws using in the beta particle's radioisotope method are the same or are like at the accuracy to the constant factor in the layer of dust particles and in the equivalent measure.

A radioactive isotope method of measurement of a dust concentration in midair is based on

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the filtration of known volume of polluting air and the following determination of sediment on the filter mass of dust on beta radiation attenuation in it.

A theoretical analysis of the a beta radiation which is absorbing in such nonevent dust layer has show that attenuation in it is always less, than in equal on the mass even film, but law of absorbing is distinguish by presence of transfer factor in the power of the exponent. In this case it is important so named uniformity of the sensitivity of the measuring system, defined by the form of a radiation intensity sharing and by an efficiency of registrations on the area of a spot. Developed by authors constructive decisions have ensure the uniformity of this sensitivity and have reduce inaccuracy of measurement.

The experimental check was made with using dust with different disperse and material compositions, it has show fairness of developing theoretical positions, has confirm a coincidence of theoretical and experimental transfer factors (a transition from dust to the film from such material), when ensuring uniformity of the sensitivity on the area of a dust preparation.

The studies have show the equivalence of a light beta radiating absorption in a dust layer on the filter and in nylon films, imitating such layer, that allows to use last as equivalent measures at qualifications and check of radioactive isotope dust-meters.

The carried studies have allow to develop and design a dust-meter, in which the radioactive isotope method of measurement is realized to concentrations of midair dust. At the measurement of concentrations a dust-meter executes subsequently a measurement of volume of air, pumped through the filter by the built-in in the instrument pump, and then a measurement of the precipitated on the filter dust mass herewith. Volume of air is defined on the number of swings of pump, but mass of a dust setting-on the attenuation of light beta radiation in the getting dust spot (on the correlation of number of pulses, registered by the detector of radiation before and after pumping of polluting air through the filter). A filtering tape NEL-3-25 is used as a filter, a source, containing the carbon-14 isotope-as a source of beta particles.

In measuring block of the dust-meter occurs a processing of the received information and its calculation to mass concentrations.

Calculation is executed automatically and on the indicator panel of the dust-meter is flashed a numeric value of a dustiness in the sampled air.

A value of a transformation factor is individually for each instrument (for different copies of instruments this difference is not great), The factor is defined in the process of its adjustment and written in the dust-meter's passport.

A dust-meter adjustment and check are realized by using the equivalent measures that were made from a nylon film. Measures present disks from a nylon film at the thickness 3, 10 and 20 micrometers, bolt in special holders, which locate in the process of adjustment or checks on the imitating dust spot filtering tape. The equivalent measures pass a qualification under their fabrication. The qualification of the measure is concluded in specifically exact measurement of their mass (balances are used with inaccuracy of measurement 1 - 3 mkg) and in determination of their area (on disk's diameter measurement's results with inaccuracy 2 - 3 mkm).

The dust-meter defines automatically in the process of measurement a necessary time for drawing of polluting air through the filtering tape. This is reached by comprising of the composition of instrument of micromanometer, defining swing of pressure on filtering tape in the air selection process. At the achievement of definite value of a pressure difference, corresponding to a dust spot shallow density of 2 - 3 mg/cm2, micromanometer gives a signal, which stops a working pump. This technical decision has allow us automatically to prevent an overflow of a filter by dust, under which possible garbling an exponential law of absorbing a beta radiating and to avoid a significant inaccuracy in the dust concentration measurement's

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results. A technical feature of the developed express-dust-meter IKAR is given below:

Limits of measurement, (mg/m3) -- 05 - 500.	Mass, not more, kg -- 2,2.
Inaccuracy of measurement, %, not more -- 25.	Performance-industrial.
Times of measurements, not more, minutes -- 15.	

A showing of an instrument do not depend on the change of disperse and material compositions of dust. Metrological qualification of instrument was carried out by VNIIFTRI on the special stand, that allow us to define the main forming inaccuracy of measurements. Master equivalent measures of shallow density of nylon films' type PET-KE were independently qualified on the mass shallow density on the VNIIFTRI's radiometric complex of the State special standard of the neutron fluency and flow density units. At the thickness of films 5, 10 and 20 mkm the shallow densities were measured, accordingly, equal to 0,517-0,519; 1,75-1,80 and 2,94-2,95 mkg/cm2. The measurement inaccuracy of the films shallow density of master equivalent measures formed a value not more 0,5% under confidential probability 0,95.

1376.
УДК 541.18

EQUIPMENT FOR MEASUREMENTS AND TESTING OF AIR CONTAMINATION AND CERTIFICATION OF CLEAN ROOMS

BALAKHANOV M. V., GRITSENKO A. P., KOCHERGA V. G., TROTSENKO N.P.

GP "VNIIFTRI"-State Enterprise "All Russian Research Institute of Physical-Technical Radiotechnical Measurements" by Gosstandart of Russia

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Clean rooms (CR) are required for realisation of the high-tech. in which parameters of all technological environments are testing. Air environment is tested on one of the main parameter. a particle aerosol contamination. As an effect, the amount of a processing, a sending and a recording information about parameters of controlled environments has increased sharply. This has led to the creation and the introduction into practice a new generation of the checking-measuring equipment- computer systems for air environment monitoring in clean rooms. On these reasons a need of association into the computer network a number of autonomous instruments becomes a main condition to fulfil requirements of standards on the testing and the certification of clean rooms. These instruments, which are used for measurements and qualifications, are analysers of the contamination of air, sensors of temperature, pressures, moisture and etc.

A short description of instruments developed in VNIIFTRI is given below: an autonomous counter of aerosol particles "Monitor A-33". having channel for the association in the computer network, and a computer system "Monitor - C" for monitoring and testing the air contamination in CR's. Instrument "Monitor A-33" is a photoelectric particle counter, which principle of action is based on the analysis of light radiation, scattered by aerosol particles when a sampling air is pumped through the illuminated measuring volume.

This instrument consists of an optical block, a pneumatic block and a block of electronics. A halogen tube was used as the radiating source in the optical block. The design of the optical block ensures a reliable checking of aerosol particles with sizes equal and more than 0.3 pm. The pneumatic block ensures a pumping of air through the aerosol chamber and a regulation of its consumption within range from 1 to 3 litre per a minute. The microprocessor block of electronics executes a collection, a processing and a displaying of a measuring information.

The base model of the counter "Monitor A-33" has the following features:

* a number of channels for the simultaneously registering of the aerosol particles - 4;

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* sizes of particles in the channels: >=0,3μm, >=0.5μm, >=1μm, >=5μm;
* a volumetric consumption of air sampling for the analysis - 1 litre per a minute;
* an indication of measurement results is numerical, on a built-in 7-sign indicator pa dimensionality of results is a number of particles per a cubic meter of air;
* time of one measurement (sampling) - from 1 minute to 9 hours (will be assign by an operator from the keyboard of the instrument);
* an additional information that is given on the numerical indicator panel in the process of measurement: current time of measurements, a number of particles in each channel for a current time, a checking information on states of working instrument:
* an RS-232C interface for the relationship with external PC;
* the instrument has a built-in block of the optical channel calibration;
* a power supply of an instrument is from industrial network 220 V 50 Hz,
* gabarit sizes - 360x300x120 mm.

Built-in RS-232C interface allows remote control (up to 100 m) by the regime of working instrument and to interchange by the measurement information with an external PC. A special software enables to unite in the computer network up to 256 instruments of given type just through COM1 port by using the standard computer analysis facilities, a performing and an archiving of a measurement information.

Parameters of the base instrument models (a threshold value of sizes of particles in channels and volumetric consumption of air) can be changed at the request of the customer.

Base model has a number of modifications and in particular model "Monitor A-33/MAC" is intended for undertaking the measurements in areas with a microbiological contamination control and is adapted to requirements of GMP rules. There are developments with autonomous (storage) by power supply and in the safety explosive performance.

A specified computerising measuring system Monitor-C consists from following elements: an IBM PC/AT computer, a network adapter. a multiplexor and aerosol measuring sensors. As sensors two-channel photoelectric particle counters are used, each counter has a built-in power supply unit and a pneumatic block. All sensors have built-in blocks of remote calibration of optical channels, operated by PC.

Measuring sensors are united with the multiplexor by means of wire communication links at the length to 100 m. A specially designed controller on 64 measuring channels (32 two-channel sensors) serves as a multiplexor. The multiplexor allows to send on the PC up to three independent commands per each sensor and to take from them up to three signals about their functional condition together with the transmission of a measuring information.

The PC interchanges by signals with the multiplexor through the network adapter-a standard 32 ranks parallel interface. It is installed on PC charge in any free slot and is united with PC through ISA bus. The application of a parallel interface has allow to avoid the using of the microprocessors in sensors and in the multiplexor at the pre-processing of a measuring information and switching of testing and control signals and to entrust these functions on PC software. These enable greatly to simplify a hardware part of the measuring system and greatly to reduce its cost. A questioning of the measuring sensors, a checking and a mode control of their work, a collection, an analysis, a keeping and a presentation of all accumulated signals is realised by means of special software with a using of the standard PC facilities in a suitable for the user type.

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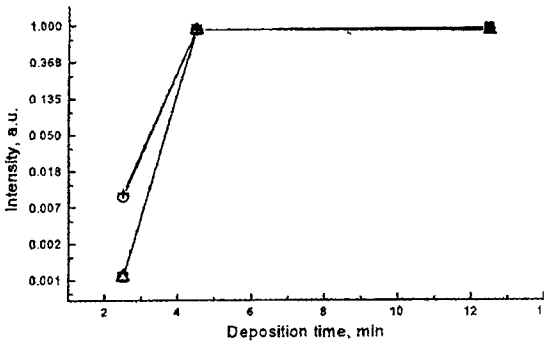
IR-ACTIVE MODES OF FULLERENE GROWN ON SILVER

V.I.IVANOV-OMSKII, E.K.KUZNETSOVA, S.G.YASTREBOV AND G.A.DYUZHEV

A F Ioffe Physical-Technical Institute RAS, St Petersburg, Russia, 194021

(First received 30 March 1998; accepted for presentation during IAS-4)

We report on the charge transfer from metal substrate to the fullerene film produced b vacuum evaporation of pure C60 on metal substrates. Intensity of four main absorption bands in IR spectra attributed to IR-active modes of C60 oscillations was measured as functions of the C60 film thickness. Fullerene films were deposited both onto glas substrates covered with Ag and KBr substrate. Ellipsometrical measurements were don at 632.8 nm wavelength. Optical and IR spectra were performed in 0.25-25 mkm spectrs range. Measurements of absorption intensity for specific optical bands appearing in U' and VIZ spectral wavelength ranges and ellipsometrical studies showed that film thickness varied within the range from hundreds to several thousands of nanometers. Dependence of intensities of four mmn IR absorption bands of C60 deposited on silver as a function of the deposition time is shown in the Figure. It was found that in the case when the film thickness is of 150 nm (2 minutes of deposition) the intensity of four the bands of fullerene deposited on KBr are much more intensive than ones for the film deposited onto silver. Increasing the thickness up to 300 nm (4 min of deposition), the absorption intensity increases correspondingly. A pronounced departure of relative ratio of high and low frequency absorption band intensities for fullerene deposited onto KBr and silver substrates was found. For films thicker than 1000 nm no difference between the bands of fullerene deposited on metallic and dielectric substrates was observed. This effect is discussed in the frames of electron screening mechanism of IR-induced oscillations of the fullerene, which causes the suppression of the IR- absorption bands.



Electronic phenomena appearing at the metal/fullerene interface are considered as a possible reason to arise electron concentration in thin fullerene films, which is necessary for the electromagnetic screening.

Figure. Dependence of intensities of four main IR absorption bands of C60 deposited on silver vs the deposition time. Crosses stand for 527 cm^{-1} mode, squares stand for 577 cm^{-1}, triangles stand for 1429 cm^{-1} mode, circles stand for 1183 cm^{-1} mode.

This study was partially supported by the US Department of Defense through the Arizona University Grant and Russian Foundation for Basic Research Gr N 97-03-32273- a, Grant of Russian Ministry of Science (Fullerenes and Atomic Clusters) N94007 and by Program 'Physics of Solid State Nanostructures.

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DIAMOND NANOCLUSTERS NUCLEATION IN AMORPHOUS CARBON MEDIA

V.I.IVANOV-OMSKII AND S.G.YASTREBOV

A.F.Joffe Physico-Technical Institute RAS, St.Petersburg, 194021, Russia

(First received 30 March 1998; accepted for presentation during IAS-4)

Keywords: amorphous carbon, diamond nucleation, copper, phonon spectroscopy

We report on observation of copper-assisted nucleation of diamond nanoclusters in amorphous carbon films. Ultradispersed copper was introduced in the bulk of amorphous carbon by plasma co-sputtering of copper and graphite on silicon substrates at 200' C, using a planar DC magnetron in argon-hydrogen (80% Ar and 20"/,' H,) plasma. It was possible to grow films with thickness from O. 1 to 2.0 μm. The copper nanosize clusters (-3 nm) are responsible for the enhancement of copper activity as a catalyst of diamond nucleation. As a. result temperature of diamond nucleation decreases from 800-900" C in conventional HTHP industrial process to 200" C in this work. Diamond nucleation was monitored by the measurement of IR-absorption at the diamond two-phonon frequencies. Anomalously high two-phonon absorption observed in this experiments allowed to increase the sensitivity of the method even in the case of very thin films (See figure). The application of the two-phonon spectroscopy to detection of diamond nucleation on the copper background in thin amorphous carbon films is important, because the close coincidence of the diamond lattice parameters with those of copper hampers application of diffraction methods.

We wi11 demonstrate experimentally that, owing to an anomalous enhancement of two-phonon absorption, it becomes competitive with the traditionally used Raman detection of diamonds in the actual case of tiny diamond crystals immersed in the amorphous carbon matrix. Moreover two-phonon absorption bands may be considered to be real fingerprints of diamonds, owing to the impossibility of any imitation. Mechanisms of the two-phonos absorption arnplification are discussed in the frames of electrodynamics of media containing nanosize inclusions of conductive phases of various shapes (spheres, plates, needles and so on). It is assumed that local field induced in the vicinity of diamond nanocrystal is responsible for observed arnplification of absorption in the actual IR frequency range, Prime novelty: Observation of high activity of ultradispersed copper as a catalyst of diamond nucleation

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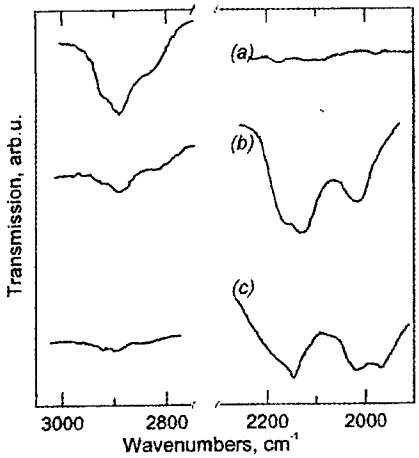


Fig. Fragments of double pass transmission spectra: curve (a) is for an amorphous carbon film (thickness = 0.8 p.m); curve (b) for an a-C:H:9%Cu film (thickness 0.8 pm); and curve (b) for a CVD diamond film (thicknes 320 p,m).

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THE ULTRAVIOLET RADIATION OF BACTERIA UNDER PULSE LASER INFLUENCE

A.M.AGALTSOV, A.N.BORDENIOUK, V.S.GORELIK.

P.N.Lebedev Physical Institute of Russian Academy of Science. 117924, Moscow, Leninskiy pr. 53.

(First received 30 March 1998; accepted for presentation during IAS-4)

The observing of the second ultraviolet radiation of the simplest microorganisms under influence of pulse ultraviolet laser affection is reported. As a source of laser radiation was used copper vapour laser, producing pulse radiation in visible spectrum region (wavelengths 510.5 and 578.2 nm) with average power 4 W and pulses repetition frequency 10000 Hz. The duration of laser pulses generation was 20 ns and their peak power 10000 W. The non-linear optical (ADP) crystal was placed after laser. The crystal was cut out so, that sinhronization conditions were performed for mixed emission compound with wavelength '271.2 nm. So, exciting pulse at laser radiation was at average ultraviolet spectrum region (271.2 nm) and was absorbed by micro- organisms by resonance manner.

For the investigations were chosen bacteria "Bacila Thurin giensis" in 0.9% NaCl aquatic solution, Shtamm War Purstake under T.C. 09.05.096.73-84. The samples were preparated in concentration range from 100 cell/ml to 100000 cell/ml. Besides bacteria, the spectra of the second radiation appearing under affection of ultraviolet exciting radiation in hard GTF hell and in saturated aquatic solution of tryptofane were studied for comparing.

The samples were placed in quartz cuvette with plane-parallel optical windows made from QU-1 glass. The second radiation was observed under 90- degree angle and was registered with small monochromator of MUS-type and rate Photomultiplier PEA-106. Accumulation time of useful signal was defined with computer control program in every fixed location of monochromator lattice. Electronic amplifier with control strob-pulse was used for performing temporary analysis. The strob-pulse duration was 30 ns and his location on temporary scale has

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been changed with delay line in range 0-200 ns.

As a result of performed analysis of bacteria in aquatic media, we founded that in second radiation spectrum, side by side with sharp peak (271.2 nm) of exciting radiation was present intensive maximum with wavelength 301.2 nm, corresponding to Raman scattering in water and also there was the wide band in more longwavelength region. Location and shape of this band changed in dependence from bacteria concentration and also from delay time of strob-pulse in relation to exciting pulse radiation.

When the delay was absent the range of the second radiation spectrum (resonance fluorescence-RF) for the sample of low concentration (100 cell/ml) was 310-410 nm. Simultaneously, in observed side by side with wide band were present sharp splashes. Their intensity was higher than that of noise signal. The RF spectrum moved to longwave region with increasing of bacteria concentration. Particualy, for the bacteria sample solution (under condition of high bacteria concentration, the short wavelength ultraviolet radiation should be re-radiated by aromatic amino-acids, for example as tryptofane. As a result of this, the second radiation maximum should be moved to violet region. This effect we have really observed in our experiments.

The investigated ultraviolet radiation of microorganisms may be close to mitogenetic radiation, predicted by A.G.Gurvich and stipulated by exciting of DNA as s result of metabolic processes (look [1,2]).

So, performed experiments showed, that method of resonance pulse laser influence per aquatic samples of microorganisms allows us to fulfil its diagnostics and concentrational analysis.

This work was supported by RFFI-project N 97-02-16404

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1983.
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MODELING OF ATMOSPHERIC TRANSPORT OF AEROSOL

VLADISLAV KATKOV

Institute of Engineering Cybernetics, National Academy of Sciences, Belarus, Minsk

katkov@newman.basnet.minsk.by

(First received 19 March 1998; accepted for presentation during IAS-4)

Despite of sarcophagus, covering damaged reactor on Chernobyl Nuclear Power Plant, the emission of radionuclides in an atmosphere continues, as well as repeated their transport owing to destruction of an underlying surface with realization of agricultural works, wood fires, melioration, construction etc. Besides the growth of cities, development of industrial manufacture, chemical processing of raw material, use of fertilizers in an agriculture and other factors require creation of adequate mathematical models for forecast of pollution transport on territory of Byelorussia and for estimation of consequences of this process.

For this reason several regional models of pollutants transport by wind have been developed in Institute of Enfineering Cybernetics which are taking into account the following factors: presence of turbulent boundary layer of an atmosphere, washing out of pollutants by atmospheric precipitation, polydispersness of radionuclides, various type of an underlying

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surface and some other. The model, created in USSR in Institute of Experimental Meteorology, was taken for a basis of our approach [1].

The three-dimensional equations of diffussion transport of each fraction were used for the description of volume concentration changes of radionyclides. The wind field is proposed known. On the top boundary the condition of complete absence of particles flow was put, on a underlying surface the partial absorption of radionuclides was taken into account, and on lateral sides the condition of absence of a flow of particles was put.

The wind field can be set in model by any of three manners: (1) in geostrophic approximation through geopotential; (2) as the values measured on an irregular network of meteostations, and (3) as the values of speed or geopotential received after the objective analysis or the weather forecast. The calculation of speed on a regular grid is realized with a special procedure of interpolation, one of variants which is described in [4].

For the numerical decision of the equations one of implicit difference scheme was used [3]. The program has been written in language C++ and works under Windows 95. The program execution on three day forward requires several minutes on the PC Pentium with frequency 100 MHz. The model is easily set up on new regions by change of the appropriate geographical map. There is an opportunity of reception a demonstration movies. The comparison of results of modeling of Chernobyl accident for ten days with the real data shows their satisfactory coincidence [2].

The model can be used for forecast development of various hypothetical situations of extreme character and estimation of their consequences for a nature and economy of Republic.

*) The research described in this publication was made possible in part by Grants № MW 9000 and MW 9300 from the International Science Foundation and Byelorussian Government.

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1012.
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ON A STABILITY OF CAPILLARY OSCILATIONS OF HEAVILY CHARGED ELLIPSOIDAL DROP

SCHUKIN S.I., GRIGOR'EV A.I., BELONOJKO D.F.

Yaroslavl State University, 150040, Yaroslavl, av. October, house 17 "D", sq. 28, Ph. (0852) 222325

(First received 21 October 1997; accepted for presentation during IAS-4)

The study of the equilibrium forms and stability of charged drops presents significant interest for physics of a liquid-droplets aerodispersion systems. The research of charged drop stability at a big deformations to oblate and prolate spheroids is one of scantily explored of questions. In this research both these questions are incorporated at study of stability of triaxial heavily charged ellipsoidal drop, which is carried out on the basis of a principle of

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the minimum potential energy of closed system. The purpose of the given work is research of charged ellipsoidal drop stability and laws of realization their instability to there own charge. The numerical analysis of expression for potential energy of a heavily charged drop, which has the form of triaxial ellipsoid, shown, that the charged spherical drop is stable in relation to indefinitely small distortion of the form at $W < 4$. A Rayleigh parameter is determined by the relation of a square of the drop charge to the volume of the drop and the interface tension coefficient. The dependence $U = U(x)$ in a range of meanings of the Rayleigh parameter $3.546 < W < 4$ has two minimum: at $x = 1$ and at $x > 3$. Thus the rather big influence can results in a bifurcation of the drop form. The spherical drop is unstable when the Rayleigh parameter meanings $W > 4$.

The condition of a drop as fattened spheroids of rotation is unstable at any meanings of Rayleigh parameter: the energy of such drop at $W < 4$ is more, than spherical drop and it have spontaneous evolution. The drop, which has the form of fattened spheroids of rotation at $W > 4$, is extended on one of directions, which are perpendicular of symmetry axis. Thus it passes to the form triaxial ellipsoid, and then extends to ellipsoids of rotation, which energy is minimum.

1030.
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SOME RESULTS OF THE INVESTIGATION OF TWO-PHASE JETS

KOSTIUK V.V., LEPESHINSKY I.A., IVANOV O.K., ZUEV YU.V., RESHETNIKOV V.A., VORONETTSKY A.V., TSIPENKO A.V.

125871 Moscow, Volokolamskoe shosse, 4, MAI, NII NT MAI.

(First received 5 November 1997)

The results are presented concerning the theoretical and experimental work of a joint group of research workers engaged in the two-phase flow investigation performed at the Chair of Air-Breathing Engine Theory (201), MAI, and the Research Institute for Low Temperatures, MAI.

The detailed comparison of the results, obtained according to the Prandtl-Abramovich first order model and its modified version, with the results obtained according to a number of the sufficiently widespread "K-E' models and the stochastic model (SSF), was performed. The results of modelling were compared with the experimental results. For an axisymmetrical jet, the Prandtl-Abramovich model is - after corresponding modification - fully acceptable and the results obtained using this model don't differ greatly from the results obtained using "K-E" and SSF models. This permitted to carry out the investigation of vaporization and concentration processes taking into account the drop coagulation and disintegration in the jet using the model of first order.

As a result of theoretical investigation, it was reviewed that on the turbulent characteristics of phase of the two-phase monodisperse water-air jet with gas temperature phase transition, the drop volume concentration in the jet initial cross-section, the air humidity and the diameter of initial part of jet exert an influence.

The computational and experimental work, carried out by the group of research workers, permitted to pass to solving a number of practical problems. In particular, the range of two-phase jet was investigated in the interests of fire-men. Also in the interests of some subdivisions of the Chair, the added gas mass determination problem, arising in the process of designing the ejecting devices (for instance, the jet engine ejector nozzles), was solved.

At present, the greatest attention in the research group is given to the work connected with the coating the part and coupling them together using for this purpose the solid particles accelerated in the flow. As a accelerating gas any gas can be used, including the air. The particles of sputtered material have a low temperature and isn't liable to be oxidized.

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7/ July /98 Аэрозольные технологии (фильтрация, производство алмазоподобных материалов, ультрадиспесрсные порошки, горение диспергированного топлива, мембранные фильтры, чистые технологии ...)

В этот же день будут представлены работы по ФУЛЛЕРЕНАМ - синтез, экстракция, свойства, теория, применение, нанотрубки..

8/ July /98 АЭРОЗОЛЬ И КЛИМАТ, КОСМИЧЕСКИЙ МУСОР, АЭРОЗОЛЬ И ОКЕАН Радиоактивные аэрозоли, аэрозоли мегаполиса, вулканические аэрозоли, облака, эрозионные аэрозоли, ...

9/July/98 Последний день - АЭРОЗОЛИ И ЗДОРОВЬЕ - использование аэрозольных медикаментов, воздействие загрязнений воздуха на организм, Нормирование аэрозольной нагрузки для различных профессий, Проникновение частиц в легкие, Взаимодействие частиц с биологическими структурами...

АЭРОЗОЛЬНАЯ ТЕОРИЯ (1)- оптика аэрозолей, коагуляция, нуклеация, конденсация...ТЕОРИЯ АЭРОЗОЛЕЙ(2)-ДИФФУЗИОФОРЕЗ, ТЕРМОФОРЕЗ...Слушание докладов выдвинутых на соискание премий Российского аэрозольного общества (Две из этих премий поддержаны суммами $300 и $200 - спонсор - директор ERNAFT OIL Mr Mirlesse (Щвейцария)

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Это наука, приборы, вычислительные программы и технологии в России и странах СНГ.

Пришла пора передать спонсорам (Фонд Армии США, Американское и Российское физические общества ...) список секций, предварительную программу симпозиума и сборник тезисов докладов. Сейчас работа по подготовке этих материалов близится к концу. Принцип отбора докладов прост:

1. Рекомендации председателей секций и экспертов. Такие рекомендации получили работы, направленные для участия в IAS (кроме трех больших статей на русском и на англ языках Никитина Анатолия Ильича из Института энергетических проблем химической физики РАН. Его работы посвящены шаровой молнии, тел/ факс 9397501 - приглашаем заинтересованных в проблеме получить информацию о новых работах Никитина)
2. Наличие документов, разрешающих печать тезисов в трудах международной конференции.- Здесь ситуация сложная - половина полученных работ не подкреплена актами экспертизы и письмами о возможности опубликования в труха международной встречи. ВСЕ ЭТИ РАБОТЫ ОТЛОЖЕНЫ до момента получения указанных документов. Эти работы могут быть включены в одну из дополнительных книжек IAS как только эти документы будут представлены в оргкомитет
3. Наличие документов, подтверждающих оплату оргвзноса либо оплату публикации (достаточно заплатить 6 руб за страницу текста (и 6 руб за каждый рисунок и каждую таблицу, если они включены в Вашу статью), чтобы работа, удовлетворяющая первым двум критериям, была немедленно опубликована.) Если при этом Вы не забыли прислать четыре листа А4 с Вашим стендовым докладом - то можете быть уверены , что Ваша работа будет представлена на IAS-4. Таким образом в круг общения симпозиума вовлекаются те, кто не может принять участие в нашей встрече - проблема денег и /или времени. Так в нашей встрече будут опубликованы доклады из Бразилии, Мексики,... Однако авторы, которые не смогут приехать на нашу встречу, не будут включены в информационные списки симпозиума, с тем, чтобы эти списки показывали только тех, кого Вы можете встретить в Питере.

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Таким образом последний фильтр помогает выделить две группы возможных участников IAS-4: Теперь видны те, кто имеет возможность принять участие в нашей встрече и те, кто заинтересован только в публикации своих работ,

Мы сделаем все, чтобы поддержать последних (если они не забыли оплатить публикацию своих работ). Участники же симпозиума получат самую широкую информационную поддержку. Практически каждая работа будет опубликована трижды - в журнале для экспресс обсуждения и коррекции ошибок, в тематическом сборнике под редакцией председателя секции и в книжке тезисов докладов IAS-4. Первые два издания будут служить общественной экспертизой окончательного издания.

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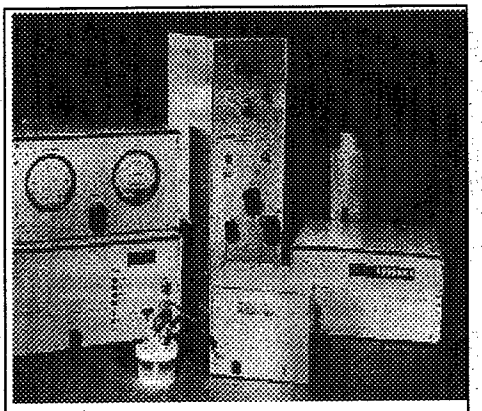
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1404.
УДК 541.18

URBAN-MARINE AND MINERAL-DUST AEROSOL PROPERTIES, RADIATIVE EFFECTS AND CLOSURE STUDIES OVER THE ATLANTIC OCEAN: AN OVERVIEW AND SELECTED RESULTS FROM TARFOX AND ACE-2

RUSSELL P.B.[1], LIVINGSTON J.M.[2], SCHMID B.[3], HIGNETT P.[4], DURKEE P.A.[5], HOBBS P.V.[6], GASSO S.[6], HEGG D.[6], STOWE L.L.[7], BATES T.S.[8], QUINN P.K.[8], HAMILL P.[9]

[1] *NASA Ames Research Center, Moffett Field, CA 94035-1000 USA*

[2] *SRI International, Menlo Park, CA 94025 USA*

[3] *Bay Area Environmental Research Institute, San Francisco, CA 94122 USA*

[4] *UK Meteorological Office, Meteorological Research Flight, DRA Farnborough, Hampshire, GU146TD, UK*

[5] *Naval Postgraduate School, Monterey, CA 93943-5114 USA*

[6] *University of Washington, Seattle, WA 98195 USA*

[7] *NOAA/NESDIS, Office of Research and Applications, NSC, Washington, DC*

[8] *NOAA-Pacific Marine Environmental Laboratory, Seattle, WA 98115 USA*

[9] *Physics Department, San Jose State University, San Jose, CA 95192 USA*

(First received 23 March 1998; accepted for presentation during IAS-4)

Aerosol effects on atmospheric radiation are a major source of uncertainty in understanding the past climate and predicting climate change. To help reduce this uncertainty, the 1996 Tropospheric Aerosol Radiative Forcing Observational Experiment (TARFOX) and the 1997 second Aerosol Characterization Experiment (ACE-2) measured the properties and radiative effects of anthropogenic aerosols over the Atlantic Ocean. TARFOX focused on the urban-industrial haze plume flowing from the eastern United States over the western Atlantic, whereas ACE-2 studied aerosols carried over the eastern Atlantic from both European urban/industrial and African mineral sources. These aerosols often have a marked influence on the top-of-atmosphere radiances measured by satellites. However, the accurate derivation of both optical depths and radiative flux changes, or radiative forcing, from the satellite-measured radiances remains a difficult challenge for the wide range of aerosol types and properties present.

In TARFOX, sensors and samplers on four aircraft, land sites, and ships measured optical depth spectra, aerosol composition, microphysics and optical properties, and radiative fluxes during many overpasses by different satellites. Closure studies show that the aircraft-measured flux changes agree with those derived from the aerosol measurements using several modeling approaches. Essential to obtaining this agreement is modeling the aerosols as moderately absorbing--i.e., having midvisible single-scattering albedo between about 0.90 and 0.95. These values are in accord with the aircraft measurements of (1) aerosol absorption and scattering coefficients, (2) unexpectedly large carbonaceous fractions of aerosol composition, and (3) unexpectedly large aerosol humidification factors.

In ACE-2, European urban-marine and African mineral-dust aerosols were measured by sunphotometers on the Pelican aircraft and the Research Vessel Vodyanitskiy, and by sensors on NOAA satellites. We present a comparison of the optical depths derived from the NOAA-14 satellite data with those measured by our fourteen- and six-channel sunphotometers. We find that the excellent agreement for urban-marine aerosols is degraded when African dust is present. Using the sunphotometer data during ascent and descent of the aircraft, we also obtain extinction profiles for separated layers dominated by African dust and urban-marine aerosols, respectively. The extinction profiles allow us to obtain size distributions for both these aerosol types, showing the distinctive differences between them. These optical depth and size

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spectra are combined with model complex refractive index spectra to calculate radiative flux changes induced by the different aerosol layers. By combining solar beam transmission measurements in the 0.94-micron band with those at neighboring wavelengths, we also determine water vapor columns and profiles, which are shown to agree well with aircraft in situ measurements.

1328.
УДК 541.18

DUST GENERATOR QUARTZ

ZVEREVA N.S.

Russia, Noginsk, tim@noginobladm.msk.su. tel.+7-(09651)42200

(First received 02 March 1998; accepted for presentation during IAS-4)

Dust generator "Quartz" is used for highly accurate dozing the particles of different mono- and polidisperse powdered materials (quartz, corundum, metal oxides, carbon black, metals, minerals, silica, pigments, abrasives, catalysts, adsorbents, cement, starch, etc.) into the gas flow.

Generated aerosol helps to control protective and explorative properties of filters and dust removal devices.

Dozing small-size particles is a technically difficult task. Main deficiencies of known generators are irregularity powder dozing and narrow concentration range of generated dust.

Aim of generator developing is achievement of high proportionality powder dozing in wide dust concentration range , including fine-dispercional disposed to aggregation powders.

Dust generator "Quartz" was successfully researched in laboratories and industrial conditions.

Specification

Feed of powder into gas flow, mg/min	3-1000
Reproducibility ,%	3-5
Range of particle size powder to be dispersed, mcm	0,5-1000
Pressure of gas flow, kg/sm2	1,1+0,1
Carrier Gas Flowrate Range ,liters/min	40-100
Period of continuous operation	unlimited
Power Requirements	220,240 VAC; 50-60 Hz; less than 250W
Concentration of generated dust mg/m3	20-1000
Overall dimensions, mm	370x270x280
Weight ,kg	8,0

No support for device installation. It is maintained by one operator.

Dust generator "Quartz" may be used for:

– research of dust capacity and effectiveness of filtration dust removal devices;
– monitoring environmental pollution of air;
– dozing of fine-dispersion powders in chemical industries, powder metallurgy, biology, pharmacology;
– calibration of pollution control equipment.
– inhalation toxicology studies in medicine, agriculture and other fields.

Main structural elements: bunker with powder and special stirrer; disk conveyer of particles; device for powder feed decrease; nozzle of high gas flow; control panel with feed blocks.

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Any anticorrosive explosion-proof desiccated gas (pressure 1-5 MPa) is used as gas-carrier.

Generator is the unique device in Russia. It provides high precision and reproducibility at low feed (about few mg/min) of particles of different powders with both wide and narrow range of particles sizes (0,5-5000mcm) and it is one of the most powerful tools for successful aerosol research.

The device is distinguished from similar ones by high reliability under long service life and by easy of operation.

1024.

УДК 541.18

SYNTHESIS OF NANOSTRUCTURED MATERIALS FROM AGGREGATES PRODUCED BY A PULSED ARC GAS AGGREGATION CLUSTER SOURCE

MILANI P., PISERI P., BARBORINI E.

INFM-Dipartimento di Fisica, Universita' di Milano, Via Celoria 16, 20133 Milano, Italy

BOTTANI C.E., FERRARI A., BASSI A.LI.

INFM-CESNEF, Politecnico di Milano, 20133 Milano, Italy

(First received 03 December 1997)

Cluster beams are a versatile tool which is assuming an increasing importance for the synthesis of nanocrystalline materials. The use of clusters as elemental building blocks can open new routes towards the creation of an entire new class of architectures and nanostructures.

The ability of structuring materials on a nanometer-size scale depends critically from the control of the precursors and of their interaction to form more complex structures. The use of aerosol techniques is a viable way for the production of macroscopic quantities of precursor clusters.

Molecular beams techniques, coupled to sources based on efficient aggregation phenomena, can unfold the opportunity of controlling parameters such as size, composition and kinetic energy of the aggregates. The availability of well characterized cluster beams will help in the study of cluster coalescence processes and reorganization after the deposition which are still largely unknown.

Here we will present and discuss the synthesis of nanocrystalline thin films by the deposition of a supersonic cluster beams. In order to meet the requisites necessary for thin film deposition we have developed a Pulsed Arc Gas Aggregation Cluster Source (PAGACS) for the production of intense and stable ionized and neutral cluster supersonic beams. Laser photoionization and mass spectrometric techniques have been used to characterize the source, the cluster mass distribution and energy.

The PAGACS has many analogies with arc discharge apparatus for the production of fullerenes and nanotubes, with this source nanocrystalline carbon thin films have been produced have by ballistic consolidation of carbon cluster supersonic beams and characterized in their structural and electronic properties in order to correlate them with the precursors and post-deposition treatments.

Structural properties and the mesoscopic elastic response of the films were measured by Scanning Electron Microscopy, Raman and Brillouin light scattering. SEM and Raman spectroscopy show that the film are a low-density porous network of nanometer-size particles. The nature of the films is essentially graphite-like with a large number of distorted bonds. The values of bulk modulus and shear modulus were estimated from the shifts of both surface and bulk phonon peaks measured by Brillouin spectroscopy. On a mesoscopic scale, the shear

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modulus is in the range of that of crystalline graphite, whereas the bulk modulus and the Poisson's ratio are significantly different.

The presence of nanotubes and ordered polyhedral particles embedded in a disordered matrix has been detected by Transmission Electron Microscopy.

1058.
УДК 541.18

DIRECT RADIATIVE FORCING AT THE SURFACE BY SMOKE AEROSOLS DETERMINED FROM SATELLITE AND SURFACE MEASUREMENTS

LI Z., KOU L.

Canada Centre for Remote Sensing 588 Booth Street Ottawa, Canada K1A 0Y7

(Received 16 December 1997)

Direct radiative forcing (DRF) of aerosols is an important climatic parameter measuring the influence of aerosols on earth's climate. Observational studies of aerosol DRF usually suffer from a shortage of in-situ measurements of aerosol optical properties. This study introduces a new approach to determine surface DRF due to fire smoke under any sky conditions using satellite and surface measurements.

The method requires no observation of aerosol optical properties. It is based on a satellite inversion algorithm which retrieves surface net solar radiation in the visible spectrum (400-700nm). The algorithm was first validated under a variety of sky conditions ranging from clear, to smoky and cloudy skies. The accuracy of retrieval is found to be primarily affected by absorbing aerosols such as smoke. With the measurements of aerosol optical thickness, the effect can be well accounted for. Without correction for this effect, the difference between observed and estimated APAR is a good estimate of DRF due to aerosols. Over the remote boreal forest region in western Canada where this study is conducted, fire activities dominate the variation of aerosol loading during the summer season. Following this concept, instantaneous, daily and monthly mean DRF due to smoke aerosols are computed. The monthly mean DRF caused by smoke reaches a maximum value of -26.0 W/m^2 during the period of active burning in July 1994, as compared to the total radiative forcing of -76.7 W/m^2 due to the combined effect of both smoke and clouds in the same month and region.

1032.
УДК 541.18

FUNCTION OF DISTRIBUTION OF FULLERENE SOOT PARTICLES

BELOV N.N.[1], SIMANCHEV S.K. [2], TOKAREVSKIKH A.V. [2]

[1] *Aerosol Technology LTD, BELOV@TEHNO.MMTEL.MSK.SU tel/fax 7-095-1474361*

[2] *Karpov Institute for Physical Chemistry , e-mail: simanch@cc.nifhi.ac.ru*

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Function of distribution of «fullerene soot» was obtained for interval of diameter of particles from 0.04 to 0.4 mkm. Function was approximated by five theoretical law.

Obtained firstly in the Kratshmer's laboratory new modification of carbon - fullerenes [1] are in the focus of many experimental and theoretical studies throughout the world. Range of using of fullerenes is increased, continuously new interesting properties are found. Also interest in soot are increased. This soot is obtained during vaporization of graphite into inert gas by different ways. It is show that the powder of activated carbon, prepared from waste of fullerenes production (fullerenes was extracted from such soot by organic solvent) favorably compares with commercially accessible activated carbon as adsorbent for removal of organic

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pollutes from one-component systems [2]. It is very important to know the function of distribution of soot particles in studies of thermophoresis, rate of sedimentation of soot particles and etc. The function of distribution was obtained for soot, generated in argon, under pressure 150 Torr [3]. In this article the function of distribution of soot, generated in helium under pressure 150 Torr is obtained.

The «fullerene soot» was generated by Kratschmer's method with some modification. The process was proceeded in the plasmochemical reactor for fullerene synthesis of «Aerosol Technology» firm. The construction of reactor is follow. The chamber of synthesis was 55 mm X 260 mm vertical cylinder with cooling water jacket. The cylinder may be disconnected in two same parts. The 10 mm hole was in face-end of upper part. The ballast 2100 cm^3 chamber was connected to reactor through this hole. The pressure in reactor was increased not more 10% due to ballast bulk. Anode - graphite 6 mm rod. Its primary length - 210 mm. Cathode - graphite 40 mm ⌀ 9 mm cylinder. Electrodes was situated perpendicularly to axis of chamber at 70 mm from lower face-end. The rate of erosion of anode was 3 g/min. (4-5 cm/min.) under pressure of helium 150 Torr. Current was 110 A, voltage - 25 V. The function of distribution is the paramount characteristic of disperse system. There is a need to measure the grate number of particles for better description of function. So it was measured 300 particles (interval of diameters was from 0.04 to 0.4 mkm). The subsequent measurements did not change the functions of distribution noticeably. The photos was made by electronic microscope JSM-35CF of firm GEOL. Then photos was magnified by graphical computer program PhotoFinish. Data were approximated by five functions by program Mathcad PLUS 5.0 of firm MathSoft. Results of approximation are shown on fig. 1.

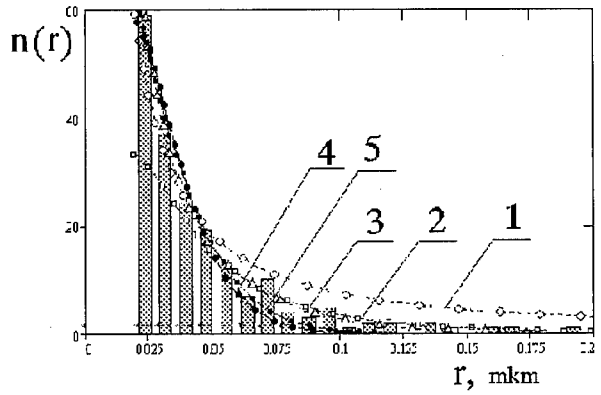


Fig.. 1. Function of distribution of soot (diameter of particles from 0.04 to 0.4 mkm was measured) .
Histogram - empirical data,
1 - Junge's law,
2 - Kolmogorov's law,
3 - Chrgiane-Mazin's law,
4 - Best's law,
5 - Litvinov's law.

Junge's law:

$$n(r) = c\, r^{-k},$$

here c = 0.377, k = 1.3, r - radius of particles.

Kolmogorov's law:

$$n(r) = \frac{A}{\sqrt{2\pi}\,\sigma r} \exp\left(\frac{-\ln^2\left(\frac{r}{r_0}\right)}{2\sigma^2}\right),$$

here A = 1.684, σ = 0.79, r_0 = 0.0349.

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Best's law:

$$n(r)=\frac{A\,k\,r^{k-4}}{\pi c^{k}}\exp\left(-\left(\frac{r}{c}\right)^{k}\right),$$

here A = 9.994Ч10^{-4}, k = 2.41, c = 0.109.

Chrgiane-Mazin's law:

$$n(r)=Ar^{2}\exp(-br)$$

here A = 1.208 106, b = 105.794.

Litvinov's law:

$$n(r)=A\exp\left(-br^{\frac{3}{2}}\right),$$

here A = 100.809, b = 160.357.

Thus, coefficients of functions of distribution are found for interval of diameter of particles from 0.04 to 0.4 mkm. It is shown, that soot consist of particles less than 0,4 mkm. It is visible, that average size of soot, prepared in helium, is roughly in one order more as comparison with prepared in argon soot.

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1202
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EXPERIMENTAL RESULTS OF HIGH TEMPERATURE FILTRATION AND DUST CAKE ANALYSIS BY CERAMIC CANDLE FILTER

JIN DO CHUNG [1], JOO HONG CHOI [2], C. KANAOKA [3]

[1] Hoseo Univ., [2] Gyeongsang Univ., [3] Kanazawa Univ.)

Baebang-Myun, Asan, Chungnam, 336-795, Korea, Dept. of Environmental Eng. Hoseo University, E-mail:jdchung@dogsuri.hoseo.ac.kr, Tel: 82-418-40-5463, Fax: 82-418-40-5460, contact person Prof. Jin Do Chung.

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Keywords: High Temperature Dust Removal, Ceramic Candle Filter, Pressure Drop, Dust Cake, Darcy Eqn.

A number of gasification systems are approaching commercial readiness for use in integrated gasification combined cycle(IGCC) power plants. The primary advantages of IGCC systems are higher energy conversion efficiency and superior environmental compliance when compared to all other coal-based power generation options. In an IGCC system, particulate matters must be removed before the raw gas is burned in the gas turbine to protect the turbine blade and to control particulate matters emissions. It is also important to note that the particulate matters removal process must be carried out by incorporating high temperature gas cleanup for optimization of IGCC system. In an IGCC system, hot gas is introduced to the combustor at about 430 ^o C and a pressure of typically 25 bar. The gas temperature is much

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lower than the PFBC system, which is operated at about 800-900 ^o C and 10 - 15 bar. Advanced cyclone, cross flow filter, granular bed filter, electrostatic precipitator, and candle filter have been developed for particulate matters collection on the advanced coal power generation system. Ceramic rigid filters and granular bed filter among them have the best potential.

A ceramic candle filtration system has been operated under the high temperature in order to obtain the design data for a pilot unit of integrated gasification combined cycle(IGCC) and high temperature gas cleanup facility.

A candle elements of 0.5m length were mounted on the tube sheet by using the specially designed filter holder. The compressed air was used for the stream gas carrying dust injected from a screw feeder and heated by an electrical heating unit. The compatibility of the filtration system involving element mounting technology was checked. Some operation results were obtained. The behaviour of the pressure drop, the pulse cleaning events, and the dust cake of the filter element were investigated in this study.

In this paper, collection and release mechanisms of dust on and from a rigid ceramic porous candle filter are studied by measuring the evaluations of pressure drop and dust layer thickness during filtration, and time behaviour of pressure inside and outside the element after the injection of compressed cleaning air and the movement of released dust.

1242.
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CHEMOJET MOTION OF SOLID PARTICLES IN AEROSOLS

MELIKHOV I.V., VEDERNIKOV A.A., SIMONOV E.F., BERDONOSOV S.S., BOZHEVOL`NOV V.E.

Chemistry Department of Moscow State University, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

Aerosols fill up the interstellar space (1) and Earth atmosphere (2). Therefore it's important to investigate the nature of the motion of aerosol particles in the surrounding gas. For aerosols in which particles mass and gas composition don't vary the motion of aerosol particles have been studied in detail [3]. However, in most natural and technogenic aerosols particles tend to evaporate or coarsen,[absorb or give off gases [4-6]. Thus a question arises of how the velocity of aerosol particles will change as a result of some physicochemical process initiated in it.

Experimental data we have obtained(7-9) show that the particle motion speeds up if the particle takes part in a physicochemical process (sorption, oxidation, catalysis) causing a change of its mass or gas composition. This phenomenon which we called chemojet motion is due to space-time heterogeneity of the interaction between the particle and the gas, more specifically to the differential of the process intensity on different faces of the particle and to process rate fluctuations on each face.

For the purpose of quantitative description of the motion caused by a physicochemical process we introduce chemojet intensity of gas (vapour) impact on the particle $\vec{F}_R$ and corresponding velocity of its motion $\vec{V}_R$:

$$\vec{F}_R = \int_S \left(\vec{J} - \vec{J}_0\right) dS; V_{Rj} = \sum_{l=3}^{3} \lambda_{jl} \left(\vec{F}_R \vec{e}_l\right)$$

where $\vec{J}$ and $\vec{J}_0$ are impulse flows transferred by gas molecules through the particle surface S under or without the process, respectively; V_{Rj} is component of the chemojet motion velocity;

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γ_{jl} are components of the particle mobility tensor; $\vec{e}_l$ is the unit vector of the co-ordinate system.

Velocity $\vec{V}_R$ was defined in special cylindrical reactor in which it was possibly to look on trajectory of particles falling down in gas. The chemojet motion of particles in the size range a=1-50 μm was investigated. The particles were in fact the agglomerates of smaller particles thus having not only surface but also volumetric heterogeneity. The experiment was set up as follows. Reactor was filled up by gas-reagent and termostated. Through a small hole in the reactor lid we injected particles which were then falling down and in 0,1-5 s reaching the bottom of the reactor, where the exact point of landing was marked. After several hundred particles had been injected we determined the co-ordinates and size of each particle on the reactor's bottom.

The distance L between the particle's mass center and the injection point projection of the reactor's bottom was considered horizontal shift of the particle in time t_k, hence $V_j=L/t_k$ represented the radial component of particle's velocity. The time t_k was calculated from the equation for a vertically moving particle adjusted for the vertical chemojet shift. In each experiment the gas composition and its temperature were approved to remain constant during the trial.

The particles were first injected in the reactor filled by non-reacting (background) gas with density and viscosity characteristics close to those of the gas-reagent.. Under these conditions we determined the average velocity $< V_{Bj} >$ of particles in the absence of any interaction with the gas. Then we estimated the average rate $< V_j >$ in the gas-reagent as well as the average radial component of the chemojet motion velocity $< V_{Rj} >=< V_j > - < V_{Bj} >$. The values $< V_{Bj} >$ were found to be close to the results calculated for the non-reacting particles. However, $< V_{Rj} >$ values were found to be sufficiently high to conclude that the presence of the chemojet motion of solid particles in the laboratory reactor was fully confirmed by the experimental data. It was discovered that trajectory of each particle twisted at large t_k but particles group motion became chaotic. It allows us to suggest that if we moved from the laboratory reactor in our model to an unrestricted aerosol we could still detect a chaotic chemojet motion characterized by diffusion coefficient

$$D = \frac{1}{3}\sum_{j=1}^{3}\left[\gamma_{jj}^2 \int_0^\infty A_{jj}(\tau)d\tau + < V_{Rj}^2 > \tau_\pi\right]$$

where $A_{jj}(\tau)$ are terms of the fluctuations correlation matrix Z_k for time shift τ. D calculation for crystals in the size range 1-10 μm which are growing in supersaturated vapour in accordance with most widely accepted current theory of growth led to value 3-4 orders higher than in the case of the Brownian diffusion. It was shown that observation for motion opens new possibilities in the important field of in situ process studies on an individual solid particle.

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1271.
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AN EFFECT OF SOURCE TERM IMPURITY CLOUD CENTER RANDOM WALKS ON IMPURITY CONCENTRATION FLUCTUATIONS

VOZZHENNIKOV O.I., ZHUKOV G.P., SVIRKUNOV P.N.

Scientific Production Association "Typhoon", Obninsk

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It is well known that turbulence has a double effect on impurity cloud dynamics in the atmosphere. The pulsations of the total spectrum typical scales of which do not exceed the cloud sizes result in cloud expansion; the pulsations of larger scales (up to the external scale) induce random walks of the cloud center. The latter must give rise to impurity concentration fluctuations, that may appear to be significant at calculations of exposure doses under pollutants emergency releases.

The goal of the paper is in studying probability characteristics of an impurity concentration caused by the impurity cloud center random walks mentioned.

The Gifford model should be used as a theoretical basis in the frames of which the fluctuations of the cloud center are described by the Gaussian distribution:

$$f(y', z') = (2\pi M_y M_z)^{-1} \exp\left(-\frac{y'^2}{2M_y^2}\right)\left(\exp\left(-\frac{(z'-h)^2}{2M_z^2}\right)+\exp\left(-\frac{(z+h)^2}{2M_z^2}\right)\right) \qquad (1)$$

where M_z^2, M_y^2 are the cloud center dispersions along the vertical and cross horizontal directions, h is the source height.

For the concentration distribution in the cloud the Gaussian model will be used as well. In particular, the exposure dose (integral over time and concentration) at the surface denoted as q_n is determined by the expression:

$$q_n = \frac{Q}{\pi S_y S_z \bar{U}} \exp\left[-\frac{(y-y')^2}{2S_y^2}-\frac{z'^2}{2S_z^2}\right] \qquad (2)$$

where Q-is the amount of the impurity released; S_y^2, S_z^2 are the dispersions of the concentration within the cloud; y', z' are instantaneous random co-ordinates of the cloud center.

In view of (2) and (1) for the distribution probability density of q_n one can obtain an expression:

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$$f(q_n) = \frac{S_y S_z}{q_n^* M_y M_z} \cdot \left(\frac{q_n}{q_n^*}\right)^{\beta^2-1} \exp\left(-\frac{y^2}{2M_y^2} - \frac{h^2}{2M_z^2}\right) \cdot \sum_{k=0}^{\infty} I_{2k}(B_1) I_k(B_2) \cos(2k\phi) \qquad (3)$$

where

$$q_n^* = \frac{Q}{\pi S_y S_z \bar{U}}, \quad \beta^2 = \frac{1}{2}\left(\beta_y^2 + \beta_z^2\right); \quad \beta_y^2 = \frac{S_y^2}{M_y^2}; \quad \beta_z^2 = \frac{S_z^2}{M_z^2};$$

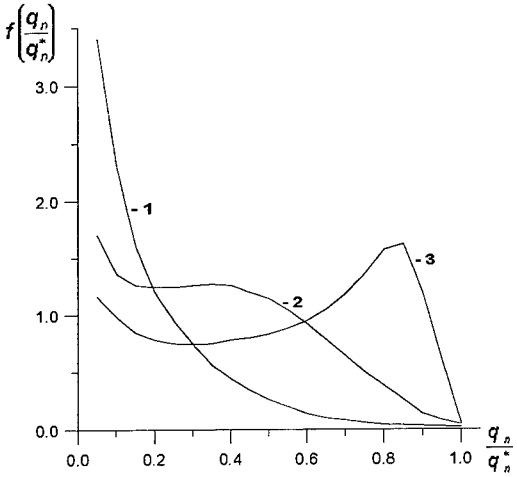
$$B_1 = r\sqrt{y^2 \frac{S_y^2}{M_y^4} + h^2 \frac{S_z^2}{M_z^4}}; \quad B_2 = \frac{1}{4}\left(\beta_z^2 - \beta_y^2\right) r^2; \quad r = \sqrt{2\ln\left(\frac{q_u^*}{q_u}\right)}; \quad \phi = \operatorname{arctg} \frac{hS_z}{yS_y} \frac{M_y^2}{M_z^2},$$

$I_k(x)$- are the modified Bessel's functions.

The first moment q_n (mean over the cloud center random positions) has the form of:

$$< q_n >= \frac{2Q}{\pi \sigma_y \sigma_z \bar{U}} \exp\left(-\frac{y^2}{2\sigma_y^2} - \frac{h^2}{2\sigma_z^2}\right) \qquad (4)$$

To calculate the distribution function $f(q_n)$ the experimental data on S_z^2 and S_y^2 were involved [1], along with the data for σ_y^2 and σ_z^2. from [2]. The calculation results coincide with the experimental conditions [1] for h=300m, i.e. weakly unstable stratification.



The figure gives the graph for $f(q_n)$ for different distances from the source term:

1) 5km;
2) 10km;
3) 30km.

As the calculations have shown, at the points of the nearest zone a great uncertainty in the q_n values takes place, and an average value of $< q_n >$ is not at all representative for the assessment of real concentrations. Here for the calculations of the pollutants impact one should use the probability calculations with $f(q_n)$ with the inclusion of more general risk conceptions. This fact should be taken into consideration when calculating exposure dose rates under emergency releases.

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1269
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DETERMINATION OF SURFACE ENERGY OF CRITICAL EMBRYOS

NASIBULIN A.G., SHANDAKOV S.D., ANISIMOV M.P., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

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New experimental results on the vapor nucleation such as an influence of total pressure (background gas) on the nucleation processes [1-5], oscillatory nucleation [6-7], etc. has been presented recently. These results need to revision of main positions of the nucleation theory. One of the theory problem is a surface energy estimation uncertainty. The energy of new phase formation of critical embryo in the classical theory is a third part of the total surface energy of critical embryos. However, application of microscopic surface tension for critical embryo is doubtful, because of too small associates which have significant fluctuation even in thermodynamic equilibrium. Moreover, the sense of surface energy is impossible to understand. We can say only about excess of embryo's energy in comparison with the same number of molecules of a bulk condensed phase.

The present work shows that excess of embryo's energy Θ (or surface energy) may be received from experimental dependencies of critical vapor activity a (or supersaturation) on temperature T, when nucleation rate J. It could be shown that

$$\Theta = -n\,kT^2 \left(\frac{\partial \ln a}{\partial T}\right)_J , \qquad (1)$$

where n is the number of molecules in critical embryo, k is Boltzmann constant.

This result may be obtained using first and second nucleation theorems [8] and the criterion of the right description of nucleation rate experiments, following from the partial derivative theory for function of two variables such as:

$$-\left(\frac{\partial \ln a}{\partial \ln J}\right)_T \cdot \left(\frac{\partial \ln J}{\partial T}\right)_a \cdot \left(\frac{\partial T}{\partial \ln a}\right)_J = 1 \qquad (2)$$

On base of Eqs.(1-2) the values of surface energy of critical embryos was experimentally determined. We used experimental results of glycerin vapor nucleation rates in atmosphere of helium and argon in the vicinity of glycerin melting temperature and experimental results for binary system of glicerin-SF_6 nucleation near the critical temperature of this system. Obtained experimental results were compared with Fisher's drop model, where surface energy is $\Theta_{drop} = 4\pi\sigma r^2$ ..

The influence of gas-carrier pressure, melting point of condensate and critical temperature of binary system on the values of surface energy was established.

The reasons of the droplet model and the experimental surface energy deflection are

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discussed.

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1374.
УДК 541.18

EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER IN REGULAR FLOW OF MONODISPERSE DROPS

ANKUDINOV V. B. , KLYONOV M. G. , MARUHIN U. A. , OGORODNIKOV V. P.

Moscow Power Engineering Institute (Technical University) .

(First received 27 March 1998; accepted for presentation during IAS-4)

The importance of investigation of heat transfer in the flows of monodisperse drops is connected with development of untraditional monogranulation technique. This technique is based on phenomena of forced capillary breakup of liquid jet [1]. One needs to optimize cooling rate of drops in the process of producing of monodisperse spherical granules [2]. It's difficult to solve this problem because of absence of methods of heat transfer coefficient calculation. So , it's necessary to obtain experimental data on heat transfer from the flows of monodisperse drops.

For this purpose experimental unit was designed, which make it possible to investigate heat transfer from regular flow of monodispers drops in a wide range of working parameters.

Vacuum oil is used in it as a working liquid. The unit is provided with two types of generators. This allowes one to produce both the hollow and ordinary drops with diameter range 50 - 3000 mkm.

For keeping temperature of oil in the generator constant the termostabilization system on the base of highly precise temperature regulator was designed. This system provides constant temperature with deviation no more than 0. 1 K.

A thermocouple detector for measurements of drops temperature in the flow was designed. In it the flow of monodisperse drops has transformed in a continues flow and than the oil temperature has measured. The temperatures is measured by copper- constantan thermocouples. The heat transfer coefficient is determined from heat balance equation for drop.

Designed investigation method allowes one to determine heat transfer coefficient with the error no more than 20%. The experimental data obtained allowes one to analyze heat transfer

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Счет 15 **от** **1998**

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from monodisperse drop flow.

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1384
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DMS OXIDATION IN A NON-REMOTE LOCATION

BARTHELMIE R.J. [1] , **PRYOR S.C.** [2]

[1] *Climate and Meteorology Program, Indiana University, Bloomington IN 47405 USA*

[2] *Dept. of Wind Energy and Atmospheric Physics, Rise National Laboratory, Denmark.*

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The role of biogenic sulfur (S) emissions in the chemistry of the marine boundary layer is important because of the potential climate feedback mechanism of aerosol sulfate formation. Most previous studies, both experimental and numerical, have focused on the remote marine boundary layer where the hydroxyl radical addition or abstraction reactions are the most important pathways for dimethyl sulfide (DMS) oxidation. However, it has also been suggested that the nitrate oxidation pathway is important in less remote locations (Yvon et al., 1996).

We examine spatial aspects of the relative importance of DMS oxidation pathways and discuss the implications for the relative abundance of various DMS oxidation products in coastal locations. An amended version of the DMS mechanism of Hertel et al. (1994) has been implemented in the Inorganic and Secondary Organic PARTicle model (ISOPART) (Pryor and Barthelmie, 1998), a lagrangian model in which gas and aerosol chemistry are fully coupled. Evaluation of this mechanism in the remote marine atmosphere suggested that it is conservative in its conversion of DMS to sulfur dioxide and non-sea salt sulfate but produces relatively large concentrations of methyl sulfonic acid (MSA) and methane sulfinic acid (MSEA) (Capaldo and Pandis, 1997).

In this application to the Lower Fraser Valley (southwestern British Columbia/northwestern Washington State). comparatively high concentrations of N compounds means that abstraction by the nitrate radical is the dominant oxidation pathway, except where trajectories originate and terminate over the ocean. During the simulation period the inclusion of DMS emissions and chemistry increases sulfur dioxide concentrations in the domain by up to 28% and sulfate concentrations by up to 10%. Further results will be presented showing the spatial variability of DMS chemistry in response to meteorology and emissions patterns, and the contribution of biogenic S emissions to secondary aerosol concentrations.

Acknowledgements

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1390
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THE ROLE OF AEROSOLS IN DRY DEPOSITION TO COASTAL WATERS

PRYOR S.C.[1], BARTHELMIE R.J.[1,2], GEERNAERT L.L.S.[2], ELLERMANN T.[3], PERRY K.D.[4]

[1] *Climate and Meteorology Program, Indiana University, Bloomington, IN 47405, USA.*

[2] *Dept. of Wind Energy and Atmospheric Physics, Rise National Laboratory, DK.*

[3] *Dept. of Atmospheric Environment, National Environmental Research Institute, DK.*

[4] *Crocker Nuclear Laboratory, University of California at Davis, CA, USA.*

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Model calculations of N deposition to seas around Denmark indicate that roughly 1/3 of total N enters via atmospheric pathways and 3/5 of the total atmospheric deposition derives from aerosol matter (Hertel, 1995). Measurement and modeling of aerosol dry deposition is confounded by the myriad of processes which determine the deposition velocity. However, it is known that aerosol diameter is critical and it has been suggested that hygroscopic growth close to the surface plays an important role in determining deposition fluxes (Slinn and Slinn, 1980). Aerosols also play a key role in determining the gaseous flux due to heterogeneous chemistry on aerosol surfaces (particularly reaction of HNO3 with NaCl to yield aerosol $NaNO^3$ and HCl vapor).

Herein, we examine the role of aerosols in dry deposition processes using size segregated and chemically speciated aerosol measurements collected during April and May of 1997 on the Swedish Island of Ostergarnsholm in the western Baltic under the Air-Sea Exchange Process Study (ASEPS). Aerosol size distributions (Dp: 0.5 - > 20 pm) were measured continuously using a TSI aerodynamic particle sizer. Size resolved aerosol measurements for chemical analysis were undertaken using a 10 stage Micro-Orifice Uniform Deposit Impactor (MOUDI) (Size segregated Dp: 0.056 - 18 pm) and a 3 stage Davis Rotating Universal-size-cut Monitoring (DRUM) impactor (Size segregated $D_{,}$: 0.069 - 2.5 pm). Aluminum foil substrates (47 mm) coated with silicon spray were used in the MOUDI to facilitate analysis for N species (Zhuang and Huebert, 1996). The sampling period was 24 hours in duration except during periods of extreme weather when filters were exposed for 48 hour periods. The filters were analyzed by ion chromatography for NO^-, SO_4^{2-}, Cl^-, Na^+, NF_4^+, Ca^{2+}, K^+, Mg^{2+} and MSA (methane sulfonic acid) using a solution of oxalic acid. A greased mylar impaction substrate was used for the DRUM impactor and was analyzed for Na through U using PIXE analysis to provide 6 hour average concentrations. In addition to the two impactors, filter samplers were also used to give bulk composition data for NO3-, SO42-, Cl-, Na+ and NF^{4+}.

The implication of these data is that NH^{4+} is principally present at (NH4)2SO4/NH_4HSO_4 in the fine faction of the aerosol, while significant amounts of NO3- are associated with larger aerosols. These data will be used with algorithms from Slinn and Slinn (1980) to estimate dry deposition of N-compounds based on the 24 hour average aerosol data. Note: It is acknowledged that the temporal resolution for the aerosol data is not ideal for this purpose,

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data are to be collected on a shorter time scale during the summer of 1998 in order to facilitate this analysis. Our investigations shows the molar ratio of Na^+ to Cl^- (by aerosol diameter and sampling day) and shows that during the first portion of the study, when the meteorological conditions were dominated by cyclone passages and measured HNO_3 concentrations were low, the molar ratios on the stages with large sea spray contributions were close to 1. Later in the sampling period when ridging dominated the meteorological conditions and observed HNO3 concentrations increased, the molar ratio on stages 2-6 increased providing some evidence for volatization of HCl vapor from sea salt aerosols (note this is also the period of highest aerosol NO^{3-}). These findings and other analyses related to calculation of N deposition will be discussed along with issues relating to measurement considerations.

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1397
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KINETICS OF FREE VOLUME CHANGES OF THE $FE_{89.8}NI_{1.5}SI_{5.2}B_3C_{0.5}$ AMORPHOUS ALLOY

MARICIC A.[1], RADIC S.[2], RISTIC M. M.[3]

[1] *Technical Faculty, , Cacak Yugoslavia*

[2] *Institute of Technical Sciences of SASA, Knez Mihailova 35, Beograd, Yugoslavia*

[3] *Serbian Academy of Sciences and Arts, Beograd, Yugoslavia*

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Changes of physical properties of amorphous alloys (AMA), under the influence of external parameters (temperature, magnetic field, mechanical strain) have been the subject of a great number of papers published up to now [1,2,3]. The correlation between thermal, kinetic, electrical and magnetic effects during the crystallization process in non-isothermal and isothermal conditions have been investigated for different amorphous alloys based on iron. In this paper the kinetics of the change of free volume of the $Fe_{89.8}Ni_{1.5}Si_{5.2}B_3C_{0.5}$ amorphous alloy in temperature regions about 100° lower than the crystallization temperature was determined using the DSC method [1]. Measurements were performed of linear expansion of the amorphous ribbon in isothermal conditions at temperatures: t_1=370, t_2=400 and t_3=450°C.

In these temperature regions the structural relaxation process takes place, decreasing the concentration of frozen defects of the vacancy type to a size characteristic for the metastable

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state at the given temperature. This process leads to a redistribution of atoms at shorter distances compared to the selected ones. So, this is an activating process and it occurs significantly faster at the temperature close to the glassification temperature..

The rate at which the unstable amorphous structure approaches the metastable structure at a certain temperature $T<T_g$, is proportional to the degree of instability.

If the difference $V-V_0$ determines the degree of instability, where V and V_0 are values of the free volume for the amorphous and metastable state at the temperature T, respectively, then:

$$\frac{d(V-V_0)}{dt} = -\frac{1}{\tau}(V-V_0) \qquad (1)$$

where τ is the relaxation time, which characterizes defect mobility, whose diffusion movement determines how the amorphous alloy approaches the metastable state.

So,

$$\frac{V(t)-V_0}{V(0)-V_0} = \exp\left(\frac{1}{\tau}\right) \qquad (2)$$

or

$$V(t)-V_0 = A\exp\left(\frac{1}{\tau}\right) \qquad (3)$$

where:

$$\tau = \tau_0 \exp\left(\frac{E}{kT}\right) \qquad (4)$$

Exchanging relation (4) in (3) and a double logarithm gives the dependence:

$$\ln\left[\ln(V(t)-V_0)\right] = \ln B\frac{E}{kT}$$

where E is the activation energy.

The experimentally obtained dependence $\ln[\ln(V(t)-V_0)]$ on T^{-1} is linear, and the activation energy was determined as E=90 kJ/mol from the tangent of the slope. The value obtained is approximately two times higher than the activation energy of diffusion for the amorphous alloy $Fe_{80}B_{20}$ investigated in [4]. However, though both alloys are based on iron their composition is essentially different. Values of the process rate constant were determined at the temperatures of 370, 400 and 420°C.

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1398.
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EXPERIMENTAL STUDY OF ULTRA-FINE MGO PARTICLES DURING THEIR CONDENSATION GROWTH NEAR THE BURNING MAGNESIUM PARTICLE

ALTMAN I.S., SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

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The nanooxides synthesis during combustion causes interest for study of condensation processes, which are accompanying the gas- and vapor-phase metal combustion. The satisfactory experimental information about condensation growth of nanooxides during combustion does not exist at present. It is known in dust flames the metal particles may burn individually. That's why, possibly, condensation in burning metal dust takes place as if it was during combustion of single metal particle.

In this work the method of study of ultra-fine condensed products during combustion of single metal particle is proposed. The method is based on the synchronous two-dimensional laser scanning of the region near the burning particle and one-dimensional scanning of radiation emitted by system. The method allows to obtain information about local extinction caused of ultra-fine products of combustion and about of nanooxides emission characteristics. The method is used for study of properties MgO ultra-fine particles forming during combustion of magnesium particle with radius r - 1 nm.

It is shown that the creating of ultra-fine oxides take place only in thin zone with width - 100 pm on distance - r from the magnesium particle surface. The upper experimental estimation for time of the MgO particles condensation growth is obtained. The conclusion is done: there are growing and ungrowing MgO particles in condensation zone; radiation is emitted by growing ultra-fine particles only. The optical characteristics of growing MgO particles are essentially nonequilibrium. The experimentally estimated time of their relaxation to equilibrium value is about 5 ms.

The obtained results can materially change the existing conception of the processes of the particles condensation growth from the gas.

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METHODOLOGICAL ASPECTS OF ESTIMATING THE MICROBIAL AEROSOL PARAMETERS INDOORS

VOROBEYCHIKOV E.V., GRANSTREM K.O., IVANOV V.P., KURTZER G.M.

St.-Petersburg I.I.Mechnikov State Medical Academy,

Fax: (812)-5431571, pac@infopro.spb.su

(First received 02 April 1998; accepted for presentation during IAS-4)

In practically unventilated enclosed spaces, the estimation of the concentration of a microbial aerosol and its space-and time distribution, as well as the prediction of the pulse of the concentration (dose) of microbial bodies getting into human body or on various surfaces is a complicated methodological task.

The current experimental contact methods of estimating the concentration of the microbial aerosol based on impacting of particles, as a rule, introduce additional turbulence into the studied medium and have a great error of measurements of the order 50%. Application of non-

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contact methods of study (i.e. optical, laser, electric induction etc.) are based on the dependence of the parameters of the utilized physical field energy on the concentration of particles requires the development of a special procedure that will provide the estimation of non-stationary quantitative characteristics of the microbial aerosol in space and time coordinates with high precision and confidence.

Theoretical investigations of the estimation of aerosol concentration, concentration pulse, and particles sedimentation density include deterministic and stochastic mathematical models which have a good correlation with the experimental data of the distribution of aerosol in an open half-space. In this case, during calculations, a model of a point pulse source of aerosol is used, and the equation of turbulent diffusion is solved with the help of the given conditions at the beginning and end. The probabilistic method is based on spatial distribution of particles which is generally assumed to be Gaussian by three spatial coordinates.

As applied to unventilated enclosed spaces, the deterministic approach has a number of drawbacks because no exact solution of the equation of turbulent diffusion has been found, while possible corresponding estimates of the parameters by means of a simplified approach, for example, substitution of the room boundaries for aerosol sources or run-off are highly approximate which leads to great errors. Besides, it is practically impossible to interpret the obtained estimates because the quantitative parameters of the internal sources and their spatial and time characteristics alter inadvertently which is not considered in this approach. The impact of casual values of the quantitative parameters of the sources requires additional procedures of averaging the estimates with the corresponding laws of distribution.

When estimating the parameters of aerosol, the application of the probabilistic approach is determined by a possibility of justified adoption of the laws of spatial and time distribution of particles in the room. From physical point of view, under such conditions probabilistic and statistical description of the distribution of aerosol is more justified. It should be assumed that in the absence of regulated air flows in unventilated space of the room, the probability of finding aerosol particles in any region depends only on the volume of this region, but not on its form and position in space, whereas the number of particles present in non-overlapping areas is an independent random value. In this case, the distribution of aerosol particles present in a particular area can be described by the law of Poisson.

Application of the law of Poisson to estimate the concentration, concentration pulse, and microbial bodies sedimentation density requires the knowledge of the mean concentration of microbial aerosol in this room. Low precision of the experimental estimates of this parameter actuates the development of probabilistic mathematical models to relate the mean concentration of aerosol to the main factors in the room (the number of sources and their capacity, room volume and age, viability of microorganisms, etc.) which affect a given value. For this purpose, the application of the methods of multivariate statistical analysis, i.e. regression analysis and the analysis of variance, the method of main components, etc. is suggested.

Along with the prediction of the concentration pulse on the basis of the distribution of Poisson the actual problem of visualizing the spatial distribution of aerosol in real time is pressing. This necessitates the study of spatial and time interval of the correlation of aerosol concentration with subsequent application of these data for the development of the system of microbiological monitoring the air in the rooms of various designation.

Experimental studies of the concentrations of microbial aerosols have been performed, real ranges of concentrations and dispersion composition of particular species of microorganisms most often encountered in practically unventilated enclosed spaces have been shown. Data on concentrations at various values of factors affecting the variability of quantitative characteristics of microbial aerosols have been obtained. On the basis of experimental data, the

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estimates of concentration pulse, of the density of sedimentation of microorganisms onto surface have been presented, as well as predictive probabilistic models to evaluate the value of the aerogemic mechanism of dissemination of opportunistic microbes under specific conditions have been designed.

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CORRELATION OF E.COLI LIPID PARAMETERS WITH CELL SURVIVAL IN AEROSOL.

GLUSHCHENKO N.N., BOGOSLOVSKAYA O.A., OLKHOVSKAYA I.P.

Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences Leninskii prosp, 38, b.2, Moscow, Russia. Fax.: (095)1378258, E mail: nnglu@chph.ras.ru

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Viability of airborne and lyofilized microorganisms bears on the search of methods for men, animals and plants airborne infections control and, on the other hand, deals with stability, survival and storing of bacterial cells being used for lyofilized vaccines for men, animals and plants immunisation. Lipids are known as a most labile cell structure. Taking into account the role of lipids in the activity of eucariotic and procaryotic cells, we assumed that composition and physicochemical parameters of cell lipids could play an important role in bacterial capacity for survival in the air .

We have found that cell viability in aerosol correlate with cyclopropane acids contents increase, with palmitic acid via palmitolic acid ratio, and might be described with the following equations: lnB = -6,31+2,25ln((17:0+(19:0) - for cyclopropane acids with correlation coefficient 0,81; and lnB = -3,95+3,37ln(16:0)/(16:1(7) - for palmitic acid via palmitolic acid ratio with correlation coefficient 0,86, where B is cell viability in aerosol.

Lipid composition to a large extent is conditioned with lipid physicochemical characteristics,i.e., antioxidant properties, lipid viscosity, oxidizing capacity of lipids.

We have disclosed that cell lipids exhibit antioxidant activity (AOA) and AOA of lipids got from various E.Coli strains vary in the limits differing in 1,5-2 times. Chemiluminescence method enabling to detect antioxidant (AO) contents and antiradical activity (ARA) in cell lipids was used to confirm antioxidants' presence in E.Coli lipids. Antioxidants of E.Coli lipids appeared to vary in contents and ARA.

ARA of E.Coli cell lipids was (3.9-4.6)(105 l/mol(s and in the order of magnitude appeared to be close to ARA value of the wellknown natural antioxidant- (-tocopherol. Acting quotient of antioxidants in E.Coli cell lipids was 0.10-0.16%, lipids from aerosolresistant bacterial straines having higher AO contents, ARA and AOA values than lipids from other strains.

We have revealed that cell lipids of various E.Coli strains differed in lipid peroxidation (LPO) products concentration, minimum LPO products being detected in aerosol resistant strains.

We determined oxidizing capacity of lipids and calculated the ratio of easy- and hardly-oxidizable lipid fractions (cardiolipin:phosphatidylcholine).

Lipid oxidizability was estimated from the data about fatty acids composition, chemiluminescent curves and double bonds number per one carbon atom in fatty acid chain. Lipids from tested bacterial strains appeared to differ in double bonds numbers and the minimum values were found in aerosolresistant E.Coli strains.

The existence of the LPO regulating system enables to change physicochemical parameters of cell lipids in a specified mode and to affect E.Coli cells survival. Synthetic antioxidants are the agents modifying lipid AOA. Introduction of antioxidants (Fenozans and Ionol) in the

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E.Coli incubating medium increased cell survival. Fenozan-1 increased cell survival 1.5times, Fenozan-22 - 1.8 times, Ionol - 2.1 times that of untreated samples.

Thus we have proved that physicochemical parametres of lipids of various E.Coli strains correlated with their capacity for survival in the air, i.e.,viability of the airborne bacteria in each group of strains was proportional to lipids AOA and inversely proportional to oxidation products contents. Inverse correlation between viability and double bonds number in E.Coli cell lipids was common for all strains tested. Introduction of antioxidants in the grows medium changed the viability of airborne E.Coli cells. Our data demonstrate the opportunity to modify the viability of airborne bacteria with control on physicochemical parametres of cell lipids.

1471
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ENVIRONMENTAL DAMAGE OF FLY ASH FROM THERMOELECTRIC POWER STATIONS FOR THE LIVING ORGANISMS - MODELLING WITH ULTRADISPERSED METAL POWDERS

GLUSHCHENKO N.N., BOGOSLOVSKAYA O.A., OLKHOVSKAYA I.P.

Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences Leninskii prospect, 38, b.2, 117829, Moscow, Russia. Fax.: (095) 1378258, E mail: nnglu@chph.ras.ru

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As statistic data show, hundreds thousands tons of industrial fly ash and aerosols pollute the atmosphere. Industrial fly ash contains a great variety of inorganic compounds, including such elements as Mn, Cr, Cu, Ni, Pb, Hg, Cd, V etc., effecting negatively on the people health.

The data of laboratory studies form the base for the correct estimation of heavy metals damage for the human being. So our colleges from the Rostov University tested ecological situation in the vicinity of the Novocherkassk's coal power station (Rostov-on-Don) and showed that the zone of extreme metal content in the atmosphere sediments was within 3 km area from the station, Sb, Cs, Ni, Co, Cd, Hf, La concentrations exceeding the fone contents by 10-20 , Sr, Mo, Eu, U - by 5-8 fold. Biogeochemical analysis had shown that the Ti, V, Cr concentrations in plants in 60-280 times exceeded fone values, and Ni, Cu, B contents were 3-8 times larger than fone. Copper contents in wheat grown as far as 5 km distance from the powers station in 1,5 times exceeded the safe level. Ti, V, Cr, Ni, Zr, Ba contents in grain were 4-60 times larger than mean fone values. We have studied dispersivity, chemical composition and solubility of fly ash samples. Particles with size 0-5 micron appeared to present 41% of total amount. Particles of fly ash consisted from SiO_2, Al_2O_3, Fe_2O_3 and trace elements Pb, Zn, Cu, Mn, Cr, Ni, Cd etc. Washout analysis with different solvents (2N HCl or ammonia-acetate buffer, 200C, 7 days incubation) showed the following sequence of elements contents in the rinsing fluids: Fe (83%)>Cr>Ti>Ni>Mn>Pb>Zn>Cu=Co. The fly ash toxicity was similar to iron ultradispersed powder (UDP) toxicity. We suggest UDP metals for modelling of ecological effects of environmental pollution with fly ash of thermoelectric power station wastes. The specialties of UDP's administrated in the organism are: 1) a prolonged action on the biological targets due to a gradual dissolution in biofluides and 2) a great variety of ionic forms of metals as well as metal complexes with biochelators. The size of metal UDP particles are similar to fly ash particles. So the use of UDP metals allows us to estimate the contribution of individual components of fly ash to total biological effect. We studied the action of fly ash components on the growth of inoculated melanoma B-16. Zn(100mg/kg), Ag(10mg/kg), Al(10mg/kg), Cu(10mg/kg) appeared to stimulate tumor growth up to 35% in comparison with untreated tumor mice. Zn (5 mg/kg), Cu (0,1 mg/kg), Fe (2 mg/kg) did not affect melanoma B-16 growth. We have studied the effect of UDP metals on the life time of AKR-mice a model of

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spontaneous carcinogenesis. The total doses were close to the greatest tolerance doses. It was found that Cu and Zn UDP administration reduced animal's life up to two times. Radioactive aerosols are known to include a non-radioactive components such as Fe. The contribution of a non-radioactive constituents was studied in experiments with simultaneous action of radioactivity and Fe UDP. It was found that a combined effect of Fe UDP in doses (0,5-1,0) mg/kg and fractionated irradiation (1Gr and 2Gr, total dose 8Gr) decreased the lifetime of the irradiated mice by 1,5-2 fold. The investigation of total effect of iron UDP and fractionated irradiation of mice showed that essential changes took place in the system of cyclic nucleotides: in thymus (a radiosensitive organ) c-AMP contents decreased in two times, in liver (a radioresistent organ) c-AMP changes were less pronounced.

1474.
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THE BASIS OF MECHANISM FOR SYNTHESIS THE PROTECTIVE COATS DEPOSITED WITH LOW-TEMPERATURE SUPERSONIC SUPERSONIC HETEROGENEOUS FLOW

NIKITIN P.V.

Moscow Aviation Institute 4, Volokolamskoye shosse, 125871, Moscow, Russia Phone: (095) 158-49-30 Fax: (095) 158-29-77, 158-42-77 E-mail: alt@tk.mainet.msk.su

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In the report are described the behavior basis of formed surface coats produced by means of the Low-Temperature Gas Dynamic Method (LTGDM) developed in Moscow Aviation Institute (MAI). It is shown that particle kinetic energy level plays main role in process of substrate coating formation. The required value of particle kinetic energy is depended on the coating type and itsprognozing properties.

Particles kinetic energy detrmines the level of plastic deformation of the particle and the substrate. During the collision between the high-velocity particle and the substrate there is generated in the volume of interaction zone the train of shock waves which causes a number of the physical-chemical transformations, for example, an extremal rize of pressure and temperature level in the collision zone, quick-flowed processes of heat-, mass-exchange, deformation hardening processes, etc. Complex action of the factors furthers more intensive dislocation density growth, that creates the necessary conditions to form chemical and mechanical bonds and consequently causes high adhesion and cohesion coat characteristics.

With help of Arrenius equation rising as the mathematical model of the topo-chemical reactions kinetics there was done as analysis of possible processes of coat formation as evaluation attempt of a main values of pressure and temperature levels in contact area of particle and substrate. It was showed that under conditions of very high collision pressure level, realizable in the contact zone one can produce satisfactory performance of cohesion and adhesion coat strngth (up to 65% of the monolitic material) even under room temperature of substrate conditions. The performance will be significantly rise if the substrate has a small preliminary heating.

In paricular, there is revealed by means of metalography and X-ray diffraction methods the significant (up to twice and more) rise of micro-hardness if coat in comparison with the initial material micro-hardness. The micro-hardness rising is stayed stabil even after prolongated annealing coat under temperature of recrystallization of the used materials. There is confirmed the coating and transitional layer influence on the substrate material specmen static strength,

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for instance, by means of the experiment it is discovered that the strength limit of copper specimens with the NbC+NiAl coats of thicness of 60 microns at the temperature of 20 K will be rised up to 20%., the reology limit is rised up to 2,58 times, the elastic module is rised up to 57%. These characteristics are rised at the temperature of 300 K up to 52%, up to 3,69 times, and up to 57% accordingly.

1476.
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LOW-TEMPERATURE GAS DYNAMIC METHOD OF DIFFERENT COATINGS DEPOSITION ONTO THE SURFACES

NIKITIN P.V., ANDREEV N. A., PROROKOV S.M., SMOLIN A. G.

Moscow Aviation Institute, 4, Volokolamskoe Shosse, 125871, Moscow, Russia, phone 7-095-158-4930, fax 7-095-158-2977 e-mail alt@tk. mainet. msk. SU.

(First received 06 April 1998; accepted for presentation during IAS-4)

This work will describe the analysis of Low-Temperature Gasdynamics Method (LTGDM) developed in Moscow Aviation Institute (MAI), method physical content, the process, accompanying its implementation and its potential capabilities for science and manufacturing.

Utilization of the traditional methods for production of structural materials is always related to large energy expenditures. First of all it is explained by the low efficiency of installations implementing these methods. Due to that during last decade the so-called non traditional methods were under development. Among them are flame and gaseous flame metallurgy, biometallurgy, chemiometallurgy etc. These methods have essential increased efficiency of energy utilization for production of a material mass unit. For example, utilization the electrical arc and high frequency plasma generators for heating in metallurgy allowed to increase efficiency up to 60%. On the basis of these installations application the wide range of different technological operations were developed and introduced to the industry. They allows to sharply increase quality of products together with decreasing of energy expenditures and production duration.

Among these technologies the special role is played by the gas dynamic methods. For example, the gas dynamic plasma methods are widely developed. Namely, for the first time in the industrial metallurgical practice the plasma technology allowed to solve the problem of compatibility barrier for different metals and their derivatives. Mobility and simplicity of this technologics in combination with high heating level of initial products (several thousand degrees) gave a chance to create materials with the principally new properties (inter metallides, metallic ceramics etc.). But having mobility and simplicity the gas dynamic plasma method has a number of disadvantages related first of all to utilization of high temperature (plasma) flow.

Later, the method of detonation deposition of coating was developed. In realization this method is simpler and less expensive the plasma one. It is based on utilization of detonation process at the instant burning (blast) of the flammable gases such as acetylene, propane etc. Method of detonation coating deposition refers to the class of high temperature gas dynamic methods. As the plasma one, the detonation method utilizes the gaseous products of blast as the gas carrier with addition of the working medium : air, water vapor, nitrogen etc. The obtained mixture together with the powder portion are heated during blast and are transported at high velocity to a position to produce coating.

Therefore in this method the particles accumulate two types of energy: heating up to the plastification temperature or even to the temperature of melting, and kinetic energy in the course of acceleration by the gas-carrier. The both type of energy play decisive role in shaping of coating.

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Together with many advantages the detonation methods has the serious drawback. Due to high temperature (several thousand degrees) the gas-carrier has strong chemical agressivity. This worsens the coating quality and requires special conditions for its liquidation.

The method of low-temperature gas dynamic coating deposition, developed at MAI (Russian patent N2082823) is the development of the cold gas dynamic method of Novosybirsk's Institute of Theoretical and Application Mechanics (USSR Pat. N 161878) and is logical advancement of plasma and detonation methods.

There is developed a new gas dynamic method (LTGDM) for synthesizing of multicomponent materials with the necessary predicted properties. The method is based on the use of supersonic heterogeneous (two-phase) flows .The main idea of this method is that new materials are synthesized as a result of high-speed (M > 1) two-phase flows impact with a barrier (a substrate) . A composition of the material is "taken" from a necessary (in order to get the necessary properties) quantity of chemical elements or chemical elements compounds (metals, oxides, carbides, nitrides and others) as powders with a dispersity from 10 up to 50μm. A necessary spectrum of heterogeneous powders constituted in corresponding mass fractions is premixed in the special gas dynamical mixers. So the obtained mixture being in aweighted state in gas flow accelerates in supersonic nozzle up to a computed speed for a given compound. Initial temperature of the particle carrier gas (stagnation temperature) is so selected that the exit nozzle particles speed would correspond to a computed one but their temperature and static carrier gas temperature wouldn't exceed 20-50 % of the particle material melting temperature. So, in order to get a carrier gas speed exceeding speed of sound in two times, initial temperature doesn't exceed 300°C at pressure 0.5-1,0 MPa. As a result, solid particles acceleration takes place in cold gas flow what excludes particles oxidation and there fore, allows to use air as a carrier gas.

NTGDM will allow to realize super fast technologies without considerable energy costs. For example, it takes several tenths fractions of a second for obtaining of intermetallic material layer Ni Al of a thickness 1 mm by means of CGDM, while using a standard chemical-thermal technology a transition zone of a thickness 60 microns is formed in ovens during 9 hours at temperature ≈ 700°C.

In the laboratory there is developed an effective technology for a production of metal-ceramic materials for the account of additional energy supply during a process of a material synthesis caused by a presence of exothermal chemical reactions in a process of high-speed particles interaction with a substrate.

The use of such method allows to form carbides coatings, borides ones, oxides ones, silicides ones and others, refractory compounds on a substrate.

The obtained types of metal-ceramic materials can be widely used in new technologies owing to high thermal or mechanical properties.

There is simultated a process of the new materials coating and synthesis by the numerical methods, the two-phase flows structure and the properties of these materials are studied using the modern methods of a diagnostics, such as : laser velocimetry and particle measurements diagnostics, X-ray spectrum microanalysis, contact auto radiogram, high-resolution auto radiogram and others.

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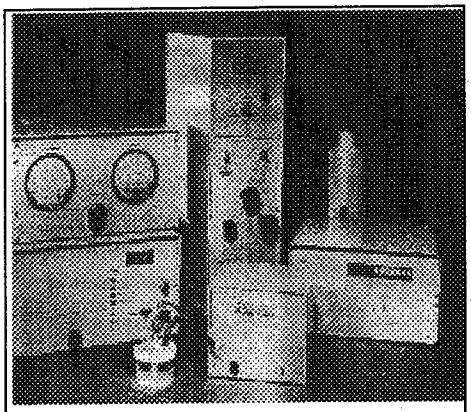
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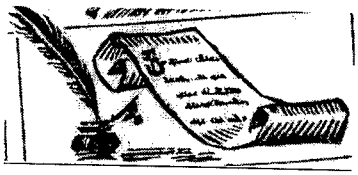
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NEW ISOMERIZATION REARRANGEMENTS FOR FULLERENES.

T.YU.ASTAKHOVA, N.YU.BUZULUKOVA, G.A.VINOGRADOV.

Institute of Biochemical Physics RAS, ul.Kosygina 4, 117334 Moscow.

(First received 31 March 1998; accepted for presentation during IAS-4)

A new approach to the problem of fullerene isomerization mechanisms is developed. The fullerene isomerizations are represented as special operations applied to the graph of the initial isomer. In this approach the isomerization rearrangements are considered as transformations of the patch of a graph preserving its fullerene character. There are proposed two classes of isomerization transformations for fullerene graphs -rotation and mirror reflection of the chosen part of the graph. It is found that the Stone-Wales rearrangements are the particular cases of the suggested transformations.

The developed matrix formalism allows to perform an efficient computer search of all isomerization transformations allowed for the chosen isomer.

The isomerization map of C_{40} fullerene is constructed as an example.

There are found three "simple" rearrangements irreducible to the Stone-Wales transformations. These rearrangements can be represented by rotation of a C-C bond or a "vertex star" and seem to be realizable under experimental conditions. The energetics and reaction paths of these rearrangements are calculated by semiempirical quantum-chemistry methods.

1447
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NEW ALGORITHM FOR THE GENERATION OF NANOTUBE CAPS

T.YU.ASTAKHOVA, N.YU.BUZULUKOVA, G.A.VINOGRADOV.

Institute of Biochemical Physics RAS, ul.Kosygina 4, Moscow 117334.

(First received 31 March 1998; accepted for presentation during IAS-4)

A new algorithm for the generation of nanotube caps is suggested in the present work. The method for the unfolding of fullerene caps on the honeycomb lattice [1] is utilized. Our approach is based on the representation of pentagons as defects on the regular honeycomb lattice, where pentagons coordinates can be defined by a pairs of integer numbers {m_k, n_k}, k=1,2,..6. The nanotubes are well defined by a tubular vector C_h, and it is well established that the given vector C_h(i,j) gives a finite set of topologically different nanotube caps [2]. The relation between the set of coordinates {m_k, n_k} and the components (i,j) of the tubular vector allows to introduce two Diophantine equations in integers connecting these values. The solution gives an extracompleted list of nanotube caps, and the topological duplicates are discriminated by the eigenvalue spectra of the F-matrices, -- an analog of the adjacency matrix for the dual triangular lattice. Their made few corrections to the numbers of isolated pentagons caps for some nanotubes [2].

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STUDY OF THE EXPLOITATION CHARACTERISTICS FOR THE GAS-DYNAMIC VOLUMETRIC FILTER OF EMULSIFIER TYPE

SHMIRKOV O.V., RUDAKOV V.P., ROMAKHIN S.S., BONDAREVA N.V., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation Institute
125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPME MAI tel.: (095) 158-0020 riame@mai2.rcnet.ru.

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Developed lately means of «wet» purification of smoke-consuming gases from solid particles trap to 90-95% of the particles with the sizes till 15 μm. The basic techniques for reaching of the purification level are the following: vortexing of the flow for rejection of the particles to the walls, smooth and stepwise resistors for the particles deposition, intensive sprinkling for the particles wetting and washing off. Using of the devices for purification of the smoke-consuming gases at a middle region power plant enabled to decrease the solid particles ejection to some tens of tons per a day. Application of them demands to supply power about 1-2 MW and several hundreds tons of water per a day. Besides, these devices are low-efficient for trap of the particles with the sizes less than 15 μm.

In the given work the results are presented that have been gained at calculated and experimental study of an up-to-date device for the «wet» purification of gas, namely, of a volumetric gas-dynamic filter of emulsifier type, having high productivity and efficiency at comparatively low consumption of energy and low consumption of water. The filter is designed to trap the solid particles in the industrial waste gases, the vapors of plasticisers and oils, the toxic components. It represents a tube with length-diameter relation of 15:1; the tube is made of the composition materials, resistant to erosion and to the alkali-acid components. At the filter inlet a vortexer is mounted of the spade type. On distance of the order of some calibers from the vortexer a diaphragm is placed. From above, over the internal wall the working liquid is supplied. Study of the gas-dynamic filter characteristics have shown that at the gas flow rate of 4.0-6.6 m^3/min and at that of water of 1.0-2.0 l/min the regime of working liquid emulsification occurs in the rising gas flows. At the regime the maximal purification of the gas is achieved, but the pressure losses in the filter increases by 1.5-2 times. Efficiency of the industrial waste gases purification from solid particles, oil particles, plasticisers and low-molecular compositions (LMC) is of 98.7-99.8% at the magnitudes of the solid particles initial concentration of 96-38 g/m^3 , that for the oil particles, plasticisers and LMC is of 50-200 mg/m^3 , and that for the working liquid is of 200-300 g/m^3 . The particles sizes were in the range of 100-1 μm. Total pressure losses in the filter at the emulsification regime are of 80-120 mm of water column at the working liquid concentration of 200-300 g/m^3 .

The main contribution to the filter resistance at the emulsification regime inserts the diaphragm (approximately 50%), however, its cross section variation does not practically influence the filter resistance.

Increase of the gas temperature in the range of 290-390 K does not practically lead to any change of the filter characteristics. The gas temperature losses in the filter amounts to 70% at the liquid phase concentration not less than 200 g/m^3 .

During these experiments it was marked that formation and retaining of the emulsification regime depend substantially on the order and way of the working liquid supply in the filter. Mounting of a thin cylinder at the filter outlet decreases as this dependence as the demands on precision of manufacturing of the section for pouring of liquid into the filter; besides, it widens the zone of the filter stable operation.

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1506.
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COMPLEX AEROSOL PROGRAM OF THE INSTITUTE OF ATMOSPHERIC OPTICS SB RAS, TOMSK, RUSSIA

V.E ZUEV

Institute of Atmosphere optics, Tomsk, Russia, zuev@iao.tomsk.su

(First received 20 April 1998; accepted for presentation during IAS-4)

The complex aerosol program contains the following major scientific areas:

1. Systematic laser sensing of aerosols using the unique Siberian lidar station.
2. Laser sensing of aerosols of natural and anthropogenic origin in different regions using the unique aircraft-laboratory.
3. Laser sensing of aerosols above the sea and ocean surfaces using the instrumentation installed on board the research vessels.

As a rule, the aerosol sensing is made in combination with the other characteristics of the atmosphere including the meteorological parameters and various gases both of natural and anthropogenic origin. Thus, the Siberian lidar station, owing to the simultaneous use of the five telescopes with the receiving mirror diameters from 0.3 to 2.2 m, as well as lasers with the wavelengths 1064, 532, 683, 628, 353, 308, 289 and 271 nm, makes it possible to obtain not only standard profiles of scattering cross sections but the particle size spectra and aerosol particle concentration in the altitude range from 0 to 50 km with simultaneous measurement of profiles of temperature, ozone and nitric oxides. In particular, using this station we investigated volcanic aerosols erupted from the Mt.Pinatubo volcano started from the first aerosol cloud over the Tomsk (06.07.1991) and ending with disappearance of volcanic aerosol traces late in 1995.

A well instrumented aircraft-laboratory AN-30 capable of continuous long distance flight during 9 hours has made it possible to investigate the ecological atmospheric conditions over 108 cities of our country. The airborne equipment consists of 15 different instruments and systems including a sun spectrometer, a chromatograph, nephelometers, a spectrophotometer, a lidar, a radiometer, an infrared system, a system for determination of pH and chemical composition of aerosol particles (up to 30 different atoms and ions), a central computer.

Over many years from 1988 to 1995 the Institute of Atmospheric Optics took part in 7 expedition voyages of research vessels over a period of 46 days in 1988, 62 days in 1989, 83 days in 1991, 19, 73, 26 and 29 days in 1995.

Over this period a great body of data was obtained and analyzed on the integrated aerosol optical thickness in 25 water areas of the Atlantic ocean from equator to 60 N and from 80 W to 20 E. The data were obtained and interpreted on the spectral dependence in the wavelength range from 0.4 to 12 mkm in the five typical water areas as well as the meridian dependence of the integrated optical thickness. In parallel with the data on the integrated aerosol optical thickness the data were obtained on the vertical thickness of water vapor for different ocean areas as well as the data on carbon dioxide concentration over the water surface. Together with the above results a great body of data on the oil slicks pollution of the ocean surface were obtained. The measurements of all the above-mentioned characteristics were made using the instrumentation created at the Institute of Atmospheric Optics, namely, aerosol lidars, radiometers, laser fluorimeters and other devices.



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OPTIMIZATION OF THE FLOW-THROUGH CHANNELS GEOMETRY OF MULTIPURPOSE EMULSION GENERATORS ON THE BASIS OF NUMERICAL MODELING

RUDAKOV V.P., ROMAKHIN S.S., BASKAREV B.N., SHMURKOV O.V., SERGEEVA L.L., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation 125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPME MAI tel.: (095) 158-0020; riame@mai2.rcnet.ru.

(First received 06 June 1998; accepted for presentation during IAS-4)

At creation of the dispersion media multipurpose generators that are used for organization of the multicomponent finely-divided flows at the low counterpressure (outflow in vacuum), the combined methods of high-quality mixing are employed on the basis of saturation with gas, emulsification and dispersion of various liquids and suspensions. At development of the flow-through channels design of the generators, empirical methods are still used for their working characteristics improvement. Optimization of the flow-through channels geometry for the emulsion generators on the basis of numerical analysis was the goal of present work.

In spite of large variety of the possible constructions of the generators there are only a limited number of the mixing schemes:
- mixing of the gas and liquid components of dispersed mixture by way of saturation of the axial circular liquid flow with the gas bubbles penetrating through the porous element;
- emulsification of the axial circular liquid flow with the heavier liquid drops penetrating from the flow periphery through the porous insert;
- mixing of the circular vortexed flow with the lighter liquid drops which are supplied from the periphery through the porous insert.

Operation of the aerosol generators which realizes these schemes is based on the physical processes the most important of which are the following:
- the gas bubbles boiling up in the moving liquid flow;
- the viscous liquid droplets motion in a liquid flow with other values of viscosity & density;
- the liquid droplets drift in the vortical flow of another liquid.

Analysis carried out in the present work enabled to substantiate the physico-mathematical model describing in terms of dimensionless parameters the processes occurring in the emulsion channels of the generators with the chosen mixing schemes. The developed model was used at the optimization by way of numerical modeling of the flow-through channels geometry providing the high-quality mixing. As the result, stability domains for existence of the mixing components flow and conditions of realization of maximal possible volumetric share for bubbles phase and droplets mass have been found in circumstances where the gained emulsion is not stratified and with and without of the flow vortexing. Parameters of the flow and the generator channel geometry corresponding to these conditions were realized in construction of different types combined generators. Experimental study of operation of the generators with optimized geometry has shown possibility of the high-efficient mixing (without stratification) of the liquids normally nonmiscible with each other at the mixture nonuniformity size of 10-80 μm along the channel length of less than 0.2 m and at the pressure differential of $1 \cdot 10^5$ - $8 \cdot 10^5$ Pa on the porous insert. The developed generators designs provided the aerosol formations creation at the pressure differential on the spray unit of less than $1 \cdot 10^5$ Pa with spraying dispersion characteristics improved by 15% in comparison with dispersion of the pure (nonemulsified) liquids.



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METAL OXIDES - THE MAIN COMPONENTS OF TROPOSPHERIC SOLID AEROSOLS UNDER THE EARTH'S ATMOSPHERE CONDITIONS

ZAKHARENKO V.S., PARMON V.N.

Boreskov Institute of Catalysis, Novosibirsk 630090, Russia

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The tropospheric solid aerosols contains considerable concentration of insulator oxides such as SiO_2 , Al_2O_3 , MgO, CaO, but being in a "pure" state, these oxides are able to absorb light efficiently only in the wavelengths region shorter than 300 nm. For these insulator oxides to absorb the solar radiation with the wavelength > 300 nm, they need to be sensitized to this spectral region. Sensitization of the metal oxides in atmospheric conditions is possible as a result of surface compounds formation, e.g., after adsorption of gas phase components of the atmosphere.

The composition of the adsorbed layer of the aerosol oxide is determined either by a relatively high concentration of the corresponding compounds in the atmospheric gas phase or by selectivity of the adsorption by components of the solid aerosol. It may be expected upon formation of the adsorbed layer on the surface of insulator oxides that these will be sensitized to the solar radiation reaching the Earth's troposphere.

For example, the atmosphere exposed magnesia was found to absorb light with wavelengths shorter than 400 nm with maximum at 360 nm [1], while such absorption being absent on the magnesia samples exposed to a rigid oxygen-vacuum pretreatment.

After long ageing in ambient air, calcium oxide powder also starts to absorb at wavelengths 300-400 nm. This absorption band decreases drastically after rigid oxygen-vacuum treatment of the sample at conditions like those for MgO.

In this work we studied photostimulated adsorption of "methane" and "ethane" set freones (CF_2Cl_2 - freon 12, CF_3CH_2F - freon 134a, respectively) on the surface of the air-exposed calcium oxide at room temperature in presence of water vapour and/or dried air.

Under the atmospheric conditions calcium oxide reacts with water vapour and transmutes to calcium hydroxide. Calcium oxide being suspended in water transforms totally to calcium hydroxide which was used to cover the reactor wall made of molybdenum glass. When the reactor wall, covered with hydroxide calcium, are exposed to ambient air for long time, hydroxide converts partly to calcium carbonate due to presence of CO_2 in the air. After soldering to a high-vacuum setup, the reactor was evacuated at room temperature for several hours.

Such prepared surface calcium hydroxycarbonate does not adsorb freones 12 and 134a in the darkness, being able, however, to adsorb solely freon 134a under the illumination. The photoadsorption activity of the calcium hydroxycarbonate with respect to freon 134a is observed at the wavelengths shorter than 400 nm, in the range of the optical absorption of air-exposed CaO.

When the freon photoadsorption occurs in presence of air, dried preliminary by its passing through a trap cooled with liquid nitrogen, the quantum efficiency and the action spectrum of the freon 134a photoadsorption change only slightly. Photoadsorption of oxygen from air is observed too, the red edge of this photoadsorption locating at 360 nm ; note, that the same red edge has been reported for the oxygen photoadsorption on CaO exposed to rigid oxygen-vacuum treatment.

This work has been supported by the Grant № 98-03-32311 from the Russian Foundation of Fundamental Researches.

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1054.
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UNSTEADY- STATE PROCESSES IN AEROSOL OF CATALYST

GLIKIN M., KUTAKOVA D., PRIN E.

State Design and Research Institute for Chemical Engineering, KHIMTEKHNOLOGIYA
Post address: Dzerzinsky st.1, Severodonetsk, 349940 UKRAINE EMAIL: prin@himn.etalon.lugansk.ua

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Keywords: catalytic surface, intradiffusion retadations, aerosol of fine mild catalytic particles

The task to produce and to maintain the optimal structure and state of a catalytic surface during a chemical conversion process is the main problem in catalysis as it gives a possibility to control the rate and selectivity of chemical reactions.

Solving this problem for carrier catalysts has been complicated because of chemical conversion rate decrease owing to the intradiffusion retardation, catalyst pores plugging by cocks, polymers, salts and blocking active catalytic surface by these materials. Some of the problems are related to insufficient efficiency of existing methods of catalyst regeneration, limited range of carriers and their modification choice; complicated preparation; high cost. In the processes on the fluidized and moving bed, catalyst attrition is observed even when using updated carriers because of their limited strength and thermal resistance.

The investigations led to the new organization of gas-phase heterogeneous catalytic chemical conversions based on the use of fine-milled active catalytic material filling the reaction volume as aerosol and creating quasistructures of the catalyst. This catalytic system recycling in the reaction unit may be an individual chemical compound, mechanic mixture or alloy of individual chemical compounds.

The expected effect after the use of the catalytic small-particle aerosol can be associated with the following:

– the increased activity of the fine-grained catalyst compared to the conventional systems; by escaping the catalysis intradiffusion stage;
- expanding the outer contact surface;
- providing the equal access to the active surface; controlling the catalyst concentration in the reaction volume during the synthesis;
- high mechanic strength and thermal resistance of catalytic material; possibility to remove cocks and salt products from the catalyst surface by mechanical processing.

Chemical conversions on the fine-like catalyst (without any carrier) have been performed for the reactions of reduction, vinylation, deep and partial catalytic oxidation of organic and inorganic compounds.

The laboratory research results show unexpected substantial aerosol catalyst activity increase compared to the best samples of carrier catalytic systems for fluidized and fix bed modes.

The analysis of possible reasons of this phenomenon was carried out for two of the best carrier catalyst samples (Pt...-Al_2O_3, 0.6% Pt, $CuCrO_4$/...-Al_2O_3, 30% $CuCrO_4$) and aerosol catalyst based on iron oxide 3.

The investigations were performed on the laboratory unit in the reactor of flow type (D=50mm) under the test reaction condition of acetic acid deep oxidation. Herein the conversion degree was up to 99.98-99.99% with the carbon monoxide content of 20 mg/m^3 and absence of incomplete oxidation products in the off-gasses.

The results of comparison of acetic acid oxidation on the classical catalytic system and on the aerosol of catalyst show extremely high activity of iron oxide aerosol catalyst. It exceeds the activity of industrial samples by five orders.



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Herein the operation concentration of iron oxide was about 3 g/m^3, while it reaches 4 kg/m^3 for the platinum catalyst and 200 kg/m^3 for copper- chromic catalyst.

The experimental data analysis allows to suppose that particle dimensions amount to several nanometers. The up-to-date scientific visions of the change of nano-size particle surface properties (such as electronic deficiency) gives all the grounds to suggest that this is the main reason of such considerable activity increase of aerosol of iron oxide catalyst.

1060.
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TO THE HIGHER FULLEREN PROBLEM

VOLKOV I.A.

All-Russia Petroleum Scientific-Research Geological Exploration Institute (VNIGRI)
Liteiny, 39, St.-Petersburg, 191104, Russia Fax: 7-812-2755756 E-mail: ins@vnigri.spb.su

(First receive 12 December 1997, accepted for presentation during IAS-4)

The problems of the higher and odd-numbered carbon clusters are principal but unresolved [1] ones. Like Balmer empirical spectral formula, the simple integer-valued formula for numberes of atoms in relatively stable carbon clusters Cn have been obtained by author. It specifies the following finite set:

n= 60, 70, 84, 120, 165(330), 280, 819(1638).

The even numbers indicated in the bracets are doubled corresponding odd-numbers. As was to be expected, the series begins with two knownfullerenes,besides, three first members are exactly in line with augents of Fowler's rules (the necessary condition for clousedness of electron shells)

$$n1 = 60 + 6S, n2 = 70 + 30S, n3 = 84 + 36S (S = 0, 1, 2, ...).$$

The displayed formula correlates well with LD-TOF mass-spectrum [2]. If we draw the enveloping line along the most peaks, marked by authors themselves, clusters Cn for n=60, 70, 84, 118, 166 will be on it. A typical FT-ICR mass spectrum [1,3] has a noticeable maximum for odd- numbered clusters in vicinity of the point n=165 in addition to the extremum (n=330) of relatively intensity for even numbered clusters. That previously unnoticed fact has been recorded only owing to the prediction by the formula and equipment with high mass resolution used in American Institute of Physics. The series ends with giant clusters (for n=819, 1638). By similar vertification we have not been possible to detect their between fragmentary published experimental evidence. Nevertheless, cited above resultsgive the assurance that the proposed formula adecuately depicts something actual law. The following task of research is the revealing of the formula physical meaning by analogy with the energy interpretation of Balmer formula. Agreement of our formula for 3-dimentional carbon clasters with Hukkel's formula for 2-dimentional structures of aromatic hydrocarbons by their simultaneously correlation with average quantum-mechanical values in problems having centpal symmetry have been established [4].

The method of the new linear reccurrencerelations developed by the author for classical orthogonal polynomials and for others specials functions used in quantum theory is the mathematical basis of the investigation.

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1107.
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USING OF POLYDISPERSE AEROSOLS AND SPECIAL AEROSOL SOURCES FOR CALIBRATION OF AEROSOL RADIOMETERS

FERTMAN D., RIZIN A.

Scientific & Engineering Centre "SNIIP", Moscow, Russia.

(First received 20 January 1998; accepted 29.04.98 for presentation during IAS-4)

The national radioactive aerosols standard exists in Russia since 1973 [1]. It reproduces and keeps the unit volume activity of the most toxic Pu-239 and Sr-90 radionuclides model aerosols and transfers its value with best accuracy to the operating measurement means (OMM) with the help of standardized methods and reference means. Polydisperse media of model radioactive aerosols in standard has a range of the sizes of particles of an inhaled faction, recommended ICRP [2]. The keeper of the standard is National scientific metrological centre "VNIIFTRI" of State committee on standards of Russia.

Direct usage of national standard for metrological provision of measuring operating means is too expensive. At each stage of developing and using measuring equipment the choosing of technical means for realizing main tasks of metrological provision shall be performed with optimal cost-effectiveness ratio. Such offers were formulated in work [3].

The national standard design was practically reproduced at participation of the authors as metrological complex in aerosol laboratory of metrological centre of Ministry of Atomic Energy in SEC "SNIIP". It is used for the calibration, certification and verification of the radiometers and other practical metrological provision. Main parameters of a metrological complex are resulted. In addition the important problems arised in radio-active aerosols metrology in last decades were resolved:

- it was extended radionuclide structure of aerosols - was added generation of natural uranium aerosols;
- questions of calibration and type samples of radiometers and measuring channels of the radiation control systems directly on consumer's place were resolved by using of priority designed model aerosol sources (Special Aerosol Sources - SAS) [3].

SAS with radionuclides Pu-239 and Sr-90 + Y-90, specially made for reference radiometer and certificated on equipment of the national radioactive aerosols standard with accuracy 10 %, have allowed at next certification of radiometer to lower meaning of its main error to 20 % (on uranium natural up to 30 %). The original technology of manufacturing of a source permits to take into account peculiarities of the sampling communications of a concrete type of radiometer, but also geometry and conditions of registration of radiation of sample radionuclides.

Structure of model radioactive aerosol particle sizes was estimated by six-cascade impactor and radiometer MS-01P.

Radionuclides and characteristics of model aerosols are close to similar parameters of the national radioactive aerosols standard. It is a necessary condition for maintenance of unity and correctness of measurements when the calibration, certification and verification of OMM are made by reference radiometer. Such procedure corresponds to a procedure of dynamic tests of aerosol monitors , accepted, for example, in standard IEC - 761- 6 and other similar documents. The meanings of sensitivity of several types OMM were defined by metrological complex equipment. Then the similar procedure with the purpose of specification of their sensitivity was lead on national radioactive aerosols standard. The experiments demonstrate good convergence of comparative measurements results.

Experience of long-term operation of the national radioactive aerosol standard in Russia, and efficiency of the used metrological provision have appeared are rather high, that on this way there were the experts of other countries. The French experts from IPSN-CEA have the most advanced

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in last years , having created aerosol standard ICARE [4]. In result of cooperation between SEC "SNIIP" (Russia) and IPSN-CEA (France) [5] was made a number aerosol samples with certain radionuclide ingredients. Independent mutual measurements of activity of these samples were carried out. Received data have allowed to increase accuracy of measurements up to level of the international requirements (error of measurements does not overtop 20 %)

The joint work of the experts of laboratories from Russia and France is step to creation of international system of the radioactive aerosols standards. This system, in opinion of authors should be based on activity of nominated autorized national laboratories, make speciality of practical radioactive aerosols metrology.

The authors of the report have expressed representation about level and functions of such national laboratory and have demonstrated it on example of aerosol laboratory SEC "SNIIP" of Russian Federation Atomic Energy Ministry. And experience of cooperation of the Russian and French experts SEC "SNIIP" (Russia) and IPSN-CEA (France) has planned main contours of system of international trust in this area and possible ways of achievement of such trust.

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1529
УДК 541.18

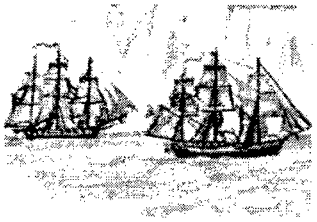
THE ROLE OF MARINE SPRAY AND AEROSOLS ON THE AIR-SEA EXCHANGE OF HEAT AND GASES

G. L. GEERNAERT, L. L. S. GEERNAERT

Ny Toftegaardsvej 22, DK-3650 Olstykke, Denmark E-MAIL: GLG@dmu.dk

(First received 15 July 1998; accepted for presentation during IAS-4)

Heat and gas exchanges are central to modelling and assessments of regional climate and marine eutrophication. Nitrogen, carbon, and heat exchange furthermore play central roles in coastal marine biomass dynamics. In order to model the exchanges of these compounds (and heat), the classical approach used Monin-Obukhov similarity theory and/or simple deposition velocities derived from laboratory or other limited studies. In this presentation, the full set of dynamical equations are used to assess the roles of source and sink terms as height dependent functions in the transport equations. Horizontal inhomogeneity is maintained as an important term in the equations, thus introducing flux divergence and the need for specifying internal boundary layers. Calculations for various scenarios will be presented, and uncertainties will be documented in order to highlight the research needs for the next decade.



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1313
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HYGIENIC CONTROL OF INDUSTRIAL AEROSOLS: PROBLEMS OF INTERNATIONAL UNIFICATION

V.V. TKACHIOV,[2] V.V. SUBBOTIN [1], B.F. KIRIN[2], V.I. DREMOV[2]

[1] *RAMS Institute of Occupational Health, Moscow, Russia*

[2] *State University of Mining Moscow, Russia*

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Long time exposure to industrial aerosols with elevated concentration of firm particles leads to the development of severe respiratory pathologies in the form of pneumoconiosis and dust bronchitis. Also silicosis (the most severe pathology) may develop due to the exposure to silica dioxide, anthrasiolicosis due to coal and dusts, anthracosis due to coal dusts, etc. 40% of all newly identified occupational pathologies relate to industrial aerosols in Russia. Economic losses due to one severe case make up almost one million of denominated Russian roubles.

The basis of occupational prevention is hygienic rating and control of dust in the air. In Russia gravimetric indices in mg/m3 are used to show the mass of inhaled dust. No legal health standards exist in Russia on the number of particles in a certain volume of air. Numerous instruments of foreign origin designed to control the number of particles, or respirable, fine, fraction can not be applied for Russia.

Duration of gravimetric measurements in Russia is equal to one-time maximal dust concentration and lasts for 30 min. of work at which dust is produced .

Both continuous and intermittent one-time sampling is possible. To compare the results with the MAC values mean concentration of all summated one-time samples taken within the period of 30 min. should be considered with regard to each one-time sample. In other countries mean shift gravimetric values (time-weighted average values) compose a standard. Other safety values have recently been introduced in some countries which are closer to those adopted in Russia.

2.2.3.570-96 Document on Health Safety abbreviated to SanPinn in Russia contains the data on methodology of individual dust exposure with the aim to regulate occupational health risks (principle of protection by time) including 2.2.013-94 document entitled Russian Guide on Hygienic Criteria of Assessment of Working Conditions on Hazardous Indices of Industrial Factors, Severity and Intensity of Work.

Principle of protection by time and reliability of occupational prevention are not possible without improvements of dust control measurements. This control should provide validity of such measurements that would help observe hygienic requirements and would not be costy. The most advantageous in this respect is regular monitoring of dust content in the air of a working zone using stationary sensors with further electronic accumulation, distribution and storage of information.

Approaches to measurements of respirable fraction abroad are different. For instance, in Germany sites of measurement are selected to achieve, if possible, in one and the same zone of gradation the same mean dust concentration. In France and Great Britain the best number of points of measurement is considered the minimal one, In the USA mines individual dust loads with extra measurements in specified sites are of particular attention.

One of the leading German specialists Dr L.Armbruster thinks the present level of dust elimination as well as measurements and assessment of dust concentration in coal mines of the EEC and the USA reflects national specific features as well as specificity of each mine which impedes the assessment of the most essential problem, the efficiency of measures on prevention of occupational pathologies. Gravimetric approach to the measurement of respirable fraction is recognized everywhere in the above- mentioned countries though the term of *fine dust* as well as the design of dust measuring equipment may differ. Unification of measurements is expected

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some years later when CEN standards, or ISO standards are ready in part of dust measuring equipment.

Doubtless, to increase the level of occupational health prevention, international unification of requirements to aerosols is needed including the ones for the assessment of monitoring efficiency for which appropriate certificates are to be issued. Establishment of permissible concentrations is a sovereign right of any nation; it depends on the level of her well-being, law, science, etc. Nevertheless, methods of measurement and values by which the measurement is produced are to be unified. Economic integration, trade relations, exchange of technologies and *know how* require health protection of any sovereign state. Unification of methods for the measurement of fibrogenic aerosols including mining dust should be developed with regard to national specificities to provide low cost alternatives for the improvement of control service and comparability of results.

1324.
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MICROPHYSICAL PARAMETERS OF STRATUS CLOUDS

IVLEV L.S. [1], **MELNIKOVA I.N.** [2]

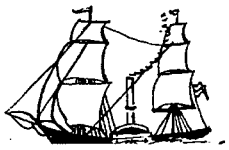
[1] *St.Petersburg State University, Physical Institute,*
Ulyanovskaya Str., 1, Petrodvorets, St.Petersburg, 198904, Russia, Tel. +7-812-4284572, 5529554
[2] *Research Centre for Ecology Safety, Russian Academy of Sciences,*
Korpusnaya Str., 18, St.Petersburg, 197110, Russia

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This presentation is the continuation of earlier studies on theoretical and applied aspects concerned the vertical profiles determination of the stratus cloudiness radiative, optical and microphysical characteristics from airborne cloud sounding data. The retrieval of microphysical natural stratus clouds parameters is necessary for problems connected with cloudiness structure, dynamics and modelling investigation and with ecological monitoring of the atmosphere pollution. Main parameters of cloud aerosols are mean radius and spectral values of the refractive index imaginary part.

The methodology of the stratus cloud optical and microphysical parameters (optical thickness, single scattering albedo, mean radius and refractive index imaginary part) retrieval was proposed earlier by the authors on the basis of airborne radiative measurements at the cloud top and base data. The cloud layer was considered without taking into account vertical inhomogeneity of optical and microphysical parameters.

It is known that atmospheric aerosols (including aerosols of anthropogenic origin) accumulate in low clouds and their vertical distribution is variable. Thus it is important either to determine averaged microphysical parameters of the whole cloud and obtain their vertical variations with purpose of the aerosols pollution and features of their distribution studying in cloudy conditions. Here the methodology above mentioned applied to airborne radiation experiments data, which were accomplished in extended stratus clouds above the Ladoga Lake (24 Sept. 1972 and 20 Apr. 1985) and the Kara Sea (1 Oct. 1972). Spectral downward and upward irradiances were measured at clouds top and base and inside clouds. Spectral values of volume scattering and absorption coefficients, the complex refractive index imaginary part and mean radius were obtained in cloud layers between measurements levels.



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1463.
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GENERATORS OF WATER-FUEL EMULSIONS IN POWER PLANTS

ROMAKHIN S.S., BAZAROV V.G., SHMIRKOV O.V., RUDAKOV V.P., BASKAREV B.N., VAVILOV A.P., MATVEYEV A.G., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation 125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPME MAI: (095) 158-0367; riame@mai2.rcnet.ru. OAS «Machinbuilding plant», town of Elektrostal' (Moscow region).)

(First received 20 April 1998; accepted for presentation during IAS-4

Preparation and burning up the water- masut emulsions (WME) in the hot-water heaters of the currently available gas-masut thermal power plants (TPP) is one of the most efficient nature protection measure. Therewith, not only volume of the harmful waste to atmosphere decreases, but burning up of the waste water contaminated with masut is provided.

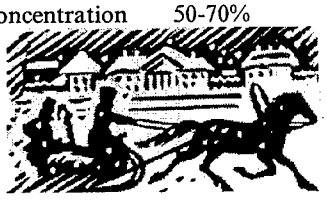
Technologically, the problem of the WME preparation is solved in the simplest way by means of its preparation immediately before the burning up. For this purpose a generator of water-fuel emulsions (emulsifier) is mounted in front of the heat-water heater which demands excessive power of the system for fuel supply since part of the pressure differential is consumed in the emulsifier. If the described way of the problem solution is for some reasons impossible then the vortexing chamber of the centrifugal sprayer can be used as the emulsifier.

The following types of the emulsifiers have been developed:
- emulsifier with coaxial flow of water and fuel and their mixing with the help of porous element (net-shaped glass);
- the same with rotation of one of the mixture components;
- emulsifier in the form of the two-component gas-liquid centrifugal sprayer with a built-in emulsifying unit;
- emulsifier with a belt of the turbulizers of the gas-liquid mixture;
- the same with a tangential supply of water in front of the belt of the turbulizers;
- emulsifier with a two-step system of the components mixing one of which is the ejecting step.

In the process of gas-liquid mixture turbulization, dispersity of the water drops depends on the regime parameters, scale of the vortexes, and closeness of the turbulizers disposal in the belt. At the centrifugal emulsification, a liquid insoluble in the ground one, is supplied to the vortexing chamber periphery of the centrifugal sprayer (or to periphery of the liquid centrifugal stage of the emulsifier); this liquid gathers in the drops of some size depending on the surface tension for both liquids, velocity gradient, time of the liquid drop being in the sprayer, relationship between densities of the both liquids, and on many other factors.

Here is list of the main results achieved:

- dispersity of the emulsion	about 20 μm
- start of the emulsion stratification	in 40 min
- pressure losses on the emulsifier	till 2 atm
- pressure losses on the sprayer	till 0.8 atm
- maximal fuel flow rate	2 l/s
- decrease of the nitric oxide concentration	25-30%
- decrease of the benz-a-piren concentration	50-70%



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1525.
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METHODS OF PRODUCTION OF THE ULTRADISPERSED POWDERS

M.I.ALYMOV*, I.P. ARSENTYEVA**

Baikov Institute of Metallurgy and Materials Science, RAS

Leninsky prospect 49 , Moscow, 117911, Russia, tel: (095) 135-8641; e-mail: alymov@ultra.imet.ac.ru

***Moscow State Evening Metallurgy Institute, Lefortovsky Val 26, Moscow 111250, Russia;tel:(095) 1266477*

(First received 15 April 1998; accepted for presentation during IAS-4)

The ultradispersed powders (UDP), nanocrystalls, serve the base for developing and wide introducing the modern high technologies into practice. At present this branch of science and technology appears to be the most quickly world-wide progressing one in terms of volume of financing. In view of the above, Russia keeps not only the priority in this field, but possesses a higher level of physical knowledge on the peculiarities of the UDP structure and properties as a special type of the solid matter. So, the numeral experiments carried out have proved that the UDP atomic structure acts as on intermediate link between the crystal and amorphous ones. High surface energy, small particles size and their production methods have come to be the reason for such a phenomenon. In Table 1 there are given the main UDP production methods for different materials and the scope of their production in the world.

Table 1. Methods of obtaining of UDP.

Method of production	UDP	Average size of particle, nm
Plazmochemical	Metals and compounds	10-300
Evaporation-condensation	Metals and compounds	1-100
Eelectrical explosion of conductors	Metals and compaunds	5-1000000
Shock-wave synthesis	Diamond-graphite, synthesized diamonds	10-100
Electrochemical	Metals	80
Cryochemical synthesis	Oxides	3-150 m2/g
Decomposition of unstable compounds	Metals and compounds	1-40
Reduction pyrolysis	Metals and compounds	10
Decomposition from solutions	Metals and compounds	20-80
Sol-gel	Oxides	5-1000
Liquid phase reduction	Metals	20-40
Gas-phase reactions	Metals and compounds	6-600
Heterophase synthesis	Metals and compounds	20-200
Synthesis based on hydroemulsions	Metals	<10
Vacuum extraction	Concentrates of fruit, extraction of medicament grass	



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L52E.
УДК 541.18

ANALYSIS OF THE HIGHDISPERSED METALS AND OXIDES POWDERS

I.ARSENTYEVA[1], N.TALIAN [2], B.IORDOVICH [3], D.KRSMANOVICH [3], E.SOKOLOVA[1]

[1] *Moscow State Evening Metallurgy Institute, Lefortovsky Val 26, Moscow 111250, tel(095) 1266477*

[2] *Belgrad University, Inst of Chemistry, Technology&Metallurgy, Njegosheva 12, 111000 Belgrade, Yugoslavia*

[3] *Kraguevaz University, Technology Institute, Svetog Save 65, 32000 Chachak, Yugoslavia*

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The following powders' gradation is represented in the sintering physics:

a) ultra dispersed powders (UDP), particle size d_p ~ 1-500 nm;

b) fine dispersed powders (FGP), d_p ~ 1-50 μm;

c) coarse dispersed powders (CDP), d_p > 1-50 μm.

UDP and FDP are the highdispersed powders. After production physical-chemical and structural parameters of the powders have considerable influence on particles' behavior at different stages of method for powder metallurgy, that is after pressing and further sintering the pellets. In this connection fine analysis of the powders showed be performed at the initial stage. Table 1 gives the main methods enabling to analysis of the high dispersed powders after their production.

Table 1. High dispersed powders' methods of the analysis.

Methods of investigations	Physical-chemical and structural powders' parameters
Transmission electron microscopy (TEM)	Estimating size, form and characteristic properties of particle surface
Scanning electron microscopy (STEM)	
Qualitative and quantitative metallograph processing	
AES investigation	Chemical analysis of heterogeneity of powder surface, molecular structure of surface
RSCA investigation	
IR-spectroscopy	
Transmission electron microscopy (TEM)	Investigating internal fine structure
X-ray structural analysis	
X-ray spectral analysis (EDS)	
Reduction melting in vacuum or with glass carrier	Determining the content of detrimental impurities (O,C,N) (for metallic powders)

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1587.
УДК 541.18

ELECTRON STRUCTURE OF CARBON NANOTUBES MODIFIED BY ALKALI METAL ATOMS

N.G. LEBEDEV, I.V.ZAPOROTSKOVA, A.O.LITINSKII, L.A.CHERNOZATONSKII*

Volgograd State University, 400062 Volgograd, Russia

**Institute of Biochemical Physics, Russian Academy of Sciences, 117334 Moscow, Russia*

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We have studied electron structure and energy zone structure characteristics of (n,0) zigzag type carbon nanotubes modified by alkali metals Li, Na atoms and intercalied by K atoms. Cycle cluster model and quantum chemical semiempirical MINDO scheme has been used for the calculation. We have obtained density of energy states of modified tubelenes. It has been shown internal and external metal atom modification of carbon nanotubes leads to high metallisation of such carbon structures.

Theoretical computings are compared to the last experimental results.

1380.
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AEROSOL REACTOR FOR CREATION OF BIPHASE ACTIVE MEDIUM OF LASERS

LETFULLIN R.R., IGOSHIN V.I., SANNIKOV S.P.

Lebedev Physics Institute of Russian Academy of Sciences (Samara Branch), Novo-Sadovaya St. 221, Samara 443011, Russia, Tel.:+7(846 2)341481, Fax.:+7(846 2)355600, E-mail: fian@ssu.samara.ru

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Gas disperse systems, consisting from small disperse particles of a metal or their connections, weighted in gas mix, present significant interest as in fundamental, as applied areas of a science. For example, such disperse system make the basis of an active medium of a lot of lasers on the metal vapours, chemical pulsed oxygen - iodine and HF lasers with the next aerosol parameters: radius of particles ~ 0,1 μm, and their concentration ~ 10^9 cm^{-3}. In this connection, the solution of the problem of reception submicron aerosol of high concentration, homogeneously dispersed in large volume is very important for prepare biphase active medium. Existing mechanical, chemical, electrolitical, condensional and other methods of reception of powders not always satisfy to the requirements, presented to the ultradisperse systems in the attitude of dispersion, the forms, distribution of particles on the sizes and pollution by extraneous impurity. As practice has shown, method of electrical explosion of wire and a levitation method of condensational reception of powders on opportunities are the most suitable for the decision of specified problem. These methods permit to receive ultradisperse powders with particles, possessing small average size, narrow distribution on the size, spherical form and high cleanliness, but in comparison small area of the space ($\approx 10^2$ cm^3), and problem of homogeneous filling of large volumes ($\geq 10^3$ cm^3) by small disperse metal particles with high concentration do not decided. By use ready powders, dispersed by dispergator, it is difficult technically to supply required parameters of dispersion, size and concentration of particles, as well as uniformity of filling whole working volume, because of agglomeration and moulding of disperse particles. Besides, the filling of large aerosol volumes with the help of dispergators proceeds for the reasonably large times ≥ 10 minutes in comparison with a time of submicron aerosol life, which for particles in a range of sizes $r_0 = 0,09 \div 0,4$ μm makes ~ 200 sc.

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In the present work a new way of reception of biphase laser active medium from submicron conducting particles of high concentration, concluded in evaporation previously put on a internal wall of a quartz chamber of a thin metal layer in electromagnetic field of a solenoid and subsequent condensation of metal vapours is offered. We this device for reception large aerosol volumes shall name aerosol reactor.

The quartz cylindrical chamber, with temperature melting of walls considerably exceeding in melting temperature of a metal film, is placed in uniform electromagnetic field of a solenoid. Aerosol reactor consists also of a power supply and battery of condensers C. On a internal wall of a quartz chamber on all length, or in a kind of a closed final ring on a centre, a film from a chosen metal and given thickness is previously put plasma powdered or other way. For protection a chamber butt-end walls from hit of a metal and ensuring of homogeneous filling of volume by metal vapours the film evaporation can be conducted at laminar flow of a carrying gas through unions on the ends of a chamber, in conditions of atmospheric or lowered pressure. The linear sizes of aerosol reactor are not limited and determined by the requirements of particular technological process.

Work of aerosol reactor we shall consider for a case, when the metal film is put on all length of a internal cavity of a quartz chamber. A block from n electrical condensers of designed capacity discharge for a small time τ on a solenoid with given parameters: by the length l, number of coils N, section of wires S and resistance of a primary winding R. Inside a closed cavity of a primary winding with the inductance L a uniform magnetic flow Φ sufficient for evaporation for a short interval of a time of a metal film is created. Further, the metal vapours are interacted with a environmental cold gas and undergo a condensational jump, accompanied by formation of submicron metal particles. The necessary average size of formed particles and their concentration are reached by variation of thickness of a initial metal film, as well as electrical parameters of the unit. Evaporation of a metal film and vapour condensation in a flow of a carrying gas gives a additional opportunity of variation the aerosol particle size. Combined use of all parameters, influencing on the aerosol particle size (thickness of a film, electrical parameters of the unit, pressure and sort of a gas, the speed of a gas flow), permits to change the average size of particles over a wide range from tens up to thousands angstrem and to reach homogeneous filling by particles whole aerosol cavity volume. The scheme of aerosol chamber with a limited length of a film has a additional opportunity of variation of aerosol parameters at the expense of change of a length evaporated film. Besides, this scheme is more preferable from the point of view of protection a chamber butt-end walls from hit of a metal, that inadmissiblly, for example, by use of such chamber inside an optical cavity of a laser to reception of biphase active medium. The offered method is universal in relation to various metals and alloys to receive for short times large aerosol volumes from ultradisperse particles with the small average size, high concentration, narrow distribution on the size and spherical form.

1487.
УДК 541.18



RESEARCH OF PROCESSES OF BURNING AND EXPLOSION IN PIPELINES

V.A. PUKHIIY.V.I.VODJANIK, N.P.KOZHUSHKOV, V.N. LITVINENKO

(Moscow - Severodonetsk)

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The results of targe-scale experimental researches on localization of a flame gas and dust of mixtures in the long pipeline by a diameter of 500 mm with the help of elements of the automatic system of suppression of explosions are resulted. The circuit of graund installation includes the explosive camera V = 10 m^3, to which the pipeline L = 22 m and diameter of 500 mm is connected. For registration of pressure of explosion in the camera and in the pipeline the

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induction gauges of pressure PG-10 were used. The passing of front of a flame on a pipe was fixed with the help of photogauges. For fixing an initial stage of development of explosion and the issues of a command signal through the block of management on operation automatic irrigator, carrying out dispersing of the fire-extinguishing powder in the pipeline, were used differential gauges of pressure of a type El-1.

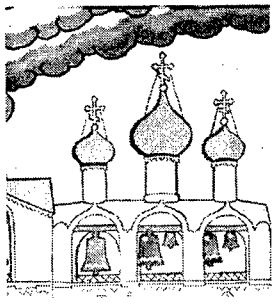
The researches were conducted on gasmixtures (stechiometric structure benzolaeromixtures) and aeromixtures (elevator a dust) mixtures. From the analysis of results of explosion gasmixtures of mixture follows, that the greatest speed of distribution of front of a flame in the pipeline and the greatest pressure in the camera arises at initiation of explosion in a top of the camera. At such conditions it speed of distribution of front of a flame in a pipe on a plot L = 1-2 m. from an end face of a pipe attached to the camera, makes V = 250 rn/s, on a plot L = 3-4 m - 300m/s, on a plot L = 6-7 m - 400 m/s and further on a pipe practically is not increased. Time during which the first photogauge established on distance 1m. from end face of a pipe, fixes passing front of a flame, makes 0,45s. Maximum pressure in the camera makesO,19MPa. At initiation of explosion at the bottom of the camera the speed of distribution of front of a flame in a pipe approximately in 3 times is less, than at initiation of explosion in a top of the camera. The maximum pressure in the camera 0,13 MPa, time of fixing by the first photogauge of front of a flame -1,1 s. Typically is intensive burning out of combustible mixture inside the pipeline, thanking turbulization. The distinction in speeds of movement of combustible mixture and high-temperature products of combustion results that on the certain time interval of process of burning the pressure in the pipeline is sharply increased, exceeding pressure in the camera. Occurs short-term "stopping up" of the pipeline and begins proceeding of gas from the pipeline in the camera. It promotes intensification of burning in the camera and results in sharp increase of speed of increase of pressure. And growth of pressure in the camera.

The analysis of results of explosion aeromixtures shows, that the parameters of explosion are stretched in time in 2-3 times and maximum pressure in the camera little bit below, than for gas explosion. Essential difference dust of explosions from gas is the absence of effect "stopping up" of the pipeline.

The analysis of results of explosion benzolaeromixtures of mixture for want of locatizations of a flame in the pipeline by a way dispersing of the fire-extinguishing of powders shows, that the distribution of a flame on the pipeline makes 3-3,5 m from a point of introduction of a powder in the pipeline. It testifies that occurs the hearthal burning of mixture on length of the pipeline.

Dynamics of development of explosion dust of mixture in the system the camera - pipeline, for want of localizations of a flame in the pipeline by a way dispersing 20 kg fire-extinguishing of a powder during 2-3 s, shows, that the flame in a pipe from a place of introduction of a powder was not distributed more than 0,5 m, for want of it the maximum pressure in the camera has made only 0,03 MPa against 0,14 MPa -similar experience without introduction of a powder.

The conducted experiments have shown basic possibility of localization of a flame in pipelines by a way dispersing of the fire-extinguishing of powders.



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14108
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THE INVESTIGATION OF THE INFLUENCE OF CLOUDS AND PRECIPITATIONS ON THE PROCESSES OF SCAVENGING THE AEROSOL FROM THE TROPOSPHERE

N.E. VEREMEI, YU.A. DOVGALUK, A.D. EGOROV, M.A. ISHENKO, YU.PH. PONOMARYOV, A.A. SINKEVICH, D.D. STALEVICH, V.D. STEPANENKO, K.S.KHVOROSTOVSKY

The Main Geophysical Observatory, Saint-Petersburg sinkev@main.mgo.rssi.ru

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The results of complex investigations of interactions of aerosol with clouds (fogs) and precipitations are considered. The effectivity of this process is evaluated. The evaluations of time variations of humid scavenging coefficient obtained from the data of nature, laboratory and numerical experiments are presented. The purpose of this work is to summarize the results of complex investigations of dynamics of humid scavenging the aerosol by clouds and precipitations, carried out by specialists of MGO during last years.

Nature experiments. Their purpose is to obtain the data of the effectivity of aerosol scavenging by precipitations in polluted industrial region and in ecologically clear region. The measurements were carried out in warm seasons of 1993 - 1994 and in cold period of 1997 at the meteorological station of MGO (Saint-Petersburg) and also in summer 1996 in ecologically clear region at the east of Leningrad Oblast (at the Field Experimental Base in Turgosh). Photoelectrical counter PC.GTA and lidar LIVO were used for measuring aerosols.

In 1993 - 1994 it was 13 days with precipitations during the aerosol measuring. The precipitations were of different intensity and continuance and were related to different synoptical situations. Aerosol measurements were carried out during 39 days. Aerosol concentration changed about 2 - 3 times a day; from day to day these variations reached 30 times. It was determined by air mass transfer, the wind near the Earth surface and local aerosol sources.

The data of measurement were subdivided on 4 groups for evaluation of the influence of cloudiness and precipitationregime on aerosol particle concentration. The 1-st group - the days when cloudiness was nonsignificant (related to heat covection) or clouds were abscent at all. From this group the days with significant cooling were selected in the 2-nd group. Convection during the days of the 2-nd group was weak. The days of the 3-rd group are that of significant cloudiness, more often stratiform, related to the frontal situation or the warm sector of the cyclon. The great cloudiness and inversion layers in the atmosphere prevented the development of convection. The days of the 4-th group are that with precipitations in the period of observations (more often - from convective clouds).

In some days synchronic measurements of coefficient of weakening radiation and that of particle concentration were carried out with making use of lidar and photoelectric counter respectively. Observations demonstrated good agreement between time variations of these characteristics.

Lidar sounding data demonstrated, that when finishing precipitations some period of scavenging the atmosphere was observed. 17 days with precipitations were analysed. The days were selected in particular groups: the days with weak precipitations of small continuance - into the 1-st group, those with weak but long precipitations - into the 2-nd one, those with significant but short-time precipitations - into the 3-nd one and the days with significant and long-time precipitations were selected into the 4-th group. The effect of scavenging was the most distinct in the long-time intensive precipitations. Data available show that The effect of scavenging takes place in 1 - 2 hours - in the case of long-time precipitations (the 2-nd and the 4-th groups). In the

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3-th group significant but short-time precipitations did not result in long-time effect. In average this effect was being observed in 30 min.

In winter 1997 were 22 days when measuring the concentration of aerosol particles d > 0.3 mkm were carried out (about 70 measurements a day). During 5 days measurements were performed in snow. For example on 18.03.1997 it was snowfall of weak and measurable intensity in Saint-Petersburg. Before and after precipitations the concentration of particles of all sizes increased, but during precipitations it decreased. Scavenging coefficient was approximately equal for particles of all sizes and it-s value was about 7,0 (-3) -- 8,0 (-3) /s.

The experiment of 10.08.96 carried out in Turgosh was shown as an example of aerosol measurement in ecologically clear region. Precipitations were in the form of rain (by portions). The results of the experiment showed that during intensive precipitations great increasing the scavenging coefficient was observed just as short-time precipitations do not cause any significant effect of scavenging the surface layer of the atmosphere.

Aircraft measurements. The flights were carried out in august 1991 in Leningrad Oblast. The precipitation zone under cumulonimbus clouds was investigated. The working hypothesis was that cumulonimbus clouds spreads more quickly than subcloud air mass. It is a result of forming the new cloud elements at the downwind side of the cloud and it was really observed in radiolocation experiments. Consequently the air at the downwind side from precipitation zone must contain greater amount of aerosol particles in comparison with the upwind side as a result of scavenging the aerosol by precipitations. In fact it means that the measurements were performed before and after the precipitation zone along the air stream. Lidar LIVO was used for measuring the aerosol. Unfortunately only limited number of experiments was carried out and only 4 clouds were investigated. The results of measurements showed that radiation weakening coefficient at the downwind side from precipitation zone is much greater than that at the upwind side.

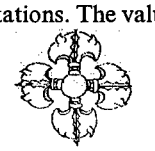
Laboratory experiments. The carbon particles were used as investigated aerosol. The series of experiments were carried out to investigate the interaction between the aerosol and fog: investigation of dry precipitation and their scavenging by fog in the Small Fog Chamber (SFC). 30 experiments were performed.

The results of investigation of dry precipitating aerosol in SFC showed that the concentration of particles d < 0,5 mkm did not vary when carrying out the experiment. For particles with d = (0,5 - 1) mkm the coefficient of dry precipitating in average reached 1,0 (-3) /s, but for particles with d > 1 mkm it's average value was about 1,6 (-3) /s.

The fog makes the scavenging process more intensive for particles with d > 0,5 mkm. For particles from the dyapason of d = (0,5 - 1,0) mkm scavenging coefficient was about 1,8 (-3) / s, for those with d > 1 mkm it is about 2,7 (-3)/ s. So, the scavenging coefficient for particles with d > 0,5 μm increases as a result of the influence of fog 1,7 - 1,8 times in comparison with dry precipitating.

Numerical simulation. In this work were presented the results of investigation the dynamics of humid scavenging the aerosol with making use of nonstationary parametrized numerical model of a convective cloud prepared by the specialists of MGO and modified by including the block of describing the spreading of solid aerosol particles and their interaction with drops and air currents. In the subcloud layer (z=200 - 400 m) the emission of aerosol particles of a given radius (10, 20 or 30 mkm) was simulated as an instantaneous source. The variation of aerosol concentration in this layer characterized by scavenging coefficient m was considered.

Calculations showed that the time variation of m has two maxima. The first of them is a result of increasing the upward air current velocity and increasing the role of convection in the process of upward aerosol transfer. The second maximum is caused by moving the particles downward as a result of downdrafts and falling precipitations. The value of the second maximum is greater



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than that of the first one by one order because the convective transfer of particles the same with their gravitational precipitating and scavenging by the rainfall is directed downward.

So, as a result of complex investigations of scavenging processes it is showed, that precipitations and fogs increase aerosol scavenging in comparison with dry precipitating. The significant effect is reached when precipitations are intensive and have a great continuance. Available data show that the effect of scavenging the atmosphere can be observed in 1 - 2 hours in the cases of long-time intensive precipitations. Preliminary results show that scavenging by snow is more intensive than scavenging by liquid precipitation. Aerosol scavenging coefficient (d > 1 mkm), obtained from results of theoretical and laboratory experiments are similar with with those obtained in nature conditions. Their values are about 1,0 (-3) -- 5,0 (-3)/s.

1421.
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THE EVALUATION OF THE APPLICABILITY OF THE CONTINENTAL AEROSOL MODEL FOR RADIATIVE CALCULATIONS

RUBLEV A.N.[1],CHUBAROVA N.YE.[2],TROTSENKO A.N.[1],TREMBACH V.V.[2],ZAHAROVA P.V.[3]

[1]. *Russian Research Center Kurchatov Institute, Russia, (rublev@imp. kiae.ru)*

[2]. *Meteorological Observatory, Moscow State University, Russia*

[3]. *Moscow State Academy of Instrument-Industry and Informatics*

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One of the ways for the testing of used models and methodologies in radiative transfer is direct comparisons of the calculated and observed solar fluxes. The experimental data were taken from two independent surface radiometry databases with various types of instrumentation obtained in different geographical regions. The first database includes solar radiation data and supporting meteorological information obtained in meteorological observatory of Moscow State University (MO MSU) in 1995 and 1996, the second one is based on solar radiometer data collected during american experiment CAGEX (1-in April 1994, 2 - October 1995 in Oklahoma). The comparisons between measured and modeled radiative fluxes were carried out for clear sky conditions. For model calculations within the shortwave SW spectral region the Monte-Carlo technique is applied in combination with line-by-line methods which account for selective absorption of the atmospheric gases.

Vertical profiles of atmospheric parameters were specified according to well-known model "midlatitude summer" proposed in [1]. The modification of water vapor and ozone content was carried out by multiplying the mass concentration profile by a constant. The vertical profiles of atmospheric aerosol lower than 12 km were taken according to CONT-1 [2] and according to BSA stratification - for the 12-20km layers. Variations of aerosol optical thickness were defined in the near-surface layer (0-2km). The aerosol attenuation was not taken into account in the layers above 20km. The analysis of the discrepancies between measured and modeled diffuse radiation shows that they vary for separate cases in the similar ranges: -24-+15 W/m2 and-17-+12 W/m2 - respectively for Moscow and Oklahoma. The extreme low values observed in Moscow can be explained by the specific meteorological conditions when absorbing aerosol particles would accumulate in atmosphere (i. e. August 1996). We draw attention to the fact that the differences between calculations and measurements of diffuse irradiance vary in the same range in spite of different types of instruments utilizing in Russia and in the USA with independent calibration technique and in spite of different geographical regions in which the experiments were carried out. On the whole some overestimation of calculated solar fluxes obtained by our model computations in comparison with direct and diffuse irradiance measurements are observed. But they are not large. Maximal difference between measured and modeled global irradiance does not exceed 1% or 0.7% from the extraterrestrial value. Therefore after converting to the daily averaged solar

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radiation absorption, it makes up about 3W/m2, e. g. 5-10 times less than the biases of 15-30 W/m2 between the experimental data and the climatic models estimates mentioned in [3].

Using the benchmark database of calculated solar fluxes the daily averaged absorption of solar radiation Q was directly obtained. The simulations were done for clear sky conditions of midlatitude summer utilizing the continental aerosol model with vertical profiles CONT-I [1] and total aerosol optical thickness 0.23 using the averaging by zenith solar angle. Q was shown to be 25-27% in relation to the extraterrestrial solar flux at the upper boundary of atmosphere depending on the day of the year. This estimates are in a good agreement with mean value Q=25% which was calculated by A. Arking on the basis of ground and satellite data for clear sky conditions [3]. According to climatic models the average atmospheric absorption is about 17% [3]. The comparisons of experimental and calculated SW fluxes indicate that there are no significant biases between them at least in clear sky conditions.

The application of continental aerosol model CONT-1 is considered to be reasonable for the estimation of solar fluxes in these regions. It should be stressed that CONT-1 contains 90% of water-soluble particles [2]. They are responsible for the single scattering albedo A=0.9 in visible spectral range which to a great extent determines the level of diffuse irradiance. Optical characteristics of water-enveloped particles have a weak dependence on their generating chemical substances and are mainly determined by water optical properties. The predominance of these particles in the atmosphere may be the main reason of the wide application of this aerosol model.

The based on good coincidence of calculations with the experimental estimates of the scattering fluxes both in Moscow and in Oklahoma natural aerosol had such value A even for the cases, when the relative humidity was equal 30-40%. Sideways this contradicts with the data [4], of which follows, that at such humidity the aerosol drops transform to solid particles, the distribution of particle dimensions narrows, and their mean radius become to 2-3 time less than initial one. All that according to our calculations, based on the Mie's theory, decreases the single scattering albedo at least up to values A=0.2-0.3. This work was supported by American foundation CRDF (grant RG2-126).

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1457
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EVALUATION OF LIQUID SPRAYING DISPERSITY BY THE PNEUMATIC SPRAYERS WITH MIXING OF THE COMPONENTS IN THE POROUS ELEMENT.

ROMAKHIN S.S., BAZAROV V.G., SHMIRKOV O.V., RUDAKOV V.P., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation Institute (Technical University). 125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPME MAI tel.: (095) 158-0020; fax.: (095) 158-0367; e-mail: riame@mai2.rcnet.ru.

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Among variety of the pneumatic sprayers different types the sprayers stand out, the flow-through channels of which have the porous penetrable materials [1,2] and among the latter ones the sprayers stand out with mixing of gas or liquid in a porous mixing element [3]. Due to the high efficiency of heat exchange, monodispersity of the generated ultrafinely-divided flows, uniform distribution of numerous channels over the surface forming the flow etc., it is possible to

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use such sprayers in various fields of engineering, for instance, in the gas generators with thermal decomposition of unitary fuels in rocket engines building.

Presently, for evaluation of spraying quality the numerous empirical formulas are largely used that describe the drop mean diameter as a function of the mixture components physical parameters (density, viscosity, surface tension), sprayer operation parameters (velocity, components relationship), and geometrical characteristics of its flow-through parts. However, calculation of the liquid drop diameter for the porous sprayers from the known equations, gained for the case of sprayers with similar construction [4], gives the results overstated by a factor of 30-50.

From the different classes of the pneumatic sprayers the internal mixing sprayers with flooded nozzle and with crossed motion of the flows (Shukhov's type of sprayers [4]) are the most similar to each other by their types of the working process organization.

Investigations carried out by Nikiyama and Tanasava [5] enabled to get the empirical dependence that takes into account the special features of gas-dynamic picture of the liquid and gas flow; these features are in the mechanism of the initial preliminary fragmentation of the liquid inside of the sprayer which mechanism differs the Shukhov's sprayer from the sprayers of other types.

Experimental study of various liquids (water, ethyl spirit, glycerin) enabled to calculate a correction factor C allowing to use the equation of Nikiyama-Tanasava for estimation of dispersity of the finely-dividing (permeability is about 0.16) pneumatic sprayers with the error of 8-10%. Mean drop diameter d is calculated from the formula;

$$d = C \cdot d_N = \frac{4 d_N (\dot{m}_l / \dot{m}_g)}{(\dot{m}_l / \nu_l \rho_l d_e)^4},$$

where d_N - mean diameter calculated from the Nikiyama-Tanasava's formula;

$\dot{m}_l, \dot{m}_g$ - flow rates of the liquid and gas

ρ_l - density of the liquid;

ν_l - kinematic viscosity coefficient;

d_e - diameter of the equivalent capillary of the porous material.

Range of the regime parameters variation was the following:

- pressure differentials for liquid and gas - till 0.8 MPa;
- liquid flow rate - till 150 g/s:
- gas flow rate - till 5 g/s.

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1479.
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ENDOHEDRAL METALLOFULLERENES: PREPARATION, EPR SPECTROSCOPY & POTENTIAL APPLICATION.

V.K.KOLTOVER, V.P.BUBNOV, YA.I.ESTRIN, E.E.LAUKHINA, E.B.YAGUBSKII.

Institute for Chemical Physics Research, RAS, Chernogolovka, Moscow Region, Russia. koltover@icp.ac.ru

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Endometallofullerenes (incarceranes, M@C2n) are endohedral carbon clusters that contain metal atoms (lanthanides, or Sc, Y, U, and Ca) trapped within a fullerene cage. The unique structure and reactivity of M@C2n are of great interest in the context of their chemical reactivity and physical properties. However, physical and chemical properties of M@C2n are as yet poorly investigated owing to poor accessibility of these compounds. Therefore, improvement in methods for the synthesis and isolation of M@C2n is one of the current problems in the area of chemistry and physics of carbon clusters. As far as the M@C2n molecules have essentially asymmetrical electron structures, they should possess large dipole moments in contrast to with empty fullerene molecules. We have developed a novel proficient method of extraction of M@C2n from fullerene-containing soots, the advantage of which lies in usage of two consecutive extraction steps, each relying on a fundamental difference in polarity between endohedral metallofullerenes and empty fullerenes. In the first step, o-xylene was used. This solvent of low polarity expelled empty fullerenes from the fullerene-containing soot but did not significantly reduce the content of M@C2n in the soot. In the second step, polar solvent N,N-dimethylformamide (DMF) was employed for the selective extraction of M@C2n from the residue soot. This method has been applied for isolation of endohedral La- and Yfullerenes from the soots obtained in the electric-arc reactor. The resultant DMF extracts virtually contain no C60, C70 and other empty fullerenes. The yield of the DMF extracts reaches 1% of the primary soot mass. We have obtained as much as 100 mg of the endometallofullerene concentrate without empty fullerenes upon extraction of 10 g of the primary soot.

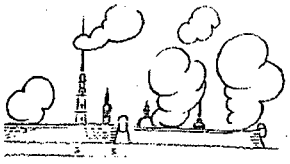
Thus, our method enables production of large amounts of concentrated M@C2n to be used in basic and applied research.

In part, it has been suggested that La@C82 be used for measurement of oxygen in microheterogeneous chemical and biological systems. Under careful deoxygenation, the solutions of La@C82 in o-dichlorbenzene demonstrate octet EPR signals with the individual line-width value 0.14 G at room temperature. This value grows with increase in the air-oxygen pressure. Similarly, the solutions of Y@C82 under careful deoxygenation demonstrate doublet signals with the line-width value 0.12 G that increases with oxygen concentration. The effects of line-width broadening by oxygen are of reversible linear character that makes it possible to use La@C82 and Y@C82 for measurement of oxygen.

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1488.
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RESEARCH OF DYNAMICS OF DEVELOPMENT AND SUPPRESSION OF EXPLOSION IN CLOSED VESSELS

A.B. BORDIAKOVSKIY, N.P. KOZHUSHKOV, A.V. GOLOTAYSTROV, V.A. PUKHIIY

(Severodonetsk - Moscow)

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The results experimental range researches on dynamics of development dust, gas and hybrid mixtures in closed vessels of volume 10 and 50 cubic metres (m^3) and their localization with the help of automatic systems of explosions suppression are held (ASES).

As aeromixtures the following components were used: elevator dust, vitan - 2 M, technical simasin, coal, phtalic anhydride. As fuel for mixtures were used: petrol, acetone, benzol. The hybrid mixtures had the following structure: elevator dust + benzol + air, phtalic anhydride + benzol + air.

The main characteristics of dynamics of explosions (dust) development are: - The maximum pressure of explosion (P_{max}) for various concentration of investigated dusts makes 0,4 - 0,8 MPa, the obtained significances Pmax are approximately higher 10 %, than Pmax for small laboratory installations;

– The values of middle visible speeds of flame distribution are rather small and make 1 - 5 m/s;

– Time from the beginning of explosion initiation before achieving Pmax depending on concentration and component makes for capacity 10 cubic metres m^3 : 0,6 - 2,2 s, for capacity 50 m : 0,8 - 3,2 s.

– The pressure increase in initial period of development of explosions occurs rather slowly and given slice of time called as "induction" period of explosion development for dust explosions considerably exceeds similar period for gas and hybrid explosions. This feature of dust explosions allows to present less rigid requests to ASES.

The characteristics of hybrid mixtures explosions have their features. It is necessary to mark that insignificant (ultralimited) additions of hybrid mixture hard component in gas mixture intensify its combustion. Explosion pressure appreciably grows and combustion reaction proceeding time is reduced. The maximum pressure of explosion Pmax is displaced in the party of poor mixtures. Increasing of the hard component concentration in the structure of hybrid mixture results to decreasing Pmax, however pressure increasing maximum speed $(dP/dt)_{max}$ is increased and at certain concentration of dust surpasses significance (dP/dt) max for gas (mixtures) explosions. Maximum pressure of hybrid mixture explosion: elevator dust + benzol + air for vessel of volume 10 m" makes 0,7 - 0,9 MPa, time of achievement Pmax -up to 1,0 sec.

Experiments on explosions suppression of combustible mixtures that have been mentioned with the help ASES, which principle of operation consists of detection of initial stage of explosion development by highly sensitive gauges and rapid injection of fire-extinguishing structure, which stops process of explosion development have shown that:

– Aeromixtures explosions are easily suppressed by water and fire-extinguishing powders. Aeromixtures explosion can be practically suppressed at any stage of their development;

– The explosions of gas and hybrid mixtures are successfully suppressed only with the help of fire-extinguishing powders. The most effective are the powders on a phosphorus ammonia salts basis;

– It is most difficult to carry out the explosions suppression of hybrid mixtures with the increased contents of a hard component, that is such mixture where (dP/dt)max reaches the greatest significance.

Experiments of explosions suppression of the above-stated combustible mixtures in vessels of volume 10 and 50 m^3 have shown that minimal explosion-suppressional concentration of fire

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extinguishing substances are within the limits of 0,6-1,5 kg/m^3 at the residual pressure in capacity after operating of ASES does not exceed 0,05 MPa.

The results of explosions suppression experiments specify that with increasing of a protected vessel volume the explosion-suppressional concentration of fire-extinguishing substance decreases. Theoretical and experimental researches have shown the possibility of using ASES for explosions suppression of acromixtures in big volumes (up to 500 m^3).

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FEATURES OF THE SORPTION OF LIGHT ATOMS ON SINGLE WALL CARBON NANOTUBES

I.V.ZAPOROTSKOVA, N.G. LEBEDEV, A.O.LITINSKII, L.A.CHERNOZATONSKII*

Volgograd State University, 400062 Volgograd, Russia

**Institute of Biochemical Physics, Russian Academy of Sciences, 117334 Moscow, Russia*

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The mechanisms of sorption of F, O, C, and Cl atoms on the surface of a single-wall carbon nanotube are studied, and a comparison is made with the case of sorption of these atoms on graphite surface. Three versions of the position of the adatoms above the surface were studied. A cyclic-cluster model and an appropriately modified MNDO computational scheme are use. The optimal geometry of the sorption complexes and sorption energies are obtained.

The fact that most advantages versio of sorption if the adatoms studied is above a carbon atom of nanotube can be explained by the fact that the sorption bond is stronger because it has a higher s-type fraction.

1467.
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DISPERSION OF EMULSIONS IN DEVICES FOR HOMOGENIZATION OF DAIRY PRODUCE

ROMAKHIN S.S., BASKAREV B.N., SHMIRKOV O.V., RUDAKOV V.P., MESCHERYAKOV A.A., VOROB'YOV S.V., TSIMIN N.I, CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation Institute

125810, Moscow, GSP-47, Volokolamskoye sh 4, NIIPME MAI tel.: 158-0020; fax.:158-0367; chegis@glasnet.ru.

AS «Mytischinskiy dairy-producing factory», town of Elektrostal' (Moscow region)

AS «Ejsk-milk», town of Ejsk (Krasnodarskiy land)

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To enhance considerably storage life of the dairy produce as the nonstratified emulsions, the homogenization process is used that is the process of enhancement of dispersion content uniformity by means of fragmentation of the fractions involved and their uniform distribution over the whole volume. One of the homogenization steps is the product dispersion in various stages of the homogenizing injector.

Presently, the homogenizers K5-OGA-1,2; A1-OGM-5 etc. are most generally employed in Russia. The product homogenization process with such homogenizers is realized at the pressure differentials of 150-180 atm on the homogenizing injector valves.

Substantial decrease of the required pressure differentials on the injector can be realized at the expense of turbulizing intensification with the help of the valves having the turbulizing turnings. At modernization of the serial homogenizer A1-OGM-5, the homogenizing injector with

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labyrinth gap and discharging chamber [1] and the injector with labyrinth gap, discharging chamber and damping cavity [2] have been developed and put into operation.

Flowing of the high-speed flow of the product through the injectors labyrinth gaps enhances the suspensions homogenization efficiency and enables to lower the required pressure differential on retention of the dispersion quality. The availability of discharging chamber in the construction makes the injector resistant to the transversal dynamic loading arising at nonperiodical disturbances of pressure in a some point of the gap. The availability of damping cavities provides the injector location steadiness at influence of the dynamic tangential loadings. These measures allow to stabilize the gap size around the valve axis.

The developed injectors have been put into service on the dairy-producing factories of the towns: Ejsk (Krasnodarskiy land), Podol'sk, Lyubertsy, Mytischi (all of Moscow region).

Modernization of the serial injector differs its simplicity, reliability, minimal expenditures; it does not demand any changes in design of the homogenizer and the modernization is substitution of the saddle and valve.

Exploitation of the injectors has shown that use of such methods of the products turbulizing provides lowering of the necessary pressure differential (it means reduce of energy consumption) by 25-30% in comparison with the serial injector at retention of the homogenization degree and quality of the products reprocessed (of the emulsion dispersity). Therewith the valve exploitation period increases by 1.5-2 times and conditions improves considerably for the homogenizers exploitation in respect to influence on servicing staff of such harmful factors as noise and vibrations. Besides, the service period for the pump and other homogenizer units increases and their wear decreases.

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1502
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HIGH TEMPERATURE REGENERATIVE MULTILAYER METALCERAMIC FILTERS FOR HIGH EFFICIENCY COLLECTION OF RADIOACTIVE AEROSOL PARTICLES IN NUCLEAR FUEL AND RADIOACTIVE WASTE REPROCESSING

A.V.ZAGNITKO[1], N.M.TROTSENKO[1], V.N.PRUSAKOV[1], V.G.GNEDENKO[1], A.N.KOSAYKOV[2], Y.O.CHAPLIGIN[3], G.I.PYSHKO[2],

[1]Russian Research Center "urchatov Institute, Sq. Kurchatov 1, Moscow, 123182, fax:095 1941994, zagnitko@imp.kiae.ru;
[2]Urals Electrochemical Integrated Plant, Novouralsk, Russia;
[3]Siberia Oil and Gas Stock Company, Moscow, Russia.

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The new types of regenerative metalceramic, all metal and all ceramic filter materials have been developed for high efficiency collection of radioactive microcontaminants with particle size exceeding of 0.01 micron. Filter materials have the anisotropical structure usually consisting of the finely porous metallic, cermet or ceramic layers attached to a coarsely porous reinforced cermet base. They are produced in the form of disc and leaf as well as of cylindrical tubes 80-1000 mm in the length. Outer diameter of cartridges is of 16-40 mm. Filter elements were made of nickel, stainless steel and aluminium oxide. They may be used for prefiltration, fine purification

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and ultrafine filtration of air and process gases from radioactive disperse microcontaminants.

The materials are manufactured in three make-ups [1], namely:
MCF-P is for gas prefiltration with efficiency E > 99 % with respect to particle size D more than 1.5 micron under differential pressure drop ΔP_0 is of about 10-15 mm H_2O; MCF-F is for fine gas cleaning with efficiency E>99.9999 % for particle with D > 0.01 μm at ΔP_0<100-120 mm H_2O;

MCF-U is for ultrafiltration of air and process gas with efficiency E > 99.9999999 % with respect to the most penetrating aerosol particles of 0.1 micron in size at ΔP_0 of 140-180 mm H_2O. Here ΔP_0 is the differential pressure drop of filter materials at air filtration rate U of 1 cm/s and air temperature of 20 ^{0}C ; E is the collection efficiency of aerosol particles at U = 5 cm/s. As a rule, the filter element differential pressure ΔP is a linear function of gas flow rate. At a constant gas temperature and face flow rate U < 15 cm/s its value can be calculated with practically sufficient accuracy using equation $\Delta P = U \times \Delta P_0$.

Developed filter elements have strong mechanical strength and corrosive properties as well as they endue the high temperatures up to 1000 ^{0}C (in oxidising atmosphere of air for Al_2O_3 material), abrupt pulsed gas flow and action of strong alpha-, beta- and gamma-radiation and neutron flow.

On the basis of produced filter elements a standard size series has been drawn for cermet modules with optimised construction at volume flow rate of gas from 1 up to 2000 m^3/h. The nuclear safe filter modules have been also developed for high efficiency filtration of air from radioactive aerosols in Atomic Power Stations. The regeneration of filter elements and modules for prefiltration and fine purification of gases are performed periodically by back pulsing of pure air or process gas. As a result, the differential pressure of material after regeneration differs from initial value of ΔP_0 not more than 20-40 %. Herewith the filter elements endue more than 1000 regeneration cycles.

At present the sintered metal, metalceramic and ceramic filters are used for fine purification of air and process gases in different fields of Atomic Industry, namely: fluorination procedure, "pure purge" process, electrolysis, reprocessing of nuclear fuel, gas cleaning in high temperature gas reactor, etc. Some problems concerning the air cleaning in Chernobyl Atomic Power Station, high efficiency collection of high disperse aerosol particles at fluorination procedure of nuclear fuel and waste enriched by U-235, gas ultrafiltration from plutonium aerosols, as well as high temperature filtration of I, C, Mo, Pt, Ag, Rh , Tc, Ru disperse microcontaminants from LiF - BeF_2 or LiF - NaF molten-salts will be discussed in considerable detail. It is well known [2], that these molten - salts are used in Molten-Salt Reactor.

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1361.
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DESIGN OF HIGH-POWER PULSED CHEMICAL HF-LASER ON BIPHASE ACTIVE MEDIUM WITH AEROSOL REACTOR

LETFULLIN R.R., IGOSHIN V.I., SANNIKOV S.P.

Lebedev Physics Institute of Russian Academy of Sciences (Samara Branch), Novo-Sadovaya St. 221, Samara 443011, Russia, Tel:+7(846 2)341481, Fax:+7(846 2)355600, E-mail: fian@ssu.samara.ru

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A perspective direction in the field of creation powerful pulsed chemical HF generators – amplifiers is to use the photon - branching chain (PBC) reaction, which is ignited in biphase active medium, i.e. in the medium, containing by a working gas and at ultrafine passive particles of a metal. However, here unsolved remains the problem of reception and homogeneous filling of large working volumes of a laser ($V > 10^3$ cm^3) by the submicron monodisperse aerosol for small times, not exceeding of lifetime of such aerosol with given properties: by the size of particles $r_0 \approx 0{,}09 \div 0{,}4$ μm and their concentration $n \approx 10^9 \div 10^7$ cm^{-3}.

In the present work a new design of high-power pulsed HF laser on PBC reaction, which initiated in the aerosol reactor is offered in essence. In such closed scheme of a laser, for the first time including by the device for reception and homogeneous filling of working volumes by the ultrafine aerosol, is considerably reduced a formation time of biphase active medium and is ensured required parameters of disperse components.

The optical scheme of a laser consists from unstable telescopic cavity, structurally connected with aerosol reactor. On a forward cavity mirror a aperture of connection with a specifying generator is executed. Aerosol reactor represents cylindrical chamber from tempriturefirmed quartz glass, on a internal wall of which a aluminium film of given thickness is previously put plasma dusting or other way. Reactor consists also from a solenoid, power supply and battery of condensers. The linear sizes of aerosol reactor are defined by a design of a optical cavity.

The formation of biphase active laser medium in the aerosol reactor occurs at the expense of evaporated metal film in magnetic field of a solenoid and subsequent condensation metal vapours. For protection of cavity mirrors from metal vapours hit and both for ensuring of homogeneous filling of reactor volume by the aluminium vapours the evaporation of a film is carried out at laminar flow of carrying gas through unions on the ends of a chamber. The small additive of a oxygen in the mixture results in formation oxidised film on a surface of formed aluminium particles. Such oxidised film, thickness 10 — 20 angstrem, prevents spontaneous hydrogen - fluorine ignition of a working laser mix at mixing with disperse component. The necessary average size of formed particles and their concentration are reached by variation of a initial film thickness, as well as electrical parameters of the unit. Combined use of all parameters, influencing on the aerosol size (thickness of a film, electrical parameters of the unit, pressure and speed of a gas flow), permits to change the average size of particles over a wide range from tens up to thousands angstrems and to reach homogeneous filling by particles whole working volume of a chamber. The aerosol chamber scheme with a limited length of a film, dusted manner of a ring on a chamber centre, has more one additional opportunity of aerosol parameters variation at the expense of evaporated film length change. Besides, this scheme is more preferable from the point of view of protection edge of a chamber walls from metal hit, that madnusseble by use of such chamber inside a laser cavity to reception of biphase active medium. The offered method of the biphase active laser medium creation is universal in relation to various metals and alloys and permits to receive for small time large aerosol volumes from ultradisperse particles with the small average size, high concentration, narrow distribution on the size, spherical form.

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Pulse from external IR laser source through a central connection aperture on a source cavity mirror initiates reaction in a central zone at evaporation by IR radiation of disperse aluminium particles, previously formed in the aerosol reactor. Again the arising radiation, superior initial on energy, initiates reaction in following cylindrical zone, possessing by greater volume and etc.. Mirrors consistently "ignite" reaction in all volume, changing a direction of photons movement. In essence in this scheme arises autowave process of excitation in active laser medium the self-preservation of photon branching zones.

In particular accounts the following characteristics of a offered design of a laser were accepted. A length of unstable telescopic cavity l_c = 49,5 cm, diameter of the first mirror d_1 = 14 cm, diameter of the second mirror d_2 = 6 cm and it focal distance F = 53 cm, diameter of source aperture d_0 = 1 cm. Accordingly, the linear sizes aerosol reactor were chosen following: l = 50 cm, diameter of quartz chamber d = 15 cm with thickness of walls H = 1 cm. On a internal wall of a chamber on all length a aluminium film by thickness h = 350 nm is put, for evaporation of which appropriate parameters of the aerosol reactor electrical circuit were selected. Accounts have shown, that the solenoid with a primary winding from a copper wire by a diameter of 4 mm, number of coils N_1 = 50, as well as condenser with capacity C = 10 mf and voltage U = 30 кV provides reception of aluminium aerosol with radius of particles r_0 = 0,2 μm and concentration $N_{Al} = 1{,}3 \times 10^8$ cm^{-3}. Then, at specified parameters of aerosol, cavity and intensity of initiating IR laser radiation I_0 = 3 MW / cm^2 the output power of HF laser $P = 5 \times 10^{10}$ W and amplifier coefficient on energy ε = 648 is reached.



1508
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ABOUT ENTHALPY OF FORMATION OF FULLERENE C70

V. P. KOLESOV, S. V. MELKHANOVA, S. M. PIMENOVA

Department of Chemistry, Moscow State University, Moscow 119899

tel: (095) 939-5373, fax: (095) 932-8846, E-mail:Kolesov@thermo.chem.msu.su

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The standard molar enthalpy of formation of fullerene C70 is one of the key values for a thermodynamic study of fullerenes and their derivatives. The results of two works in which the combustion energy of C70 has been measured differ substantially: $\Delta_c u^o$ =-35587+25 J g^{-1} [1] and $\Delta_c u^o$ =-35802+31 J g^{-1} [2] (the uncertainties are given for 0.05 significance level). The discrepancy of these two results stimulated a new determination of enthalpies of combustion and formation of fullerene C70 in this work.

Two samples of C70 were obtained, purified and analysed at the Chemistry Department of the Moscow State University. Sample 1 was obtained from fullerene-containing soot extract by column chromatography (separation on graphite, with toluene + n-hexane, 8:2, as eluent). After purification by HPLC C_{70} was annealed at 250°C and 10 Pa for 1 h; no weight loss was detected after annealing. HPLC analysis indicated that the sample contained 2.0% of C_{60}. The contents of the solvent was negligible. Sample 2 was in addition purified by sublimation; it contained 1.2% of C_{60} and about 1% of heavy fullerenes (C_{78} and C_{84}), according to the HPLC analysis.

The energy of combustion was measured using a static bomb isoperibolic macrocalorimeter. Weighed amount of C_{70} (40 to 60 mg) was sealed in a terylene-film bag and placed in a small thin-walled quartz crucible-tripod standing in a small platinum cup. Benzoic acid was used as an auxiliary material to produce a proper temperature rise and to ensure a complete combustion of C_{70}. Special attention was paid to the analysis of combustion products. After each run the combustion products were analysed for carbon dioxide. No soot was revealed after combustion

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experiments. Qualitative tests for CO with indicator tubes were negative within the limits of their sensitivity (0.0001 mol.%).

Five runs were made with the sample 1; the mean value of massic energy of combustion, $\Delta_c u^o$ =-35664+44 J g^{-1}, was based on the mass of the sample of C_{70}. The results for sample 2 (three runs) don't differ significantly from the results given above for sample 1. The standard molar enthalpy of formation of crystalline C70, calculated using this value, is equal to 2439+37 kJmol^{-1} or 34.84 kJ(g'atom C)$^{-1}$. This value lies between the data [1,2].

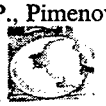
It is important to notice that the quantity of carbon dioxide recovered in combustion products of both samples of C70 was about 99.8% from theoretical one. The deficiency of 0.2% undoubtly exceeds the error of analyses. To check the accuracy of the method, the combustion energy of graphite was measured. The Acuo value was in agreement with recommended one, and the quantity of CO2 in combustion products was close to theoretical (99.99%). So, obviously, the detected deficiency of CO_2 in combustion products of C70 is not accidental.

A similar problem was displayed at the determination of the combustion energy of fullerene C_{60} [3]. Two samples were studied, and about the same deficiency of CO_2 (=0.2%) was revealed in all runs with sample 1, which was dark brown and powdery. On the contrary, the quantity of CO2 discovered in combustion products of sample 2, which had a developed crystal structure, was in good agreement with theoretical one (99.99+0.02%). The mean value of the energy of combustion Of the Sample 1 Of C_{60} Was =130 J g^{1} lower than the more reliable value, Obtained for the sample 2.

The deficiency of CO_2 in combustion products of both samples of C_{70} and of sample 1 of C_{60} is probably connected with a low degree of crystallinity and a great number of defects in these samples. This could increase the possibility of retaining some occluded impurities. Taking into account the difference between the energies of combustion of two samples of C_{60}, one can suppose that perhaps the energy of combustion of C70 should be a little greater (=100-150 J g^{-1}') than a value $\Delta_c u^o$ =-35664+44 J g^{-1} obtained in this work. Obviously for reliable determination of the enthalpy of formation of C_{70} a pure sample with developed crystalline structure is needed.

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1019.
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ON DEFINITION OF ABSORBTION AND REFLECTON COEFFICIENTS OF PARTICLES BY UNDERLAYING SURFACE

VOSZHENNIKOV O.I., NIKONOV S.A.

TAIFUN

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The scheme for specification of interaction between impurity particles and underlaying surface for stachastic Monte-Carlo models of atmospheric diffusion is proposed. The absorbtion and reflection coefficients in this scheme are defined by means of falling stream and stream of absorbing particles by surface which are stated by the differencial equation generated by the condition of constancy streams within surface layer. The proposed scheme are tested in Monte-Carlo Langevin model for the different types of impurity and underlaying surface. The obtained results cotton with conventional expert assessments.

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1257.
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A COMPLEX OF INSTRUMENTS FOR REALIZING THE BASIC TECHNOLOGIES OF ENVIRONMENTAL-STATE EXPRESS-ANALYSIS

PHILIPPOV V.L., MAKAROV A.S., IVANOV V.P., KOZLOV S.D.

The Federal Research & Production Centre -The State Institute of Applied Optics Kazan, TR 420075 RU

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Keywords: Ecological-monitoring system, express-analysis, spectrometers, spectrofluorimeters, laser-locators

In the interests of practical usage of instrumental equipment for a regional ecological-monitoring system, the FNPTS "GIPO" has developed and is sequentially implementing a programme of creating the basic technologies of express-analysis of an air medium, a water quality, industrial wastewater, different elements of underlying surfaces on the basis of the available experience of optoelectronic instrument development and conversion production facilities. The manufactured pilot models of instruments (aerosol spectrometers, gas analyzers, spectrofluorimeters, laser-locator complexes) meet the requirements of State Standard (GOST) for use of a photometric method of monitoring and measuring the different environmental-ingredient content.

In the paper, the fulfilled arrangements including the substantiation of requirements for sensors, the interaction organization in the interests of their introduction as soon as possible, the creation of standard-methodical base are described in detail.

The scientific bases of instrument developments are the results of long-term investigations of environmental spectral and space-time characteristic variations in an optical spectral region [1,2].

Depending on an use procedure, the instruments are divided into local-monitoring sensors and remote ones. The remote sensors can be mounted on different carriers, their choice is determined by a task to be achieved as well as by economic considerations [3,4].

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1512.
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STRATOSPHERIC INTRUSIONS AS TRANSFERRING RADIOACTIVE AEROSOL TO THE ATMOSPHERIC SURFACE LAYER

I. N. KUZNETSOVA, N. P. CHAKINA

Hydrometeorological Research Centre of the Russian Federation, Moscow, Russia E-mail
anaumov@mskw.mecom.ru

The Russian radiometric network registers episodes of sharp increase in the surface air radioactivity to the levels of 5-10, in some cases of 20-40 background values. At the radiometric stations, total beta-activity (TBA) concentrations and densities of their fallouts are measured, as well as, in certain cases, contents of particular isotopes, among which the cosmogenic Be-7 is of a special interest as a marker of stratospheric air.

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Frequency of the increased TBA levels occurence has no pronounced annual cycle and varies largely from year to year: in 1993 to 1997, there were registered 88, 205, 123, 124, and 82 episodes/year, respectively; in two first months of 1998, about 80 episodes are already observed. In the cases of simultaneous increase in TBA and Be-7 concentrations, one can believe that the radioactive aerosol is of stratospheric origin. The radiometric network data allow one to document a limited number of such episodes (<10 for 1996-1997). In the cases when the Be-7 concentration is not measured, stratospheric origin of the aerosol can be but hypothesized.

It is known that the stratospheric air intrudes tropospheric levels when deep vertical circulations arise in the tropospheric frontal zones. The intrusions manifest themselves through folding of the tropopause - an interface between the troposphere and the stratosphere.
The tropopause routinely defined through the air temperature lapse rate - so called thermal tropopause - usually exhibits discontinuities in the areas of intense stratospheric intrusions. Stratospheric origin of the air can be determined, apart from direct measurements of chemical composition, by evaluation of potential vorticity - a Lagrangian invariant of diabatic motion. In the stratosphere, potential vorticity is one order of magnitude larger than in the troposphere. A level at which the potential vorticity sharply increases from tropospheric to stratospheric values is called dynamic tropopause. Outside the zones of strong vertical motions, the dynamic tropopause is close to the thermal one. Due to the potential vorticity conservation properties, the dynamic tropopause is not destroyed by stratospheric intrusion, but forms a fold or a funnel.

The dynamic tropopause can be calculated on the basis of objective analysis (or numerical forecasting) data on pressure (height), temperature, and wind. Accuracy of the calculation depends on horizontal resolution of the data under use. By comparing the air circulation conditions in the lower troposphere and the dynamic tropopause topography, one can identify, in the tropospheric frontal zones, "tongues" of stratospheric air sinking into the troposphere and sometimes reaching the surface layer.

For an episode of extraordinary sharp (15 to 20-fold) increases in TBA and Be-7 concentrations in Novosibirsk and Barnaul and the next day in Krasnoyarsk in March 1996, we have shown that the air radioactivity peak observation time is in a good agreement (within the data time resolution) with the time of a deep funnel passage over the three stations. For other documented episodes of increase in both TBA and Be-7 concentrations (Turukhansk, January 1997; Salekhard, June 1997; Krasnoyarsk, October 1997; Syktyvkar, January 1998), analysis of the tropopause topography evolution reveals analogous processes of the tropopause funnel fast motion. For the high TBA episodes with no available data on Be-7 concentrations, in a number of cases, stratospheric intrusions are also revealed.

The life time, depth, and dimensions of the stratospheric intrusions vary largely. The rawinsonde network being sparse, especially in Asian Russia, small funnels and folds can hardly be resolved. However, sufficiently large and deep intrusions can be successfully traced in rawinsonde data and described by numerical forecasting models of the atmosphere.

1498.
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TITRATION CALORIMETER IN DIAGNOSIS OF MICROORGANISMS

G.V.KOTELNIKOV, A.N.SHKIDCHENKO, E.A.PERMYAKOV

Institute for Biological Instrumentation of the Russian Academy of Sciences PERMYAKOV@IBP.SERPUKHOV.SU

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Microbial heat production is an integral index for physiological activity of microorganisms which depends on the degree of providing them with carbon and oxygen sources, on cultivation temperature, culture age and other factors.

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Information on heat production intensity of a microbial population is of particular interest when cultivating in the area of critical oxygen oncentration where it is possible to pass from aerobic metabolism of substrate utilization to anaerobic one, the readings of the other measuring systems being uncertain.

The variation in intensity of microbial heat production can represent the main criterion of evaluating the effect of various pharmacological and biologically active substances on a microbial population.

It is interesting to solve the problem of measuring heat production in samples of liquid culture with the help of a titration calorimeter. Amongst the most known foreign titration calorimeters we can list the following: OMEGA, an ultrasensitive titration calorimeter of Microcal Corp., USA, 1991; ITC-2, an isothermal titration calorimeter of the Johns Hopkins University Biocalorimetry Center, USA, 1990; a twin titration calorimeter, Colorado University, USA. The first titration calorimeter (KTD-101) in Russia was designed in 1998. This instrument has calorimetric cells as long gold tubes. An additive introduced into the cells can be distributed evenly throughout the volume of the sample placed into the cell. Additives can be introduced repeatedly. Dispensing of additives is carried out with an automated syringe driven from a stepped motor computer-controlled. The time of setting the system of heat production measuring does not exceed 20 s which makes this instrument practically inertia-free for measuring heat production.

Experimental data (1,2) on heat production measuring allowed to provide for necessary ranges of heat production measuring in the KTD-101.

The heat flow value released in fermentation processes under control is of about 4.5 W per 1.5 l of liquid culture.

Calculated for a calorimetric cell of 01.1 cub. cm in volume, the value of registered power is of 3 mW.

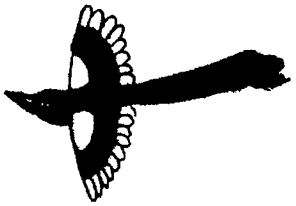
The titration calorimeter KTD-101 permits a reliable measuring of heat production in a sample under investigation its threshold sensitivity being of 0.05 microwatt.

Brief specifications of the calorimeter

Calorimetric cell volume 0.1 cub.cm
Titrant dose range 0 to 10 microliters
Power sensitivity not more than 5.10^{-8} W
Reaction heat sensitivity not more than 10^{-6} cal
PC software operates in WINDOWS-95
Power supply:
- power consumption, V.A not more than 300
- voltage, V 220±22
-frequency, Hz 50±1.

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1503.
УДК 541.18

INFLUENCE OF CERAMIC PARTICLES ON MECHANICAL BEHAVIOUR OF ALUMINIUM NANOCOMPOSITES

N.F.KUZMINA, R.K.ISLAMGALIEV, R.Z.VALIEV.

Institute of Physics of Advanced Materials, Ufa State Aviation Technical University, Ufa 450000, K.Marksa 12, Russia, valiev@ipfm.rb.ru

(First received 13 April 1998; accepted for presentation during IAS-4)

Recently a number of special methods of mechanical deformation such as torsion straining under high pressure and equal channel angular (ECA) pressing were developed for formation of nanocrystalline structures in various metals and alloys. This approach termed severe plastic deformation (SPD) [1] implies large plastic deformations under high applied pressures at relatively low temperatures (usually less than 0.4 T_m). The SPD procedure has a number of advantages as compared to other methods, namely, condensation in inert atmosphere [2] and ball milling [3]. One of these advantages is a possibility to fabricate massive specimens free of residual porosity and impurities. In addition, the obtained bulk specimens can be successfully used for thorough structural characterization and investigations of mechanical behaviour. Moreover, the SPD procedure can be applied for formation of nanostructures in various metals, alloys and intermetallics using both starting monolithic ingots and powders.

The method of SPD was used in the present work for formation of nanostructures in metal matrix composites [4]. These materials had recently aroused interest among experts in material science due to expectation of a number of attractive properties such as high microhardness, high strength, elevated thermal stability, good wear resistance and high strain rate superplasticity .

Two kind of initial metal matrix composites were used in this paper: Al6061 +10%Al_2O_3 and Al2009 + 15%SiC. These composites have been prepared by liquid metallurgy route. In this case, ceramic particles were added to a melt of matrix alloy and the melt was cast into billets. Chemical composition of Al6061 and Al2009 matrix alloys was: Al-1,0%Mg-0,6%Si-0,3%Cu-0,2%Cr and Al-3,7%Cu-1,3%Mg-0,25%Si, respectively.

Two techniques of SPD were used in order to introduce the nanostructure into bulk samples of aluminium composites. First, initial material were subjected to SPD under the pressure 1,2 GPa. This resulted in fabrication of samples, 20 mm in diameter and 1 mm in thickness. Second, composites were subjected to quenching from 490-520°C, the SPD under the pressure 3,5 GPa and ageing at 80°C. This procedure resulted in specimens of 13 mm in diameter and 0,3 mm in thickness.

The structure of samples was examined by JEM -100B transmission electron microscope. Electron diffraction patterns were taken from an area of 2 μm2. The grain size was determined by dark field images as a mean value of the maximum grain size and its cross-dimension. Mean grain size was obtained by averaging of more than 100 grains. Microhardness was measured by a Vickers diamond pyramidal indenter with a load of 0.1 kg. Tensile specimens were pulled to failure in air at strain rates 10^{-4} - 10^{-3} c^{-1} using a testing machine "Instron" operating at a constant rate of cross-head displacement.

TEM investigations of composites processed under 1,2 GPa revealed the formation of uniform structure with a mean grain size of matrix alloy of 0.3 μm and of 0,1 μm in Al6061 and Al2009 composites, respectively. Analogous studies of composites processed under 3,5 GPa, showed the formation of more disperse structure with a mean grain size of about 70 nm in both matrix alloys Al6061 and Al2009.

The Al_2O_3 ceramic powders in Al6061 nanocomposite had equi-axed shape with a size from 0.2 μm to 5 μm. At the same time, the SiC particles in Al2009 nanocomposite had the plated

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shape with maximum sizes up to 10 μm and its cross-dimension up to 0.5 μm.

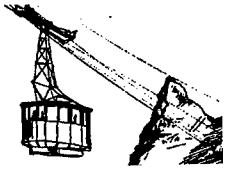
Typical electron diffraction patterns of nanocomposites fabricated by SPD under 3,5 GPa revealed the numerous spots positioned in the form of circles. Same diffraction patterns were observed also in various metallic materials subjected to SPD. Moreover, recent direct measurement of grain misorientations [5] indicated on significant fraction of high angle boundaries in the structure of specimens processed by SPD.

According to their structure, the samples of nanocomposites revealed the differences in their mechanical behaviour. For example, the samples processed at 1,2 GPa showed only the moderate microhardness 1200 MPa (Al6061) and 1700 MPa (Al2009) as well as tensile strength 420 MPa (Al6061) and 550 MPa (Al2009).

At the same time, nanocomposites subjected to SPD under the pressure 3,5 GPa demonstrated the elevated thermal stability up to 250°C and in 2-3 times higher microhardness in comparison with initial samples. Moreover, ageing of nanocomposites at 80°C during 6 hour increased the value of microhardness in Al2009 composite up to very high level of 3300 MPa. In this sample, the value of microhardness was significantly more than microhardness of 2500 MPa in commercial aluminium alloys [6,7] processed by SPD. The elevated strength properties of aluminium nanocomposites were confirmed also by direct tensile tests. For example, tensile strength of Al6061 nanocomposite (690 MPa) was higher than tensile strength of usual commercial aluminium alloys . At the same time, samples of Al2009 nanocomposite were brittle. Apparently, the plated shape of SiC particles in Al2009 nanocomposite leads to the limited ductility, although it is favourable to very high microhardness.

A number of conclusions may be reached from this investigation. First, nanostructures may be successfully fabricated in aluminium composites by severe plastic deformation. Structure of matrix alloys in these materials is characterized by a mean grain size of 70 nm and micron size of ceramic powders. Secondly, the samples of aluminium nanocomposites exhibit an attractive mechanical behaviour, a namely, high microhardness (3300 MPa), high tensile strength (690 MPa) and elevated thermal stability (up to 250°C). Third, the level of strength properties depends not only on a mean grain size of matrix alloy but also on morphology of ceramic particles. Although the plated shape of particles leads to very high microhardness it results in a brittle sample. In order to obtain simultaneously high strength and ductile samples of aluminium nanocomposites it is preferable to use ceramic particles with equi-axed shape. Firth, the processing of nanocomposites by SPD under imposed pressure 3,5 GPa in combination with preliminary quenching and subsequent ageing leads to higher mechanical properties in comparison with processing at 1,2 GPa.

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1528.
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BIOLOGICAL AEROSOLS GENERATED BY SHOWER BATHING

A. PAUL ADAMS, J. CLIFTON SPENDLOVE

Private consultants in Microbial Aerobiology 4166 Fortuna Way, Salt Lake City, Utah 84124
phone: 801-278-1200 (Formerly Life Science Division U.S. Army, Dugway Proving Ground)

(First received 18 April 1998; accepted for presentation during IAS-4)

A study was made of the number of bacteria aerosolized by communal shower bathing at high school. Aerosol samples were taken in the boys' dressing room and near the shower stalls of boys' gymnastic class. Two types of aerosol samplers were used: Litton high-volume sampler and the Andersen six-stage sampler. As many as 50 bacteria per liter of air were aerosolized during the showering process.

Of those bacteria isolated, 0.74% were found to be S. aureus. as determined by their ability to ferment glucose anaerobically and to produce coagulase. It was postulated that a boy may inhale as many as 74 S. aureus in 10 minutes. Based on infectivity data published in the literature, it was hypothesized that as many as 10% of the bathers may be infected or colonized by a dosage of 74 S. auerus and that some degree of hazard may exist.

1504.
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STRUCTURE AND MECHANICAL BEHAVIOR OF NANOCOMPOSITES PROCESSED BY SPD CONSOLIDATION OF METALLIC AND CERAMIC POWDERS

I. V. ALEXANDROV, Y. T. ZHU*, G.I.RAAB, N. M. AMIRKHANOV, R. K. ISLAMGALIEV, R. Z. VALIEV

Institute of Physics of Advanced Materials, Ufa State Aviation Technical University, Ufa 450000, K. Marksa 12
**Los Alamos National Laboratory, Los Alamos, NM 87545*

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The procedure of processing nano- and submicrocrystalline metals and alloys termed severe plastic deformation (SPD) [1,2] implies large plastic deformations under high applied pressures. Recently it has been shown that severe plastic deformation can provide formation of nanocrystalline structures having high angle grain boundaries [1,2]. Special methods of mechanical deformation were developed and used for this purpose such as torsion straining under high pressure, equal channel angular (ECA) pressing and others. Recently it has been shown that SPD deformation also facilitates consolidation of ultra disperse powders in massive samples with a density close to the theoretic one [3].

The results of investigations of structure, thermal stability and mechanical behavior of ultrafine-grained Cu and Al samples fabricated by SPD consolidation of powders and composites on their base containing up to 5 volume % of SiO_2 and Al_2O_3 particles are given in the present work.

Micropowders of Cu, Al with a mean particle size of 30 and 50 micrometers correspondingly were used as starting materials for consolidation. A mean particle size of SiO_2 and Al_2O_3 was 20 and 50 nm, respectively.

The process of massive samples fabrication consisted of two stages - precompacting of powders in a vacuum chamber and subjecting the prepared precompacts to SPD by torsion under the pressure 1.5 GPa and 6 GPa at room temperature. This resulted in fabrication of samples, 20 mm in diameter and 1 mm in thick and samples of 10 mm in diameter and 0.2 mm in thick.

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TEM investigations of Cu base samples processed at 1.5 GPa revealed the formation of uniform structure with a mean grain size of about 150 nm. At the same time in the case of Al-base samples a mean grain size was equal to 120 nm.

Analogous studies of structure of Cu base samples subjected to SPD under high pressures equal to 6 GPa revealed the formation of more disperse structure and high density of dislocations equal to more than 10^{14} m^{-2}. A mean grain size estimated by dark field images was approximately similar and equal to 60 nm both in the pure Cu samples and in the nanocomposites on its base. Studies of structures of Al and Al+5%Al_2O_3 samples processed under higher pressure revealed a mean grain size of about 200 nm.

Values of microhardness of Cu and Cu+5%SiO_2 samples fabricated by SPD consolidation under pressure 1.5 GPa were equal to 1850 MPa and 1800 MPa, respectively. On the other hand, in Cu and Cu+5%SiO_2 samples fabricated by SPD under a high pressure of 6 GPa larger values of microhardness equal to 2600 MPa and 2800 MPa, respectively were observed. These values remained unchanged in both cases till the temperature 200 °C.

The microhardness of Al and Al+5%Al_2O_3 samples processed by SPD consolidation under the pressure 1.5 GPa was 1200 MPa and remained unchanged up to 450 °C. The results of investigations of thermal stability of Al and Al+5%Al_2O_3 samples processed under 6 GPa were rather unusual. It happened that in an initial state after SPD their microhardness was equal to 440 MPa and 560 MPa, respectively, that is significantly smaller than in samples processed under lower pressure. Following annealing resulted in an increase of microhardness at temperatures above 300 °C where an active growth of grains occured. It was assumed that such a change in microhardness can be connected with the superplastic behavior observed in the deformed alloy already at room temperature and the transition to an usual state after annealing.

"Stress-Strain" curves of Cu and Cu+5%SiO_2 samples processed by SPD under the pressure 1.5 GPa and subjected to elongation at a strain rate of 10^{-4} s^{-1} showed that at room temperature a strength of samples was sufficiently high and yield strength exceeded 300 MPa, however their behavior was rather brittle. Elongation to failure equal to several percent was revealed during deformation at 200 °C. Further increase in temperature of deformation to 300-400 °C resulted in a significant increase of ductility but decrease of flow stress.

Room temperature elongation at a rate of 10^{-3} s^{-1} of the Cu sample fabricated by SPD under high pressure of 6 GPa showed that small ductility and very high strength is typical for it. Short time annealing at T=200 °C for 3 min led to a significant increase of ductility and a record increase of flow stress to 790 MPa. It is important to note an unusual character of "stress-strain" curves of this nanostructured Cu displaying in the absence of a stage of steady plastic flow.

At the same time, as seen from the stress-strain curves, the characterized by strong strain hardening mechanical behavior of these samples, significantly differed from the characterized by an absence of strain hardening in a wide strain rate range behavior of utrafine-grained Cu with a grain size of about 200 nm, fabricated by SPD from monolithic ingots [4].

Room temperature tensile tests of Al and Al+5%Al_2O_3 samples fabricated under the pressure 1.5 GPa like similar processed Cu samples revealed a limited ductility equal to 1-2%. An increase in the temperature of deformation led to a significant rise of ductility of these materials at relatively low flow stress. For example, during elongation at T=300 °C the plastic flow stress of the Al sample fabricated by consolidation of micropowders was 60-65 MPa and the ductility was about 40%. In the Al+5%Al_2O_3 composite the flow stress was higher by 10-15% and the ductility was a bit smaller. An important specific feature of the deformation behavior of these materials was a significant strain rate sensitivity of flow stress. At T=400 °C an elongation to failure of about 200% was revealed in the composite at low flow stress equal to 20 MPa and the parameter of strain rate sensitivity of flow stress was equal to 0.35.

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Apparently, the presence of even a very small porosity in ultrafine-grained materials fabricated by SPD consolidation results in their strong brittleness at room temperature. This is evidently true for explanation of low ductility of Al and Al+5%Al_2O_3 samples revealed during their elongation at room temperature. At the same time superplastic-like deformation is observed in ultrafine-grained Al at higher temperature, that was indicated from elevated elongation to failure and strain rate sensitivity of flow stress. One can assume that in the case of full density of these samples and in the presence of a very stable fine grains superplasticity should be enhanced in Al and/or Al compositions. This is very attractive from a practical point of view since superplasticity in ultrafine-grained metallic materials takes place at relatively low temperatures and/or high strain rates [5]. It seems that the improvement of thermal stability by optimal content and size of oxide particles will be useful for a solution of this task.

Thus, the obtained results testify that SPD consolidation of Cu and Al powders and their 5% compositions with nanopowders of oxides allow us to process samples with ultrafine-grained structure whose specific features substantially depend on applied pressure during severe torsion straining. An increase in pressure from 1.5 GPa to 6.0 GPa leads to differences in nanostructure formation in Cu and Al. Moreover, the combination of very high, record strength and some ductility is revealed in samples of nanocrystalline Cu having a full density, that is very advanced for practical application of this material. However, the presence of only several percent of residual porosity leads to their brittleness at room temperature. In addition, typical features of superplastic flow were observed in ultrafine-grained Al samples during their tensile tests at high temperatures. One can expect outstanding superplastic properties of these nanomaterials at achieving full density of these samples.

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1023.
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THEORETICAL AND EXPERIMENTAL STUDYING OF LANGEVIN MONTE-CARLO SCHEME FOR ATMOSPHERIC TURBULENT DIFFUSION

ZHUKOV G.P., NIKONOV S.A.

TAIFUN

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Monte-Carlo scheme of diffusion based on Langevin equation is considered. The conditions which lead to absolute (Taylor form of diffusion theory) and relative diffusions are deduced. These conditions are checked using simple numerical model compared with both the theoretical pridictions of dispersion's growing of plume diffusing into semi-infinite space and the experimental data on diffusion plume from Obninsk meteorological mast (300 m of height). The results evidence that it is necessary to use Lagrangian velocity variance in model, Eulerian one gives over- stated characteristics of diffusion. Also it is shown that the direct implementation of vertical gradient in Monte-Carlo Lange- vin model causes too fast diffusion of plume.



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1530.
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EXTREME AEROSOL EVENTS AND HEALTH IMPLICATIONS

G.L. GEERNAERT, P. WAHLIN

Ny Toftegaardsvej 22, DK-3650 Olstykke, Denmark E-MAIL: GLG@dmu.dk

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Of all the atmospheric pollutants, aerosols provide the most severe impacts on human health. Aerosols affect airways diseases, which lead to respiratory infections, sensitization to indoor allergens, and acute and/or chronic changes in pulmonary function. These health effects are near-term responses, and can be indirectly measured in terms of health various endpoints. Examples include lost days of work, visits to the hospital, and lower job productivity. Given that particulates below 2.5 micron are the most serious for health considerations, the sources of these particulates must be identified in order to construct effective emissions control strategies. Health damages are measured in terms of economic loss, and the damages are distributed into the indoor and outdoor components. Heating systems, industrial production, traffic, and urban construction all contribute as the most important sources. Using examples from Europe and also case studies in southeast Asia, extremes of aerosol concentrations will be discussed in terms of their health and economic impacts. The talk will summarize with uncertainties in existing estimates, with a list of research topics which are necessary to increase the performance of next generation health impact assessments due to extreme aerosol concentrations.

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NUMERICAL MODELING OF GAS-AEROSOL INTERACTION IN WET ATMOSPHERE

A.E.ALOYAN, V.O. ARUTYUNYAN, P.I. LOUZAN

Institute for Numerical Mathematics, RAS, 8, Gubkin str., 117333, Moscow, Russia hvhov@inm.ras.ru

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KEYWORDS: turbulence, air pollution, photochemistry, numerical modeling

MODEL DESCRIPTION

For numerical simulation of minor gaseous constituents in the lower troposphere and their interaction with aerosol, a complex of mathematical models is necessary to be developed allowing one to consider a series of interconnected physical, chemical and dynamical processes. In particular, gas- and aqueous-phase photochemical processes are closely connected and have to be modeled jointly. This stems from the fact that the increase of acidity depends (inversely) essentially from concentrations of active radicals, ions, and ozone in a surrounding space of aerosol particles. From the other hand, the increase of ambient air temperature can lead to formation of new particles and the widening of drop size spectra is related to turbulent pulsations. Evidently, these mechanisms can be described in full measure using hydrodynamical models. Our mesoscale wet convection model is based on 3-dim non-hydrostatic atmospheric thermo-hydrodynamics equations, heat, specific humidity, and water content influx equations, as well as terms accounting on phase-transitions of humidity and long-wave radiation heat influx (Aloyan et al., 1992, 1993, 1995, Penenko and Aloyan, 1985).

In the background of flow formed, the transport and diffusion of multicomponent gaseous pollutants and aerosols is considered having regard to gas- and aqueous-phase photochemistry and aerosol formation due to convection and coagulation (Aloyan et al., 1992, Mattijsen et al., 1995, Seinfeld, 1986, Schwartz, 1986). Mathematically this can be written down as:

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$$\frac{\partial \varphi i}{\partial t} + \nabla U \varphi i = \nabla K \varphi i + B_{ij}(x, \varphi i, \varphi j) + C_{ij}(x, \varphi i, \varphi j) + P_{ij}(\varphi i, \varphi j) + M_{ij}(\varphi i, \varphi j) + I(\varphi i, t)$$

where φ_i is the concentration of gaseous pollutants or aerosol particles ($I = 1, 2, \cdots, n$); K is the turbulent diffusion coefficient; $\boldsymbol{x}$ is the radius-vector; U is the wind velocity vector; B is a nonlinear operator describing the gas-phase photochemical processes; M describes aqueous-phase chemical processes; P describes condensation and evaporation; C describes coagulation.

In the photochemical block, two oxidation mechanisms of S(IV) to S(VI) were considered: (1) gas-phase oxidation of SO_2 and dissolution of H_2SO_4 in cloud drops, (2) dissolution of SO_2 in cloud drops and oxidation of sulfat-ions in solution under interaction with O_2, O_3, H_2O_2, and dissolved metals. Besides, condensation processes for the gas-particle system was studied by the example of H_2SO_4 vapors.

NUMERICAL EXPERIMENTS

The above mentioned complex of models has been used to perform numerical experiments for simulating the following processes: (1) aerosol formation processes and atmospheric circulation; (2) new particle formation and further growth in saturated vapor bringing to disperse phase development (here a coagulation-induced formation of the atmospheric sulfuric acid aerosol particles is considered both for polluted and non-polluted atmospheric conditions); (3) formation of acid drops having regard to the dependence of dissolved SO_2 on pH, Fe and Mn, pollution level of the atmosphere as well as to fluxes of atmospheric radicals OH and HO_2 into drop (in so doing the influence of dissolved Fe and Mn on drop acidity is assessed); (4) interaction of ozone with cloud drops depending on fluxes of radicals OH and HO_2, and dissolved metals Fe and Cu in drop.

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1514.
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THE INFORMATION-ANALYTICAL COMPLEX FOR THE ACCOUNT OF AEROSOL EMISSIONS IN THE ATMOSPHERE

A.I. DEGTIAREV[1], A.D. NAUMOV[2], V.P.VALTERAN [3]

[1] *Institute of geography*

[2] *Hydrometeocenter of Russia Russia, Moscow e-mail: anaumov@mskw.mecom.ru*

[3] *Gaspromavia RAO Gasprom*

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Aerosol emissions of an antropogehic derivation transferred in the boundary layer of the atmosphere with the help of particular meteorological conditions are one of the main sources of pollution of the air. The antropogenic load on the condition of an environment more and more increase. therefore, a forecast and a monitoring of pollution in the atmosphere become one of actual problems at present time.

The informational-analytical complex (IAC) of Hydrometcenter of Russia permits to make calculations of the concentration of polluting substances (PS) in the atmosphere from one or some sources of pollution. IAC include:

* the data base of pollution sources;
* the data base of meteorological conditions;
* the base of actual polutions in the atmosphere (if such ones are present);
* a account model of distribution PS in the atmosphere - OND-86 (Berlyand method);
* the account model of distribution PS in the atmosphere - it is the Gauss statistical model for a constantly acting source;
* the account model count of distribution PS in the atmosphere - it is the Gauss statistical model for a instant source;
* the account model of distribution in the atmosphere - it is the Gauss statistical model for a temporarily acting source;
* the archive of account results;
* the comparison block of account results;
* the visualization of account results.

The data base of polluting sources includes the information about a source power[g/s], a height of a source and its diameter [m], and also a speed of aerosol emission [m/s].

The data base of meteorological conditions must include the information a wind velocity on a level of 10 m temperature of the surface, snow conditions, all clouds in the bottom layer of the atmosphere (if such information is present), and a rouhtness of the surface (a field, a wood, buildings etc.).

The data base of observations contains the data about time, the measured concentrations of pollution at the control region, names of pollutants.

The data of control measurings can be used for comparison with results of model accounts.

The calculations of distribution PS in the atmosphere can be made with the help one of the following models: OND-86 - is applied for design and construction of industrial enterprises and their reconstruction, and with ecological examination.

The OND-86 is developed in GGO institute, St.-Petersburg.

There are 3 versions of the Gauss statistical model of caring in the atmosphere. The variants of the models used in the complex take into account condition of stratification of the atmosphere, a quality of the surface, time of the day and the availability of snow cover. The models can be used for the monitoring and the forecast of the content in the atmospheric air for gas and aerosol derivation.

The Gauss models take into account particular meteorological conditions. For example, the

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values of maximum concentration PS in the undersurface layer of the atmosphere changes some times from dependence under conditions of stratification of the atmosphere. Besides from dependence on the condition of the surface the distribution of maximum concentration PS change considerably too The models can be used for an ecological monitoring a forecast-express of the atmospheric condition of the air near sources of pollution.

The results of calculations are presented in digital and graphic sights, as fields of the concentration of polluting substances at the given high-altitude level, schedules of high-altitude sections, temporary changes of concentration in the points of the settlement area.

The offering program-information complex permits to decide a enough wide circle of practical tasks of simulation for distribution processes of industrial sources emissions of pollution.

The dialogue mode of a mutual relationship of the user with the complex enables to execute accounts on various source data, variants of the models and reduces number of errors of input information. Used in the complex the settlement model is not deprived defects and therefore is constantly modified.

It is necessary to emphasize, that the unification of intermodular relations permits, without specific efforts, to increase the information environment of the complex, to include new variants of the models and blocks of processing and display of account results. It permits to consider the offering complex, as a "opened system" for users, admitting expansion and improvement of the complex without participation of developers.

The first version of IAC was developed in State institute for applied ecology (see proceedings of IAS-3 in AEROSOLS journal). The further development of the complex was conducted in Hydrometeocentre of Russia, Institute of a global climate and ecology and Institute of geography. Accounts on the base of IAC were made for ecological monitoring of Kurgan (town). IAC was used for an estimation of gas-aerosol emissions at designing of Artur D.Littl company for gas pipeline in region of Uralsk. On the basis of accounts on IAC ecological valuations of pollution of a air the enterprises AO " Odincovo factories" were executed. Accounts of pollution of the atmospheric air were conducted together with MosCHMC institute.

1537.
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THE GRAIN ORIENTATION IN GASEOUS-DUST MEDIUM

V.I.SIKLITSKY

A.F. Joffe Physico-Technical Institute, 194021 St. Petersburg, Russia e-mail: siklitsky@pop.ioffe.rssi.ru

(First received 28 April 1998; accepted for presentation during IAS-4)

In gaseous-dust oblate dust particles (grains) rotate and have different orientation in space (Le Borgne & Mauron 1989; Le Borgne, Mauron & Leroy 1986; Mauron & Le Borgne 1986). Thus we can determine the function of orientation of dust particles in gaseous-dust medium. Based on Barnett effect the orientation function is obtained in this paper.

In interstellar and circumstellar media the grains rotate with high angular velocities. The rotation is due to such processes as collisions with ambient gas atoms, hydrogen molecule formation on the grain surface, photoeffects, non-uniformity of the accommodation ability on the surface area etc. (Hunter & Watson 1978; Purcell 1979). The equilibrium angular velocity may reach $\Omega \approx 10^6$-10^9 rad s^{-1}

Any rotating grain acquires a magnetic moment $\mu = \chi\Omega \cdot V\ (m_e c/eg)$ because of the Barnett effect. One can say that any rotating object is magnetized as strongly as it would be if at rest in an external field $B_0 \approx (2Vm_e c\Omega / eg)$. Here m_e is the mass and e the charge of electron, V is the grain volume, χ is the magnetic susceptibility of the grain substance, and g=1-2 is the

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gyromagnetic ratio. The field B_0 for a grain with $\Omega \approx = 10^5 - 10^6$ rad s^{-1} is about 0.05-0.5 G, i.e., it is much larger than the typical interstellar field value of $\approx 3\ 10^6$ G. For pure silicate, ice or carbon dust grains with $V = 10^{-14}$ cm^3 and $\Omega = 10^6$ rad s^{-1} one gets $\mu = 10^{-20} - 10^{-21}$ erg G^{-1}, and for a similar dust grain with paramagnetic inclusions $\mu = 10^{-18}$ erg G^{-1}. These estimates show that the magnetic moment of a cosmic grain is mainly caused by the Barnett effect (see Dolginov & Mytrophanov 1978).

In the process of the grain rotation the angular velocity vector Ω precesses relative to the grain body. This leads to a continuous reorientation of the electron spans in the body. The reorientation takes some time and leads to the energy dissipation. In turn this leads to some lag in the orientation of p with the Ω direction. The energy dissipation leads to orientation of the Ω with respect to the direction of angular momentum J and to orientation of the angular momentum with respect to the grain body axes. If the grain is axisymmetric, with the symmetry axis a, then the process results in $a \parallel J$ for an oblate and $a \perp J$ for a prolate grain. This process for a grain $V = 10^{-14}$ cm^3 and $\Omega = 10^{-6}$ rad s^{-1} needs a time less than a year. So we can assume that J possesses the orientation with respect to the axis a from the very beginning.

If there is an external field B_{ext}, then the magnetic moment of the grain also takes part in the processional motion around the field lines. The characteristic time-scale of precession is $t_{pr} = 2\pi J / \mu B_{ext}$. A dust grain's precession in the interstellar medium tends to be upset many times during t_{pr}, since the time interval between collision t_{sc} with the surrounding atoms is typically less than t_{pr}. Although $t_{sc} < t_{pr}$ a sum of fragmentary precessions is sufficient to smear out any alignment of J except that which is parallel to the magnetic field B.

This will lead to a random distribution of turning angles of the vector J about the direction of B for grains in the dust medium. Averaging of the directions J about the field direction leads to the field being likely to become the orientation axis of the grain ensemble even though the orientation mechanism is not dynamically caused by the field (Dolginov & Mytrophanov 1978).

The mechanism of Davis & Greenstein when applied to standards interstellar conditions (diffuse HI clouds) requires a magnetic field to achieve alignment which is about one order of magnitude too high compared with other determination. The suprathermal rotation of grams which may occur because of the molecular H_2 formation on the gram surface (Purcell 1979) increases the effective rotational temperature of the grain and provides a better alignment. However, the time necessary to reach a sufficient alignment is too long.

The time of alignment in gaseous fluxes is much shorter in many cases. They are an effective mechanism of alignments especially in stellar vicinities where the stellar wind provides a stationary, well directed flux. Various gaseous fluxes and streams are common in interstellar and circumstellar media. The alignment in a gaseous flux takes place only until the grain velocity differs from the flux velocity. The time t_{car} necessary for the grain to get the flux velocity is longer than the alignment time in many cases. It is the time necessary to transmit the momentum $m_{gr}/V_{flux} = m_{at}n_{at}S_{gr}\ V_{flux}^2\ t_{car}$, i.e. $t_{car} = m_{gr}/m_{at}n_{at}S_{gr}V_{flux}$. The time t_{at} of alignment in the gaseous flux can be estimated as follows (Dolginov, Gnedin & Silantev 1979).

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1535.
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EFFECT OF FILIFORM-STRUCTURE-BASED, SPACIALLY-DISTRIBUTED AEROSOL FORMATIONS ON ELECTROMAGNETIC WAVE PROPAGATION OVER A SUPER-WIDE RANGE OF FREQUENCIES

V. A. ALEKSASHENKO [1] -, L. I. STUPNIKOVA [2], A. A. SOLOVYOV [3], L. G. SUKHOVERKHOV [4]

[1] *GosCNIRTI, Moscow ; [2] GosCNIRTI, Moscow ; [3] OVTill, Omsk; [4] RNTOO oSferan, Moscow*

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The results of investigation into effect of filiform-structure-based spacial forma tions on electromagnetic radiation over a range of frequencies from radar to optical are summerized.

Considerable recent attention has been focussed on scientific and technological problems re lated to the capability for asserting influence on electromagnetic-wave propagation channels over a super-wide range of frequencies (from radar to optical) [1...2].

This capability, along with conventional use for reducing observability of various objects, can be used for radio channel screening in a desired frequency band, for communication link blocking, in anti-terrorist security arrangements, for assistance in offensive commando operations etc.

One possibility is that spacially-distributed formations (SDF) can be used to significantly to reduce electromagnetic radiation in a desired frequency band.

During the progress of our work a comparative analysis of various techniques for SDF generation has been performed in terms of:

areas of application, operating frequency band, formation time, life time, weight and size, attenuation characteristics, cost.

The following types of spacially-distributed formations were compared:

plasma formations; chaff; SDF based on excited molecules; SDF based on highly-excited atoms and molecules; SDF based on ultradispersible elements; classic aerosol formations, that is, the two-phase systems containing dispersible particles of any form having the representative dimensions much less than the wave length and the density equal to density of the bulky specimen,



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SDF based on filiform structures, that is, the elements whose length is considerable greater than thickness (C/d>5), and whose density is one or two orders of magnitude lower than the density of the bulky specimen.

The analysis showed that the spacially-distributed formations based on filiform structures were preferable.

The results obtained can be summarized as follows.

1. A theoretical model for generation of the spacially-distributed filiform formations was developed, on the basis of which we have estimated:
- the critical frequency beginning with which the media containing filiform structures attenuate electromagnetic-radiation notably better than other types of SDF;
- the attenuation of electromagnetic radiation per unit length p/C and the absorbability per unit
- weight G' . The values of these quantities (f18 +100 dB/m, G' =10 ...10 m /kg.) are abnormally large, two or three orders of magnitude larger than that of other types of SDF (in particular, of chaff, the most effective absorption medium);
- weight and consumption of a material whereof the most effective SDF is developed. So, against a radiation source moving at speed of 20 m/sec., it was found that SDF of representative size 10...100 m, providing attenuation by 20 dB (100- fold), require (10 ...10) kilos of material per centimeter (total weight of 0,18...4,3 kg) depending on the type'of material and the repre sentative size, which is considerably less than for other types of SDF.

2. The laboratory and quasi-full-scale experiments have, basically, supported the theoretical results. Several types of materials used for SDF were identified.

3. While predicted results remained unattainable, we were able to obtain the attenuation per unit length p/C =10 dB/m and the absorbability per unit weight G' =10 ...5~10 m /kg, that is, the parameters superior to those of other types of SDF.

Conclusions:

1. The comparative analysis of various methods and means for effecting the electromagnetic wave propagation channels showed that the filiform-structure-based, spacially-distributed aerosol formations are best suited for this purpose since their attenuation characteristics are superior to those of other types of formations.

2. Futher investigations are needed to solve the problem of determining the optimal composition of the material with the aim to realize the theoretical attenuation characteristics

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1568.
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THE PRINCIPLES AND METHODS OF BIOLOGICAL AEROSOL INVESTIGATION

V.V.VLODAVETS, S.U.LYSENKO

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Bioaerosols in the indoor air and atmospheric air containing bacteria, viruses, mould spores, yeast, algae and protozoa, obey the physical laws like any aerosol particle of a certain size. At the same time they are the biological objects, and their viability and biological properties depend on many environmental factors. That is why the apparatus for bioaerosol catching must combine high efficiency of catching and maximum favourable conditions of preserving viability and biological activity of microorganisms.

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The latter is especially important for detecting low-viable species of bacteria and a number of viruses in the air.

These are the principal requirements for the devices and methods of bioaerosol study.

1. High efficiency of bioaerosol catching.
2. The preserving of viability of the maximum amount of microorganisms caught.
3. Simplicity of apparatus preparing, of sampling and possibility of subsequent sterilizing of instruments.

All methods of bioaerosol investigations may be divided into 3 main groups.

I. Qualitative methods which don't make it possible to detect the content of microorganisms in a certain volume of air.

II. A large group of devices for the calculation of microorganisms in a unit of air volume. This large group of devices should be subdivided into the methods where microorganisms are caught onto the surface of solid nutritive media, and into the methods where bioaerosols are caught into the liquid media.

III. Macroscopical research methods that are intended mainly for the studies of the bigger objects of air plankton (mould spores, yeast and yeast-like fungi), as well as for growing microcolonies on the surface of filtration stuffs. And besides, in such cases the use of special investigation methods is possible.

There are some specific features and difficulties while sampling bioaerosol from the moving means of transport (automobiles, planes).These difficulties are especially great when studying viable microorganisms in stratosphere.

All methods of bioaerosol investigations, except microscopical ones, provide for catching microorganisms followed by the use of bacteriological, virological and micological methods of sample analysis.

While analysing the content of certain species of microorganisms in the air, especially low-viable ones in aerosol, the priority should be given to microbiological methods of detection and identification of microorganisms.

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NITROGEN OXIDES AND OZONE IN THE ATMOSPHERE OF CITIES

BEZUGLAYA E. YU., SMIRNOVA I. V.

Main Geophysical Observatory, St. Petersburg

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Of pollutants released to the atmosphere with anthropogenic emissions from industry, power plants and transport nitrogen oxides are among the most important. They form basically in the process of organic fuel combustion at high temperatures which then change to NO_2. The reactions with participation of nitrogen oxides in the atmosphere and photochemical processes lead to 0_3 formation Until recently, the urban air pollution level was believed to be determined by the amount of emission released into the urban air basin and by local conditions of transport and dispersion of pollutants over the given territory.

This study has been made to get a more complete idea on the location latitude effect upon NO_2 concentrations. For this purpose regression analysis was be made on the mean concentrations of NO_2 in Russian cities depending on the site latitude. Analysis shows that the mean many-year concentrations of NO_2 in cities on the territory of Russia increase noticeably southward, the mean latitudinal NO_2 concentrations increase between 70° N and 40° N (12 - 33 ppb). The coefficient of correlation between the NO_2 concentrations in cities and the latitude of the location is 0.66.

The correctness has been checked against the data of major European cities [The Air Quality in Major European Cities, 1995] from the data of Russia [E.Bezuglaya, 1991] and the USA

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[National Air Quality, 1992] for 1990. The largest values of NO_2 concentrations clearly increase southward by the factor of more than 3 from 8 ppb near 64° N to 60 ppb or 38° N. The coefficient of correlation between the NO_2 concentrations and the latitude of the location for major cities is 0,79.

The observed distinct increase in the nitrogen dioxide concentration from north to south is related with the differences in total solar radiation intensity as well as the differences in NOx concentrations. Within the latitudes under study the total solar radiation changes by the factor of more than two and the mean NO_2 concentrations also increase by the same factor. On the average for a year the content of NO_2 in NO_x at a given latitude can be predicted rather accurately. These limiting values increase appreciably from the location latitude 70° N to 50° N and very slightly at smaller latitudes. The low concentrations of NOx contain more than 50% of NO_2, if NOx concentration is higher than 50 ppb a part of NOx in the form of NO_2 decreases. The mean limiting values of NO_2 with NOx =100 ppb are equal to 25 ppb at latitudes 60-70° N, and 45 ppb at latitudes 40-50° N. At high latitudes the emissions of nitrogen oxides from industrial sources are usually low, therefore the limiting concentrations of NO_2 in the urban atmosphere are not observed.

An increase in the total concentration of nitrogen oxides is also observed which can be explained by the effect of natural NO_x emissions. In the territory of Russia they account for about 40% of the sum. of anthropogenic and natural emissions.

Ozone concentrations are related with NO_2 concentrations and NO/NO_2 ratio. The relationship between the annual mean concentrations of NO_2 and 0_3 (ppb) can be seen from the data for 25 cities of Europe [Air Quality...1995]. The correlation coefficient is equal to 0.714.

To be able to forecast ozone concentrations in Russia cities, the regression equation obtained was checked against the mean concentrations of NO_2 and 0_3 (ppb) in St. Petersburg

According to the calculations, the highest summer concentrations of 0_3 (up 26 to 30 ppb) are observed on the territory of cities located to the south of 55° N. Forecasted ozone concentrations differ from observed ones by 10-20%.



1581.
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COMPLEX METHOD FOR SOLVING THE PROBLEMS OF DECONTAMINATED SOLUTIONS WASTE RECOVERY

TATIANA DOVBISHEVA

Belarussian State Politechnical Academy, Ecology Department. Pr.Skariny,65, Minsk, Belarus. Tel.: 375/172/ 399265 Fax: 337/017/2313617

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Accident of Chernobyl is largest on scales manufacturability accident from ever having by a place on a planet. It radioactivity wing touch the practically whole of northern hemisphere. All territory of Belarus was subjected of radioactivity of pollution. The area of a territory, where density of pollution Cs^{137} exceeds 37 kBk/m² makes 46.45 thousand km². On polluted territories at present some millions the person lives and is engaged by industrial activity.

At fulfilment of the national program of liquidation of consequences of accident on Chernobyl there was necessity of realisation of radioactive decontamination of work in a polluted zone.

As a result of realisation of decontaminate of processing of various objects of industrial and municipal purpose during last years significant volumes fulfilled of radioactive decontamination of solutions, containing alongside with of radioactivity were formed by pollution (predominate

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pollution (predominate Cs^{137} and Sr^{90}) of surface active substances, of complexing agents, as well as ions of salts. Active fulfilled of radioactive decontamination solutions it is necessary of reclaim. At present these solutions reclaim of grouting with subsequent of burial of radioactive waste in burials, that certainly increases their quantity at a territory of Belarus.

Within the framework of the national program of liquidation of consequences of accident on Chernobyl in of Belarussian state politechnical academies are developed ways of clearing fulfilled of radioactive decontamination of solutions from of complexing agents, such as ADTA and of oxalic acid as well from of surface- active substances.

These development permit together with salvaging of radioactivity of pollution of sorption to create complex installation for salvaging fulfilled of radioactive decontamination of solutions, that will allow in some times to reduce quantity of radioactive waste, being a subject of burial of radioactive waste in burial.

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VARIABILITY IN OZONE LAYER PARAMETERS OVER TERLS MEASURED WITH ROCKET, GROUND AND BALLOON INSTRUMENTS: OZONE, AEROSOL, NEGATIVE ION CONCENTRATIONS, TEMPERATURE, WIND

B.H.SUBBARAYA [1], A.JAYARAMAN [1], S.LAL [1], S.P.PEROV [2], V.I.ERMAKOV [2], G.M.KRUCHENITSKY [2], S.F.TIMASHEV [2]

[1] *PRL, Ahmedabad 380009, India (fax:91- 79- 6560502 , e-mail:jraman@prl.ernet.in)*

[2] *CAO, Moscow 141700, Russia (fax: 7-095-5763327, e-mail: sperov@per.nifhi.ac.ru)*

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Three Indo/ USSR Ozone Campaigns were successefuly carried out in March-April of 1983, November-December 1987 and January-June 1990 at TERLS (Thumba Equatorial Rocket Launching Station), 8 N, 77 E and over equatorial part of the Indian Ocean (1990) from ship-born rocket and balloon facilyties. The last campaign had correlated with the worldspread international campaign DYANA: India and USSR took part in that. Many results and findings obtained from those campaigns as well as descriptions of insruments used have been presented at International meetings and published in international journals [Ahariya et al., 1984; Subbaraya, 1987; Seshadri at al., 1988; Subbaraya et al., 1989; Perov, 1992 a, b; Krishna Murthy et al., 1992; Ishov et al., 1992; Offermann et al., 1994; Subbaraya et al., 1994a, 1994b; Perov et al., 1996, 1998]. We give here the summary of the most important scientific results and conlusions after careful analysis of all sets of observations obtained by all means.

1. Remarkably large variabilities in ozone profiles (0 - 75 km), which were never reported early for tropics, had been established. It seems to be due to very strong dynamical forcing (energy, momentum, mass transport), mainly from the tropical troposphere (deep convection, thunderstorm, tropical cyclon etc.) as well as from the stratosphere itself with perturbations in ozone, water vapour, carbon dioxide, aerosol which are the more important trace constituents that play a direct role in the middle atmosphere chemistry and radiation budget.

2. Day-night variations in the mesosphere show the nighttime increase that is found to be altitude dependent with typical values of 10 - 20% at 45 km and 55 km, and a factor of 3 - 4 at altitudes 65 - 70 km. A variability in the values of ratios of night/day ozone concentrations observed in separate sets of rocket flights reflects corresponding changes in water vapour and in dynamical parameters (tides, gravity waves (GW), equatorial planetary waves (EPW)).

3. Total ozone (TO) diurnal variation with minimum during the noon period has been observed with the help a Brewer spectrophotometer throughout the operational time of 12 March - 23 May 1990, which included three 30-days periods of solar activity with double

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about 120 units of the Ottawa Index (2.8 GHz) with background value of 130 units. While the pattern of this variation remained generally the same, the amplitude of this main harmonics (with variable period 250 to 500 min), varied from day to day from 4 to 15 D.U., representing a change of 1.6 - 4% in TO. The daily average values show a seasonal increase from 265 to 280 D.U. A series of synchronous measurements of TO have been conducted at the Lake IssykKul` , Kurgyzstan, located at the same longitude of 77 E like Thumba, but at 42.6 N. Statistically proved correlation between the variations of daily mean TO over the Lake Issyk Kul` and Ottawa Index has been revealed. In the Thumba case such a correlation can not be considered statistically proved [Ishov et al., 1992]. The most important results of statistically careful analysis of all data sets at Thumba are that the amplitudes (1 to 15 D.U.) and periods (5 to 500 minutes) of variations in TO show a good correlations with the well known 27 days (in our case 30 days) solar activity periodicity. This seems to confirm the dynamical nature of TO oscillations and their connection with vertical wind variations caused by GW and tides [Perov et al. 1996]

4. Six/seven rocket launchings and five/seven balloon launchings from research ship "Academician Shirshov" were conducted on three days (Jan. 31, Feb. 21 and March 11 1990) in the equatorial region (Indian Ocean/Arabian Sea). Using the temperature and wind data from these launchings, the diurnal and semi-duirnal tide components in wind and temperature in the middle atmosphere are obtained and are compared with theoretical predictions. It is found that significant departures with factors of 10 to 100 at different heights (at height of 28 km for which theory gives deep minimum even up to 1000) occur between observed and theoretical values [Krishna Murthy et al., 1992]. Evidence of 8 hrs and may be 6 hrs harmonics has been demonstrated [Perov et al., 1992]. This confirms the findings given above (3.). Such a strong tidal wave seems to be considered as a dynamical forcing on the ozone profiles. Analysis of all rocket flights data (obtained by 3 types of optical and 2 types in-situ (chemiluminescent) instruments as well as by balloon ozonesondes for different time of day and night shows two O3 maxima (morning and evening) and O3 minimum at noon, as measured by Brewer instrument, at the altitudes above 28 - 30 km.

5. The data collected during the intensive observation period of the second phase of Indo/USSR Ozone Campaign in December 1987 have been utilized to study various interesting features of ozone variations over India. The effect of the weather systems including western disturbances on the TO and its profiles has been studied [Seshadri et al., 1988; Perov, 1989, 1992]. From the results of the series of rocket measurements of wind , temperature (T), ozone and atomic oxygen (odd oxygen - Ox) concentrations for the period 3 - 7 December 1987 one may note a periodic variability of the parameters indicated in the layer between 20 and 90 km: a conventionally adopted period is about 4 days. Spatial-temporal characteristics of the variations observed in the atmospheric parameters allow to identify them as equatorial planetary Kelvin waves. Following conclusions may be drawn from the all data analysis: the values of amplitudes both of odd oxygen and temperature increases with height up to 90 km; the amplitudes of T and Ox and their phases are not consistent with the theory treating the photochemical equilibrium of ozone in the upper stratosphere and in the mesosphere, the vertical profiles of the amplitudes obtained would represent superposition of several wavelenghs: 16 km, the biggest; 10 km, 20 and 40 km, which may correspond to Kelvin (and possibly Rossby) waves and tidal waves as well in equatorial region overThumba. Amplitudes of equatorial waves in T and in wind recorded above 40 km are found to exceed the values that were reported earlier; amplitudes of values dOx/Ox (increasing with the height from 10 - 20% at 30 - 40 km to 80 - 100% at 80 - 90 km) have been recorded in such waves for the first time. Two important conclusions may be drawn from the evidence on the vertical structure of the variance in wind, T and Ox. The first conclusion concerns the height regions of the atmosphere where such waves are generated: our results say about two possible layers connected with disturbances in the region near upper troposphere (tropopause) and in the 35 - 40 km layer. The second conclusion to be drawn regards to a possible existing

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system of interactive quazi-stationary waves in the layer 20 - 40 km.

6. One of the important aspects of stratospheric aerosol problem of analysing the specific features of heterogeneous processes involving aerosols of polar stratospheric clouds (and possibly aerosols near very cold tropical tropopause) is the effect of metastable nitric acid dihydrat and hydrat on the kinetics of reactions under considerations (Timashev et al., 1994). Dynamic supertemperature fluctuations determining decomposition of some molecules, ion clusters etc. can arise in the high energycontent medium of aerosol particles as a result of collisions of these particles initiated by acoustogravity and gravity waves, natural sonic noises in the stratosphere, and various geodynamic phenomena. The rocket observations dated August, 25 (Antarctica) and December, 3 and 5(Thumba) in 1987 were made in experiments in which the state of aerosols was determined by passing a flow of air containing aerosols through a special flow reactor isolated from external light sourses. The state of aerosols was monitored by observing light pulses emitted by them and interpreted as radiative de-exitation of initially highenergy-content aerosols. The concentration of the particles had a maximum at tropopause in all the three flights.

7. Relatively large (upto 50%) spatial-temporal variability of aerosols parameters (derived from key series of balloon soundings to study light negative ion profiles over Thumba at the geomagnetic equator has been interpreted by influencing GW and tropical cyclon disturbances [Gupta and Perov,1998].

All the findings reported above were published/presented before they have been confirmed by satellites (i.e.UARS, ASTROSPAS-CRISTA) and lidar observations (France) except 6, 7, and in part 3, 4.

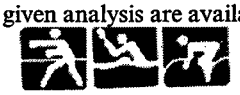
Recommendations: Correlative (validation) programme of ground-, balloon- and aircraft-based observations together with satellite overpasses must be carried out in India because our results show evidence for large variability in ozone, aerosol etc. demonstrating some serious methodical problems of middle atmosphere observations in tropics by satellite technique even for TOMS observation over Indian stations [Bojkov et al., 1996].

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1544
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EXTINCTION OF LIGHT BY AEROSOL SOOT PARTICLES WITH DIFFERENT MORPHOLOGY

E. F. MIKHAILOV, S. S. VLASENKO, A. A. KISELEV AND J. F. SAPHRONOVA

St. Petersburg State University, Institute of Physics, Department of Atmospheric Physics
198904 Petrodvoretz, Ulianovskaya 1, Russia tel: [+7] 812-428-7240; FAX:+7 812-428-7240 vlas@phys.niif.spb.su

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The particles of soot fraction of atmospheric aerosol effectively interact with solar radiation, while absorbing and scattering light in the wide range of spectrum [1]. On the other hand, soot particles interact with the atmosphere itself, because being an active centers of heterogeneous nucleation they take part in the condensation and vaporization processes of the water vapour [2]. The cause of such "efficient" behaviour is in the specific structure of soot aerosol, its particles appear to be a fractal aggregates of large number of nanometer size carbonic spherules [3]. Specified processes of soot "ageing" in atmosphere result in aggregates structure parameters altering "restructuring", that in its turn produces the alteration of optical characteristics of soot aerosol. In this sense the processes of soot interaction with radiation and environment become inseparable, thus constituting how much important is to establish the correlation between soot aggregates morphology and its optical properties. To solve the task we undertook the set of experiments aimed to find the relation between the extinction of visible light by aerosol soot particles and its structural parameters - mean gyration radius, size distribution, anisotropy coefficient, fractal dimension and primary particles diameter. Extinction and angular scattering diagram were measured in the polar nefelometer directly in the aerosol flow. To study the structure effect while keeping chemical composition and therefore refractive indexes unchanged, the soot aerosol flow was subjected to heating up to 1000 degrees C in the flow furnace, thus modifying the whole set of controllable structure parameters. Simultaneously with optical measurements the particles were sampled for transmission electron microscope viewing with the consequent digitized image processing, providing the averaging over the few hundreds particles in each temperature case. It was found that structural parameters practically doesn't exhibit alteration if heating doesn't exceed 600 degrees, but with the gaining temperature the mean aggregates size gradually reduces from 0,6 mcm to 0,3 mcm; projection fractal dimension retrieved from the well-known statistical relation between the mean size of fractal aggregates and the mean number of monomers in it abruptly falls from 1,7 to 1,1. Synchronous measurement of light extinction in the laminar aerosol flow demonstrated the steep rise of reduced extinction from 7 sq. meters per gram up to 15 sq. meters per gram. Such structure characteristics behaviour witnesses the process of disintegration of clusters, which are falling apart into smaller ones, probably keeping its fractal nature up to some temperature limit, when the primary particles themselves start to burn out. Apparently soot clusters disintegration clears the way for incident wave to irradiate the previously inaccessible internal parts of the cluster, so that more of primary particles become involved in the absorption - scattering processes. With the further heating the soot aerosol evolves into system of small chain-like aggregates and the scattering diagram approaches the form of Mie scattering diagram for the composition of small (but still non-Raleigh) polydisperse spheres. This is demonstrated by relative increasing of forward scattered light for the clusters subjected to the strong (T >700 deg.) heating.

The obvious strong correlation between measured extinction of light and the structure parameters of atmospheric soot aerosol allows a new point of view on the known in literature variety of extinction values for carbon smokes: probably it could be explained by variability of optical characteristics due to environmental conditions and the different ways of origination.

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1556.
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ON THE REASONS OF THE ATMOSPHERIC POLLUTION WITH THE CARCINOGEN AROMATIC CARBOHYDRATES OF STRIY AND STRIY DISTRICT, LVIV REGION (UKRAINE)

MIROSHNICHENKO A.N.

Charitable independent environmental laboratory, Charitable Foundation EcoPravo-Lviv, The Environmental Public Advocacy Center, 2 Krushelnitskoi str., 290000 Lviv, Ukraine, +380 (322) 271446, 722746 e-mail epac@epac.lviv.ua

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The increasing of falling ill of the inhabitants of Striy and Striy district, Lviv region with malignant neoplasms determined the importance of quantitative defining of the pollution level of the region with polycyclic aromatic substances (PAS). As it is known PAS are the most carcinogenic pollutants of the air. One of the best studied and wide-spread carcinogens is 3,4-benzopyrene. In a series of cases it is used as an indicator of the PAS group in general.

The peculiarity of the region is that in ... km from Striy there is The Dashiv Soot Plant which produces the technical soot. As it is known from the literature [*] in the production of the soot the emission factor on benzopyrene and perylen can reach 30mkg per 1kg of soot. That's why we have studied the level of pollution of the region on the content of benzopyrene.

For the air samples selection the aspirator of air type YuZ-10 with the productivity 750 l/hour was used. The selection of samples was done on the cloth filters DYY-15. The filters were fixed in the cone chucks at the height 1-3m above the ground level. The capacity of the air pumped through the filters made 5-6m^3. The quantitative determination of benzopyrene was done on quasi linear luminescention spectres by the combined method of additions and inner standard on the diffractometrical spectrometer DFS-12. The preciseness of determination is 10-10 mgr/m^3. The results of the analysis are given in the table.

As it is seen from the table despite the place and time of the samples taking utmost possible concentration (UPC) of benzopyrene exceeds the limit for one order and even more. It is set that the pollution of the atmospheric air can exceed UPC for two orders. The degree of the air pollution with the carcinogens depends on the air flow direction, what is seen from the experiment data of the simultaneous analyses of the benzopyrene content in the air samples at the factory territory and 2miles from it.

Nevertheless the pollution of the environment with the carcinogens is not only a result of gases amission . One of the possible and really existing ways of the soil and water pollution with the carcinogens is the soot which is the component of the solid emissions of the factory and which made approximately 289,902 tons/year.

It should be pointed out that the the Dashiv factory soot analysis showed that in 1 kg of soot there is 880 mkg only of the benzopyrene.

The study of the pollution of the adjoining to the factory territory (area of 12 km^2) for carbon showed, that the anomalies for the carbon are characterised by the medium contrast, maximum concentration (Kk = 3,57) was registered at the distance of 1 km from the factory.

The results obtained on the pollution of the city Striy atmospheric air with benzopyrene showed that the concentration of the carcinogens considerably exceeds UPC. Nevertheless, if the

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concentration of benzopyrene as a result of the jams while the intensive city traffic (8.00a.m. - 16.00p.m.) exceeds UPC 54-58 times, and at a diminution of the traffic flow (evening - night) benzopyrene concentration decreases approximately 5-5,6 times, but anyway exceeds the UPC for one order , the analysis of the air carried out in the settlement zone showed the considerable impact of the industrial enterprises on its pollution with carcinogens. Thus the content of benzopyrene varies from 37,2 to 167,7ngr/m3. This fluctuation can be connected only with the direction and strength of wind from which the degree of distribution (concentration) of the carcinogens in the air of the region depends.

Thus, the analysis held allowed to conclude that one of the main reasons of the increase of the malignant tumours in the region is the pollution of the atmospheric air with polycyclic aromatic substances.

By now the activity of The Dashiv Soot Plant is suspended.

* Serth R.W., Hugnes Th.-Environ. Sci. Technol., 1980, v.14, p.298-301

Observed area The time of the air selection The time of the air selection Concentration found # (beginning) (end)

#	Observed area The time of the air selection (beginning)		The time of the air selection Concentration found (end)	
1	The factory entrance	14`00``	21`00``	20.7
2	-//-	21`40``	7`25``	128.2
3	-//-	7`30``	14`00``	16
4	Two miles from the factory	14`20``	21`10``	65.5
5	Striy city, the zone of the intensive traffic	22`20``	8`00``	10.2
6	-//-	8`00``	14`30``	57.7
7	-//-	14`30``	21`30``	54.5
8	Striy city, the settlement zone	15`20``	23`20``	166.7
9	-//-	23`25``	11`55``	37.2
10	-//-	7`00``	15`00``	37.5

1307.

OZONE CONTENT, ATMOSPHERIC AEROSOLS AND CLOUDS IMPACT ON SURFACE UV RADIATION: SIMULATIONS AND OBSERVATIONS

MELNIKOVA I.N. [1], VAROCOS K. [2], GUSCHIN G.P. [3], NOSKOVA V. [4],

[1] *Research Centre for Ecology Safety, Russian Academy of Sciences, Korpusnaya Str., 18, St Petersburg, 197110, Russia*

[2] *Athens, Greece*

[3] *Voeikov Main Geophysical Observatory, Karbysheva, 7, St. Petersburg, 194018, Russia,*

[4] *St. Petersburg Technical University, Dept. of Mechanical Physics, Politechnical Str., 29, St. Petersburg, 194100, Russia*

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Calculations of surface UV-irradiance (total and diffuse) were accomplished for different atmospheric ozone, aerosols and surface albedo models. Results were compared with data of ground and aircraft spectral measurements of UV-radiation flux. The influence of atmospheric aerosols and albedo on ratio of the diffuse radiation to the total one at visual and UV wavelengths is determined.

The evaluation of cloud impact on surface UV-radiation is obtained from routine UV-radiation measurement data. One can suppose that surface UV-irradiance may increase slightly

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under condition small cloud amount comparing the case clear sky by reason of reflection and scattering of solar radiation from cloud sides. Then with growing of cloud amount surface UV-irradiance decrease. The elaboration of three-years set of data of UV-irradiance measured in St.-Petersburg and Athens is undertaken. The influence of solar zenith angle is taken into account. The dependence of surface UV-irradiance on cloud amount and solar zenith angle is presented.

1560.
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BIOSENSORIC APPROACH FOR DETECTION OF MICROORGANISMS

RESHETILOV A.N., ILIASOV P.V.

Institute of Biochemistry & Physiology of Microorganisms RAS 142292, Pushchino, Moscow region, Nauki av., 5 Biosensor research group Phone 007 (095) 9257448 Fax 007 (095) 9233602

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The detection of microorganisms in various media is acute for a number of human activity areas, for instance food industry, environmental monitoring, clinical diagnostics and so on. The existing set of the methods includes direct techniques based on cell count (cytofluorimetry, cultivation on agarized media followed by the clone count, microscopy methods) as well as the indirect ones based on the determination of enzyme activities. In clinical practice and at evaluation of food quality the ELISA-based methods and DNA assays (including PCR) have also been used. The most of these techniques are characterized as time and labor consuming and require high-qualified personnel.

The biosensor assay is characterized by speed, simplicity and precision and in the same time, as a rule, doesn't require use of the expensive equipment and highly-qualified personnel. The biosensoric methods of microorganisms detection is intensively developing nowadays; thus, the use of immunosensors for bacterial and yeast cells detection have been described [1,2]. An integration of DNA-biosensoric techniques with PCR opens new possibilities for microbial detection. Such approach allows the assay of DNA sequences specific for the microbial species or taxonomic group.

A promising way is the development of biosensoric methods of cell detection based on registration of their oxide-reductase activities (including dehydrogenase). The analysis of cell dehydrogenase activities can be realized by means of the standard electrochemical transducers used in biosensors - oxygen, ion-selective or mediator electrodes. The receptor of the biosensor in this case will be represented by a membrane containing microbial cells received from the sample. The biosensor based analyzer will register the activities of the microbial enzymatic systems; for a number of cases, if the certain species (strain) will dominate in the sample, it will be possible to identify it using the specific portrait of substrate specificity that represents the ratio of cell catalytic system activities for the set of test substrates.

We used the registration of oxide reductase activity of microbial cells for creation the model biosensor system containing Gluconobacter and Pseudomonas bacteria immobilized on Clark type electrode. The cell membranes of Gluconobacter genus contain dehydrogenases capable to oxidize a broad spectrum of organic substances - sugars, alcohols, and polyols. The oxidation process is accompanied by oxygen consumption and during oxidation of a number of sugars also by appearance of the acidic intermediates. This allows apply the Clark electrodes as well as ion-selective FETs in biosensors for microbial cell detection. The experiments showed that under using of oxygen electrode the lower limit of cell detection made up 0.15 mg of cells/mm^2 (wet weight) in the receptor element, or 10^6 cells in the sample. The value of the same order was obtained for the biosensor based on pH-sensitive FET.

It has been shown that a number of Pseudomonas strains harbor plasmids encoding the

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enzymes of xenobiotics catabolic pathways that usually belong to oxigenases. Thus, the main steps of degradation are accompanied by oxygen consumption that makes possible the use of such microorganisms for the respective compound detection. Early we reported about the creation of the sensor for naphthalene detection based on P. putida BS238 (pBS2) strain [3]. The transducer of the sensor was represented by oxygen electrode. The technique developed allowed the evaluation of sensor signal dependency on immobilized biomass concentration. The minimal cell concentration in the biosensor receptor made possible the obtaining of signals different from the noise made up approximately 10^6 cells/cm^2 that is ca 10^4 cells in sample.

The application of each of the mentioned transducers has restrictions; thus, the use of an oxygen electrode is impossible at anaerobic microorganism detection while the use of pH-sensitive transducer - in the case of absence of pH changes at test compound transformation. These approaches are also not suitable for detection of endospores or other resting/being in anabiosis condition microorganisms as well as viruses. In such cases seems perspective the use of immunosensors or DNA sensors based on coupling the ELISA or DNA assay with biosensoric approach (ion-selective transducer or surface plasmon resonance device). Nevertheless, we think that the approaches described above and based on amperometric and potentiometric assay are able to ensure the sensitive detection of the presence and quantification of microorganisms.

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1522
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HYDRIDES OF SINGLE-WALLED CARBON NANOTUBES

L.A. CHERNOZATONSKII, N.G. LEBEDEV*, A.O. LITINSKI*, I.V. ZAPOROTSKOVA *

Institute of Biochemical Physics, Russian Academy of Science, 117334 Moscow, Russia
**Volgograd State University, 400062 Volgograd, Russia chernd@sky.chph.ras.ru*

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Carbon nanotubes are the richest material for various applications in science and technology. These carbon structures show some unique properties, which allow to use them as interesting physical and chemical systems. Due to their small sizes (the diameter is some nanometers, the length is up to some micrometers) nanotubes represent the quasy-one-dimentional nanosystems, which can widely used in nanoelectronics, medicine, aerosol technology and so on. In particular, it is suggested that nanotubes might be effective as a hydrogen-storage material.

As it is well-known fullerenes C_{60} and C_{70} are effective adsorbents of light atoms (H, O, F, He and so on) because of the curvature of their surface. They connect themselves to these atoms, radicals and functional groups, thus compounds and crystal structures with various physical-chemical properties are obtained. Carbon nanotubes similar to fullerenes to be suggested are effective adsorbents too.

Here we present the results of calculations of adsorbtional properties of small diameter single-walled nanotubes (SWNTs) being compared with C_{60}. We carried out the quantum chemical calculations of (9.0) zigsag-type and (6,6) (10,10) armchear-type SWNT which were interacting with atoms H and compared the results with those for the case of hydrogen adsorbtion on a

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graphite surface and fullerene C_{60}. For the calculations we used the MM2 molecular mechanic method (for modeling geometry of SWNT hydrides) and MNDO-method, modified within a cyclic cluster model for nanotubes.

We considered the infinite carbon tubes as models of SWNTs. So we applied the ionic-embedded covalent-cyclic cluster model developed for the calculation of electronic structure, energetic cheracters of the band structure of solids and polymers. For determination of the most energetically propable hydrid structure we carried out calculations of two types of hydrogenization of SWNTs: a) atoms H were placed over C atoms of each fourth neighbour layer of hexagons (on six H atoms over each layer) so that rings of the superlattice, containing adatoms, are not displaced relatively to each other; b) even rings of adatoms are displased relatively to odd onee on a C-C bond length.

The analysis of the results has shown that the second variant of hydrogenization is more energetically advantageous. Furthermore the results show a good agreement with those of calculation of single atom adsorbtion. Allowing for hydrogen adsorption in the ratio C4/H on the surface of the (10,10) tubes, we obtain reasonable agreement with the experiment of A.C. Dillon group (Nature 386,678 (1997)). Considered hydrogen adsorption in the ratio C2/H proves to the possibility of SWNT's using as a good hydrogen storage.

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1628
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VOLGOGRAD PM-10 SATURATION STUDY

J.SCHWEISS [1], E. BEZUGLAYA [2], I. SMIRNOVA [2], S. CHICHERIN [2], L. KURDINA [3], L. FOKINA [4]

[1] *EPA USA,*

[2] *Main Geophysical Observatory, St. Petersburg,*

[3] *Volgograd Center for Hydrometeorology and Environmental Monitoring,*

[4] *Volgograd Committee for Environmental Protection*

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Fine particulate is more harmful for human health than coarse particulate as it was established by many scientific researches. In accordance with RAMP program in Volgograd from 29 July through 26 August 1997 the second stage of saturation study was carried out on the distribution of small suspended particles PM10 over the city area. During the experiment there were made 500 measurements of PM-10 concentrations at 25 sites located in the north and south areas of the city over the vast territory (the city extent is almost 100 km). Three organizations conducted jointly studies during the given experiment: Volgograd Center for Hydrometeorology and Environmental Monitoring (VCHEM), Volgograd Committee for Environmental Protection (VCEP) and Main Geophysical Observatory (MGO). MGO collected, processed, made statistical analysis of information obtained as a result of experiment.

The principal aim of Volgograd experiment was determination of spatial temporal changes in PM10 concentrations and contribution of basic enterprises of the north industrial area to the total air pollution, obtaining the ratios between the concentrations of fine dust (PM10) and total suspended particulate, comparison of the concentrations of metals measured from PM10 filters and at the fixed monitoring network in Volgograd.

Studies were carried out in the area of industrial enterprises in the north Volgograd limited by triangle formed by Red October plant, Aluminum plant and Silicate plant, and in the south city part in the area of Foundry and Mechanical plant. Two pairs of stations functioned during the experiment for estimating the correctness and accuracy of instruments for PM-10. The data have shown a good compatibility, correlation factors are equal to 0.97 and 0.99..The presented materials show that the repeatability with parallel measurements is rather satisfactory.

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The mean over the experiment period concentrations of PM-10 at different stations range from 131.8 to 36.9 μg/m³. The highest daily mean concentration at the north Stations is equal to 385.4 μg/m³, at the South stations 406.0 μg/m³, the lowest respectively 19.1 and 2.8 μg/m³. During the experiment two stations were taken as background . The background in the south part of the city was 28% lower than in the north. The results allow us to describe thoroughly enough the field of PM-10 concentrations in the north and south parts of the city where the basic sources of air pollution by PM-10 are located. The data of instruments located on the territory of north industrial area near the roadway reflect the motor transport effect. The maximum mean over the observation period concentrations are observed in the area of Volgograd Aluminum Plant (104-132 μg/m³). In this area PM-10 concentrations above 100 μg/m³ are observed during 16 days. The lowest mean PM-10 concentrations are observed in the south part of the city, in arboretum where the mean is 36.9 μg/m³. Due to the detailed picture of PM-10 concentration distribution on the city territory an approximate contribution of each plant to the total city air pollution can be estimated. In the north part of the city the VAP contribution is 23%, "Red October" Plant - 16%, SMP - 13%< including brick production - 20%.

Analysis of the experiment results enables one to recommend it for extending to other areas in Russia to estimate the fields of fine particles (PM-10) concentrations on the city territory. The Volgograd PM-10 study is of important significance for possible future steps in developing the monitoring system and air protection activity in Russia.

1644.
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SOOT PARTICLES RESTRUCTURING IN FLOW CONDENSATION CHAMBER

E. F. MIKHAILOV, S. S. VLASENKO, A. A. KISELEV

St. Petersburg State University, Institute of Physics, Department of Atmospheric Physics
198904 Petrodvoretz, Ulianovskaya 1, Russia Phone: [+7] 812-4287240; FAX: 4287240 vlas@phys.niif.spb.su

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In most cases, carbon black particles resulting from burning of hydrocarbon raw materials are structures of complex organization composed of a large number of primary nuclei (monomers) of nanometer size. The internal structure of such aggregates complies with the known fractal scaling relationship between the number of monomers and aggregate size, that is why such particles are often referred to as fractal clusters. The main distinction of these aerosols particles is their physics properties dependence on their internal geometric structure.

The specifity of soot particles in relation to other similar objects is determined by a relatively low bond energy of the interparticle contacts in the aggregates that account for the strong structural changeability of the aggregates under the effect of external factors. From the viewpoint of the applied studies, especially those concerning the effect of soot aerosols on atmospheric processes, investigation of the restructuring processes of carbon black aggregates in an environment of condensing water vapor is of particular importance. Under conditions of higher humidity, carbon black particles become compact, thus increasing their fractal dimension and simultaneously decreasing their sizes [1]. Despite the importance of this mechanism of aerosols transformation, the process of interaction between soot particle and water vapor was studied rather unsufficiently. The study is complicated by the fact that condensing ability of soot agglomerates varies with their hygroscopicity and surface structure which in turn strongly depends upon conditions of clusters formation. So while exploring aggregates restructuring under the effect of condensation it is necessary to monitor humidity of water vapor condensing on the soot particles surface. That is why we applied the special modification of flow diffusion nucleation chamber [2] designed for measuring of condensation activity of large aggregates.

To study the structural changes of soot aggregates resulting from water vapor condensation

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the soot aerosol mixed with water vapor in certain proportion and passed first through the preheater and then through tube cooler where condensation took place. Water vapor was produced by clean air bubbling through water maintained at certain temperature. Varying the water temperature one was able to regulate the vapor concentration. On entering the condensation chamber after preheater, the relatively warm vapor diffused to the cooler walls of chamber where it condensed. Energy was transported to the walls too thus cooling the flowing aerosol stream and resulting in supersaturation of vapor (up to 200%) in a region downstream from the entrance to chamber. When passing through the region soot particles appeared to be centers of vapor condensation that accompanied by restructuring of aggregates.

The result of condensation effect was estimated by means of electronmicroscopic analysis of the particles sampled on formvar film using the thermoprecipitator. The structural and disperse parameters (cluster size distribution, average size of monomers, fractal dimension) were determined using specific image processing technique.

The soot particles size distribution was found to change significantly upon vapor condensation, which is indicated primarily by a decrease in characteristic size of clusters. The changes observed in particle size distribution appeared to be accounted for by the compaction of large aggregates. Note that nearly spherical globules of closely packed primary particles were formed on the clusters. These globules can cover the cluster either partially or completely and form compact aggregates. The formation of these structures can be accounted for by the effect of surface tension of condensed water on particles in aggregates.

It is of interest to note that the structural change of soot aggregates took place even in slightly undersaturated vapor (more than 95%). In the case restructuring increased the fractal dimension of aggregates but they retained their branched character (there were no compact globules on aggregates). This effect appeared to be bound up with capillary condensation on the interparticle contacts in aggregates. This process gave rise to association of adjacent branches of cluster and formation of multiply-connected chains of primary particles. As a result, the cluster structure retained its rarefied character only at large scales (comparable with the cluster size), while the branches themselves are no longer the chains of monomers, but formations of closely packed particles. When the partial vapor pressure increased, the deformation involves larger and larger cluster branches that yield more and more compact aggregates.

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1592.
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THE EFFECT OF INTERNAL STRUCTURE OF THE RADIALLY NON-UNIFORM PARTICLES OF MARINE AEROZOLE ON LIGHTSCATTTERING

KOKORIN A.M.

St.-Petersburg Branch of P.P.Shirshov Institute of Oceanology Russian Academy of Sciences
199053, 1-Line W.O.,30 . kokorin@gk3103.spb.edu

(First received 01 June 1998; accepted for presentation during IAS-4)

In this work an accurate solution of the problem of difraction on an anti-reflection sphere (ARS) is used for the assessment of the influence of internal structure of oceanic aerosol particles on lightscattering characteristics. The ARS is a two-layered sphere with a homogenious non-absorbing nucleous and an inhomogenious shell, with a power law of the inhomogenety behaviour. For the calculations of the properties of lightscattering the conventienal model of the

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marine aerozole was used (SPA, 1984). The model is a combination of the two components: (1) "WATER-SOLUBLE" with the soluble particles of calcium sulphate and organic substance and (2) "OCEANIC" with particles of salt. The results of the numerical modelling are considered for the three possible mechanisms of changes in the ensemble of aerozole particles in the variable field of the atmosphere humidity: a) uniform swelling of the whole volume of a particle accompanied by decreasing the refraction index (the model of a homogenious sphere); b) enlarging of a particle with partial soluting of the initially dry solid nucleous (the model of ARS); c) enveloping of a particle by a water shell with the remaining non-soluble nucleous (the model of the two- layered sphere). The results of the calculations showed that the lightscattering coefficients of the polydispersed systems of particles for the three cases considered above are very close in magnitude. The angular properties of lightscattering are much more sensitive to the internal structure of particles. The phase functions for the all three cases practically do not differ for the humidity less than 70 percent. For the magnitudes of the humidity exeeceding 70 percent the phase funstion for ARS-model in the range of the large angles of scattering qualitatively and quantitatively differ from that for the models of the two-lagered and homogenious spheres. For example for the "Water-Soluble" fraction the largest difference in the scattering intensity (40 percent and even more) is observed in the range of backscattering angles. For the "Oceanic" fraction the difference in some cases can be egual to even more than 200 percent. So for the magnitudes of the humidity exceeding 70 percent the effect of the internal structure of particles of the ARS - type on the phase function becomes essential in the range of large angles of scattering. In addition the large differences in the behaviour of the degree of linear polarization are observed for all considered models. Conditious were reveiled for which an effect of depolarization com be observed for the case of an ARS-model of "Oceanic" fraction.

1596.
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AEROSOLS AS A CAUSE OF OZONE'S VARIABILITY IN SPACE AND TIME

L.S. IVLEV [1], V.P. CHELIBANOV [2]

[1] *Institute for Physics, St Peterburg State University, Russia*

[2] *OPTEC Ltd, St. Petersburg, Russia chel@lekmedial.spb.su/Fax: 7-812-2185159, 7-812-3277222*

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The time variability of ground ozone content has as regular (pseudoperiodical) so unregular character. The first type of variability is caused by sunearth connections as well atmosphere general circulation and wave motion. The statistic analysis of ozone experimental data has been carried out to determine different fluctuation periods from minute to season variations for various climate regions from polar to tropical latitudes.

Daily, 48 hours and season variations are shown evidently. The variations with shorter periods depend on many factors including observation latitude, profile and type of ground surface. An interference of wave processes of different origins which is responsible for period duration changes is assumed to exist. A special attention was paid to the nature of fluctuations with periods from 5 to 7 minutes. The second type of variability is caused by aperiodic atmospheric processes in particular by discharging ozone destructing and ozone generating substances of different concentrations and flow rates into atmosphere. Sources of aerosols of different nature as well nitrogen oxides, organic substances have a special significance. Experimental data on ozone concentrations in dependence of aerosols and nitrogen oxides are considered.

1546.
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THE OPTICAL CHARACTERISTICS OF MODEL AEROSOLS IN THE ATMOSPHERES OF EARTH, MARS AND VENUS: METHODICAL QUESTIONS AND RESULTS OF ACCOUNTS

M.YA MAROV, V.P. SHARI

M.V. Keldysh Institute of Applied Mathematics, Russia Academy of Sciences, Miusskaya sq., 4, Moscow, 125047, Russia; fax: + 7-095-9720737 marov@spp.keldysh.ru

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For IBM compatible PC special technique and its program realization was developed for the evaluation of complete set of spectral properties of light scattering by polydisperse system of spherical particles (Mie scattering) including volume coefficients and angular dependences of elements of phase matrix. The respective algorithms are based on the classical approaches of light scattering theory (see, e.g., [1]). A broad parametric study for the various model aerosols was performed. This technique was earlier successfully applied for the analysis of nephelometric measurements made by Venera 9-14 spacecraft, which allowed to identify structure and physical properties of the Venus cloud deck [2,3].

Further development of this approach was focused on further expansion of these opportunities with raising efficiency of numerical evaluation of the problems involved, and targeted to set up of data banks for the characteristics of light scattering by aerosols of a natural and antropogeneous origin in the atmosphere of the Earth [4,7]. In this regard the problem of evaluation of Mie coefficients for relatively large particles closely related to wide distributions of particles by sizes for real aerosols was successfully solved. The program (MONO) involves characteristics of single spheres and allows to check the correctness of a method selected for their account, while the program (POLI) for polydisperse case allows to accomodate different patterns of distribution of particles by radii, including modified gamma-distribution, log-normal distribution and their sums, as well as exponent distribution Junge etc.. Utilization of additional service programs allows also to display the computed angular dependences of elements of a complete phase matrix or frequency dependences of volume factors on the screen of monitor or print them out.

Special attention was given to the accounting of light scattering characteristics of particles in partially absorbing media. The technique made possible to evaluate optical characteristics of water-oil emulsions and was earlier accepted as the Manual by the USSR Ministry of petroleum industry (ID 39-3-680-82). The experience acquired is pertinent for the control of sea aerosols and detection of oil pollution of the ocean.

In the databank basic models of aerosols adopted in 1978 by the Working group of Standard Radiating Atmosphere (SRA) and Radiation Commission of International Association of Meteorology and Atmospheric Physics (IAMAP) and additionally specified in 1984 [8] were adopted. The optical characteristics of typical atmospheric aerosols for 61 wave lengths from 0.2 to 40 μm were included: meteoric dust at the top atmosphere (h>30 km); background aerosols and volcanic ashes in the stratosphere; near-surface boundary layer of the troposphere above continent and sea surface for the conditions of a pure atmosphere, as well as urban aerosols of the polluted atmosphere. The models of continental, urban and sea aerosols represent combinations of four basic components: water soluble particles; insoluble dust particles of soil origin; carbon aerosols of antropogenic aerosols or particles of sea sprays. These components make a basis for the databank formation and storage. For each component the complete set of optical characteristics of single scattering including volume scattering, absorption and extinction coefficients is incorporated, beeing accompanied by all elements of a phase matrix for scattering angles from 0 through 180 degrees with a step of 1 degree. They can be used for an estimation of aerosol component contribution in radiation transfer and relevant climatic effects. Some results of

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calculation of model aerosols optical characteristics in Earth's atmosphere were published as Keldysh Institute Proceedings [4].

Within the framework of technique developement for the Europen global ozone monitoring using the method of star occultation by the atmosphere (Global Ozone Monitoring by Occultation of Stars, GOMOS) the continuous efforts were paid to fill up the databank by the optical characteristics for the global background aerosols of all basic layers in the height range from15 to 50 km [5] This analysis was focused on the specific patterns of height distribution and latitudinal and seasonal variations, with the involvement of chemical structure and physical properties. The respective parameters of stratospheric and mesospheric aerosols, including particles effected by volcanic eruptions, meteoric dust, and noctilucent clouds in the wide range of waves lengths were accurately specified. To simplify the reference and the results of measurements evaluation for the inverse problem solution, analytical polinomial function were introduced, which approximate spectral dependences of the volume characteristics of the radiation transfer in the wave lengths range 0.2-1 μm.

A comprehensive analysis of light scattering for a number of wave lengths and various physical properties of dust particles in the atmosphere of Mars and model aerosols of the Venus clouds was performed [6]. The particles of mineral dust of Mars were simulated by silicates and limonites, whereas aerosols in the atmosphere of Venus – by sulfuric acid droplets and particles of crystal sulfur. The influence of a various degree of absorption by Martian aerosols on the spectral characteristics of light scattering were considered. In turn, for each of four modes of the Venusian clouds a complete matrix of light scattering for the wave length of 0.63 μm along with the spectral dependence of IR opacity of clouds in the wave lengths from 2 up to 40 μm was investigated in detail. The main goal was to estimate the contribution of clouds in the net flux of thermal radiation and aerosol contribution to runaway greenhouse on Venus. For each of the three basic layers of the Venus clouds the comparison of angular dependences of elements of matrixes for each mode of aerosols composing these layers was carried out. These results form the basis of the comparative-planetology section of the database, essentially expanding the information on optical properties of aerosols of atmospheres of the planets of the terrestrial group and create important basis for correct interpretation of the ground-based astronomical observation and future space flights.

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1597.
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MODEL FOR PROPAGATION OF AEROSOLES OF VARIOUS ORIGIN UNDER THE CONDITIONS OF FOREST VEGETATION

KOLESNIKOV E.YU., IVLEV L.S., EFREMOV M.N.

Scientific Research Institute of Physics, State University of Saint-PetersBurg, Russia;
State Technical University of Mari Autonomous Republic, Yoshkar-Ola, Russia.

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A model for description of polluting impurity propagation in the lower atmosphere sublayer is proposed.

Simplifying assumptions are as follows:

a) the impurity transport is described within the quasi-stationary approximation;

b) the change of orientation of wind velocity vector is ignored, allowing to seek a solution for two-dimensional problem ("plane problem") and estimating the concentration q(x,z) as q(x,y) ~ $\exp\left(-y^2/2\sigma_y^2\right)$. In addition, the technique of variables splitting has proved to be efficient for obtaining a complete spatial field of concentrations $q(x,y,z)=q_1(x,z)q_2(x,y)$

c) the impurity transport is considered under the conditions of neutral thermal stratification;

d) the thermal vertical floating (up-drifting) of a torch is not taken into account;
This may be accounted for by introducing the effective altitude of the source of atmosphere pollution.

e) the estimation domain is assumed to be horizontally homogeneous (uniform), so that $\frac{\partial K_{ij}}{\partial x} = 0$ holds.

f) the forest is approximated by a continuum (a continuous medium) with regularly ordered roughness elements;

g) the specific features of transient boundary layer resulting from the effect of a wind stream over-running the forest are neglected.

The considered model is a parametrical. The estimation domain is subdivired into two subdivided into two subdomains: I - up to the border of a forest which has a smooth lower boundary; II - the forest area including the upper aerial layer over the forest.

The model is based on the balance equation. An advective flow is represented by sedimentation and transport of the impurity acted upon by the field of the wind of medium strength.

The diffusion term in balance equation is expressed by the local concentration gradients of impurity with regard for the tensor character of turbulent diffusion coefficient.

Tensor components K_{ij} are estimated by the corresponding Reynolds tensor. A simple relation connecting the specific energy of turbulence and dynamic velocity is proposed for the case of most typical conditions in the lower atmosphere sublayer.

This allowed to obtain $K_{iz}(z)$ in analytical form. The "sewing" of thermodynamical modes of atmosphere for two layers of subdomain II, namely: inside the forest and above it according to the present model, is achieved owing to the continuity of vertical profile of $K_{iz}(z)$.

The vertical ascending of average velocity of wind within the subdomain I is represented by traditional logarithmic function.

Similar relation has been obtained for the second subdomain on the basis of estimated profile of $K_{iz}(z)$ and empirically obtained pattern for the path of mixing inside the wood, which was accurately checked and proved to be reliable, Vertical profile of the wind average velocity within the disturbance layer above the forest (up to the altitude of 1,5 h_{ij}) was approximated by the

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linear function.

An empirical relation for the capture coefficient β and the experimentally detected linear dependence of the impurity "sedimentation flow" on the wind average velocity are introduced in the present model.

The model has provided a particularly detailed description considering a bilateral deposition of impurity presumably on both sides of the surface.

According to the model the set of equations are linear partial differential equations of the second order of a hyperbolic type. The equations which hold for subdomain I and II differ from each other in the actual prescription of the vertical profiles of the wind velocity and the components of tensor K_{ij}, the sink of impuruty occuring specifically inside the second subdomain. After the diffusion equations had transformed into the finite difference equations the numerical solutions were obtained by PC iteration Gauss-Seidel technique involving accelerating factor ω.

The calculations based on the proposed model allow to compare the profiles of impurity concentration under the conditions both inside and outside the forest. The vertical profile of impurity concentration can be estimated at a variety of distances from the source of atmosphere pollution.

1598.
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PHYSICAL TECHNIQUES OF ULTIMATE ANALYSIS IN ENVIRONMENTAL MONITORING

V.I.KOUDRYASHOV, L.S.LVLEV

Institute of Physics of St. Petersburg State University, Russia

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Physical techniques of ultimate analysis such as fluorescent X-Ray (RFA) and neutron-activation (NAA) analyses allow simultaneous determination of 2030 elements in each analysis, the measuring time not exceeding several minutes. Both techniques provide low measuring thresholds and high sensitivity, RFA being non-invasive technique. Practically no sample conditioning is required in the majority of analyses. The application of these techniques provides data on a space-time distribution of elements over the environment under investigation which is of great interest and meets the needs of ecological surveillance and problems of climate.

As an example, the analysis of atmosphere samples and deposits collected in Mexica in course of determination of lower atmosphere optical-meteorological parameters after the eruption of Popocatepetl and Colima volcanoes in 1994-1995 has revealed that the effect of the outburst of volcanic matter dominated the environment ranging up to 600 km over the period of several months. It was not until the beginning of the rains season that the composition and concentration of elements in the atmosphere changed.

Daily measurements of elements concentration dynamics in the atmosphere taken at Kemerovo town (in 1990) in addition to rather routine data on variations of elements content and degree of air pollution allowed to detect the supply of certain metals into the atmosphere produced by technogenic sources operating for a short period of time during the night hours (approximately at 0 o'clock).

The mapping of industrial and some other technogenic pollution has been revealed and recorded during synchroneous measurements at a variety of observation points in course of ANZAG-87 experiment in Alma-Ata city. Ultimate analysis has revealed the directions of pollutant cloud drifting which appeared above the city, as well as approximately estimate the velocity of its propagation (as far as 25-30 km from the city the concentration peak levels of elements such as Zn,Pb,S were recorded every 3-5 hours). Introducing of the enrichment factor into the data processing technique allowed in a number of cases to separate the effect of natural supply of pollutants from technogenic supply.

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In the course of investigation of industrial facilities area pollution beyond the city of Cheboksary (in 1993), vegetation defoliage and snow coverage allowed to detect a ring structure of pollution area (2-3 rings) containing various elements ranging up to 50 km outside the city.

Ice sediments (deposits) analysis in the Pamir, Tien-Shan, and Altai, conducted on samples collected during the scientific- research expeditions, in 1984-1994, from large areas, has indicated the presence of sulphur and heavy metals, revealing a certain effect of industry on atmosphere pollution over the Central Asia territory in 1972-1992.

1650.
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DISCRETE MODEL OF NONEQUILIBRIUM VAPOR - CRYSTAL TRANSITION AND THE PROPERTIES OF SMALL CONDENSED PARTICLES

S.I.IGOLKIN, V.N.USKOV

Baltic State Technical University, St.-Petersburg

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Theory of condensation /1/ is based on the term "liquid nuclei". The arising and growing of a nuclei is described by the mathematics formulas operated with the surface tension of a liquid. A lot of materials, particular at reduced pressures, do not have a liquid phase, nevertheless, they condense and form the complex fractal structures or, for example, fullerenes, which by no means consistent with the nucleation theory. Very small condensed particles and clusters formed at nonequilibrium, fast and deep supercooling of vapor bypassing the liquid state possess a new important properties, determined by specific internal and surface structure. The abilities of some substances to change the physic-chemistry characteristics in a cluster phase motivate us to search the unity way of such transitions description to bring all kinds of condensation according to the properties of particles. New approach is the base of analysis and computation of condensation kinetics for any initial and final state, and the classic nucleation theory is an important particular case. Method of description is borrowed from low temperature plasma kinetic theory /2/ and based on a deep analogy of plasma phase transitions and all other ones. The evaporation process can be reflected in the same terms as the ionisation. The recombination is full analogue of the condensation and interlevel relaxation of exited electrons in plasma is close to the structure transformations in condensed matter.

Every atom in a crystal grid has its own position replied to discrete energy potential. The sum of joined potential amount to the full bind energy of cluster. Every level can be filled by some ways and at the different rate, depending on an external parameters and the prehistory of the process. In a perfect crystal all the lowest energy levels are filled and upper ones are empty. The defects of a crystal grid accord to the partly filling of any upper energy levels. The existence of some crystal modifications means the different schemes of population permitted for this substance. It is close analogue of the metastable states of the exited atoms and molecules, known from the spectroscopy measurements.

In such terms we got a convenient system of the description of the crystal grid filling throughout the discrete states or energy levels /3/ attached to the well developed in /2/ mathematics apparatus of interlevel transitions. Small solid particles has some different discrete places to join other molecules and clusters. Depending on the necessary computation accuracy and on a kind of a matter been studying it's possible to take into account all permitted positions inside a grid, or any of them, the states inside a volume, on the surfaces and on the summits of a crystal. The growing of cluster means the filling of corresponding levels. For the two-levels scheme (surface and inside a volume state only) we have the classic nucleation model which is, as early, incorrect for any size solid aerosols and for all liquid particles containing no more, approximately, than 102 molecules. The further growing of the aerosols is differ for every model.

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The classic case of liquid drop condensation replies to the immediately relaxation to the base, the most energy profit state. All the rest ways allow the filling and freezing of other permitted positions related to higher energy levels. At a deep supercooling the filling of high exited levels is preferable. That's why the process of vapor-crystal condensation in a fast expanding vapor jet, for example, at the low temperatures and pressures can not lead to the dense perfect crystal grid formation.

All phase transitions, size and structural changes can be formalised in the terms of the populations of corresponding states of a matter. Porous, fractal and thread-like aerosol particles reply to the partly filling of the most profitable energy levels. Discovered in the experimental investigations of condensation specific thin and long metal threads, the plate nets and the volume clouds of fractal-cluster particles reply to the occasional or regular filling of corresponding states. In a case of fast carbon condensation we got the fulleren balls. Here every atom joins three other ones and, hence, fills three potential holes only.

The row of unusual features of high dispersed matter incline us to speak about a separate phase of a substance. The most important among it's properties are the significant store of internal energy of new crystal structures and ability to release it in a relaxation process. Such phase state and transitions, for example, are the most probably reason of anomaly optic phenomena in atmosphere. The majority of ones are connected with the long living aerosol cluster clouds. This conclusion is the only to explain the high energy, low-rate relaxation and self-heating of the fractal-cluster aerosols. The shifts of the melting temperature and saturated vapor pressure under the external forces with the diminishing of particles sizes are among the other facts hardly explained in the common terms. All of them are proper to the suggested here model of cluster phase.

The physics constants of the substances, as the temperatures and enthalpies of the phase transitions, dissociation energy and so on, contain enough information to build the approximate schemes of the energy levels and to analyse the condensation process parameters. The exact computations and measurements continue to be the subject for the further elaboration.

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THE LASER WITH INTRACAVITY REACTOR FOR PROCESSING OF DISPERSIBLE PARTICLES

WOLKOV S.A.

St.-Petersburg Institute of Fine Mechanics and Optics 197101 Russia, St.-Petersburg, Sablinskaya st. 14.

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The efficiency of laser processing of dispersible materials is largely determined by a way of organization of interaction of laser radiation with a dispersible system.
In the present paper the new method of laser processing of dispersible particles is suggested. This method consists of introduction of treated particles in the form of gas-dispersive mixture into the waist of high-power laser beam.

The experiments have been carried out using the Nd-glass laser rod placed inside the resonator which geometry is close to confocal. The reactionary cell was made in the form of the

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vacuum chamber with the sprayer of a disperse phase. Working volume of cell was combined with the waist of a beam. In experiments the powders of materials with various optical and thermophysical characteristics - C, Zn, Ni, Cu etc. were used. The chamber could be filled in with various gases which pressure may be varied over a wide range.
The experiments yield the following results:

The dynamics of laser generation has nonlinear character. The effect of Q-modulation leading to considerable increase of radiation power in comparison with free-running mode is found out.

The optimum relations between the parameters of laser medium (gain, function of pumping, volume of laser rod), parameters of resonator and parameters of gas-dispersive system (factors of efficiency of absorption, scattering, concentration of particles, gas pressure) which are necessary for steady and effective operation of the laser-reactor are found.
In our experiments the use of particles with parameter Mie>5 the value of initial aerosol losses could be as high as 80%, thus the intensity of radiation in resonator and the duration of laser pulse has appeared enough to make quick heating and evaporation of particles.

The use of inert gases in the reactionary cell has allowed to organize the effective vapor condensation and to obtain ultradispersive particles and aggregates of different materials.
In an outcome of the present research the project of the quasiCW laser-reactor with a flowing aerosol cell of the closed cycle.

1604.
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ABOUT THE LASER WITH ACTIVE AEROSOL MEDIUM



WOLKOV S.A.

St.-Petersburg Institute of Fine Mechanics and Optics 197101 Russia, St.-Petersburg, Sablinskaya st. 14.

(First received 06 June 1998; accepted for presentation during IAS-4)

The idea of creation of the laser with active aerosol medium is discussed in literature for a long time. The difficulties of realization of this idea are related both with the problem of inversion and formation of optically homogeneous medium.

In the report the results of research of quasihomogeneous optical discharge plasma in aerosol media including the chemically . active ones are represented.

The systems of [He],([Ar]) - [M] ; [He],([Ar]) - [O] - [M], where [O] - gaseous oxidizer, and [M] - dispersed metal have been investigated.
The formation extended quasihomogeneous plasma or plasma-chemical channels has been carried out using two methods:
1) by focussing of high-power laser radiation in gaseous dispersive system by raster optical elements,
2) by radiation of high-power opened electrical discharge on a surface of a dielectric limiting reactionary volume.

The dense quasihomogeneous metal plasma in volume of 20 sm. x1.5 sm^2. with temperature in some eV is obtained. The specific released energy contributions to gaseous dispersive system corresponding to quasiuniform plasma channel are measured. The results of diagnostics of parameters of plasma (concentration of charged particles, temperature, speed of retraction) using spectral and probe methods are represented.

For chemically active gaseous dispersive systems the power thresholds and rate of exchange oxidizing responses initiated by laser radiation or source of a solid spectrum are measured.

The spectra of chemiluminescence of some responses interesting for creation of laser medium are investigated.

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The generation of stimulated emission on oscillation - rotation transitions of a TiO molecule with partial inversion is obtained in the range of 12 mkm. The energy of pulse under laser initiation of a chemical response has been measured to be about several millijoules.

1636.
УДК 541.18

PRODUCTION OF HIGH-DISPERSED OXIDES OF ELEMENTS BY "TECHNOLOGIC COMBUSTION" METHOD IN REACTORS BASED ON COMBUSTION CHAMBERS OF LIQUID-PROPELLANT ROCKET ENGINES

S.N.BUYNOVSKII, L.A.GAPONENKO, V.G.GERLIVANOV, E.A.CHERNYSHEV.

SRC RF GNIIChTEOS, Moscow

(First received 09 June 1998; accepted for presentation during IAS-4)

Intensive and environmentally safe process for element oxides production on the ground of thermal interaction of organoelement compounds with oxidizers in highlyefficient compact reactors are being developed in SRC RF GNIIChTEOS. Small-size combustion chambers (CC) of liquid-propellant rocket engines (LPRE) employment as technically elaborate chemical reactors is promising for technologic processes.

The outlook for such engines use as chemical reactors demonstrated their peculiarities: high capacity potential; excellence of operation arrangement, providing highly efficient component burnings; no need in significant outside energy sources; relative simplicity and compactiness of the design; the possibility of considerable increase of CC operation resource due to calorific intensity drop on retention of high capacity; units and assemblies suitable for process equipment of commercial plants. The use of thermal and corrosion-resistant structural materials in combinations with limited reaction product stay in CC provides minimum affect of reactor wall material on endproduct purity.

The experimental research was conducted at a multipurpose process plant where a modified CC of small-size LPRE of a reclaimed rocket was employed as a chemical reactor.

Pilot lots of ultra-dispersed high-pure iron oxide pigments of various colour grades were produced; the analysis of their physical-chemical and applied properties proved high quality of the pigment qualities. Positive results were obtained when they were applied on polymers in the context of packing materials for food industry, parfumery and cosmetics, decorative paints etc.

Technologic processes of titanium, silicon, lead and other element oxides have been tested by means of "technologic combustion» of their organic compounds with oxygen and air. At simultaneous use of several raw components the possibility of mixed oxide production was demonstrated. The developed processes have no sewage and are environmentally safe in terms of influence on the atmosphere.

1583
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APPARENT CHARGE METHOD FOR INVERSION OF CHARGE DISTRIBUTIONS

E. CURTO, J.-C. LIN, J.W. GENTRY

University of Maryland, College Park, Md. USA

(First received 01 June 1998; accepted for presentation during IAS-4)

Principal Ideas:

The objective of experiments were to determine the charge distribution on iron and carbon fibers from measurement of the location of deposition of the fibers in a rod-cylinder electrostatic precipitator. A silvered mylar strip was placed on the central rod. After the experiment this was

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peeled off and the fibers counted. They were sized according to their lengths (L_P) and diameters (D_P) . Since the electrical field was sufficient that all the fibers were collected before the end of the precipitator, a collection efficiency Ef could be determined as a function of precipitator length (L_E). The essential experiments were carried out by Cheng, who then interpreted her experiments assuming that all fibers of the same mobility had the same charge. The scope of this investigation is the development of a method for estimating the charge distribution from these experiments. What we present is an efficient correlation which can be modified to apply to other types of classification. The only restriction is that the collection efficiency must increase monotonically with an increasing number of charges.

Essential Integrals:

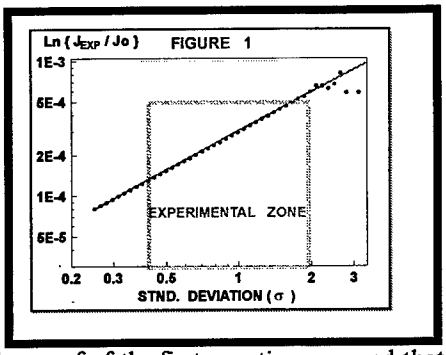
The algorithm requires that there exists a theoretical or experimental correlation of the efficiency which relates the location of deposition to the number of elementary charge for a particle of specified size and shape. That is when the number of charges J is specified for fibers of a given length and diameter, one can determine unambiguously the fraction of particles which will deposit at a distance L from the entrance to the precipitator. This fraction we designate as Ef (the collection efficiency). This implies that for a specified field strength, fiber diameter and fiber length, the effective charge (J_E) can be calculated directly from the Ef. The core of the algorithm depends on two integrals designated as **I1** and **I2**. These are defined by

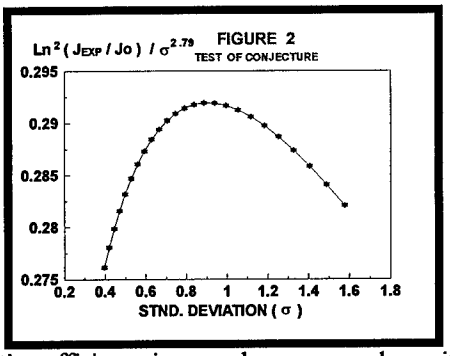
$$I_1 = \int_0^1 \mathrm{Ln}[J_E]\, dEf = \int_0^\infty \mathrm{Ln}[J]\, F_D[J]\, dJ = \mathrm{Ln}[J_0]$$

$$I_2 = \int_0^1 \mathrm{Ln}\left(\frac{J_E}{J_0}\right) dEf = C_1 \quad \sigma^n = C_1\left(\int_0^\infty \mathrm{Ln}\left(\frac{J_E}{J_0}\right) F_D[J]\, dJ\right)^{n/2}$$

The first equation is quite remarkable for the first integral which is the value of the apparent charge averaged over the efficiency depends only on experiment while the second integral in this equation is a mathematical moment independent of experiment and depending on the charge distribution function. The value of the integral is the log mean charge. Previous we showed that if the distribution function F_D can be approximated by an arbitrary sum of log normal distributions and the efficiency is a power law expression, then the relation is exact. The second equation I2 treats the variance. Again the first integral depends only on experiment. Instead of an exact relation, one has an empirical approximation which fits the data over a wide range. The testing of the integrals with a data simulated using a log normal distribution function are shown in Figures 1 and 2 below. The first figure tests the deviation between J_E and J_0. One notes that the error is less than 0.05%. As indicated above we believe that this relation is exact, so that the error in this case is attributed to the numerical integration used to obtain J_E from the simulated data. A value of σ = 1.5 is a very broad distribution. The second integral tends toward 0 as the standard deviation $\rightarrow$ 0, increasing as the variance in the distribution increases. The test procedure was to assume a value of σ, then to simulate the experimental measurements. The parameters of precipitator length and particle mobility were chosen so that the efficiency ranged from 0 to 1. The integral Int-2 was calculated and then divided by σ^n giving the constant C1. The value of the parameter n was adjusted so that C1 shows the minimum variance. This value was found to be 2.79. In subsequent work with other classifiers, different values of n were found. It appears that n is peculiar to the type of classifier and does not correspond to an integer power of σ. This value (2.79) was then used to determine a particular C1 for each σ. One notes that the variation over the range of σ values normally encountered (0.4-1.6) is less than 5%. This suggests that the method outlined here could be used to obtain the log mean charge within 0.05% and the standard deviation within 5%.

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The proof of the first equation assumed that collection efficiency increased as a power law with charge number, and secondly that the distribution consisted of an arbitrary sum of log normal distributions. The power law assumption allowed one to obtain the inverse, expressing the apparent diameter as a function of efficiency. Numerical simulations with a number of relations for efficiency (or penetration) strongly suggest that so long as the efficiency is monotonic between 0 and 1 with charge, it is not further restricted. Although one can not express an arbitrary function with a countable number of log normal distributions, this restriction is more theoretical than practical as we were able to approximate an arbitrary step input with a series of identical lognormal functions with fewer than 2% outliers. Subsequent refinements reduced the error to any arbitrary value. Since an arbitrary distribution function can be approximated by a sequence of step inputs, it follows that the function can be represented by a series of log normal distributions. We believe that this is adequate for the demonstration of equation 1.

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1582.
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EXPERIMENTAL MEASUREMENTS WITH THE ORIFICE-ORIFICE CLASSIFIER

Y. MARUI, J-C. LIN, Y.C. CHANG, J.W. GENTRY

University of Maryland, College Park, Md. , USA

(First received 01 June 1998; accepted for presentation during IAS-4)

The object of these studies was to develop an inertial classifier utilizing a modification of a Mercer inertial impactor. In the inertial impactor the flow is perpendicular to two discs, the flow is through a central orifice in the top disc and around the second plate. The configuration is very similar to that shown in Figure 1. The modifications made for these instruments were to (1) make the bottom plate from porous metal with independent flows, (2) to consider the bypass stream as the product, and (3) to consider two configurations with independent flow rates. The smaller particles are entrained in the orifice-disc configuration as the larger particles are collected on the porous disc. By varying the flow rate and the separation space the size of particles collected can be varied. Both the simulations and the experiments confirmed this behavior. In this abstract we discuss the orifice-orifice configuration.

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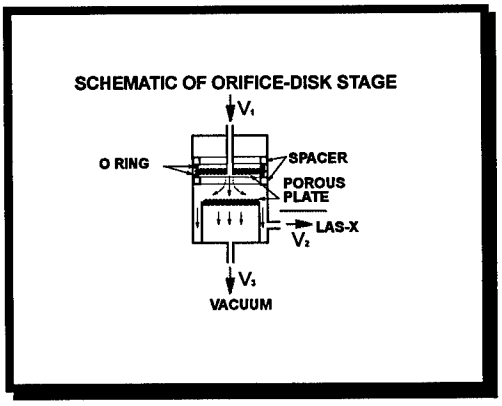


Figure 1

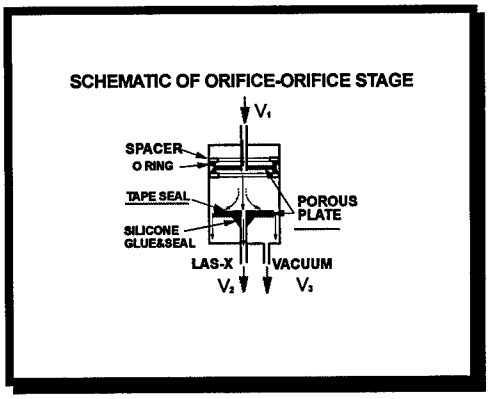


Figure 2

Discussion

The goal in the orifice-orifice configuration was to preferentially collect the larger particles. The smaller particles and the bulk of the gas flow would be vented through the porous plate. This configuration is close to that used in particle concentrators, where the particle stream passes through nozzles into a second stage while 90% of the flow is diverted. From the beginning of our experiments, this configuration did not work so effectively as the orifice-disc classifier. However, the results below show the feasibility of the approach which we adopted and suggested how the design could be improved. In all cases reported in this work the aerosol steam consisted of a 7.5% sugar (a surrogate for surfactant-protein) solution. After generation of droplets in the range 3-10 μm from the aqueous solutions with a Collison nebulizer the particles were passed into a drying chamber. Sufficient flow was diverted so that
the flow entering the inertial classifier was the LAS-X sampling rate + the secondary flow around the plate. It is simple that this simple configuration was adequate to give a sharp parcel concentration for the larger particles.

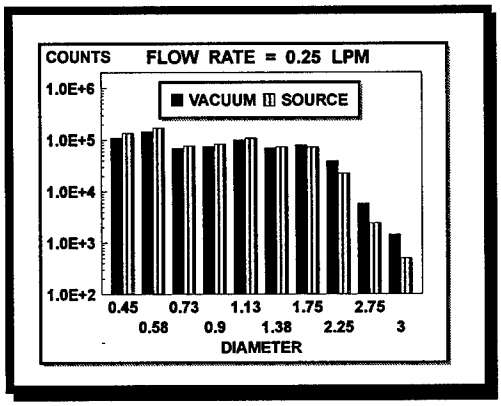


Figure 3a

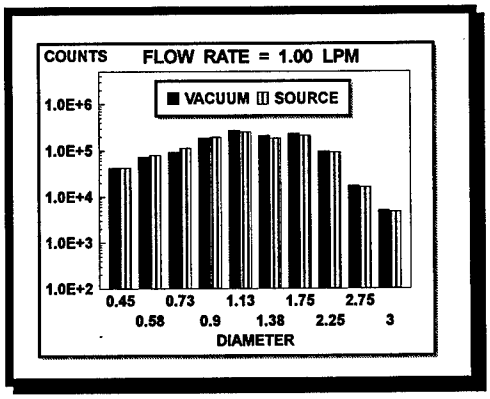


Figure 3b

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Figure 3 presents the particle size distributions as measured for two different flow rates through the exterior. Flow rates of particles through the opening in the central orifice were at rate 0.06 LPM , the sampling rate of the LAS-X . The flow rate in the anterior region was 0.25 LPM (3a) and 1.00 LPM (3b). The plate separation distance was 2.54 cm. The flow with out diversion is designated as source, while the flow which is diverted is indicated a vacuum. The particle sizes counted were 0.45-3.0 μm. Until the particles were larger than 1.8 μm there was little difference in the distributions. For larger particles there was significant deviation.

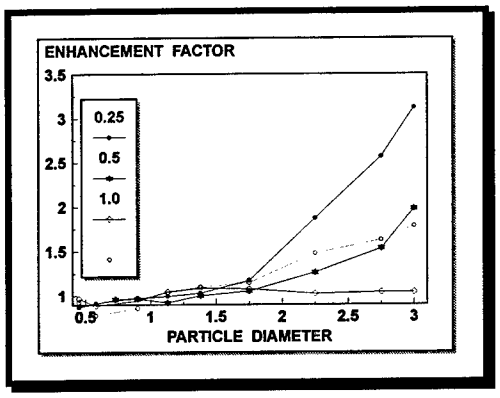


Figure 4

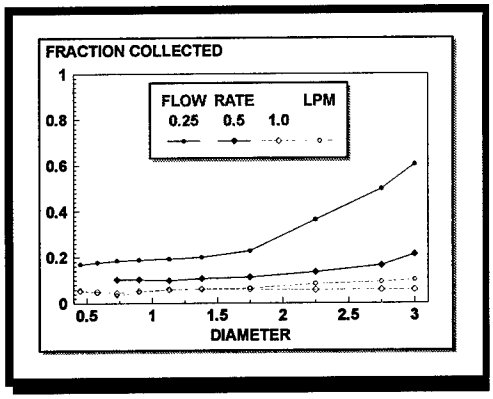


Figure 5

This effect is shown more clearly in figure 4 where the enhancement rate is plotted as a function of the diversion flow 0.25, 0.5, or 1.0 LPM. This ratio indicates how much greater the concentration of particles of a specified size for the case where there is diversion. If there were no concentration this ratio is 1.0. No significant enhancement occurs for particles below 1.8 μm. For our design purposes this is too large, so that the dimensions of this configuration must be changed. The data are replotted in Figure 5, so that the fraction of particles available for collection are expressed as a function of size. The maximum value of 1.0 would mean that all particles larger than a selected size are collected. The data clearly show that the yields for larger particles are satisfactory when the flow rate is 0.25, but drops substantially at lower flow rates. The explanation for this behavior is the onset of turbulence, so the particle stream is mixed rather than remaining laminar until it passes into the next chamber.

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SLABS AND FIBERS DEFORMATIONS IN INORGANIC FULLERENE-LIKE STRUCTURES

A. ESPINOSA C.

Instituto Nacional de Investigaciones Nucleares, Carretera Mexico-Toluca, Km.36.5,52045 Salazar Edo. de Mexico, Mexico.

*Retorno 505 No.115 (antes 6) U. Modelo, C.P.09090, Mexico, D.F.Mexico. *e-mail: aesc@nuclear.inin.mx*

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Nanotubes and fullerene structures were first predicted and experimentally observed in carbon particles . Some fullerene-like properties and characteristics have been studied in other compounds.

The concept of fullerenes have been extended beyond carbon chemistry in the study of fullerene-like structures and fibers, specially in layered metal-chalcogenide compounds[1-3], which have been named inorganic fullerene-like structures-IF.

An analysis of the theoretical energy calculations of the deformations of different numbers of packing layers of MOS2 is presented, theoretical energy calculations of layers deformations, layer defects and twist defects of MOS2 have been investigated. The models have been studied theoretically by molecular mechanics calculations, high resolution transmition microscopy (HRTM), and computer simulations which have complemented each other in the microscopic description of MOS2 slabs. The total calculated energies include contributions from the bond stretching and bending, torsions, inversions (improper inversions) and van der Waals energies. The MOS2 slabs force field used for the calculations has been described previously [4]. The energy minimization procedure utilized a conjugate-gradient technique.

The molecular structure and schemes [5-7] for the minimum energy stacking layers deformation for MOS2 are shown in figures 1-4. Four slabs structures were subjected to bendings of 30, 60 and 90 degrees. The minimum energy for each structure were obtained using a molecular mechanics force field from which it can be seen that the energy of one slab remains almost constant during the bending and it grows as the numbers of slabs is increased.

The distance of the S-S bonds presents a significant difference from the natural value (3.16 angstroms) near the boundaries, as it could be expected, and this change can be seen in figure 5, in this figure it is also shown with the number 4, the spread of the atomic distance in the bends.

The theoretical HRTM images are useful to distinguish fibers and slabs in real experimental images (figures 6-7).

Aknowledgments

The author thank J. Fujioka for his enlightening comments and helpful suggestions.

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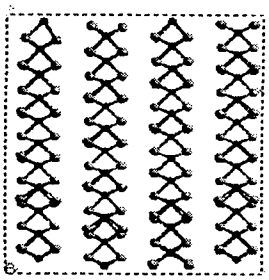


Fig. 1 The crystal structure in [0 0 1] direction of MoS2 for 4 slabs.

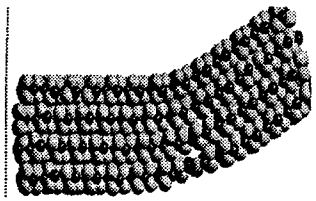


Fig. 2 4 Slabs Of MOS2 bended 30 degrees.

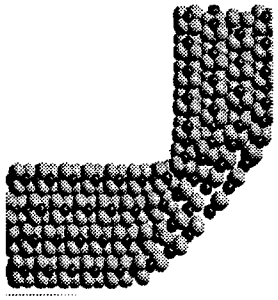


Fig. 3 4 Slabs Of MOS2 bended 90 degree

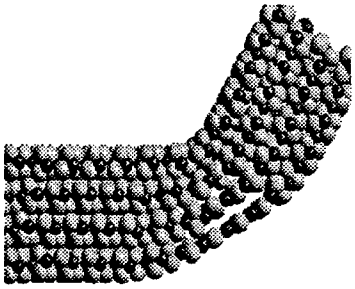


Fig.4 4 Slabs Of MOS2 bended 60 degree

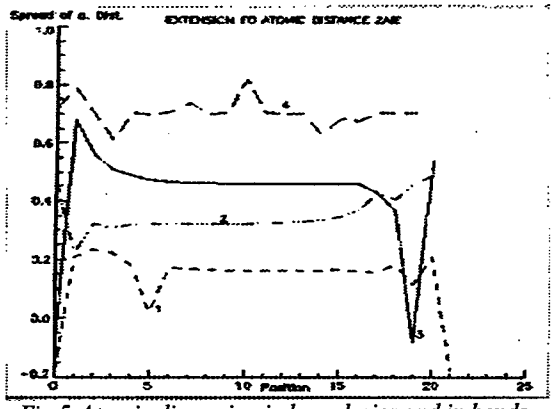


Fig.5 Atomic dispersion in boundaries and in bends.

1533.
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ACTIVITY SIZE DISTRIBUTION OF RADIOACTIVE AEROSOLS IN THE ATMOSPHERE

C. PAPASTEFANOY, A. IOANNLDOU

Nuclear Physics Department, Aristotle University of Thessaloniki Thessaloniki 54006, Greece, e-mail: papastefanou@physics.auth.gr fax3031 998058

(First received 27 April 1998; accepted for presentation during IAS-4)

KEYWORDS Activity Size Distribution, Radioactive Aerosols, Atmospheric Aerosols, Radon Decay Products

The aerodynamic size distribution of radioactive aerosols was determined by using low-pressure as well as conventional low-voluine and high-volume impactors. The activity distribution of short-lived Rn decay products 214Pb and 212Pb measured by a-spectroscopy, was largely associated with submicron aerosols in the accumulation mode (0.08 to 2 μm). The activity median aerodynamic diameter (AMAD) ranged from 0.09 to 0.37 μm (mean 0.16 μm) for 214Pb and from 0.07 to 0.25 μm (mean 0.13 μm) for 212Pb. The mean values of the geometric standard deviation (a,) were 2.97 and 2.86, respectively. The

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activity size distribution of Be measured by y-spectroscopy (E,=477 keV), was largely associated with submicron aerosols in the accumulation mode (0.4 to 2.0 μm). The activity median aerodynamic diameter (AMAD) ranged from 0.76 to 1.18 μm (average 0.90 μm), indicating post-condensation growth either in the upper atmosphere or after mixing into the boundary layer. The geometric standard deviation, a,, ranged from 1.86 to 2.77 (average 2.24). In estimating lifetimes of radioactive aerosols, in ambient air, a mean residence time of about 8 days averaged for tropospheric aerosols.

Representative plots for 46 low-pressure impactor measurements illustrating aerodynamic size (D") distributions of 212Pb and '214Pb (R=radioactivity) are presented in Fig.1.(a) Type results occurred 46% of the time, (b) 39% of (he time, (c) 8.7% of the time, and (d) 6.5% of the time. Lower D" limits are arbitrary (Papastefanou and Bondietti 1987). A typical plot of tlute activity size distribution of 7Be versus aerodynamic diameter (Dp) is represented iii Fig.2 for 11 measurements carried out by I-ACFM impactors (Papastefanou and Ioannidou, 1995).

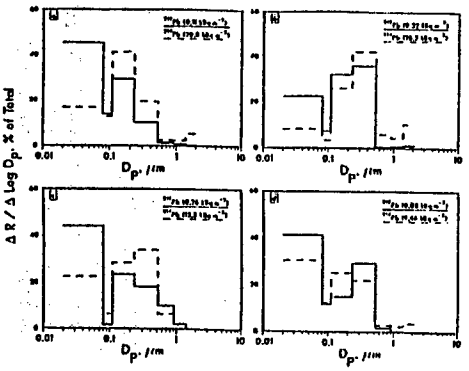


Fig.1. Representative plots from 46-low-pressure impactor measurements illustrating aerodynamic size (Dp) distributions of 212Pb and 214Pb

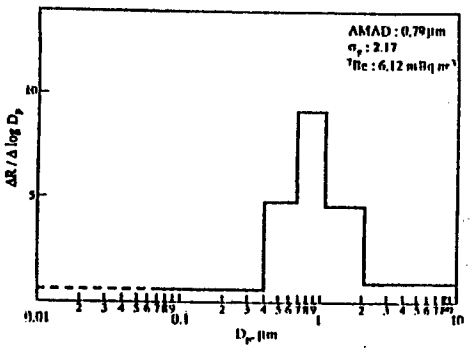


Fig.2. Typical plot of aerodynamic size distribution of 7Be aerosols.

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1541.
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THE PLASMA RECOMBINATION ON THE DUST PARTICLES IN THE NON-SELF-SUSTAINED GAS DISCHARGE.

V.V. IVANOV, A.F. PAL', T.V. RAKHIMOVA, A.O. SEROV AND N.V. SUETIN.

Moscow State University, Nuclear Physics Institute, 119899 Moscow, Russia,

Troitsk Institute for Innovation and Fusion Research, 142092, Troitsk, Moscow reg., Russia. e-mail: ivv@mics.msu.su, afpal@mics.msu.su

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At the present time the experimental and theoretical aspects of the dusty plasma phenomenon in plasma are being studied intensively [1–3]. In particular the nano- and microparticles initiation

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and growth in the hydrocarbon plasma have been observed in a number of experiments [4]. However these particles influence on the plasma kinetics has not been examined. We proposed to examine at first the influence of the carbon particles with known phase structure, size and shape on the discharge plasma characteristics. The experiments with the non-self-sustained gas discharge controlled by an electron beam with current density 60 $\mu A/cm^2$ and energy 120 keV in the presence of measured glass carbon microparticles were carried out. The plasma in this type of discharge is sustained by the external ionisation source that excludes the influence of dust particles on the ionisation kinetics and permits to investigate charged particles losses on the microparticle surface directly. The experiments were carried out with the helium at the atmospheric pressure. The powder consisting of glassy carbon balls of 20 - 30 μ m across was used. The dust particle concentration was defined by measuring the laser radiation absorption in the dust cloud.

The observed discharge characteristic may be explained by suggesting the recombination coefficient β equal to $2.5 \cdot 10^{-8}$ cm^3/s and cathode fall equal to 450 V. Addition of the microparticles into the plasma leads to the discharge characteristic changing. The experimental and calculated dependencies of the discharge current density on the microparticles concentration N_d at the different external electric fields is given in Fig.1 (diffusion-drift spherical transport model for electrons and ions with the Poisson equation for electric field was used). The increase of microparticle concentration at the constant external field leads to the increase of plasma volume recombination rate and to the decrease of plasma and current density. The plasma density dependence on the external electric field at small dusty concentrations N_d is connected exclusively with that of corresponding electron drift velocity, but significant deviations from this dependence are observed at large N_d concentrations. This fact is displayed as the weakening of the current density dependence on the N_d as the applied voltage U_{ext} decreases. The calculated dependencies differ significantly from the experimental one at the large N_d only.

To describe the charged particles losses on the microparticle surface the integral coefficient of plasma recombination rate β_d on the microparticle surface may be introduced as $S = \beta_d n_e N_d + \beta n_e^2$, where S is the electron beam ionisation rate, n_e is the electron concentration. The calculated and experimental recombination coefficients dependencies of the applied voltage are closely similar at the middle N_d values but there is significant difference at the N_d greater than 10^5 cm^{-3}

The work was supported by Russian Fund for Fundamental Research (grants 96-02-18938 and 96-15-96447).

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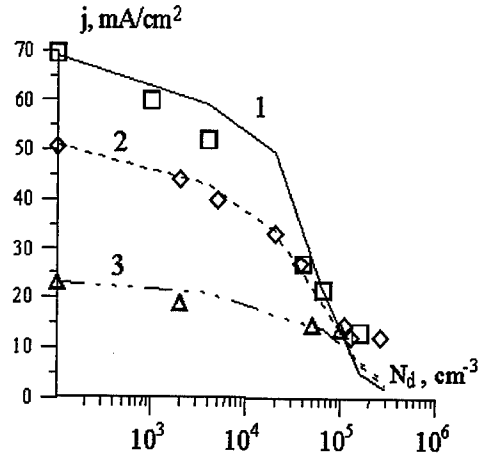


Fig. 1.

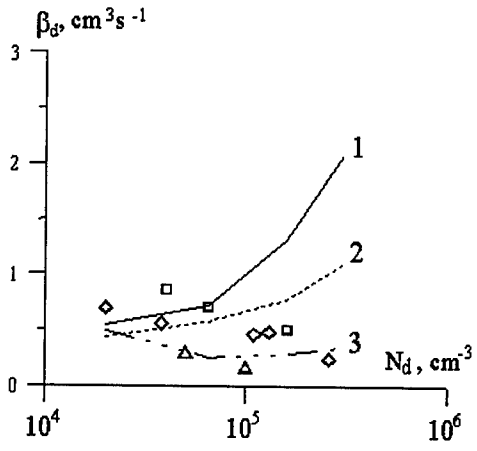


Fig.2.

Fig.1. The calculated (lines) and experimental (symbols) dependencies of the discharge current density on the microparticle concentration N_d at various applied voltage values: 1 is for 940 V, 2 is for 720 V and 3 is for 480 V.

Fig.2. The corresponding to Fig. 1 dependencies for coefficient of plasma recombination on the microparticle surface

1651.
УДК 541.18

ABOUT INFLUENSCE OF HUMIDITY ON BURNING AND COMBUSTION OF ORGANIC DUST IN FILTERS

PUHLIYI V.A., KOLUVAYI A.G., POTEHIN V.G.

(Moscow and Cherkassy) Moscow Aviation Institute, 127349 Moscow, Muranovskaya 17-147, Russia

(First received 15 February 1998; accepted for presentation during IAS-4)

It is known that water can be used to stop or slow down burning processes if it is not involved into exothermic reactions with burning materials. Also, humidity can prevent organic dust from combustion. Three aspects of humidity influence on combustion and burning processes can be analyzed:

1. Humidity lows temperature of combustion or burning areas;
2. Humidity lead to increase of time of combustion period because of two reasons: evaporation carries out an energy necessary for combustion; time of dust heating increases and slows down chemical reactions;
3. Evaporation lead to change of concentration of burning materials and slows down chemical reactions if temperature does not changes.

Calorimetric and thermal equations of condition were determined and combustion adiabates for organic damp dust in air were calculated for wide area of humidity values and lower concentrations. The obtained results allow to determine parameters of burning waves, of combustion of normal and compressed mixes. Conditions of self-supported burning without submission of oxygen from the

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outside were determined.

Burning wave propagation velocity for various humidity values and dust with convective and non convective heat transfer in air are given. Because of long time of evaporation for damp dust (tens of mass percent) laminar burning velocity was small (approximately 1 centimeter per second). Self combustion of such mixes is impossible due to large critical diameters (hundreds of meters).

The results of present work include thermodynamic and kinetic calculations and can be used for analysis of combustion and burning of organic dust, to prevent filters from explosions. An equation for estimation of minimal ignition energy was suggested.

1590.
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AEROPALYNOLOGY IN RUSSIA: RECENT STATE AND PROSPECTS

VALENTINA V.UKRAINTSEVA.

Komarov Botanical Institute of the Russian Academy of Sciences,
Popov Steet , 2 , St.-Petersburg , 197376, Russia

(First received 01 June 1998; accepted for presentation during IAS-4)

Pollen and spores of plants as a component of atmosphere aerosol are a source of great value of information. Investigation of airborne pollen and spores has wide range of application in medicine, plant pathology, ecology, agriculture, foresty etc. (Grana, 1992.Vol.30.No. 1, 2) and in an environmental expertises (Ruffin e.a.,1983; Nilsson, 1991 and so on). Some airborne pollen and spores types are as known of cause of allergy, asthma and alviolity problems when they come in contact with human and animal micosa. That is because very important to know if that pollen/spores family is estimated to be presented or not in air and level of its presence: Absence, Low, Medium, or High. If the pollenotic patients are informed on this subject, they are able to better organize their own life, as concern work and holidays, in order to avoid running risks of diseases or take preventive therapeutic measures. Sampling is also essential for the preparation of adequate extracts.

A study of content and concentration of airborne pollen and spores has been carried out at St.-Petersburg by author using first both gravimetric (in 1992-1993) and volumetric (in 1993-1994) methods of sampling. Obtained data allow us to make some conclusions of principle: (1) at first steps of airbiological investigations needed to use both gravimetric and volumetric methods of sampling; (2) in large towns like Moscow, St.- Petersburg, Novosibirsk, Tomsk etc. it is necessary to use for a sampling 2 - 4 Burkard Volumetric Spore Traps because the content of aeroallergens and its concentration differs on principle in different sites ; (3) it is necessary a long standing monitoring of airborne allergenic pollen and spores to use obtained data for preventive medicine. Thanks to these studies first the Data Bank of Allergenic Airborne Pollen has been created at St.-Petersburg.

Over the years more then 20 European countries have contributed data for allergen service information to the International Association of Aerobiologist (IAA), working group <European Allergen Network> (EAN). In the ten past years the number of airborne pollen and spores monitoring stations in Europe and North America has increased considerably, namely due to a growing awareness of the importance of having knowledge of atmospheric content and concentration of pollen and spores for the etiology of pollinosis (Aerobiologia ,1992. Vol. 8. N. 2/1; Traveller's Allergy Service Guide, 1992; Allergy Service Guide in Europe, 1994). In spite of rather good success at the field of aeropalynology in 1960-1970 in my country we have at the moment a few aeropalynological monitoring sits only, e.g. in Moscow, at St.-Petersburg and at Novosibirsk. Russia and neighbour countries (Belorussia, Ukraine, Georgia, Kazakhstan, Tadjikistan) are a vest and complex territories, where almost all types of climate and vegetation known to man are represented. It is therefore very important to study the same precision of

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analysis of air samples. This is because the greatest goals for aeropalynologists of my country and for aeropalynologists of above neighbour countries (former the USSR) at the moment are: 1) distribution pollen and spores monitoring stations and regional nodes over Russia ; 2) to reach the target of constitution of National Airborne Pollen And Spores Data Bank; 3) installation of Russian Aeroallergen Network Server and collaboration both with aerobiologists of European Aeroallergen Network and with aerobiologists of America; 4) creation of <Atlas Of Airborne Pollen And Spores Of Russia>. The <Atlas Of Airborne Pollen And Spores Of Russia> will contain descriptions and illustrations of most important allergenic pollen grains and spores taxa from different districts of Russia and neighbouring territories. It will be serve as an aid to people engaged in aeropalynology, allergology, agriculture, environmental expertises, criminology , etc.

Sum up all above one can see we have a lot of greatest goals at the moment at the field of aeropalynology. It is hardly too much to say that realization of these goals has very important scientific and applied interests. That is because I believe it is worth to pool our efforts for its realisation.

1652.
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FIELD EXPERIMENTAL INVESTIGATION OF EXPLOSION OF ORGANIC DUST IN FILTERS

PUHLIYI V.A., TAUBKIN I.S., PLAHOV S.I., AKHACHINSKII A.V., SAKLANTIN A.R.

Moscow Aviation Institute, 127349 Moscow, Muranovskaya 17-147, Russia

(First received 15 February 1998; accepted for presentation during IAS-4)

Many technological processes include production or processing of disperse (dust) materials and may cause an explosion. Burning of airmixes inside the processing unit leads to pressure increase that can break the unit and explosion of the accumulated dust in a room.

Within the framework of development of the "NPO Tekstilmash" of a complex line of clearing of air at the factories of linen branch the complex of explosive tests of the filter equipment was carried out. The explosive tests of a breadboard model of the drum-type filter and fibre catcher were carried out on the open area. For registration of superfluous pressure on the case of the filter 3 gauges «DD-10» were installed. Signals which from through inductive station «ID-2I» were shoed on the oscillograph «N-117». At the bottom part of the filter 3 kilograms of linen dust were set. Explosion pressure was measured as P = 100 kPa.

The analysis of experimental data showed that beginning of opening of the case of the filter has taken place with superfluous pressure P=46 kPa with the maximal speed of increase of superfluous pressure dP/dt = 460 kPa/s.

Explosive tests of fibre catcher have shown, that the products of explosion of a linen dust successfully are dumped from the device through the extension tube, not putting (except for destruction of a membrane) damages of a fibre catcher case. Therefore, because of the final burning of slowed down dust in the extension tube, pressure increased a little inside the unit case.

The carried out explosive tests of experienced samples of filters have allowed to develop highly effective explosion-proof drum-type filters and fibre catchers for linen production factories.



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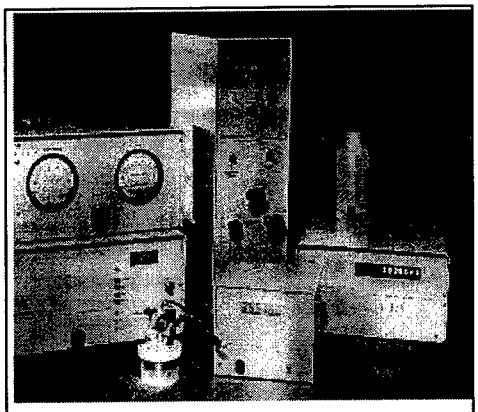
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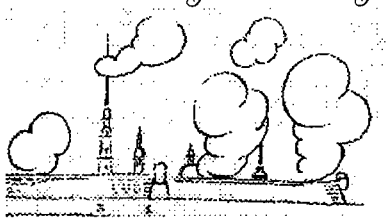
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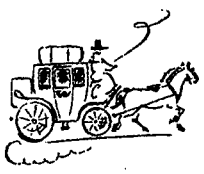
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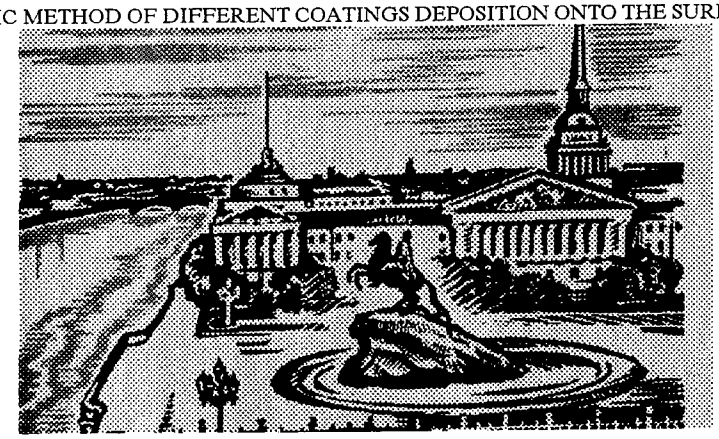
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1174.

MICRODROPLET METHOD FOR DIAGNOSTICS OF BIOLOGICAL ACTIVE SUBSTANCES IN AEROSOL SAMPLE

Belov N.N. [1], Belova N.G. [1], Galkin A.S. [2]

[1] - *Aerosol Technology Ltd,*
Phone/Fax: 7-(095)-1474361, EMail: belov@tehno.mmtel.msk.su

[2] *Moscow State University, Biological Faculty, Biochemistry Department,*
Phone: 7-(095)-9391376

Concentration of biological active substances in aerosol samples is low and sample itself is very complex. Two particles from the same sample can have completely different properties, structure and history. The investigation of such a complex mixture is non trivial task.

Let's imagine that sample contain few small (about 1 micrometer) particles with biological active substances, for example, proteins. All other components of collected sample and instrument surfaces are source of noise. It would be great to establish some kind of preliminary selection for the next step of analysis. Such methods were developed for chemical analysis of aerosol particles. Usually, particle is evaporated and then analyzed on mass-spectrograph [1].

There are instruments that can measure fluorescence of single particles during sampling process. However particle velocity is too high for detailed (for example biochemical) analysis.

In present work it is suggested to use virtual impactor with transparent bottom and special optics for diagnostics biological substances in aerosol sample. As shown, there is an opportunity to use single particle precise mechanism for sensitive and rapid bioaerosol analysis of single particles. Some of used methods were developed for microelectronics [2-3].

There are elements of Virtual impactor architecture that useful for installation of an additional optic devices. Source of ultraviolet radiation can be positioned in the horizontal air-output slot of the impactor. So there is an opportunity of detection of fluorescent signal from biological particle. To determine location of the fluorescent particle position-sensitive photo pipe can be used. All this data gives complete information about location of impactor bottom particles (at least the big ones) and their quantity.

Fig.1. Virtual impactor with simple optics installed enabled to determine the moment and position at what biological substance appears.

The another way to monitor biological particles is to use fluorescent microscope. Such microscope with great sharpness length and low resolution.

Impactor bottom (3) is quartz window. Light divider (5) leads UV light of lamp (4) on particles at bottom and flying ones (2).

Position-sensitive indicator (6), can be video camera or Position Charged Links matrix. It measures number of fluorescent particles in impactor. Such data is important to monitor dynamics of biologic debris concentration in air. However for complete information about bioaerosol an additional analysis have to be performed on the sediment.

According to the experiments [4] bacteria get into the sampler rarely. It is necessary to pump tens and hundreds of liters of air to capture a single particles. When quantity of captured particles is big enough air flow is redirected to another virtual impactor. This enables to continue collecting the sample for more detailed biochemical analysis.

Transparent bottom of virtual impactor provides optical measurement of colour changes after analytical biochemical reactions. Single particle technology with precise placing of each droplet used for input of biochemical reagents on surface of each bioaerosol particle. The Precise single particle technology uses for droplet printers widely.



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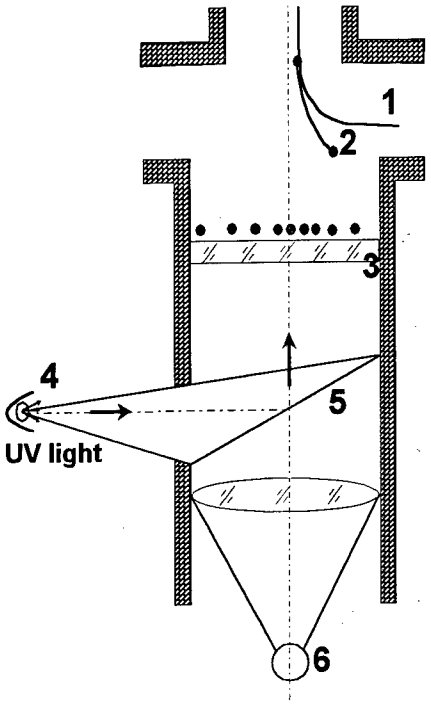


Fig. 1.

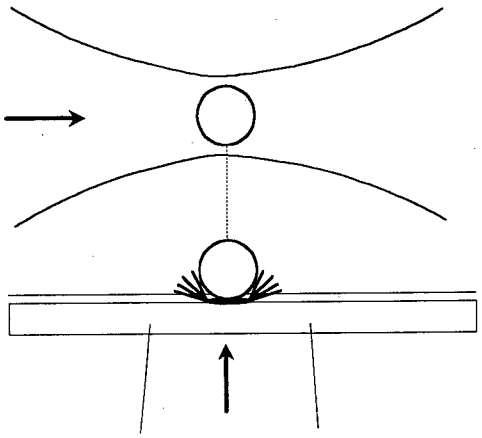


Fig.2.

Our investigation devoted to application of common analytical biochemical reactions [5-9] with single particle technology for investigations of bioaerosols. The offered methods have general character and are used by the scientists for realisation of the quantitative analysis at determination of the contents of biologic active substances, such as proteins, nucleic acid (NA), carbohydrate.

The physical-chemical properties of proteins are determined qualitative and quantitative structures of amino acid included. Methods of quantitative determination of NA are based on determination of the contents of making their components: of the nitrogen basis, leptos and phosphorus NA.

The Mainbaum method of determination of the RNA with orcine contents is based on reaction of orcine with ribose, from RNA. As a result RNA hydrolyse in presence of HCl acid, furfurole derivative will be formed. It gives a product of green colour at heating with orcine. The reaction is not high specifics - painted products will form deoxyriboses, polysaccharides and some other chemicals. However sensitivity of the reaction of orcine with rebose is high [7].

Derivatives of hydrocarbon (furfurole type), formed at heating with concentrated H_2SO_4 and artron, give colour chemicals. The developed colouring is proportional to quantity of taken glucose [8].

Proteins of microscopic particle from aerosol sample may be coloured by single droplet (50 mkm) of Fomins reagent with bi-ureton reagent for detection of the peptide links. This reaction proceeds coloured products of aromatic NA. This products may be detect by microscopy easy. For more thin determination of protein concentration in a preparation it is possible to use coomassie brilliant blue. The method is based on linkage with proteins of one of acid colour -

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coomassie brilliant blue. At linkage with proteins, the absorption spectrum of colour is varies.

These investigations of selected micro pieces of aerosols sample provides important information about biological active components of bioaerosol sample.

Present investigation uses laser technology for take-off single particle from sampler surface [2-3] for additional analysis. Particles selected from air places with random order on transparent surface of aerosol sampler. Some of them may be microorganisms. These particles must be investigated more careful. Such distribution is received at fall of particles on the bottom of virtual impactor.

Figure 2 presents the scheme of removing of single particle from sampler surface by laser beam of sharp focusing (indicated by arrow) [2], [3].

In this scheme the particles fly away from a plate owing to evaporation of thin sorbing layer on a surface of a glass. Intensive laser radiation forms local gas explosion that pushes a particle from a glass surface. The evaporation of a sorbing liquid requires an appreciable intensity of radiation. The process can be initiated by cowering the plate with a thin film which has high absorption on a wave length of used laser.

This thin film evaporation provides taking off microorganisms from sampler surface without damage of their membrane.

Investigations of optical fields inside of bacteria shows that their membrane may be opened without stressing it's main organs. This effect can be reached by focusing the laser beam inside of bacterium. For this operation Nd or ruby compact laser may be used. Chosen particle can be measured alone after it was took off the plate and passed into the laser beam area for analysis.

This technology leads to increasing of sensitivity of bioaeosol investigations.

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1175.

DIAGNOSTICS OF VITAL MICROORGANISMS IN AEROSOL SAMPLES

Belov N.N.[1], Belova N.G.[1], Ugarova N.N.[2]

[1] *Aerosol Technology Ltd,* Phone/Fax: 7-(095)-1474361, belov@tehno.mmtel.msk.su

[2] *Moscow State University, Chemical Faculty, Enzymology Department,* Phone: +7-(095)-9392660, Fax: 9393589, EMail:UNN@enzyme.chem.msu.su

Bioaerosol sampler has two conflicting demands. From one side biosampler needs in great air volume of sample with great efficiency of separation of aerosol particles from measured air. From another side all selected particles needs in great care. This demand carried out from method of measurement of bacteria in sample by counting of colonies that grew from bacteria on nutrient media after incubation time. It is a problem to prevent bacterial flora from death during collecting aerosol sample.

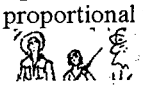
From the one side, sampler should provide collecting enough aerosol particles to contain no less than 3-10 bacteria. Bacteria concentration in air is about one in tens or even hundreds of liters **[1]**. Accordingly, sample should contain particles collected out of few hundreds of liters of air. Moreover sample have to be collected each 1-2 hours. This leads to implementation of high efficient air filtration when throughput is about ten liters per minute. Debris particles that collected from a huge volume of air should be transferred into a much more less volume of sorption liquid or be immediately placed into the nutrient medium.

There are methods of detection of bacteria in aerosol sample, based upon calculation of colonies, produced by bacteria. This is the reason why sample for such methods should be made very gentle from aerosol sample volume. There should not be any collisions of bacteria with dry surface. Nearly all ways of increasing filtration efficiency - charging particles, collision of particle on a high velocity with an obstacle, acoustic or ultraviolet fields - lead to the death of bacteria or make bacteria unable to multiplicate.

From the other side when sample is ready it takes colony a lot of time to grow enough to become detectable. So information about dangerous concentration of bioaesorol comes late enough to become not the in-time warning but the explanation of happened disaster.

In this study it is suggested to use bioluminescence for detection of vital cells.

Bioluminescence is the light emission upon oxidation of the organic substance, luciferin, catalyzed by enzyme, luciferase. For firefly luciferase-luciferin system, a necessary and compulsory component of the reaction is adenosine-5'-triphosphate (ATP). It is only at the presence of ATP that the yellow-green light is appeared in this system. Bioluminescence intensity is directly proportional to ATP concentration. Owing to a high quantum yield of bioluminescence in firefly luciferase-luciferin reaction, fairly simple instruments can be used to detect so small ATP quantities as femtomoles by bioluminescence. Bioluminescent ATP assay is the most specific, sensitive, rapid and convenient method to detect ATP micro quantities.
ATP is present in all living cells - plants and animals, microorganisms and man. When the cell dead, the intracellular ATP disappears very rapidly (during minutes) under the action of specific biocatalysts, ATP-ases. The synthesis of new ATP portions is stopped much more quickly. Bioluminescent ATPmetry is a rapid, simple and highly sensitive method for detection of living matter. ATP amount is directly proportional to the number of cells in the sample. The



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sensitivity of detection is less than a thousand cells per ml of the sample. Analysis takes only several minutes.

During the last years ATPmetry has become a basis for so termed "rapid microbiology". Compared to conventional microbiological tests, the "rapid microbiology" method decreases ten-folds the analysis time, gives quantitative parameters, markedly simplifies the analysis procedure and makes automation feasible. Basic field of "rapid microbiology" applications is detection and control of microbial contamination in biological samples, food products, environment (air, water, etc.). Special methods are used to destroy all cells except bacterial ones and eliminate the nonbacterial ATP from the sample to be analysed. At the same time bacterial cells and its intracellular ATP are not changed. So, it is possible to detect microbial contamination even in the sample that contains both bacterial and somatic cells, for example, the animal or human cells.

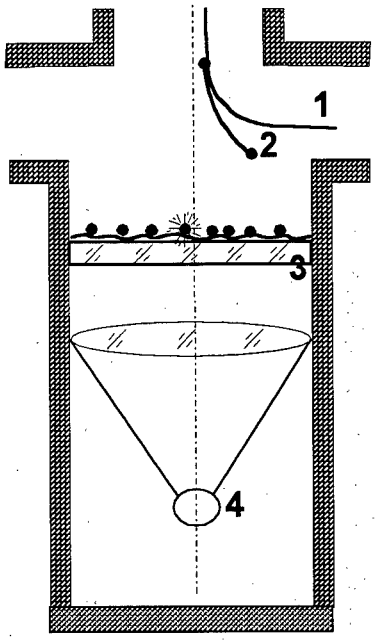


Fig.1.

Best results for measurement of alive bacteria shows virtual impactor with transparent bottom (3). This bottom covered by thin film of reagents for opening of membrane of microorganisms and for activation of ATP-reaction. Each cell gives series of visual quantums. Measurements of bioluminescence pulses sequence by high sencitivity photopipe (4) provides real-time information about bacteria concentration in air.

Work is partially supported by grant 4-14 in direction "Egineering Enzymology" subprogram "Novel bioengineering methods" of Russian Science and Techlology Commitee.

Authors appreciate Aerosol Technology Ltd firm for financial support of researches.

This material is based upon work partially supported by the European Research Office of the US Army under Contract No. 68171-97-M-5652

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1176.

PHASE MICROSCOPE FOR BIOAEROSOL DIAGNOSTICS

Belov N.N. (1), Belova N.G.(1), Tychinsky V.P.(2)

(1) - Aerosol Technology Ltd,
Phone/Fax: 7-(095)-1474361, E-Mail: belov@tehno.mmtel.msk.su

(2) - Moscow State University of Radioengineering, Electronics and Automatics
Phone: 7-(095)-4346792

Concentration measurement and identification of microorganisms, collected from monitored air, is important problem. At present for these purposes a following technique is used. Aerosol particles from monitored air are collected and placed on a surface of nutrient medium. Each alive bacterium produces colony by self duplication. Colony border is nearly a circle. The differences of refraction parameters of biomass, that forms colony, enables determine colony position and their quantity.

The opportunities to determine a bacterium kind are rather limited. For this purpose the test sowing on various nutrient mediums are used.

This investigations introduces the phase microscopy technology for the diagnostics of microorganisms in sample of bioaerosols. This method provides super resolution with using of optical laser radiation with small intensity. Phase microscope [1] gives the distribution of a phase in the interference image of object. It enables to reach the resolution up to tens nanometers, which is characteristically for electronic microscope. At the same time Phase Microscope does not distort a test and does not kill microorganizms. Moreover investigations by this microscope of the functioning of live bioorganizms can be used for identification of their class and type.

Phase microscope gives a possibility of direct determination of the form and sizes of viruses. Phase microscope used for measurements of height profile of viruses Influenza A. This viruses is about 200 nm in diameter. Results of measurements selects its dense nucleocapcid and protein membrane. Phase microscope technology provides topogrammes of phase image of vaccine of pox-viruses, Riccetsia provazecii[1].

Phase microscope may be applied for investigation of virus structure (nuclea, metahondrii and analysis of cell-virsuses interaction [1]. This technology used for decoding of the structure of the petide-lipide membrane with thickness 50 and 80 nm of cell of Cjriolus fungus [1]. This microscope used for investigation of This microscope has given a opportunity to study in a real time disease of a cell by Influenza A virus [1].

These measurements do not require hard influence on biological structures. It need not in vacuuming of sample. It uses small intensity laser beam in visual spectrum. (Vacuum and electron ray destroy microorganizms). There is no influence on biological processes during experiment.

Membrane fluctuation is a common process of living cells. Another common process is ATP-reaction. Both of this effects were investigated using dynamic phase microscopy. These processes shows micro fluctuation of optical path on membrane surface with measured square near 0.01 micron^2. Position of fluctuation area correlates with local variations of height profile near ATP-cluster.

Spectral analysis of space and temporal fluctuations during ATP-reaction shows that there are contrast components with range of frequency 2-8 Hertz. Intensity of such fluctuation indicates changes on distances near 30 nm. Such spectrums helped to discover basic space-

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temporal shifted components and correlated areas (50-200 nm) for several active points.

The study of a microorganism structure with the resolution up to hundreds nanometers provides wide opportunities for their identification. However the most wide opportunities become available by method of dynamic microscopy - second step of Phase microscopy application. Changes of correlation characteristics under displacement of different points can be measured. The resolution that is fine enough to detect a single liposome or molecule of ATP lead to new methods of microorganizms identification. Direct measurement of frequency ATP simulation in microorganism, the displacement of optical active parts of microorganism gives contribution to a dynamic correlation picture, given by phase microscope. Urgent problem of certification of such spectra and connection them to particular kinds of microorganisms becomes very important. Interesting that such measurements can be conducted all time of development of microorganism colony in medium.

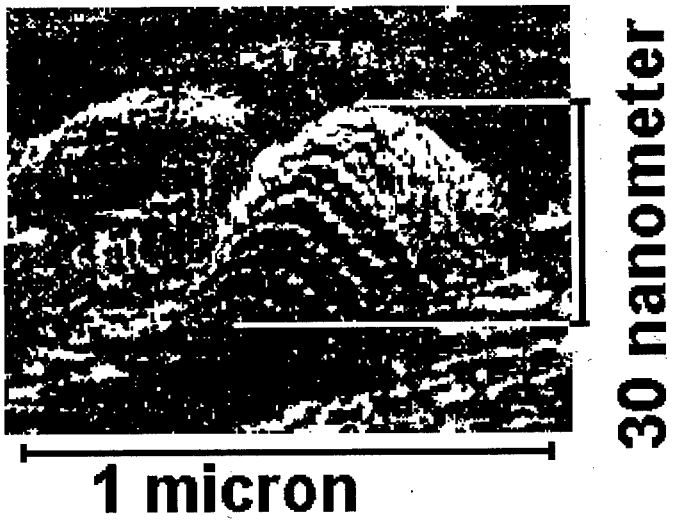


Fig.1.

The method of active spectroscopy of bacteria colonies is carried out of the method of dynamically spectroscopy. First step is periodical measurement of phase portrait of precise surface part until area of regularly changed structure detected. This mechanism provides early diagnostics of colonies.

At study of dynamics of movement of microobjects the kind of microorganism can be established by use of the super resolution. After this it is advisable to stop a growth of microorganisms in this colony. The local lighting of this microcolony by UV-radiation through objective of phase microscope can be used for this purpose. For this purpose the UV-radiation by a additional mirror cut from the measuring circuit and is directed on nutrient medium through objective of phase microscope, for example, from small-sized spark gap. Such suppression of identified microorganism colony permits to lower masking of one colony by another.

Use of optical microscope with the super resolution allows to observe alive microorganisms during their living. The resolution of phase microscope is sufficient to show their internal structure. Thus a wide spectrum of the additional information, necessary for

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identification of microorganism occurs. This information on the sizes of separate microorganism particles and character (speed, frequency, availability of pulsation,...) their mutual displacement. Such approach permits to increase aerosol concentration of aerosol sample on nutrient medium.

The sight field of phase microscope (5 x 5 micron) can be essentially reduced by electronic zooming. As a result the given equipment permits essentially to increase the accuracy of the bacterium analysis for case of slow changing bacteria. For the modern measuring techniques it is the principal restriction.

On the other hand the detecting ability of a equipment permits essentially to increase bacterium concentration on unit of a surface of nutrient medium..

The authors thank Aerosol Technology LTD for financial support of some part of researches.

This material is based upon work particularly supported by the European Research Office of the US Army under Contract No. 68171-97-M-5652

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1177.

DIAGNOSTICS OF POLYNUCLEOTIDES IN SAMPLES OF AEROSOL (AIRBORNE)

Belov N.N. (1), Belova N.G. (1), Morosov S.Yu. (2)

(1) - Aerosol Technology Ltd,
Phone/Fax: 7-(095)-1474361, EMail: belov@tehno.mmtel.msk.su

(2) - Moscow State University, Biological Faculty, Virusology Department,
Phone: 7-(095)-9395534

Sample of bioaerosols is a collection of great number of microscopic organic and inorganic particles. The analysis of this complicated mixture is an important problem that has no solution yet. Usually analysis consists of indentification and detemrmination of type of microorganisms at random position. Present investigations are devoted to using of PCR-method for analysis of sample that consists of aerosol particles collected from monitored air.

DNA contains the main information about microorganism. Multiplication of DNA by PCR method creates area with equivalent DNA molecules (like colony). All this DNA molecules are equal to source DNA. These source DNA molecules are extracted from bacteria sampled from air. (Please note, that concentration of bacteria in air so small that probability of close neighbourhood of two or more microorganisms is negligable small).

Method of Polymerase Chain Reaction (PCR) initially was described in 1985 by Saiki et al. (Science: 230, 1350-1354). Now many variants of PCR are widely used in different fields of molecular biology, genes engineering and biotechnology. The basics of this method is amplification of DNA fragments while having surplus of DNA-replica and ferment DNA-polymerase. Usually thermostable DNA-polymerase, such as Taq-polymerase from thermoohilic bacterium Termus aquaticus, are used. At the beginning of Polymerase Chain Reaction highmolecular two-chain DNA (or single-chain DNA for example cDNA-copy RNA) after melting and annealing of source becomes a primer for ferment-polymerase [1]. Ferment-

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polymerase produces two-chain DNA fragments that vary in size from few tens up to thousands of nucleotic pairs. Size of fragments depends on position of link areas of source DNA on polynucleotid. Reaction continues with duplication of first step products, i.e. DNA-fragments of fixed size. When quantity of DNA sources, polymerase and deoxynucleotidtriphosphates is enough, any part of polynucleotid (DNA or RNA) can be amplified. So even in situation when the only one polynucleotid molecule is available, it is possible to amplify it or it's part up to quantity that is easy to detected by standart methods. For example brome atidia in agar or polycrealamid geles. Test procedure can be greatly reduced in case of use of radioactive deoxynucleotidtriphosphates or their fluorescent analogous. According to this PCR is the most sensitive detection method for biological objects that contain polynucleotides (including viruses, bacteria, primitives, fungi et others). Certainly PCR can be used for detection of single nucleotides in any medium. PCR is widely used in agriculture for diagnostics of animal and plant pathogens. It's high precision and cheapness (comparing to other methods) made PCR the main method for diagnostics of infectional and inherited human diseases.

Last years PCR is used widely as the method for monitoring of biologic debris (including single nuclear acids) of the environment, food, medicines etc. Monitoring of pathogen microorganisms at their low concentration in soil, water and air become available only because of PCR. Moreover, PCR method significantly simplifies micro biological control. Now can be reduced such great work as laboratory incubation of microorganisms for following identification. There is an opportunity to extract stamm from specific DNA sources, not only to detect that there is precise type of microorganisms. An additional advance is that PCR method enables to test any type of microorganisms even in spore. But it is impossible to detect viability of detected microorganisms. Nevertheless PCR can be used as initial procedure of monitoring of polynucleotides and microorganisms in environment. Indeed PCR is outstanding method for this purposes.

This multiplication of DNA helps to receive large area around microorganism placed on surface of biosampler, filled with equal DNA molecules. This "colony" of DNA may be selected and measured by phase microscope. This device has an excellent resolution - 50 nm and best. Phase microscope investigations are safety for alive microorganisms. So this technology provides new directions for investigations - dynamical correlation spectroscopy. Time-space correlation vibrations and moving provides good information about source microorganisms. PCR method helps to enlarge area with important information. So phase microscope will find it more simple and with great speed. This method helps to go away from demand on careful collection of microorganisms from air. This direction of bioaerosol sampling is very perspective.

Authors appreciate Aerosol Technology Ltd firm for financial support of researches.

This material is based upon work partially supported by the European Research Office of the US Army under Contract No. 68171-97-M-5652

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ABSTRACTS
INTERNATIONAL AEROSOL SYMPOSIUM
IAS-4 (St.Petersbourgh 06-09 JULY 1998)

1045

PULSED LIGHT DEVICE FOR DEACTIVATION OF BIOAEROSOLS

Wick C.
ERDEC

(First received 22 December 1997; accepted for presentation during IAS-4)

The health care community has sought to reduce the hazardous bioaersol levels in hospitals, and operating theaters for many years. Historically, filters and other such devices have been used to some effect, but the problem persists frequently resulting in patients contacting serious infections as a result of the environment. A new device which utilizes high energy pulsed light to completely deactivate bioaerosols is presented. The Pulsed Light Device (PLD) uses high intensity, broad-band pulsed light as the mechanism for killing micro-organisms. Experimental results demonstrated high effectiveness for air streams having flow rates of 20-200 cfm containing Bacillus spores.

Other experiments demonstrated that the PLD could maintain a clean environment in a closed room for more than eight hours, during which high concentrations of Bacillus spores were continuously inoculated into the inlet air stream. Further, the PLD could rapidly decontaminate the air in a room after spores were dispersed inside it. Experiments indicate that the PLD is fully capable of both modes of operation.

1044.
УДК 541.18

THE METHODICAL APPROACHES TO BIOLOGICAL INDICATIONS OF AIR WASTES OF THE ENTERPRISES OD A MICROBIOLOGICAL INDUSTRY

Omeljanets T.G., Artyukh V.P., Ganeva S.L.
Ukrainian Scientific centre of hygiene, 50, Popudrenko str., Kiev-94, Ukraine,253660

(First received 23 September 1997; accepted for presentation during IAS-4)

When manufacturing the products with the help of microbial synthesis the pollution of industrial and environment by both viable microorganisms-producents and various protein substances by intermediate products of metabolism of microorganisms - ferments, antibiotics, vitamins and etc. is observed.; by impractical microorganisms and their conglomerates; by a dust of a ready product is observed. These biological pollutants can extremely adversely influence on the health of workers, and on the population, who is living in region of accommodation of such enterprises (diseases of a leather, respiratory ways, allergenic disease etc.).

In this connection a major moment at an estimation of biological action of either pollutants the careful its identification and effective method of determination its ingredients is necessary. Especially it has the important meaning at development of the hygienic rules of the allowable contents biological pollutants in industrial and environment objects.

From all methods of the control of biological pollution in air the most full methods of determination microorganisms-producents with use the various apparatus for the samples are developed. At an estimation of microbial pollution of the air in a working zone we used a number of devices - Krotov device, multicascade impactor MB-2, device PAB-1, device MD8 of

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firm "Sartorius". The device MD8 with the soluble gelatinous filters is the most convenient.

At determination of protein products, which formed in process of microbial synthesis a method of the immunochemical analysis is the most perspective, it characterised by a high sensibleness, selectivity, expressiveness, allowing determine specific individual albumins.

We used a method of the immunofermental analysis at determination polypeptid-proteins wastes in the air of a working zone and in atmospheric air. Thus we used immunity serum, which was received by immunisation of by a final product (fodder additive of a concentrate of lysine) with using Freund's adjuvant, for increase immunogenity of an antigen the methylated albumin was introduced into the animal.

The selection of samples of the air in a working zone and in zone of air wastes of the enterprises of a microbiological industry was made by aspirator "Krasnogvardeez" on the filter as FPP. Elution of the samples was made with the help of a buffer solution Tries-HCl 0,01M pH7,8. A concentrate of lyzine contained about 12 % albumin. The chromatographic analysis of a concentrate has revealed presence polypeptides and the protein fragments.

The quantitative determination of an antigen was carried out by a method ELIZA with application of fluorescent or ferment label (peroxidaze). In a case of ferment label the determination, besides, was made according to the intensity of the luminescence in a luminometer.

The results of researches testify, that a method allows to differentiate specific substances of a protein nature from the common protein pollution and to allocate them, even if their amount makes 0,5 -1,5 % from total protein.

The determination of the specific proteins is especially urgent for large microbiological manufactures, which make tens and more preparations using thus many producents and causing the rather complex - structured factors of pollution. Pollutants of a protein nature are rather diverse through the biological properties, and consequently, through the consequences of their influence on health of the persons, from complete tolerance up to provocation of rather heavy diseases. And, the quantitatively insignificant fractions can appear stronger allergens in comparison with other fractions. Therefore it is important to determine just this the most important by influence on organism) part of protein pollution, as the determination of total albumen can mask presence of the specific protein pollutants, to provoke arthefacts and to result to wrong conclusions.

1104.

SATELLITE ESTIMATION OF SPECTRAL SURFACE UV IRRADIANCE IN THE PRESENCE OF TROPOSPHERIC AEROSOLS 1: CLOUD-FREE CASE

Krotkov N.A.*, Bhartia P.K.**, Herman J.R.**, Fioletov V.***, Kerr J.***

*Raytheon STX Corporation, Lanham, MD 20706 U.S.A.

**Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, MD 20771

***Atmospheric Environmental Service, Downsview, Ontario, Canada

(First received 18 January 1998; accepted for presentation during IAS-4)

The satellite algorithm for determining the surface UVA(320-400nm) and UVB(290-320nm) flux in cloud-free conditions is discussed including the estimate of the various error sources (uncertainties in ground reflectivity, ozone amount, ozone profile shape, surface height, and aerosol attenuation). The presence of aerosols tends to reduce the logarithm of the UV flux linearly with aerosol optical depth. The slope increases with aerosol absorption and solar zenith angle. Using Brewer #14 measurements of UV flux and aerosol optical depth on clear days at Toronto the estimated slope falls in the range 0.2 to 0.3 (aerosol single scattering albedo about 0.95). It is shown that the Brewer measured spectral dependence of UVB (or UVB/UVA flux ratio) can be accurately reproduced using just total column ozone amount and the solar flux spectrum. The Brewer #14 measurements of absolute UVA flux can be reproduced with the

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aerosol model derived within uncertainties of the instrument calibration.

We have applied the algorithm to the data collected by the Total Ozone Mapping Spectrometer (TOMS) instruments that have been flown by NASA since Nov. 1978. It was demonstrated that in the absence of clouds and UV-absorbing aerosols, TOMS measurements of total column ozone and 380nm (or 360nm) radiances can provide estimates of surface spectral flux to accuracies comparable to that of typical ground based instruments. A newly-developed technique using TOMS aerosol index data also allows estimation of UV flux transmission by strongly-absorbing aerosols. The results indicate that over certain parts of the Earth, aerosols can reduce the UV flux at the surface by more than 50%. Therefore, the most important need for reducing errors in TOMS derived surface UVB spectra is to improve the understanding of UV aerosol attenuation.

Key words: measurement and monitoring of aerosols; tropospheric aerosols (dust, smoke); multiple scattering and absorption of ultraviolet radiation by aerosols.

More information: see the following NASA web pages:
http://jwocky.gsfc.nasa.gov http://skye.gsfc.nasa.gov
Corresponding author address: N.A.Krotkov,
Raytheon STX Corporation 4400 Forbes Blvd., Lanham, MD 20706-4392;
Phone: (301)-7945075; FAX: (301)-4411853,
EMail:krotkov@hoss.stx.com

1103

ULTRAVIOLET MODEL OF VOLCANIC CLOUDS FOR REMOTE SENSING OF ASH AND SULFUR DIOXIDE

Krotkov N.A.*, Krueger A.J.**, Bhartia P.K.**

*Raytheon STX Corporation, Lanham, MD 20706 U.S.A.;

**Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, MD 20771

(First received 18 January 1998; accepted for presentation during IAS-4)

The Total Ozone Mapping Spectrometer (TOMS) instruments have detected every significant volcanic eruption from November 1978 through December 1994 on the Nimbus 7 and Meteor-3 satellites and since July 1996 on the new satellites, TOMS-Earth Probe and ADEOS. We apply a radiative transfer model to simulate the albedos of these fresh eruption clouds to study the limitations of the present SO2 algorithm which assumes an absorbing cloud above a scattering atmosphere. The conditions are found to be approximated when the total absorption optical depth is less than 2 (i.e., 100 DU SO2 at 312 nm or 300 DU SO2 at 317 nm).

The spectral dependence of the albedo of a non-absorbing Rayleigh atmosphere can be specified by only two parameters which are uniquely different when ash or sulfate aerosols are present in the stratosphere. However, the interaction between ash scattering and SO2 absorption within a volcanic cloud produces a non-linear effect at strongly absorbing wavelengths that accounts for overestimation of sulfur dioxide in ash-laden volcanic clouds by the Krueger et al. (1995) algorithm. Correction of this error requires knowledge of the ash properties.

A method for determining two of the ash parameters from the longer TOMS wavelengths is described. Given the altitude of the cloud, surface reflectivity, and an estimate of effective variance of the ash size distribution, the optical thickness and either the effective radius or the

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index of refraction can be deduced. The ash retrievals are also needed to evaluate the tephra/gas ratio of eruptions and to compare the ash properties of different volcanoes.

Key words: measurement and monitoring of aerosols; stratospheric aerosols (sulfate and volcanic ash); multiple scattering and absorption of ultraviolet radiation by aerosols; non-spherical aerosols (volcanic ash); volcanic inputs to the atmosphere; volcanic hazards (ash avoidance by aircraft).

More information: see the following NASA web pages:
`http://jwocky.gsfc.nasa.gov http://skye.gsfc.nasa.gov`

1102

AEROSOL RESEARCH ISSUES RELATED TO HEALTH AND DEFENSE POLICY

Geernaert G.

National Environmental Research Institute, Denmark

(First received 13 January 1998; accepted for presentation during IAS-4)

Aerosols have been identified as one of the key atmospheric constituents which govern health policy, tactical defense operations, and climate. Aerosols originate from a number of natural and anthropogenic sources. Wind blown dust and sea spray are among the natural emission types, which are not easily governed by emissions controls. While also classified as a natural source, forest fires are, on the other hand, in most part controlled by human intervention.

The anthropogenic emissions are governed in most part by the industrial and traffic sectors. These sectors may be characterized with "controllable" emissions, where policies may be formulated to reduce or optimize emissions based on their impact across a variety of economic. In order to optimize labour output, health, tourism, defense, and other sectors, policymakers are obliged to select the appropriate environmental and economic instruments which satisfy a cost-benefit analysis. Such analyses are based on scenarios, options, and forecasts. This presentation summarizes the aerosol research issues which are necessary to carry out, in order to identify the type and extent of emissions control policies. The focus of the presentation will be on the health sector, and a secondary focus will be on defense. The discussion will highlight the experimental needs, quality of parameterizations and models, and the needs of the customers and stakeholders. The points will be illustrated with case studies from Europe, the USA, and southeast Asia.

1099

MICROPHYSICAL PROCESSES AFFECTING THE FORMATION OF THE BACKGROUND STRATOSPHERIC AEROSOL

Hamill P.

Physics Department San Jose State University San Jose, California, USA

(First received 13 January 1998; accepted for presentation during IAS-4)

We consider the characteristics of the background stratospheric sulfate aerosol layer and show how microphysical processes along with transport can lead to the observed properties of the layer.

It is generally believed that the source of the stratospheric sulfate particles is binary nucleation of sulfuric acid and water to form solution particles. This process would take place preferentially in the tropical upper troposphere and the particles would then be transported by updrafts into the lower stratosphere.

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We show results of nucleation studies based on the classical heteromolecular nucleation theory as adapted for the presence of hydrates. However, in the upper troposphere, environmental conditions are such that the critical nucleus is very small, containing just a few molecules of sulfuric acid. Under these conditions, a nucleation process may not be necessary, and the direct coagulation of hydrates may be the dominant mechanism for sulfate particle formation. We compare the two processes and show how they can affect the size distribution of the aerosol in the lower stratosphere.

The particles remain for most of their lifetime in the "tropical stratospheric reservoir" where they grow larger by means of condensation and coagulation. We show that these processes alone do not lead to the observed size distributions. To match the observed size distributions requires the mixing of older and newer air parcels.

That is, fresh aerosol particles will be much smaller than particles that have been in the stratosphere for long periods of time. However, a simple mixing of air masses still does not yield expected results. It is necessary to include the sedimentation of particles to get size distributions that are in agreement with measurements.

The transport of the aerosol particles to mid-latitudes can be studied using data from the SAGE II satellite system. We show that this process leads to a gradual lowering of the aerosol layer. The data also suggest a decrease in the particle number density. We suggest that this decrease is accomplished by several different mechanisms, such as sedimentation of larger particles and the removal of particles near the tropopause by cumulus clouds that pierce into the stratosphere. However, as suggested by recent studies in stratospheric dynamics, the most important removal process is probably non-isotropic transport through tropopause folds.

The aerosol particles that are carried to very high latitudes will be trapped in the polar vortex during the winter months. As the temperature decreases, these sulfate particles may serve as condensation nuclei for the formation of polar stratospheric cloud particles. We consider the formation of ternary system particles and show that modeled results agree with observations of the clouds by the SAM II satellite system during periods of time when ternary system particles are expected to exist.

In summary, we show how nucleation, condensation, coagulation, and sedimentation along with transport can account for the observed properties of the stratospheric aerosol layer.

1098

WET ELECTROSTATIC PRECIPITATION OF FINE PARTICLES

Siebenhofer M., Lorber K. E.

Institut fur Entsorgungs- und Deponietechnik Montanuniversitat Leoben, Austria

(First received 14 Jan 1998; accepted for presentation during IAS-4)

Particle precipitation has been an important role in off-gas purification since industrial activities have become an important factor in environmental issues. While precipitation by settling was the major dust separation process for a long period, a significant progress was made with the invention of particle precipitation by dry ESP. The treatment of large gas flow rates and the treatment of off-gas with high dust load has been possible since then.
But electrostatic precipitation has always had some specific limiting properties which affect its application negatively. Gas temperature, moisture of the gas and the specific electrical resistance must not deviate strongly from the design specification. A rapid loss in collection efficiency has to be accepted in case of out-of-specification operation. The particles to be precipitated must nearly have ideal adhesion properties since they must be collected at the precipitation electrode on one hand and they must be removed by rapping without redistributing in the off-gas on the other hand. The geometry of the precipitator does not

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permit deviation of electrode distances and the electrical insulation has to consider the application of high voltage under increased thermal, mechanical and electrical stress inside the ESP. As a matter of fact, particle precipitation is still a major challenge in modern off-gas purification. Many processes cause the formation of an increased amount of submicronic particles. On the other hand, air borne particles with low sedimentation properties are a significant health risk because of their respiratory properties, their high catalytic activity due to several photocatalytic gas phase reactions, and their adsorptive properties for gaseous pollutants.

Modern off-gas purification therefore has to pay increased attention to the efficient precipitation of submicronic particles. Filtration techniques can cover a wide range of efficient particle separation in industrial application. Dust collection by filtration is increasingly preferred over electrostatic precipitation. Even in the field of waste incineration filtration is state of the art meanwhile. Is therefore any application left for electro precipitation in modern off-gas purification? As demonstrated by several examples, it is. But application focusses on wet electro precipitation. This precipitation technique does not suffer from most of the above mentioned limits and disadvantages of dry ESP. Wet electro precipitation does not have to consider the specific electrical resistance of the particles to be removed. The adhesive properties of the dust do not limit the precipitation as the collecting electrode is formed by an aqueous film which can be renewed continuously.

The paper presents several results of industrial application of wet electrostatic precipitation The application considers the precipitation of quartzite aerosols as well as sodium chloride aerosols from off-gas of incineration processes and high temperature conversion processes. Soot particles, as well as paraffinic aerosols formed by condensation have been succesfully removed by wet electrostatic precipitation. Even mixed organic/inorganic aerosols are collected at aqueous precipitation electrodes. The examples demonstrate, that wet electrostatic precipitation does not have general applicability but may still prove advantageous or exclusive in specific application.



1092.
УДК 541.18

RADIATIVE FORCING BY VOLCANIC AEROSOLS FROM 1850 THROUGH 1994

Andronova N.G.[1], Rozanov E.V.[1], Yang F.[1], Schlesinger M.E.[1], Stenchikov G.L.[2]

[1] *Department of Atmospheric Sciences, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801*

[2] *Department of Meteorology, University of Maryland, College Park, MD 20742*

(First received 10 January 1998; accepted for presentation during IAS-4)

We use our detailed radiative transfer model and observations of the time evolution of the latitude-altitude distributions of zonal-mean optical properties for the Pinatubo aerosol to calculate the time evolution of its radiative forcing. We represent the zonal mean of this radiative forcing in terms of the zonal-mean optical depth of the Pinatubo aerosol, together with the solar insolation at the top of the earth's atmosphere, the planetary albedo in the absence of the aerosol, and the surface-air temperature. We use this representation, together with the volcano optical depths compiled by Sato et al. [1993] to calculate the radiative forcing by volcanic aerosols from 1850 through 1994.



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1038.

OPERATION OF HOT BENCH FILTRATION SYSTEM OF DUST REMOVAL FOR ADVANCED GOAL UTILIZING COMBINED SYSTEM

Choi J.-H.[1], Park G.-W.[1], Jeong H.[1], and Chung J.-H.[2]

[1]Dept. of Chem. Eng., Gyeongsang National University, Chinju 660-701, Korea,

[2]Korea Electric Power Research Institute, Taejon 305-380, Korea

(First received 6 September 1997; accepted for presentation during IAS-4)

Candle filter is one of the most promising system for a particulate removal et high temperature such as IGCC and PFBC. In order to develop the design technology of ceramic candle filter system, it is very important to optimise the pulse cleaning system and to understand the behaviour of pressure drop developing to depend much through the filter element during the operation. These characteristics i on the property of filter element, mounting of filter element, dust properties, a d operation conditions.

Our purposes: was to obtain the design data for a commercial filter system. For this aim, a dench scaled test facility mounted seven candle elements of 1m length was burned gas behavior and Jet cleaning ested. The hot gas stream was prepared by the mixing of an oil and fly ash from a conventional power plant. Pressure drop pressure development in the filter element inside during the pulse as observed in the several operation conditions.

The analysis of pulse nozzle system was also carried out by FLUENT program.

1046.

A PORTABLE HIGH-THROUGHPUT LIQUID-ABSORPTION AIR SAMPLER [PHTLAAS]

Dr. S. Zaromb, Dr. A. Birenzvige, R.W. Doherty

(First received 13 January 1998; accepted for presentation during IAS-4)

The portable high-throughput liquid-absorption air sampler [PHTLAAS] is an outgrowth of a high-volume vapour collector that was first developed at the Argonne National Laboratory [ANL] for the ultra-sensitive detection of trace concentrations of hazardous or illegal compounds whether in vapour or aerosol form. The sampler is characterized by its light weight (about 1 Kg) and low power consumption (less than 20 watts DC).

The PHTLAAS was evaluated as a sampler for aerosol particles in the size range of 2 - 10 micrometers (aerodynamic diameter) in a wind tunnel. The sampling efficiency was found to be between 20% - 85% (depending on aerosol particle size) at sampling rate of 230 - 250 litter / minute. The sampling efficiency was invariant to the orientation of the intake slit in respect to the wind direction, or the vertical inclination of the sampler up to 75 degrees off the vertical for aerosols of 3 microns diameters and wind speed below about 2.2 m/min (5 MPH). More recently an improved version of the sampler yielded a collection efficiency of about 20% at a sampling rate of 380 litter / minute.

The paper will describe the sampler and its characteristics in details. Also discussed will be test results using fluorescent particles as well as biological particles of Bacillus Subtilis (BG). performed in a wind tunnel and a static aerosol chamber. Potential uses for the sampler will be discussed as well.



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1178

NUMERICAL ANALYSIS OF FLOW FIELD IN THE CERAMIC CANDLE FILTER USED IN INTEGRATED GASIFICATION COMBINED CYCLE

Seo, Taewon[1], Choi, Joo-Hong[2] Chung, Jae-Hwa[3], Jeong, Hyun-Il [3]

[1] *Andong National University,* [2] *Gyeongsang National University ,* [3] *Korea Electric Power Research Institute*

(First received 22 January 1998; accepted for presentation during IAS-4)

The regulation of the exhausted gases contained CO_2, SO_x, and NO_x becomes more and more stringent in the world and this regulation is forced to study the clean coal technology to minimize the environmental contamination. Because of the stringent regulation to protect the earth by the fully-developed countries the next generation of firing system to be constructed in the next century is either IGCC (Integrated Gasification Combined Cycle) or PFBC (Pressurized Fluidized-Bed Combustion).

The IGCC has increasing attention as the clean coal power plant system to minimize the environmental contamination and to increase the thermal performance. The removal of the particulate contained in the hot gas is important to protect the gas turbine. The particulate produced in the combustion process of IGCC have been gotten rid of by ceramic candle filter. To increase the performance of the filtering process is of importance to get uniform velocity profile in the candle filter. The objective of this study is to analyze the velocity and pressure distribution in the candle filter and to investigate the effect of the porosity and the length of the filter. It is assumed that the flow field in the candle filter is axi-symmetric and steady-state.

K-ε model in the flow field and Darcy's law in the porous region are adapted in the numerical calculation. It is found that the effect of the porosity in the flow field is negligibly small while the effect of the filter length is significant.

RAS

INTERNATIONAL AEROSOL SYMPOSIUM *IAS-4*

TITLE OF SESSION AEROSOL and CLIMATE

ChairProf. **MICHAEL E. SCHLESINGER,**

Professor of Atmospheric Sciences, University of Illinois at Urbana-Champaign, received his Ph.D. in 1976 from the University of California, Los Angeles. Professor Schlesinger directs the Climate Research Group (CRG) within the Department of Atmospheric Sciences. He is an expert in the modeling, simulation and analysis of climate and climate change, with interests in simulating and understanding the climates of the geologic past and possible future climates resulting from increased concentrations of greenhouse gases and anthropogenic sulfate aerosols. He carried out the first detailed comparison of climate and climate changes simulated by different atmospheric general circulation models (GCMs). His CRG has two tropospheric GCMs - one with interactive photochemistry, two stratospheric/tropospheric GCMs - one with interactive photochemistry, two oceanic GCMs, and a variety of simpler climate models, including the energy-balance climate/upwelling-diffusion ocean model with which he made projections of global temperature change to the year 2100 for the 1990 Intergovernmental Panel on Climate Change (IPCC) report. Results from doubled and quadrupled carbon-dioxide simulations from one of the tropospheric GCMs have been used in many climate-impact assessments, including that for the United States published by the EPA in 1989, wherein the results are called the OSU (Oregon State University) simulation, as well as in contemporary integrated-assessment models. In 1991 Professor Schlesinger investigated the urgency of climate-change mitigation and found that "the penalty for a 10-year delay in initiating the transition to a reduced-greenhouse-gas scenario is small." Recently, he discovered a 65-70 year temperature oscillation in observed surface temperatures for the North Atlantic Ocean and its bordering continental regions, a finding that was reported in Discover magazine as one of "The Top 75 Science Stories" of 1994.

His research currently focuses on:

1.Estimating the temperature sensitivity of the earth's climate system.

2.Determining the effects on past and future climate of the sun, sulphate aerosols - both of volcanic and anthropogenic origin - and natural variability.

3.Simulating and understanding the onset of the last ice age.

4.Performing integrative assessment of climate change, including the impacts of climate change and adaptation and mitigation responses.

5.Understanding the roles of clouds in climate and climate change.

He is an active participant in international efforts to simulate and understand past and future climate changes; has directed NATO and other conferences in England, Italy and the United States; has edited three books; has contributed to many assessments of climate change, including the IPCC and the Energy Modeling Forum (EMF).

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Главный спонсор IAS

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AEROSOL TECHNOLOGY

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АТЕСН - главный спонсор и организатор Международного Аэрозольного Симпозиума.

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6/July/98: Секции связанные и биоаэрозолем и переносом аэрозоля в атмосфере.

7/ July /98 Аэрозольные технологии (фильтрация, производство алмазоподобных материалов, ультрадисперсрные порошки, горение диспергированного топлива, мембранные фильтры, чистые технологии ...)

В этот же день будут представлены работы по ФУЛЛЕРЕНАМ - синтез, экстракция, свойства, теория, применение, нанотрубки..

8/ July /98 АЭРОЗОЛЬ И КЛИМАТ, КОСМИЧЕСКИЙ МУСОР, АЭРОЗОЛЬ И ОКЕАН Радиоактивные аэрозоли, аэрозоли мегаполиса, вулканические аэрозоли, облака, эрозионные аэрозоли, ...

9/July/98 Последний день - АЭРОЗОЛИ И ЗДОРОВЬЕ - использование аэрозольных медикаментов, воздействие загрязнений воздуха на организм, Нормирование аэрозольной нагрузки для различных профессий, Проникновение частиц в легкие, Взаимодействие частиц с биологическими структурами...

АЭРОЗОЛЬНАЯ ТЕОРИЯ (1)- оптика аэрозолей, коагуляция, нуклеация, конденсация...ТЕОРИЯ АЭРОЗОЛЕЙ(2)- ДИФФУЗИОФОРЕЗ, ТЕРМОФОРЕЗ...Слушание докладов выдвинутых на соискание премий Российского аэрозольного общества (Две из этих премий поддержаны суммами $300 и $200 - спонсор - директор ERNAFT OIL Mr Mirlesse (Щвейцария)

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<<< INTERNATIONAL AEROSOL SYMPOSIUM >>>

Saint-Petersburg 6-9 July 1998

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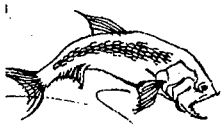
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	Noginsk	Administration of Noginsk region
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1055.
УДК 541.18

THE INFLUENCE OF AEROSOLS ON ATMOSPHERIC ABSORPTION OF SOLAR RADIATION

ARKING A.

Johns Hopkins University Baltimore, MD 21218 USA

(Received 16 December 1997; accepted for presentation during IAS-4)

There has been an ongoing debate over the last few years concerning the source of a discrepancy between observations and theoretical calculations of the amount of solar energy absorbed by the atmosphere. Based on a quasi-global, multi-year set of ground-based observations, combined with satellite measurements of top-of-the-atmosphere flux, absorption is 0.24 (expressed as a ratio with respect to incident flux at the top of the atmosphere). Models underestimate that absorption by 0.05 to 0.08. Some studies have attributed the discrepancy to clouds, while others have shown that the discrepancy is independent of clouds and, instead, correlated with column water vapour. At this point, the source of the discrepancy remains a mystery. Here, we examine the role of aerosols in atmospheric absorption, and test the possibility that aerosols account for some or all of the discrepancy. We use the output of chemical transport models to study the effects of three broad categories of aerosols: sulphates, mineral dust, and carbonaceous aerosols. We find that the discrepancy is not correlated with either sulphates or mineral dust, but there is a small but significant correlation with respect to carbonaceous aerosols.

However, based on their amount and distribution, the carbonaceous aerosols could only account for a small fraction of the discrepancy. To account for a major fraction, the total aerosol burden would have to be predominantly carbonaceous, with single scattering albedos ~0.75 or smaller, a highly unlikely situation at the vast majority of observation sites.

1066.

PUTTING METAL ATOMS INTO FULLERENES: ENDOHEDRAL METALLOFULLERENES

SHINOHARA H.

Department of Chemistry, Nagoya University, Nagoya 464-8602, Japan

(First receive 27 December 1997, accepted for presentation during IAS-4)

Endohedral metallofullerenes are novel fullerene-based materials and have attracted much attention in the last four years. In the last couple of years, some important progress have been made in direct structural analyses of metallofullerenes by using synchrotron X-ray diffraction and 13C-NMR studies. Recently, we have succeeded in determining the endohedral nature of the metallofullerene, Y@C82, and obtaining its total electron density via synchrotron X-ray powder diffraction(1). The results reveal that the yttrium atom is displaced from the center of the C82 molecule and is strongly bound to the carbon cage.

In the present study, both the isomer and the endohedral structures of a typical di-metallofullerene, Sc2@C84, have been determined for the first time by high-resolution 13C-NMR (2) and synchrotron X-ray diffraction studies, respectively. The results show that one of the major isomer of Sc2@C84, i.e., Sc2@C84 (III), has a D2d (23) symmetry and that some dynamical averaging of the Sc ions might be taking place around the optimum scandium position. This is a striking contrast to the Y@C82 case, where the yttrium atom is attached to the carbon cage even at room temperature.



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Some important features of the crystal structures of Y@C82 and Sc2@C84 will also be presented and discussed.

1185.

HOT PARTICLES OF CHERNOBYL ORIGIN IN ENVIRONMENTAL SAMPLES

TSCHIERSCH J., WAGENPFEIL F.

Institute of Radiation Protection GSF-National Research Center for Environment and Health

D-85764 Neuherberg Germany

(First received 31 January 1998; accepted for presentation during IAS-4)

Pure nuclear fuel particles were released into the atmosphere during the reactor accident in Chernobyl. These particles are connected with high concentrations of radionuclides and are called "hot particles". During resuspension experiments in the 30-km exclusion zone of Chernobyl, airborne hot particles were sampled and analysed. Detection methods for hot particles were (digital) autoradiography and gamma-spectrometry. In the size range larger 3 μm aerodynamic diameter approximately 36 hot particles per 1000 m^3 were measured during anthropogenic enhanced resuspension.

Hot particles in the environment cause samples which are not uniformly contaminated, especially if there are only few hot particles in the sample. Because of the inhomogene distribution of radionuclides in environmental samples a significant measurement uncertainty may result. In laboratory experiments the analytical uncertainty for various sample media (filter, soil) and measurement geometry were investigated. A single hot particle was analysed for instance in a sample without any other contamination in a frequently used 1000 cm^3 bottle by gamma-spectrometry. The measured ^{137}Cs activity may range between a factor 10 too high or a factor of 20 to low (related to the actual activity of the hot particle) depending on the position of the single hot particle in the sample. For most measurement geometries it was possible to formulate a procedure by which the relation between the measured and the actual activity concentration can be calculated in dependence on the position of the hot particle.

993.
УДК 541.18

BUILT - IN SENSORS (BIS) FOR DIAGNOSTICS OF LIQUID SYSTEMS ON PARAMETERS OF PARTICLES OF WEAR.

LOGVINOV L.M.

Samara state aerospace university named by acad. S.P. Korolev

(First received 26 December 1997; accepted for presentation during IAS-4)

In a structure of any liquid system of a product of an air engineering, machines and process equipment there are plenty of tribomechanical units (valves, plungers, bearings and etc.), the reliability of which significantly depends on a level of contamination and other parameters of a liquid /1,2,3,4/. It is known, that the imperfect control of a technical condition of tribomechanical units, included in structures of liquid systems, frequently causes failures and emergencies with products. Taking into account the fact, that the information on a history of development of wear process can be received from parameters of particles of wear, generated, it is possible to consider, that quantity and the size of particles, produced by the contacting pair, present the valuable information on a technical condition of whole unit of friction /2,3,4/. The travel of a liquid together with particles of wear in remote sites of a system permits to find out

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these particles in any place of hydraulic system, provided that built - in sensors (BiS) of technical condition of liquid systems of machines /3/, offered in 1984/5/ by the employees of ONIL-16 SSAU, will be used for this purpose.

Existing till now way of the control of a level of contamination of a liquid, based on the analysis (including automatic) of samples taken, does not permit to receive the information on a level of it's contamination in a real time scale /2,3/. Besides, for this method are inherent significant errors, stipulated by difficulties of maintenance and control of degree of cleanliness of sample containers and presence of "filter effect" of a small backlash in the sample valve, especially at sampling from highways of high pressure (up to 30 MPa). BiS of parameters of disperse phase (DP) offered /3,5/ do not require conventional sampling of a liquid and permit to increase objectivity and efficiency of the control.

In the report generalized functional and physical models, as well as principles of construction and feature of designs and characteristics of BiS of parameters of DP are considered in detail. In the report mathematical model of internal flowing part of photoelectric BiS and basis of their metrological maintenance are adduced.

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994.
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HARDWARE METHOD OF INCREASE CONCENTRATION LIMIT OF PHOTOELECTRIC ANALYZERS OF CONTAMINATION OF A LIQUID

KUDRIAVTCEV I.A.

Samara state aerospace university named by acad. S.P. Korolev

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The concentration limit determines maximum accounting concentration of particles in a researched liquid, when the readout number of particles differs from valid not more, than on 10-15 %. This error is stipulated by coincidences of particles in sensitive volume of an analyzer, i.e. simultaneous presence in it more than one particle, that results in imposing of target electrical pulses of a photoelectric analyzer.

The existing photoelectric analyzers of contamination of a liquid register pulses only in case when the interval between them exceeds size of a duration of a pulse /3/. Thus the concentration limit is determined by the parameters of sensitive volume of a sensor.

The form and parameters of target pulses of a photoelectric analyzer are determined by

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distribution of light exposure in sensitive volume of a sensor, form of a particle and its speed, as well as passband of a electronic amplifier. Imposing of pulses results in formation of a signal of the complex form with local maxima and minima. The analysis of the form of such signals permits to recognize в¤Г«м-лГ pulses and, thus, to increase concentration limit /2/.

It can be executed by fixing of size of local maxima, even if the pulse was not finished. Necessary condition is suppression of false maxima, produced by noise, otherwise the concentration measured will be overestimated.

In photoelectric analyzers of a type AZJ-915 and POTOK-945 /3/ the analysis of amplitude of pulses from a output of a sensor is performed with the help of a row of comparators, the outputs of which are connected with the inputs of digital counters /2/. The thresholds of operation of comparators are chosen in order to execute the analysis of the sizes of particles pursuant to GOST 17216-71 (St.Standart). The amplitude of a target pulse of a sensor, determined by the size of a particle, is fixed in a moment when the comparator with a maximum threshold resets. Thus the analysis of a following pulse is made after reset of a comparator with a minimum threshold.

Change of logic of work of a analyzer in order to fix all local maxima of pulses, will allow to decrease "dead" time of a analyzer. For this purpose it is enough to register amplitude of a pulse in case of sequential set and reset of one of comparators, if between these events does not occur setting of any other comparators. The size of a hysteresis of comparators should not exceed level of noise /2/.

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PIEZOELECTRICAL CONVERTERS IN MONITORING SYSTEMS OF PARAMETERS OF METAL PARTICLES

POMINOV E.I.

(Samara state aerospace university)

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The principle of action of piezoelectrical converters (PEP) for the control of size distribution of metal particles in liquid or gaseous dispersion fluids is based on the transformation of energy of impact of particles onto a sensitive surface of a piezoelectrical crystal to electrical signal. Signal of PEP is an radio-wave pulse with initial amplitude, which is proportional to mass and speed of particle at the moment of impact. The pulses from separate particles are being amplified, detected and sorted in dependence from magnitude for various channels of registration, according to certain sizes of particles.

Obviously, the sensitivity of a device is completely determined by the ratio of amplitude of a useful signal to peak value of a noise voltage on the output of an amplifier (SNR). A technique and results of calculation of the SNR for PEP and amplifiers with various parameters are

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discussed in the report . The analysis of the results obtained shows, that the sensitivity of PEP is limited by the noise of amplifier. Maximum of the SNR is attained at some optimum active resistance of a piezoelement's load and grows weakly with the reduction of capacity of a load. The amplifiers with various types of active elements do not permit to obtain significant gain. However, the application of the amplifiers, using bipolar transistors or OA is more preferable; for them the best accordance with output resistance of piezocrystal is provided, which is determined as by small resistance of piezocrystal near the antiresonant frequency, as by relatively small value of resistance of dielectic loss. The maximum of SNR is attained at Q-quality of a resonant contour of an amplifier 1.5 ...3 times smaller, than Q-quality of a piezocrystal; it corresponds to a threshold of sensitivity of PEP about 6.4 mm (at SNR equal 3) for bronze particles at speed of 15 m/sec. at the moment of impact (experimental value is equal 7 mm).

The process of the transformation in PEP is executed in some stages. On the first stage the initial distribution of particles in space in the PEP input is being transformed to a casual sequence of pulses; the intensity of pulse flow is proportional to the concentration of particles, and the amplitude distribution of pulses is correlated to initial size distribution of particles. On the second stage the reverse transformation to experimentally observed size distribution is being made. The discrepancy of the function restored of a distribution of particle size from the initial one is determined by the errors of the control of parameters of dispersion phase. The differences between speed and density of particles, conditions of impact of particles during the analysis, and values, used during experimental graduation of PEP, will result in occurrences of systematic errors, and their fluctuations during the analysis will cause casual errors. However, even during the control of particles of the same size and parameters in the same flow, deviation of signal's magnitudes is observed. It is caused by unevenness of the characteristics of a sensitive surface of the piezocrystal, speed of a flow in the cross-section of a channel and speed of particles driven on various trajectories.

In the report a technique and expressions obtained for density of probability of restored size distribution for monodispersed particles at various modes of flow of dispersion fluids in a channel of PEP are discussed.

Estimations of mean value and standard deviation for densities of probability have given values, correspondingly 1.08 and 0.124 for laminar mode and 1.006 and 0.051 for turbulent mode of the flow.

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INDICATOR OF QUALITY CONTROL OF JET FUELS OF A TYPE POTOK-RT

LOGVINOV L.M., MALYGIN N.A., SMAGIN W.À., COURDIN G.À.

Samara state aerospace university named by acad. S.P. Korolyov, Samara research institute "ECRAN"

(First received 26 December 1997; accepted for presentation during IAS-4)

It is known, that the reliability of fuel systems of products of a air engineering is significantly determined by a degree of their contamination (mechanical impurity and emulgated water) /1,2/. The developed indicator of the control of a degree of jet fuel's cleanliness permits to determine excess allowable and limiting levels of the contents of mechanical impurity and emulgated water during refuel of flying vehicles and executes switching of external executive devices (slide-valves) if a limiting level is exceeded.

The block diagram of an indicator of a type "POTOK-RT" consists of photoelectric built - in sensor (BiS), performed in explosion-proof variant and included in gap of fuel main with

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diameter of 100 mm, as well as electronics unit /2/. Photoelectric BiS works on a principle of measurement of light flows, scattered by particles (droplets) of insoluble water /2,3/. For use of a photoelectric sensor for the control of parameters of mechanical impurity and emulgated (insoluble) water in jet fuel were conducted experimental researches on valuation of a spectral structure of mechanical impurity and emulgated water, passed through the filter-separator if fuel flow changed /2,3/. Results of experimental researches have allowed to establish, that the particles of insoluble water have the sizes, more than two times exceeding average size of filter pores(~ 5 mm) in a wide range of the flows, and overwhelming number of particles of mechanical impurity have sizes in a range 5 ...10 mcm (i.e. less than 10 mcm) /2,3/. Thus, with the help of photoelectric BiS, if a filter with performance of 5 mcm is available in a hydraulic path, one can separately register the parameters of mechanical impurity and water, emulgated in jet fuel.

Main constructive and metrological characteristic of a developed indicator of a type "POTOK-RT" are informed in the report. Particularly, "POTOK-RT" can supervise a degree of cleanliness of fuels of a type TC-1, T-1, T-2, PT, T6 and other, when fuel flow is within the limits of 50...2500 (l/min) and pressure in a highway - 0.1 ..1.6 MPa.

Operation of a device in a range of temperature of a environment from -50 up to + 50| C is permitted. The range of particles size registered is 5...50 mcm, range of indication (in % of mass concentration): for mechanical impurity - 5.10^{-4}; for emulgated water - 5.10^{-3}. Mass of a sensor is not exceed 10 kg, and electronics unit - not more than 40 kg. Feed of an indicator is performed from a alternating current circuit 220 V / 50Hz and direct current source - 27 V. Consumed capacity: on an alternating current - 150 VA; on a direct current - 70 VA.

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1000.
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APPLICATION OF MICROCOMPUTERS IN SYSTEMS OF RECOGNITION OF COMPLEX PULSES FROM PARTICLES ON THE OUTPUT OF PHOTOELECTRIC GAUGES.

KUDRIAVTCEV I.A., FADEEV V.V.

Samara State Aerospace University named by. Acad. S.P. Korolev (SSAU)

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The photoelectric analyzers of disperse phase (DP) parameters use a principle of registration of a light flow, scattered by the particle in sensitive volume of the gauge. /1/ As a result of simultaneous presence more than one particle in sensitive volume of the photoelectric gauge imposing of electrical pulses on its output occurs. Thus the multichannel peak analyzer, processing target signal of gauge, can not correctly interpete a pulse, being the result of imposing of two and more separate pulses. So the concentration measured is distorted.

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Concentration determination error value depends on a duration of target pulses and concentration of DP. In /2/ there is the formulation of the numerical approach to the calculation of value of this error.

The employees of research laboratory of SSAU ONIL-16 have developed the technique of processing of target pulses of a gauge, enabling to increase number of pulses, correctly registered by multichannel peak analyzer owing to analysis of pulse form.

The principle of work of the system offered leans on the allocation of local maxima and minima in the form of complex target pulses, produced as a result of concurrence of particles in sensitive volume.

The processing of a signal is conducted with the help of a system of comparators, separating such pulses into different ones the amplitude of which is determined by separate particles, participating in concurrence.

Necessary condition of correct division of pulses is exception of consideration local extremal values, stipulated by noise. It is made with the help of comparison of size of local minima with a level of a voltage, a little exceeding noise level.

The modern element base permits to organize high-speed digital processing of a target signal of a gauge and to make the analysis, proceeding from a duration local maxima and minima. Modeling of complex pulses with the help of a computer has shown, that local maxima and minima in complex pulses have a duration, essentially exceeding average duration of noise peaks, which can be accepted for separate pulses. Thus, using the sampling of a target signal of the gauge and carrying out the analysis of sample as values in a real time scale, it is possible to distinguish noise peaks and peaks, produced as a result of concurrences of pulses. The efficiency of such time recognition is more significant owing to the reduction of threshold value necessary for correct minima determination and, accordingly, increase of quantity of separated complex pulses.

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1025.
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ON SOME TURBULENCE MODEL OF FREE TWO-PHASE JETS

TSIPENKO A.V.

125871 Moscow, Volokolamskoe shosse, 4, MAI, NII NT MAI.

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For the theoretical determination of the parameter fields in two-phase jets, there exist a great number of approaches based on the different notion about the discrete fraction, the different approach to taking into account the turbulence. Besides, the engineering practice constantly requires - when modeling such factors as flow nonisotermicity, particle polydispersity, collision of one particle with another, phase transitions, etc. But these factors shade the peculiarities connected with different approaches used at constructing models, though the understanding of internal

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peculiarities of models is necessary at the selection of a concrete model for solving a concrete problem.

In this work an attempt to show the peculiarities of five different approaches to modeling the two-phase turbulent axisymmetric jet is made based on the detailed experiments /5,6/. The model 1 is the Prandtl-Abramovich model of first order. The model 2 is the model of Gavin at al. /3/, the model 3 is the model of Elghobashi at al. /4/. The model 4 is the model of Zaichik at al. /1/, the model 5 is the model of Mostafa at al. /5/ (this is so-called stochastic model). A detailed modelling of experiment was carried out according to the model of authors and also - according to the modified versions of models.

Based on the calculation performed, the following conclusions can be drawn: the best results can be expected from the stochastic model taking into account the interaction of particles but this model is not suitable for the realization on PC at this stage; for obtaining the minimax assessment, the model 1 is the most suitable; for carring out a more detailed calculation, the modification of model 3 is advisable as a most simple one.

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1036.
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AEROSOL EMISSION FROM CONTAMINATED STRIP OF SOIL DURING HARROWING AND TRUCK MOVING

GARGER E.K.

Institute of Radioecology UAAS Tolstoy St. 14 252033 Kiev, Ukraine

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Measurement of ^{237}Cs air concentration and "hot" particles for simulation of agricultural works (harrowing) and driving of vehicles along a dirt track into the exclusive Chernobyl zone allowed to estimate the emission flux and rate using solution of the turbulent diffusion equation for a dust strip[1]. Measurements were conducted by the gradient installation at the 1.0, 1.8, 2.5, 3.5 m heights and impactor with the aerodynamic cut off diameters 2.0, 4.0, 7.0, 12, 20, 30 μm [2]. Experiments were carried out from two strips with the density contamination by ^{237}Cs 0.31

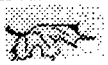
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$\pm$ 0.05 , 0.56 $\pm$ 0.06 [Mbq m^{-2}] and also the density of number "hot" particles 27.10^{-4} [m^{-2}], 60.5 x 10^{-4} [m^{-2}] respectively.

Vertical flux of ^{237}Cs for six experiments was varied from 22.2 $\pm$ 5.0 to 460 $\pm$ 90 [mBq m^{-2} s^{-1}] depending on a kind of vehicles and meteorological conditions. The emission rates have values from $0,07x10^{-6}s^{-1}$ to $1,5x10^{-6}$ s^{-1} and were by three-four orders of magnitude higher than for the wind resuspension conditions. "Hot" particles were measured in the third experiments that was given estimations of the emission rate (1.1-2.5)$x10^{-6}$ s^{-1}.

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1182.
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POINT IONS APPROXIMATION WITHIN THE MARCH MODEL FOR THE FULLERENE MOLECULE

DESPA F.

Department of Theoretical Physics Institute of Atomic Physics

Magurele - Bucharest, PO Box MG-6 Romania

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Progress in the investigations of the Buckminsterfullerene has until recently been largely confined to the molecule model within which the positive ions are uniformly smeared over the surface of a sphere and the valence electrons constrained to move on the sphere surface.

The model has successfully been used in describing some electronic and optical properties of C60.[1-4]

Recent interest centers on new approach[5-8] of the continuum positive charge model which employ Thomas-Fermi theory in describing the electron distribution and the stability of the fullerene. The latter molecule model was inspired from the March's one-centre model[9] for heavy, almost spherical molecules. The results were decidedly encouraging, and led them to suggest possible improvements. One of them we attempt to present in this paper.

We shall use a point ions approximation within the March model for the fullerene molecule and, we shall self-consistently derive the electron distribution of a fullerene molecule by a systematic application of the well-known results of the many-body perturbation theory.

Previously,[9] the March's one-centre model was employed to investigate special molecules XY_n, like CH_4 or SF_6, and it has been provided with a sound theoretical basis.[10] Shortly, the positive charges of the Y nuclei are smoothed out uniformly over the surface of a sphere with the X atom at the centre and, then the essential problem being to apply self-consistent field methods for the delocalized electrons.

As a theory in its own right, the method developed by March has not been without its successes, and it seemed a natural step therefore to investigate whether the method could be extended to the fullerene molecule. The March model strictly corresponds to the endofullerene molecule and it has been explored recently by Clougherty.[8]

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For the fullerene case, there is no central atom and the boundary conditions imposed in the March model change at the origin.[6]

The molecule model assumes that the valence electrons cover the inner and the outer surfaces of the uniformly charged fullerene cage moving in a common potential generated both by the positive charges and by their distribution. One point need stressing here: Smearing the positive ions into a continuum surface charge distribution, as indicated above, it leads to electrons moving in a less rapidly varying spatial potential than for the point ions in the fullerene molecule. (Note that inside a sphere, the electrostatic potential due to a surface charge distribution is constant.) Mostly, the inside electron distribution seems to be affected by employing the continuum positive charge approximation; only lesser than half of all the valence electrons of the fullerene molecule are inside the shell.[6,7] Therefore, the fullerene molecule being too "rarefied" within its natural limits, some objections can be risen on its mechanical stability.[5-7]

This situation can be overcame in a case which we shall present here by employing a point ions approximation. In this case, the valence electrons are found to be confined, in majority, inside the shell as a consequence of the adequate changing of the internal electrostatic potential. Moreover, both the inside and the outside electron distributions show distinctive peaks near the fullerene cage,[11,12] fact which differs from the other results recorded in the field[5-7]

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1183.
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DETERMINATION OF EFFECTIVE ANNEALING TEMPERATURE RANGE IN THE FULLERENE FORMATION

OSAWA E., SLANINA Z., ZHOU X., MATSUMOTO T.

Computational Chemistry Group, Department of Knowledge-based Information Engineering, Faculty of Engineering, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempakucho, Toyohashi, Aichi 441-8122, Japan.

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Our knowledge on the events occurring in the course of fullerene formation is limited primarily because experimental techniques for high-temperature chemistry have not been well developed. For example, it is not yet clear if the distribution of configurational isomers in

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higher fullerenes fraction represents thermodynamic equilibrium or a snapshot of kinetic process. An well-known example favoring the kinetic view is the disagreements in the kinds and relative amounts of the isomers of [78] fullerene separated from the extract of soot produced by arc discharge of carbon electrodes: Diederich et al. first separated two isomers, D2v(I) and D3, in a ratio of ca 5:1, then Kikuchi et al. gave three, D2v(II), D2v(I) and D3, in a ratio 5:2:2, then Taylor et al. and we found ratios of 18:52:30 and 595: 1026:386, respectively, for the same three components as found by Kikuchi et al. This and other examples might appear to demonstrate experimental difficulties in controlling high-temperature processes.

However, we doubt the validity of these determinations for two reasons. First, all of the above analyses (HPLC) ignore possible variation of extinction coefficients among the isomers at the UV wavelength with which relative peak height was determined. We noticed considerable differences in the shape of spectra of the above three isomers around 312 nm. Second, structural assignments have been heavily assisted by the computed enthalpies at 0 K (for ab initio methods) or at room temperature (for semiempirical methods). This is doubly wrong because the annealing occurs at much higher temperature, and the effect of vibration must be explicitly taken into account by using free energies. Regarding the second point, recent progress in evaluating free energies of fullerene isomers over a wide range of temperatures (typically 0 to 10000°K) using higher levels of MO theories has provided reliable criteria to determine equilibrium compositions of isomers and straighten the past confusion.

Under this circumstance, if we assume thermodynamic equilibrium and have accurate experimental compositions of isomers, we will be in a position to estimate the temperature of annealing. For this purpose, we need accurate distributions of isomers in higher fullerenes. Fortunately, recently reported method of introducing helium atom into the inside of fullerenes under high pressure of helium (BC provides a convenient determination of isomeric compositions. Although the rate of He incorporation by this method does not exceed a few tenths of percent, highly sensitive 3He NMR allows analysis of the mixture without further purification. Applying the method to a sample of 'highly purified fullerene fraction containing mostly C78' and a similarly designated sample of C84, Saunders and his coworkers found that the purified samples contain five and nine isomers of [78]- and [84]fullerenes, respectively. In contrast, only three isomers of [78]- and two isomers of [84]fullerenes have been described previously.

Thus, temperature range of annealing process in the fullerene formation has been estimated to be 2300°K with standard deviation of a few hundred°K, by fitting the isomers distribution of [78]- and [84]fullerenes obtained by 3He NMR measurements to the computed free energies of isomers vs temperature relation. Stone-Wales rearrangements occur in this temperature range about 105 times per second, fast enough to reach complete thermal equilibrium among configurational isomers of IPR fullerenes.

1194.



FULLERENE MOLECULE AND ALKALI FULLERIDES

APOSTOL M.

Department of Theoretical Physics, Institute of Atomic Physics, Magurele-Bucharest MG-6, POBox MG-35, Romania email: apoma@theor1.ifa.ro fax: 40-1-423 17 01

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With the advent of the C60 fullerene molecule we are in the presence of a new microscopic object: a hollow, highly-symmetric, (quasi-) spherical molecule consisting of a large number of carbon atoms. Molecular physics can, therefore, borrow standard methods for treating such an object from solid-state and condensed matter physics.

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To the first approximation the fullerene molecule may be viewed as a spherical, elastic shell of atoms; having derived its elastic energy, one may obtain the corresponding vibration spectrum.

The linear elasticity of a spherical thin film has to be established from first principles.

The oscillation modes of this sphere can be classified into four classes, out of which a few particular modes only can be computed anallytically. The vibrations are coupled to rotations, the main effect of this coupling, however, being static deformations beyond the harmonic approximation. If such a molecule is being to blow up during rotation, this would happen for certain polar angles on the sphere; a situation never reached, however, for the fullerene molecule. The dynamical anharmonicities of such an elastic, hollow sphere are, nevertheless, an extremely intriguing subject.

Carbon is a life element (is our life carbonic?). We know it, mainly, as sp2-hybridizations in graphite layers, or sp3-hybridizations in diamond. Is the fullerene molecule a curved, spherically-shaped graphitic layer? The electron affinity of carbon is 1.26 eV, while the electron affinity of the C60 fullerene molecule is much higher, about 2.65 eV.

Any standard theory of chemical bonding would have principled difficulties in accounting for this discrepancy.

How does a fullerene molecule react to an electron moving in the vicinity of its surface? One may think that the molecule gets polarized, and bound states will appear for the moving electron.

The electronic spectrum of such a quantum system is a hydrogen-like spectrum, in agreement with the experimental indications of the single-charged fullerene anion.

Highly-charged anions could also be treated within such a simplified model, at least in principle.

Layered structures of graphite have been doped in the past with alkali cations, which are easily accommodated in-between the layers, with the hope, among others, to fabricate electric charge batteries. Solid-state fullerites accept easily alkali cations, too, and form stoichiometric compounds to various degrees. The best known among these alkali fullerides are A3C60, where A denotes Rb, K, Cs, or even Na and Li. These compounds have a fcc- structure, with two distinct coordination sites for the alkali cations, one tetrahedral, the other octahedral. These two types of sites look like fullerenic cages wherein alkali cations are accommodated. The tetrahedral coordination is rather tight, so that the relatively small-size alkali cations occupy central positions inside. On the contrary, the octahedral coordination is pretty wide, and, while large alkali cations like Cs are central in these coordination, small- and even medium-size alkali cations, like Li, Na, and, respectively, K are placed off centre, along the structural directions of high symmetry. For example, a K cation may ocupy one of the eight corners of a small cube centered on the octahedral coordination. Detailed computations using inter-ionic potentials confirmed this picture, leading to the conclusion that ocathedrally coordinated alkali cations in some fcc-alkali fullerides may acquire off-centre sites placed along the (111)-symmetry directions.These off-centre positions of the alkali cations in alkali fullerides give certainly birth to a certain disorder, though not a completely undetermined one, i.e. this disorder is only a partial one, preserving to a certain degree the original ordering of the host lattice. This circumstance is rather singular, in any case not very common in solids, and its effects on the transport phenomena, thermal properties, local electronic structure, etc remain to be investigated. In particular, diffusion of the interstitial impurities on off-centre sites may exhibit new, universal features, still unknown, to a large extent.

The off-centre sites may degenerate in highly-doped alkali fullerides into clusters of small-size alkali cations built inside the octahedral cages. Tetrahedral-, cubic-shaped and even cubic-centered Na clusters (i.e. Na_4, Na_8 and, respectively, Na9) have been reported in alkali-

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doped fullerites, and the questions of their stability, the nature of their chemical bonding, the degree of ionicity, the extent of their metallic behaviour, etc, have been rightly raised. These atomic systems are very complex to be approached by any specific theoretical method, even a numerical one. We are left, for the time being, with approximate models, able to give only a qualitative understanding of these micro-objects. Such an approach is the Thomas-Fermi model, where the electronic cloud moves in a self-consistent potential, usually of high symmetry. The Thomas-Fermi model for this situation tells us that the tetrahedral cages are too small to permit clusters building; that the alkali clusters in the octahedral cages are only formed in the presence of the cage walls which give rise to huge, repulsive electronic potentials; in other words, these clusters are actually groups of alkali cations strongly squeezed inside the fullerenic cages; this squeezing generate a high degree of collectivization of the alkali electrons, so that we may view these micro-objects as small metallic drops; whose ionicity is not very high, however: the Na_4 cluster, for instance, has a total charge of about +2.7 electronic charge, the Na9 cluster is almost neutral, while the Na8 cluster seems to be rather unstable. Alkali clusters in highly-doped fullerides may exhibit their own molecular dynamics, which is worth-testing by various spectroscopical methods.

There is no perfect solid, and the alkali fullerides are no exception. Usually, the defect concentration increases with increasing temperature. However, upon certain conditions of preparing the sample, when the preparation involves an equilibrum process, a slight defect concentration may appear, which is independent of temperature, and this seems to be the case for some alkali fullerides. In these compounds there seems to exist a small concentration of alkali vacancies in the tetrahedral coordination, which give rise to an additional line in the NMR spectra of 87Rb and 39K. This phenomenon is known as the T-T□ splitting of the NMR spectra of the alkali cations in Rb_3C_{60} and K_3C_{60}, and the mechanism of alkali vacancies migrating through the lattice seems to explain the occurrence of the additional T□-line, beside the T- and O-lines originating in the two distinct types of coordination (tetrahedral and octahedral) of a perfect compound.

The octahedral off-centre positions of the alkali cations in these compounds may also distort the shape of the alkali NMR lines originating in the tetrahedral cordination. Usually, the off-centre sites generate a quadrupolar coupling whose effect in the NMR spectrum is averaged out by the tunneling of the atoms between the highly-symmetric off-centre sites. However, in the case of K_3C_{60}, the alkali cations in the tetrahedral sites are polarized by the octahedral off-centre cations, in such a way that a net effect is obtained in the form of an assymmetric shape of the tetrahedral NMR line. This seems to be again a rather unique situation, pertaining to the fullerenic compounds.

1076.

LASER BEAM EVAPORATION OF ICE PLATE AEROSOL PARTICLE

KUCHEROV A.N.

Central Aerohydrodynamic Institute (TsAGI), Department of Fundamental Research, 140160 Zhukovsky, Moscow region, Russia

(Received 01 October 1997; accepted for presentation during IAS-4)

When the investigating the destruction process and describing the mass and heat exchange of ice aerosol particles under laser beam radiation a large number of particles may be treated as plate disk, the thickness of which is less than its radius [1]. The physical evaluations show that energy demand and time necessary to heat an ice aerosol particle up to the melting temperature are significantly lower than those for the melting process. Similarly, energy

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expense and melting time are significantly lower than evaporation time and evaporation energy of a particle, transformed into a droplet.

Studying the sublimation and evaporation process of a single ice disk is made at temperature T,K and heat release intensity q,W/m³ averaged over the volume of the aerosol particle. If the beam intensity is moderate, then the melting temperature is not reached. Let's call the maximum heat release intensity q, at which the particle is not melted, threshold of melting q_{melt}. In the first its value depends on ambient air temperature T_∞, pressure q_{melt}. and minimum particle size (half thickness of the disk). In Fig.1 the dependence of p_∞ value on the ambient temperature T_∞ is drawn at a pressure p_∞=1bar and a disk half thickness r=d/2=1mkm. For comparison, the dependencies of q_{melt} value versus T_∞ are also drawn for a sphere and long thin cylinder of r=1mkm.

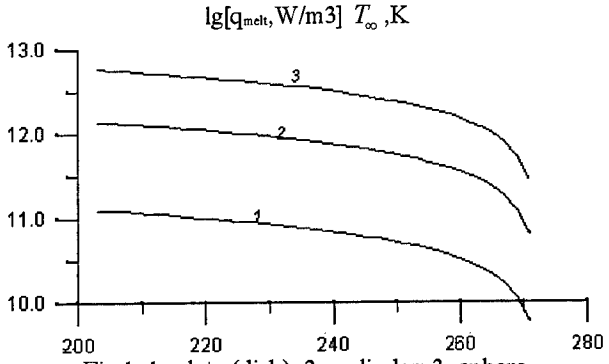


Fig.1. 1- plate (disk); 2 - cylinder; 3- sphere.

Thermal physical and optical properties of ice and water are insignificantly different ones from another [1-3], except thermal conductivity coefficient and vapour saturation pressure. In the same time the vapour mass flow from the disk surface is significantly less than that from the cylinder surface. The latter is less than vapour mass flow from the sphere surface if the cylinder and sphere radii are equal. Thus, the phase state of an aerosol particle (ice or water) influences on heating and evaporation process firstly through the ice aerosol particle form. When $q < q_{melt}$ the particle slowly sublimates losing its mass. The dependencies of the ice particle evaporation efficiency on ambient physical parameters, incident radiation, particle size are investigated. The characteristics of plate (disk) and spherical ice particles sublimation and evaporation, as well as the super cooled water droplet evaporation are compared. This work is done under the financial support of the Russian Foundation of Fundamental Investigation (RFFI) and ISTC (Project 200).

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1213.
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RADIOACTIVE DISTRIBUTION OF SIZE PARTICLES FOR SIMULATION OF SOME ANTROPOGENIC ACTIVITIES

GARGER E.K.[1], KASHPUR V.[1] PARETZKEH.G.[2], TSCHIERSCH J.[2]

[1] *Institute of Radioecology UAAS Tolstoy St. 14, 252033 Kiev, Ukraine*

[2] *Institute of Radiation Protection GSF-National Research Center for Environment and Health D-85764 Neuherberg, Germany*

(First received 5 February 1998)

Results for the antropogenic activities conducted in the frame of the Project ECP 1 "Contamination of surfaces by resuspended material" is presented. The accent is made on the describing of the radioactive distribution of size particles for the emission and transport processes simulated in the real field conditions into 30 km exclusive zone.

For tractor and truck experiments the character of the radioactivity distributions of size particles had the similar form with two maximums for the 2-4 μm range and the 12-20μm one. In all agricultural experiments it was a considerable part of activity distributed at the particles of 0.1 μm to 2.0 μm that is at the inhaleable range of size distribution. This part was equal 33% ± 6%.

From vertical profiles of Cs-137, Sr-90, Pu-239+240, Pu- 238 and Am-241 concentrations in two emission experiments with the high values of the emission rates and assuming that ratios between Cs-137 and other nuclides did not change with different ranges of size particles it was carried out the radioactivity size particle distributions for these nuclides by Cs-137 size distributions. The air concentrations of the plutonium sum was made up 36-40% from the total concentration for the inhaleable (0.1 - 2.0 μm) range and for giant particles (12.0 - 20.0 μm) - ~ 20%.

Ratios of the settling and friction velocities wg / u* were calculated for the estimation of the transport ability the large and giant particles. These ratios were 0.026-0.070 for different experiments . It means that particles with d = 12 - 20 μm may consider as light particles that is to neglect their settling velocity during the windy and unstable conditions preservation. So this supports a necessity to take into consideration this fact for the different tasks of dose assessments and radioactivity redistribution in the underlying layer of ground.

Measurement of the number concentrations to shown that the mean number concentration for large particles (3-10 μm and 10-30 μm) six times more the mean number concentration of fine particles (0.6-1.0 μm). The variation factor is more for giant particles (10-30 μm) and the ratio (Nmax / Nmin) has three order of magnitude for this range of particles compare with 7 times for the fine particles range.

Measuring were allowed to estimate the radioactive loading of size particles and to show the enrichment of resuspended particles compare with soil particles for the inhalation, respireable and large ranges of particles. The enhancement factor is increased from 4 to 29 times for (d < 2 μm) and (7 - 16 μm) ranges respectively.



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1057.
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MONODISPERSE LATEXES. MAKING, USING, CHARACTERISTICS.

CHECHIK O.S.

Scientific and production firm "VAPA", S-Petersburg, Russia.

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Monodisperse polystyrene latexes is especial group of latexes. Their main distinction is a narrow latexes particles distribution on size. It permit to employ these latexes for calibrating and checking of distinguish devices (electronic microscpes, particles counters and other), for checking of filters and filtering devices, for creation of modelling colloid systems with giving characteristics. Other specific region of their employing is a protein sorbtion on latex particles surface for making of medical diagnosticums.

We can make these latexes in laboratory scale by means emulsion polymerisation of styrene in presence of little strictly measuring amount of emulgator (sodium laurate or myristate as usually). We can receive by this way latexes with particles diameter in diapasone 0,05 microne. For making of latexes with larger particles we use usually seemed polymerisation.

An essential difficulty of these latexes receiving is their reliable attestation (determination of middle particle diameter and of degree their polydispersity. For their describing we use the average-number (S d/n) value of diameter and average-square deviation from average diameter. We use for measuring these characteristics two methods: electronic microscopy (miroscope Tesla BS-242E) and laser spectroscopy (Coultronix N4).

The characteristics of latexes we received are next:

Latex concentratio 10% (mass)

Particles dimensions diapason 0,05 - 4,0 microne

Particles dimensions measuring error 1-3%

Polydispersion extent 5% (for latexes with particles diameter 0,05-0,1 microne and 3,0-4,0 microne 10%).

It should be emphased, here are showed the guaranteed values of characteristics. Real values can be higher. Real measured polydispersity extent can be in diapason 2-3% and less.

Other characteristics of these latexes are next:

Dissoluble in water touch concentration less as 0,1%, it can be decreased, particularly with particles diameter more as 0,3 micrine, by dializing. Latexes particles material is polystyrene, its densityis 1,05 g/ml, refraction index is 1,59.

Depending on supplied latex volume we can sell it at a price 1000-3000 USD per litre. Analogous latexes supplied abroad at a price 6000-30000 USD per litre. Of course, these products are expensive, but a particles number in 1 ml of latex is 10^8 - 10^{13}. It is enough for reliable measuring to treat signals from 10^4 - 10^5 particles, so a value of one measuring is not so high. There are other methods of minimising of measuring value, now we work on one of them together with B.M.Zelicson ("Optica", SPb).

On inquiry of customer we can make modified latexes: painted, nonsedimented, carrying on particles surface carboxylic group, metal ions, metal atoms, including copper, silver e.o.

Other region of monodisperse latexes consuming is making on their basic of distinguish diagnosticums by sorbtion on their particles surface of distinguish proteins. The most interesting latexes are here on their particles surface are fixed functional groups: carboxylic, amino- et other, they allow strong to bind proteins macromolecules, excluding their desorbtion from particles surface. We can supply these latexes too.

Monodisperse latexes application here before "perestroika" became broadening, so it can

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expect to groww consuming of these latexes with renewal of home industry, especially based on high technologies.

1010.
УДК 541.18

SOME REGULARITIES OF A PRECIPITATION OF STOKE AEROSOL AND ITS ACCUMULATION ON A SOIL AND A VEGETATION

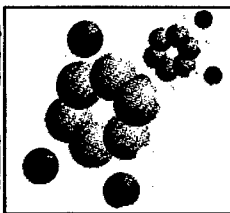
GRIGOR'EV A.I., SIDOROVA T.I.

Yaroslavl State University, 150040, Yaroslavl, av. October, house 17 "D", sq. 28,
Ph. (0852) 22 - 23 - 25 Grigor'ev A.I.

(First received 21 October 1997; accepted for presentation during IAS-4)

Smoke aerosols are known to be among the main sources of heavy-element soil pollution in urban areas. In connection with scheduled environmental studies, we measured the concentrations of various chemical elements Pb, Ni, Cu, Zn, Ba,and Co in the soil around a petroleum refinery. It is apparent that the positions of maximum concentration of different elements do not coincide. This result is in general quite unexpected, since indirectly through the relation describing the precipitation of smoke onto the soil it indicates that smoke particles of the same origin have different physicochemical properties.

It is not surprising that particles with different physicochemical properties appear in the smoke aerosol formed in the burning of combustible substances of complex chemical composition, since the chemical composition of a certain particle is determined by its entire history: the place at which it is nucleated in the flame and the chemical composition and temperature of the surrounding vapors and the products of combustion. Let us assume as an initial idealization that a smoke particle is formed as a result of condensation of vapors on a nucleus in accordance with the Maxwell equation, according to which the flux of condensing vapor of a substance onto a particle is proportional to the difference between the partial vapor pressure of this substance in the surrounding medium and that at the surface of the droplet, where the vapors can be assumed to be saturated. Since the pressure of the saturated vapor varies exponentially with temperature, it is easy to see that the temperature of the gaseous combustion products surrounding a smoke particle at the center of the flame and that of a smoke particle at the periphery of the flame will differ by hundreds of degrees. In this situation the mass fluxes of condensates onto the particles in the two situations will differ both in intensity and in chemical composition. As a result, the spread in the physicochemical properties of the material of different smoke particles can be extremely wide.



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1054.
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MATHEMATICAL MODELLING OF DISTRIBUTION OF ECOLOGICAL RISK ZONES IN ATMOSPHERE AND ON THE UNDERLYING SURFACE FROM AIR ANTHROPOGENIC SOURCES

ARGUCHINTSEVA A.V.

Irkutsk State University, Russia

(First received 11 December 1997; accepted for presentation during IAS-4)

At present the standard methods of air pollution estimate are able to calculate absolute concentrations of ingredients for concrete meteorological situations. Usually the joint realization probability of all meteorological parameters of these situations is approximately equal 0. In contrast to such approach the mathematical models considered in this work take into account the probabilistic distribution function of the stable climatic characteristics of the region and all wind situations. These models are a special case of solution of boundary problem with the random coefficients for description of natural processes dynamics. In order to calculate a probability of realization for some solution it is evidently necessary to consider a set of solutions for various combinations of random values of coefficients, initial and boundary conditions.

The behaviour of these coefficients is determined by multi-dimensional function of probability density. A concrete form of theoretical density function may be established from a minimal discrepancy with an empirical distribution law (assigned on the base of external factors for the problem under consideration). The problem solving is considerably simplified when analytical solutions are used for the differential equations of transport and turbulent diffusion. The results will enable to perform a probabilistic evaluation of studied phenomenon, e.g. frequencies of the given criterion exceeding. Such the results may be following: probability of appearance of various climatic extrema, probability of exceeding indicated norms for the pollutants and for duration of living organisms stay (residence) in such dangerous zones. In addition a quantity of pollutants deposited on the surface (soil, water bodies) from sources can be evaluated for the studied time interval. Problems of the second pollution of surface can be solved.

1053.
УДК 541.18

MODELING OF MESOMETEOROLOGICAL PROCESSES AND POLLUTANTS TRANSPORT IN THE BOUNDARY LAYER

ARGUCHINTSEV V.K.

Irkutsk State University, Russia

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Transport of atmospheric admixtures from their sources depends on meteorological conditions, orography and interaction of admixtures with the earth's surface.

For determination of admixtures motion velocities and coefficients of turbulent diffusion it is necessary to solve the equations of geophysical thermodynamics in combination with equations of admixtures transport.

We consider the statement and the method of solution of non-stationary three-dimensional nonlinear problem for mesoscale processes arising over thermal and orographic nonhomogeneities of the underlying surface on a background of time and space - variable large-

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scale meteorological fields. The model is constructed without the hypothesis on quasi-static and without the simplifications of the free convection theory.

The model takes into consideration all the components of Coriolis force and atmospheric compressibility. The model will enable to give an account of a broad spectrum of mesoscale phenomena: breeze, mountain and valley circulation with external wind, katabatic winds, dry winds, orographic waves, mesoscale structure of meteorological fronts, convection which is generated by anthropogenic factors etc.

Integration of the equation was realized for Cartesian coordinate system with the aid of the fictitious regions method. To solve the equation we use the methods of constructing of conservative finite difference schemes based on the conservation laws. The time approximation of the problem is constructed with the aid of two-cyclic full splitting. We use the nonmonotone factorisation for the numerical realization of the finite difference equations.

Numerical experiments were realized for study of mesometeorological processes and aerosols transport in the region of Lake Baikal.

1078
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OPTICAL DISTANCE PROBING OF EXTRACTIVE PULPS

TERENTIEV V.E.

All - Russian Scientific Centre "State Optical Institute name after S.I.Vavilov", Russia, 199034, St.-Petersburg, Birgevaya line, 12 Tel: (812)218-00-82, fax:(812)218-37-20, E-mail: Leader@soi.spb.su

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The problem determination of small concentration of elements and combinations in the form of admixture with a mass portion ~ 0.1% and less in the extractive pulps (the dispersion systems of a fine - fragments solid substance with water) is solving at present by means of a laboratory method titration of samples, selected from the extractor with periodicity defined of the duration of analytic measuring (more 40 minutes). It's suggested the new probe of principle - optic-electronic analyser of admixtures, allowed to measure a concentrations of admixtures in extractive pulps continuous in process of production [1,2]. In given work the theoretical and methodical principles of optical distance probing of extractive pulps were examined, the results of the industrial probations of the analyser were presented.

It's supposed in theory, that pulps is describing by the strong stretched forward diagram of the light scattering, and theory, were developed in work [3], is spreading on pulps. Side by side with calculation of the scattering, determination of concentration SO_{3free}, P_2O_5 and other admixtures in pulps is founding on differences of optical spectrums between molecular interaction for different admixtures in the same condensed medium [4]. Influence of a pulp boundary on optical bunch is defining by refraction of radiation in the perturbed by boundary layer. Liner depending is supposed between indices absorption, scattering and correspond concentrations of admixture and of suspended substance.

With calculation the named assumption the formulae, established a communication of concentration of admixture as well as suspended substance in pulp with reading of the analyser, were defined. Methodic principles of foundation, colibration of analyser of admixtures in pulps were elaborated. Some results of measurements were presented.

At time the industrial probations of analyser the effect "Vanish of boundary division of pulp - air", consist in stabilization of the analyser reading by disturbance of stratification of pulp sample account for intensive mixing by the rest of the same conditions, were discovered. It's possible that effect is conditioned by optical pulp characteristics, namely, by great value of

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average quadratic scattering angle in one scattering act $<\vartheta^2>$ in comparison with diffraction angles Θ of radiation bunch in result refraction in perturbed by boundary layer.

In regime of continuous probing of extractive pulps the mistake of measurements of concentrations SO_{3free} isn't exceed $\pm$ 0,1÷0,15% mass for concentrations 1,0÷3,5% by a correlative coefficient no less 0,9 with data of control analytic measurements [2].

Author thanks to Mrs. M.N.Batova for participation in industrial probations and treatment of results, metrological certificate of optic-electronic analyser of admixture.

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EXOGENOUS SUPEROXIDE IS A VITAL NECESSARY COMPONENT OF THE ENVIRONMENT

GOLDSTEIN N.

Stahnsdorf, Germany Email: 100345.205@compuserve.com Fax:+49(0) 3329-660200

(First received 19 February 1998; accepted for presentation during IAS-4 Published by recommendation of Professor Korkina L.G.)

During the last nearly thirty years, a large body of experimental evidence has accumulated that suggests an important role for reactive oxygen species in numerous pathophysiological processes. The discovery by McCord and Fridovich in 1969 that an enzyme exists that has superoxide dismutase activity, suggesting the continuous formation of superoxide in mammalian cells in vivo as well as involvement of the superoxide in the inflammation and post-ischemic reperfusion syndrome consolidate the opinion about the "good" superoxide dismutase and the "bad" superoxide that they scavenge (1). However, the superoxide is not all bad effects how. Moreover, we have reported that gaseous superoxide (GS) is an inalienable part of the atmosphere, and is also essential for the terrestrial organisms (2). Uninterrupted deprivation of the atmospheric superoxide lead to the degeneration of the hypothalamic and pituitary nervous and secretory cells leading to numerous movement and autonomic disturbances and death of animals. Hypothalamus by means of the "periscope" from the diencephalon, vomeronasal system may monitor exogenous GS and is probably the first brain structure sensitive towards the GS changes in the ambient air. In this connection it is not unlikely that the partial lack of the GS could be the cause for the so called sick building syndrome and other complex vegetative disturbances, in human-beings.

Inhaled artificial GS provokes cascade of dramatic biochemical and physiological reactions. Thus, inhaled GS suppresses monoamine oxidase activity in the regions of hypothalamus and basal ganglia activating brain dopaminergic and serotoninergic mechanisms (3) as well as enhancing brain tissues superoxide dismutase activity. Catalase, glutathione peroxidase, glutathione reductase and glutathione are also involved in these reactions. In addition, inhaled GS suppress cytochrome P-450 activity in the liver causing changes in the metabolism of xenobiotics including various drugs. In the fore-part of pituitary, inhaled artificial GS activates

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both adrenocorticotropin and thyroid hormone producing adenocytes stimulating the cortisol production by the adrenal glands and activating the cell respiration, in vivo.

The biochemical changes observed underlie the numerous physiological and therapeutic effects caused by inhaled artificial GS. We have reported that the GS potentiates pain-relieving action of the opioid and non-opioid analgesics in animals and human-beings (4 - 6), weaken action of the narcotic and sedative drugs, improves disordered movement and autonomic functions in parkinsonian patients (3), and the respiratory function in asthmatics (7, 8). Exogenous GS abolishes toxic effects caused by the hyperbaric and normobaric oxygen, and enhances efficiency in the various experimental conditions, in animals. In addition, inhaled artificial GS modifies spontaneous activity in animals, and decreases temporal and spatial threshold of the smell (9) and gustatory, in human-beings.

Thus, all our data suggest that the gaseous superoxide found in nature a constructive use and is a vital necessary component of the environment.

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THE CHARACTERIZATION OF $SMCO_5$ POWDER

TALIJAN N., MILUTINOVIC-NIKOLIC A., JOVANOVIC Z.

Institute of Chemistry, Technology and Metallurgy, Njegoseva 12, Belgrade, Yugoslavia

(First received 19 March 1998; accepted for presentation during IAS-4)

In the course of studying the field of permanent magnetic materials of the Sm - Co type, it was noticed that although the properties of the final magnet strongly depend on the character and behaviour of the starting SmCo5 powder, the methods for powder characterisation have

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not yet been systematised.

If the SmCo5 powder is to be used in the production of sintered SmCo5 magnets it should be of the following characteristics: the samarium content must be in the interval from 32 to 39 mass%; the minimal content of the SmCo5 phase must be 95-97 mass %. [1] For achieving high magnetic performances it is necessary that the particle size of the starting powder be between 1 -10 μm. [1] It is very difficult to align particles larger than 10μm, and particles smaller than 1μm are easily oxidised. In both cases the magnetic properties decrease. The oxygen content in the starting powder is between 200 - 2000 ppm depending on the process of powder synthesis. The allowed oxygen content in the final sintered magnet is 0.6-0.8 mass %, and it requires continual oxygen analysis, not just of the starting powder but also of all the steps in the production of sintered SmCo5 magnets, specially the milling of SmCo5 powder. [1]

After considering all the experimental results obtained during the investigation of the synthesis of sintered SmCo5 magnets, a selection of appropriate methods for the characterization of the starting SmCo5 powder was made. [2]

The suggested methods were confirmed experimentally as being necessary for the reliable and adequate characterization of the SmCo5 powder used as the starting powder for the production of sintered SmCo5 magnets. The selected methods include: X-ray Micro Analysis using EDS for chemical analysis; Scanning Electron Microscopy with appropriate software for the quantification of the images for microstructure and morphological characterisation; X-ray diffraction analysis for the qualitative identification of the SmCo5 phase and calculation of the crystalline lattice parameters and TGA for estimating the thermal stability of the SmCo5 powder; oxygen content using a LECO device, as well as magnetic measurements. Some of the results of the characterization of the SmCo5 powder obtained using the chosen methods are presented in this paper. [2]

It was confirmed by micro-X-ray spectral quantitative analysis using the corresponding energy dispersion spectra that the obtained samarium content (38 mass %) corresponds to the projected chemical composition enabling optimal magnetic properties.

The morphological characteristics of the starting and milled powders were investigated for different milling times using SEM analysis with appropriate software for the quantification of the visual information. By comparison of the observed particles size with the results of magnetic measurements it was possible to examine the influence of the milling time on the change of the particle dimensions and relative change of coercivity. It was found that for all the investigated milling times (up to 120 minutes) the decrease in particle size was followed by an increase in the coercivity. In the same time, increase in the oxygen content was acceptable up to a milling time of 60 minutes. [3]

X-Ray diffraction analysis was used to quantitatively determine the phases present in the starting and optimally milled powder. Only the SmCo5 phase was identified by X-ray diffraction. In this way a minimal amount of 95 mass % of SmCo5 was confirmed. [2,3]

The parameters a and c of the hexagonal crystalline lattice of the SmCo5 phase were calculated on the basis of the obtained diffractograms for the initial and milled powder. The experimentally calculated values of the parameters a and c of the SmCo5 hexagonal crystalline lattice of the starting powder and milled powder differ from the standard values by less than 0,2%. [2,4] Applied milling conditions did not induce defects in the crystalline lattice of the

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$SmCo_5$ powder.

The thermal stability of the $SmCo_5$ powder in a static air atmosphere was investigated by thermogravimetric analysis (TGA) using a DuPont Thermal Analyzer. Investigation of the behaviour of the $SmCo_5$ powder during heating was carried out using fresh samples of $SmCo_5$ powder for each of the investigated temperature cycles. It was found by TGA that oxidation of $SmCo_5$ was negligible below 200 ^{o}C. X-Ray diffraction of the residues remaining after thermogravimetric analysis of the $SmCo_5$ powder, heated at 240 ^{o}C, showed only the presence of the $SmCo_5$ phase. Different crystal forms were identified by X-ray diffraction depending on the maximal heating temperature. The following phases were identified: Sm_2O_3, Co, CoO, Co_3O_4 and $SmCoO_3$. According to the TG and X-ray results, for each of the investigated temperatures, the corresponding chemical reactions were established. [5]

Based on the obtained experimental results of testing the character and behaviour of powder of the intermetallic compound $SmCo_5$ and by processing of the experimental results, the most suitable technological parameters are designed for all steps in the procedure of obtaining the sintered $SmCo_5$ magnets.

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NIIOGAS:
Москва, 1-й Нагатинский проезд *095-* 1112419; 1113127
1st Nagatinsky Proyezd, Moscow, 113105, Russia
Telephone:7-095- 111.24.19; 111.31.27 Telex: 112153 IPRIT

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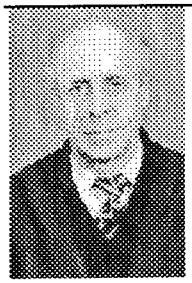
for ceaning of gases from sulphuric acid and having traces ot arsenic, selenium and sulphur oxides. It is used in mineral fertilizer production and other industries. polymer electrostatic precipitator makes it possible to save 14 t of lead, while eliminating lead soldering that is harmful for human health.

This electrostatic precipitator having a vertical gas flow is a metal housing lined with acid-resistant brick wherein receiving and curona. The receiving electrodes made of polymer are shaped as hexahedral tubes.

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INTERNATIONAL AEROSOL SYMPOSIUM *IAS-4*

July 6-9, 1998 **S.PETERSBURGH *RUSSIA***



TITLE OF SESSION **SPACE DEBRIS**

Chair Prof. **GEORGY M. CHERNYAVSKY**

Fax 7-095- 4202275
phone 7-095- 4295311
Morozov@cpi.rssi.ru
Director of Center of Program Studies of Russian Space Agency
117418 Moskva Profsoyuznaya 84/32

INTERNATIONAL AEROSOL SYMPOSIUM *IAS-4*

July 6-9, 1998 **S.PETERSBURGH *RUSSIA***

TITLE OF SESSION **CLIMATE & AEROSOLS**



Chair. **PROF KONDRATIEV KIRILL YA.** *(14.06.20)*

Phone 7-812-2317773, 2307837
Fax 7-812-2307994
Russian Scientific Center of Ecological Safety
Address: Korpusnaya St. 18 197042 St. Petersburg RUSSIA
Nansen@sovam.com

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July 6-9, 1998 **S.PETERSBURGH *RUSSIA***

TITLE OF SESSION **MARINE AEROSOLS**

Chair. **ALAN WEINSTEIN, PH.D.**

Associate Director Environmental Science
Office of Naval Research Europe
International Post: 223 Old Marylebone Road, London NW1 5TH, UK
US Post: ONR Europe, PSC 802 Box 39, FPO AE 09499-0700
Tel: 44-171-514-4964 FAX: 44 171 723 6359
E-Mail: aweinstein@onreur.navy.mil http://www.ehis.navy.mil/



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1420.
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INFLUENCE OF DIFFUSIVE LEAKAGE IN METHODS OF PARTICLE REJECTION FROM SURFACES

CASTILLO J.L.*, GARCIA-YBARRA P.L.**

**Dept. Fisica, UNED, Apdo. 60141, 28080 Madrid, Spain;*
***CIEMAT, Avda. Complutense 22, 28040 Madrid, Spain*

(First received 26 March 1998; accepted for presentation during IAS-4)

Keywords: Brownian Diffusion, Thermophoresis, Blowing, Aerosol Deposition, Aerosol Physics

In some industrial applications and material processing techniques, one tries to avoid the problems associated with the arrival and deposition of small particles on specific locations. For instance, in coal combustion processes, the deposition of soot particles and flying ashes on combustor walls and heat exchange tubes leads to slagging and fouling and provokes a reduction in the efficiency of the process. Also, in CVD growth techniques care should be taken to reduce the deposition of particles on the surface of the growing solid, to avoid the pollution of the resulting materials.

Several methods have been proposed to reduce particle deposition on the walls confining particle laden gases: such as thermophoresis, blowing, buoyancy effects, etc. The efficiency of these methods lies on the generation of a particle repulsion field near the wall. However, due to the unavoidable presence of Brownian diffusion some particles will diffuse against the repulsive force and reach the solid surface. This work deals with the analysis of the deposition flux due to Brownian diffusion under these constraints. The asymptotic limit of very large Schmidt numbers will be studied.

Heating the surface and imposing a thermal difference between the wall and the mainstream can reduce particle deposition rates. Then, thermophoresis (drift of particles down a temperature gradient, Rosner et al. 1992) pushes the particles away from the heated surface and a dust free region generates around the surface due to this thermally induced repulsion. Anyway, there exists a particle leakage towards the surface due to Brownian diffusion. Previous theoretical works, Gokoglu and Rosner, 1986, Friedlander et al. (1988), Garcia-Ybarra and Castillo (1996&1997), as well as recent experimental measurements, Wirzberger, et al. (1997), show the persistence of particle deposition rates which decrease exponentially with increasing wall-to-gas temperature differences.

Blowing is another mechanism commonly used to keep the particles away from walls. Here, the convective flow near the solid body opposes the transport of the aerosol particles to the wall. Also, buoyancy effects may be used to achieve this goal by locating the worthiest walls on the top. In any case, due to Brownian diffusion some particles are able to leakage against the flow field or buoyancy forces and deposit on the surface. The deposition rates of large particles will be analyzed in the limit of high Schmidt numbers.

As a model problem, the laminar (and self-similar) boundary layer around a wedge shaped solid will be considered. In the differential equation governing the particle mass fraction, the highest derivative (of the mass fraction with respect to the spatial similarity variable) is the term accounting for Brownian diffusion which is multiplied by the inverse of the particle Schmidt number.

In the limit of very large Schmidt numbers, the solution of this equation becomes singular. An approach in the same way as the analysis presented by Garcia-Ybarra and Castillo (1997) is always feasible.

Numerical evaluation of the asymptotic expression for the deposition rates will be presented and compared with the complete numerical solution.

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977.
УДК 541.18

ON THE OPTICAL METHOD REGISTRATION OF THE AIR RADIOACTIVE EJECTION OF NUCLEAR POWER STATION

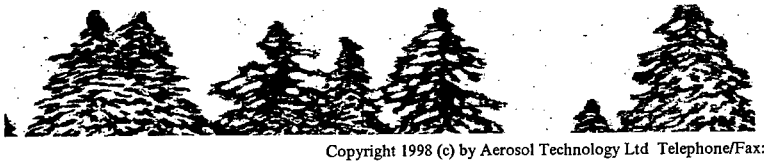
AVAKYAN S.V., VORONIN N.A., IL'IN V.V., SEROVA A.E., STARCHENKO A.N., TCHARUHCHEV A.V.

All-Russian Scientific Center "S.J. Vavilov State Optical Institute", 199034, St. Petersburg, Russia; Scientific Research Institute of Complex Task of Optical-Electronic Devices, 188537, Leningrad region, Sosnovy Bor, Russia.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

In this paper the investigation of the possibilities of the registration by optical-electronic devices of the radioactive air ejection of nuclear objects with taking into account the optical air fluorescence mechanizm from [1] are carried out. It is known the radioactive gas and aerosol ejections during and after accident at the atomic power-station are very dangerous source of environmental pollution. These ejections are spread by meteorological air flows over considerable distances (up to several thousands km and more). Therefore the dissipation and settling of radioactive nuclides are occurred over very large area.

Existing remote sensing methods of the registration of radioactive clouds don't provide necessary information. The radar as and lidar methods detect the aerosol component of the ejection that often does not allow selecting the signal from the radioactive air ejection or a thunderstorm cloud and the aerosol (smoke) component which exists also above the thermal power-stations. The measurements of gamma-radiation from the radioactive nuclides are possible only at a distance ~ 100 m.



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The fact that Chernobyl ejection was detected in first time outside the former USSR (Sweden, Uppsala) by abnormal changes in the parameters of the atmospheric electricity in the radioactive cloud came from Chernobyl [2] confirms the importance of the registration of the ionizing ejection component for the purpose of identification of its radioactive origin. However discussion of the possibility of using this method for the nuclear ejection registration [3] has come to the conclusion that electrical data are not sufficient for determination of the cause of the observed abnormal spatial changes in the atmospheric electricity because there are too many physical processes which can provoke them.

In [1] the optical method of registration of radioactive air ejection by means of particular bands of atmospheric fluorescence with very high threshold of excitation was presented. There are three emission bands which are quite prominent and lie in the blue range of spectrum. It is important that they are absent in other events of natural and technological air emissions, besides short time lightning. It should be mentioned that just blue fluorescence of the air was observed above Chernobyl nuclear power plant.

The intensity of these emissions is much higher than background, especially at night. The transformation ratio from gamma-radiation flux to the visual one (for three bands) is 10^{-1} - 10^{-2} and for accident the intensity of optical emission (for radioactive cloud of 10^5 - 10^6 Ci) could be approximately 10^{13} - 10^{15} photons.s^{-1}.

The preliminary estimate can be made by making use of this data on the emission intensity. At the small size of a cloud (~100 m) the intensity of optical emission in the blue spectral range will be (1 - 100)(10^{-6} W, which at the distance R=1 km give the irradiance 10^{-12} - 10^{-10} W.m^{-2}. Measurements of these small intensities are difficult because there is a background radiation, especially during day-time.

For reduction of the background influence and for increase of the signal-to-noise ratio in the working spectral ranges the high performance spectroradiometric apparatus will be used. In the first experiments the spectroradiometer "Luch-1", which has been made before is supposed to be used. The characteristics of the apparatus "Luch-1" are: spectral range - 200 - 1100 nm, the entrance pupil - 0.06 - 0.07 m^2, the focal length of the objective lens - 1200 mm, the width of entrance slit - 0.1 - 4 mm, the viewfield angle - 0.1 - 3 mrad, dynamic range of photo-received devices - 10000, the spectral resolution - 0.5 - 10 nm, the scan speed - 5 nm/c, the range of the measured brightness (with 1 mm slit) - 10^3 - 10^8 W.$sr^{-1}m^{-3}$, the range of irradiances - 10^{-12} - 10^{-5} W.m^{-2}.

We are planning to develop special apparatus equipped with CCD TV camera (threshold flux is 10^{-14} - 10^{-13} W) for measurements of the energetic characteristics of the optical emission of the radioactive air ejection (cloud) in the night. This approach allows the standard apparatus to be used for longterm registration, measurements and information processing.

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978.
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MEASUREMENT CHARACTERISTICS OF RECEIVERS AND SOURCES OF RADIATION

MIKHAILOV O.M.

ARRC "S.I. Vavilov State Optical Institute (GOI)"

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The paper considers the problems of measurement of the active radiation and its conversion when having a contact with objects of the environment. A large number of receivers of optical radiation with different methods of performance are known, from selenium photo-element and thermo-element to photoelectronic multipliers and avalanche photo diodes. Their main purpose is to indicate the radiation or its modified state. The purpose of any measurements, however, is to obtain true, reproducible and stable results with preset error of measurements and selected confident probability. Such properties belong only to measuring photo receiving devices developed in cooperation with the State Optical Institute.

The paper shows the investigation results of boundary, specific and spectral power characteristics of the photoreceivers being widely used in industrial developments and in optophysical research and providing the unity of the radiation measurements. The measurement receivers of optical radiation, i.e. vacuum photo elements (F21, F28, F35, etc.) vacuum photo multipliers (FEU-142, FEU-154, FEU-100, FEU-84), phosphide-gallium, silicon and germanium photodiodes (FD-Fg, KFD-105A, FD288k, FD-9g, etc.), thermoelements and bolometers (e.g. RTN-30, PP-1). The latter are used as non-selective wavelength receivers in the wide spectral range with linearly-limited voltage and current characteristics and stability. Spectral operation range of measuring receivers is from 0.1 mkm to 11.0 mkm, the linearity of the power-current or light characteristic maintains with variation of radiation on their sensitive elements to 10^8 times (with photomultipliers to 1000 times), long-term reproducibility of power units storage within 10 years is ±5%, the non-stability error of measurement results does not exceed ±1%. the variation range of the incident measured flux is 10-100000 W.

The techniques of spectral correction of absolute and relative spectral sensitivity of receivers have been shown for solving the given photometric problem of measuring the efficient values. The above mentioned involves the use of measuring photoreceivers as standard means of measurements for carrying out equally spectral and light measurements. The property of self-calibration of silicon and germanium photo diodes eliminating the use of the expensive standards of power spectral measurements has been especially emphasized. Transfer and storage of the radiation power unit in different parts of spectrum in 450.....800 nm wavelength is done by the measured current value in Ampers with total error of power determination to 0.1%.

The measurement radiation sources in the traditional spectral region are well known, these are "light measuring" lamps and black body models. The paper emphasizes the broadening of operational possibilities of instruments and the universal character of research due to the development of new fields of science and an increase of dynamic and spectral ranges. The ordinary radiation sources are not able to operate as measuring devices. New standard grid-power sources have been created. Their operation takes into account the broadening of the spectral region into the UV part (gas discharge lamps DNK-90 and VMF-25), the possibility of measuring pulse radiation with up to 1 ms duration (pulsed standard lamps IShO, IPO, ISK, etc) and the necessity of modelling small size objects (stars imitators) and solar radiation. The common range of the confident radiation wavelengths is 0.1... 2.5 mkm, stability and reproducibility of radiation is, type of radiation is a linear or solid spectrum.

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The paper briefly considers the problems of spectral and integral attenuation, absorption and diffusion of the measured and active radiation. To conclude, it is noted that the developed methods and means of radiation measurement make it possible to create optoelectronic devices of high accuracy concerning the parameters of power variations of the coherent and non-coherent radiation.

984.
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THE EFFECT OF MAN FACTOR ON ATMOSPHERIC ECOLOGY (AEROSOL POLLUTION)

ANDREYEV E.

All-Russian Vavilov Scientific Centre SOJ ; Birjevaya linia, 12, St-Petersburg, Russia

(First received 18 November 1997; accepted -9.02.98 for presentation during IAS-4)

The advantages in studies of the Earth atmosphere allow to understand clearer the effect of man factor on atmospheric processes which determine its state and radiative properties. Modern scientific knowledge at the Earth atmosphere may outline the four main negative effects of man factor on environment: stratospheric ozone depletion, acid rain , toxicity and global warming. The atmospheric aerosol takes active part in these processes due to its chemistry and optical characteristics. The presence of aerosol particulates in atmosphere stimulate different chemical reactions on their surfaces. So the chemical composition of atmosphere changes. The aerosol particulates effect also on radiation processes in atmosphere. Annual release of polluting chemicals in continental U.S. by industrial activity shows a scale of effect on environment [1].

Table 1.

Sourse	Quantity (kilotons)
Heating and power generation	33000
Transportation	9100
Industrial processes	6100
Rockets	3

The particulates contribute a significant part of this release. As an example, annual contributions (in kilotons) of the most important gases released in stratosphere by different sources are shown in the table 2.

Table 2.

Source	Cl	H_2O	H_2	Nox
Industrial	300			
Volcanoes	100-1000			
Natural	7.5	15600	340	280
Rockets	0.79	3.25	0.2	0.016

Note: chlorine data are global, other data for northern mid -latitudes. The properties of aerosol particulates as catalysts are known insufficiently. Studies indicate that the rate of the catalysis of ozone depletion by fine fraction of particulates depends on their surface area, and that the threshold surface area for ozone depletion is 5...10 mcm^2/cm^3. It should be noted that the lifetime of particulates in the stratosphere is on the order of 1...2 years. This phenomenon

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was seen during the eruption of volcanoes El-Chichon in 1981. Another problem of aerosol pollution is global actinometric measurements and its influence on optical characteristics of atmosphere [2]. The concentration of particulates can reach 10^{10} particles on cm^2 of vertical column in the atmosphere of industrial zones and megapolices. The spectrophotometric observations indicate that the atmosphere above such regions remains strongly turbid during a long time without natural purification. Under strong aerosol pollutions of air the radiation absorption by aerosols can reach values to be compared with those for molecular absorption by all atmosphere gases. So one should take into account aerosol atmospheric component when considering such phenomena as "green-house' effect and rainfall at forecasting a local weather. Analysis of different aspects of aerosol pollution shows the necessity for studies of optical and physical properties of aerosol particulates from different souses and operative optical monitoring of aerosol pollution of atmosphere above industrial regions.

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METROLOGICAL PROVISION OF AEROSOL MEASUREMENTS

MIKHAILOV O.M. , KANATENKO M.A.

ARRC "S.I. Vavilov's State Optical Institute (GOI)"

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Strictly speaking, the total complex of aerosol research, the corresponding temperature tests (including terrestrial ones), and technological processes of aerodispersion systems are not possible to be based on the developed national scheme of transfer and storage of physical units, i.e. calibration scheme, standards, test pieces and working means of measurement. The main reason is the lack of a single or a few physical values that would describe the state of aerosol measurements with a sufficient completeness. Therefore, the latter are of indirect or total character. However, basic research, physical (optical) experiments and the equipment for scientific and applied research can not do without measurements with the results expressed in legal units and the measurement value has a preset probability.

Metrological provision of any kind of research and developments is a special kind of activity which is finally aimed at the achievement of the unity of measurements being carried out. The development of optical aerosol devices, their units and elements, the unique measurement and test methods require experimental research to determine the degree of their correspondence to the established regulations and standards of metrology.

Carrying out optophysical research and tests is generally of a unique pre-informative character with regard to standard and even precision measurements. In such case metrological provision of aerosol research can be based on three techniques described in the paper and conditioned by the content, the method and the final aim of comprehensive tests of measuring aerosol devices, simulation of the external conditions effects and the performance of aerodispersion systems and optophysical aerosol research. The first provides a metrological certification of the set-up and is based on the direct measurements. The second involves the measurement of a few physical values and a by-element certification of the test complex. The third includes the research where new physical quantitative and qualitative relationships are

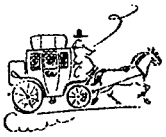
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established. In this case the metrological provision is based on certification of the procedures of carrying out the measurements and can also involve a partial metrological certification of separate elements of the scheme. This is the most inexpensive, reliable and universal technique. The three techniques require a deep analysis of the error of measurement results and an establishment of confident limits of their effect.

The paper shows that the basic measure of reliability of aerosol measurement results is the comparison of the measurement results and their mutual recognition on the inter-laboratory and international level. At the Vavilov's State Optical Institute there is a branched network of standard samples and specimens and a developed information automated system of optical measurement means. An operative data search of the instruments can be done both by name (or type) and by preset measurement parameters in correspondence with the measurement problem being solved. Standard samples and means of measurement can be placed prior to the local test schemes and provide the unity of measurements of such fields as dispersion media research, colorimetry, polarimetry, spectrophotometry, scattered radiation measurement, etc.

Standard samples of the Vavilov's GOI are used for measuring spectral coefficients of absorption, radiation, transmission and reflection (direct and diffuse), refractive index, gas mixtures, content, normalized characteristics of glass properties, colorimetric relationships. Standard optical measurement means include, in particular, models of black bodies, photoreceiving devices and radiation sources for 100...11000 nm spectral region.

The developed methods, standard means and measures for measuring coherent and non-coherent radiation and its modifications coefficients and the certified methods of carrying out optical, optotechnological, holograghy, fluorescent and spectrophotometrical measurements are aimed at providing reliability and unity of measurements in the research and and building of optoelectronic instruments including those for aerosol measurements.



980.
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TOOLS OF MEASURING VISIBILITY OF OBJECTS THROUGH AEROSOL MEDIA

YEVSIKOVA L.G., PUISHA A.E.

ARRC "S.I. Vavilov State Optical Institute (GOI)"

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

Observation through aerosol media (fog, rain, smoke, etc.) involves the problem of estimating the visibility of real (voluminous, relieved) objects against real backgrounds, since for such objects luminosity both over the surface of the object and over the surface of the background varies among different sections of the area, thus eliminating the possibility of using the concept of contrast.

At the Vavilov's GOI the method of estimating the visibility of real objects in full-scale conditions with observation through aerosol media has been developed basing on measuring the value of the degree of the object visibility [1]. For this purpose, the notions of conventional contrast, conventional threshold contrasts of visual perception of real objects and their limiting range of visibility have been introduced [2].

Test samples of non-adaptive visibility meters IF-173, IF-173M [3] have been created, with improved optotechnological, accuracy and ergonomical characteristics with the following

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technical parameters:

Magnification, x	1.5... 10
Field of view angle, deg	40... 5.7
Size of the exit pupil, mm	2 x 2
Dioptry focusing, dptr	4
Angle of turn of the line of sight, deg.:	
by the horizon	360
by the vertical	10
Overall dimensions, mm	870x290x160

The serviceability of the developed methods has been confirmed by full-scale and laboratory tests [4]. It has been shown that the use of IF-173 and IF-173M equipment makes it possible to measure true, visible threshold contrasts of any objects and their limiting visibility ranges to an accuracy of 8-12% against any backgrounds, in any conditions of observation with no long distant tracing being required.

For estimating the visibility of real objects in the near IR spectral range, the structural and principal circuits of the IR visibility meter in 0.7...0.9 mkm spectral range have been for the first time developed at the Vavilov's, the calculations of the overall dimensions and aberrations of the optical system have been carried out and a laboratory model has been made with the following technical parameters:

Visible magnification, x	4
Field of view angle, deg	11
Focal distance of the lens, mm	120
Exit pupil diameter, mm	5.7
Diameter of photocatode of EOC, mm	25
Electronic-optical magnification, x	1
Dioptry focusing of the eye-piece, dptr.	4
Focusing adjustment of the lens with object distances being, m	15 and 500

A software product of the calibration of the model and experimental data processing has been developed.

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986.
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UV, VISIBLE AND IR HIGH-QUALITY SMALL-SIZED OBJECTIVES FOR RESEARCH OF ATMOSPHERE OPTICAL PARAMETERS

KAMESHKOV G.B., MIRZOEVA L.A., GRAMMATIN A.P., LUSTBERG E.A., MAKOVTSOV G.A.

All-Russian scientific center "S.I. Vavilov State Optical Institute"

Russia, St.Petersburg, 199034, Birzhevaya line, 12.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

Standard small-sized and light-weight high-quality objectives operating at wide spectral range from UV (0.3 μm) to middle IR (6.0 μm) for aerospace purposes have been produced and tested in All-Russian research center "S.I. Vavilov State Optical Institute" in 1996.

UV objective, 130 g mass, holds high image quality in wide temperature range. Petzval's scheme is used as base element of the objective. Galilee's system with angle magnification less than one is placed before it. Concave- plane Smith's lens is put behind Petzval's objective near image plane in order to correct image curvature. It allowed to reduce general length of the objective to 35 mm. Objective includes 7 lenses, three of them are of lithium fluoride and other four of silica glass. Focal length of the objective is 21 mm, diaphragm ratio is 3.5, angle field of view is 30^0. Total transmission in operating range 0.3-0.4 μm is 75%, energy concentration in circle dia 27 mm is 80%, relative radial distortion at edges of filed of view does not exceed 4%. When heating up to $+50^0$C image plane is shifted by minus 0.016 mm, when cooling to -20^0C by 0.019 mm correspondingly.

Lens IR objective, 210 g mass, is meant to operate at temperature 90^0K. Objective includes 4 lenses, two of them are of silica, two other of fluorite. Four-layer AR-coating on silica lenses provides high transmission (more than 70%) at spectral range 2.6 - 5.0 μ. Focal length of the objective is 18 mm, diaphragm ratio is 1.6, angle field of view is 28.4^0 at temperature $+20^0$C as well as at -170^0C, energy concentration is more than 80% both in the circle dia 20 μ (at the spectral range 2.6 - 3.0 μ) and in the circle 35 mm (at the range 2.6-5.0 μ).

Five-lens objective, 240 g mass, is meant to be used in optical assembly of spacecraft astro-measuring system. When being developed, we paid special attention to provision for following requirements: - small chromatic aberrations at spectral range 0.5 μ wide (operation spectral range is both at visible and near IR ranges); - high-stable image scale within the temperature range 20^0C 30^0C; - efficient attenuation of side illumination from Sun radiation coming to the objective from blind, lighted by the Sun; - low level of light scattering from intensive point sources of radiation (bright stars) within field of view; - decrease of light size of front optical component by matching its first surface with aperture diaphragm, in order to have minimum length and mass of anti-sun blind.

Focal length of the objective is 60 mm, diaphragm ratio is 3.8, angle field of view - 8^0. Total transmission is 90% at spectral range 0,5 - 1.0 μ. Perfect combination of optical materials used for the lenses allowed to achieve high level of achromatization at the working spectral range. Level of scattering was decreased not only by reduce of number of working surfaces bordered on air (three middle lenses were combined into unit by cementing) but the use of five-layer achromatic AR-coatings.

All samples of above described objectives were manufactured and executed tests confirmed that specified characteristics were obtained and they are in agreement with computation.



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APPLICATION OF TIKHONOV REGULARIZATION METHOD TO OBTAIN SIZE DISTRIBUTIONS

ALVAREZ, M. L.[1], CANALS, A., MORA, J., TODOLÍ, J.L.

Department of Analytical Chemistry, Alicante University Box 99, 03080, Alicante, Spain

(1) On leave from Institute of Materials and Reactive for Electronics, Department of Research on Electronics for Solid State (DIEES-IMRE). Havana University, Cuba.

(First received 30 March 1998; accepted for presentation during IAS-4)

Keywords: Particle/aerosol size distributions, laser diffraction particle sizing, aerosol characterisation, ill-posed problems, inversion.

Laser Diffraction Spectrometry is a powerful non-intrusive technique for size analysis of aerosols and suspensions. This optical technique do not require single particles to be measured successively and the interaction between light and the ensemble of all illuminated particles is analyzed. This technique is useful for studying dispersion phenomena, aerosol characterization, powders, etc.

The determination of size distribution by light scattering involves a inverse scattering problem, that is associated with the obtention of the size distribution from energy data. The inversion by numerical quadrature is one method to solve this problem. We have applied the Tikhonov Regularization Method (TRM) with the L-curve criterion[1] in order to obtain the regularization parameter. Liquid aerosol and powder of paint are the samples characterized in this work. For theses samples, deviations of particle size measurement for statistical parameters are more important than in the case of the representative parameters. The TRM has been proved to be suitable for certified distributions and has provided successful results.[2]

Pneumatically generated aerosols have been widely studied in Atomic Spectrometry techniques, since their drop size distribution influences the analytical signal.[3] In the present work, the nebulizer employed was the Single Bore High Pressure Pneumatic Nebulizer (SBHPPN). The liquid aerosol was generated from lubricating oil diluted with MIBK (60% in oil). The powder sample was POLIPOX 6 FR gray PR-7004 SMMT and the solvent used to stabilize the slurry was sodium hexametaphosphate in water (HMP, 1.8 g/l). Such a particles are used in paint manufacture.

The scattered energy was measured by means of a Commercial Instrument (CI) (Malvern, mod. 2600c). Figure 1 shows the volume undersize distributions for the samples tested. Two plots appear in this figure: (a) volume undersize (%) measured by the CI and calculated from the same light scattering data using TRM, for liquid aerosols; and, (b) volume undersize (%) measured by the CI and calculated from the same light scattering data using TRM, for slurry.

The matrix used to solve the inverse scattering problem by TRM for the aerosol and the slurry was obtained applying the Fraunhofer diffraction theory and the Mie scattering theory, respectively. In both cases (aerosols and slurries) the inversion method TRM offers always 0 % of volume for minimum limit of measurement with this instrument. For the remaining diameter ranges the results obtained with TRM (L-curve criterion) are close to CI.

Parameter characteristics obtained for drop/particle distributions are shown in Table I. In this table the representative diameters (i.e., median volume, $D_{50\%}$) as well as some statistical parameters (i.e., Sauter mean diameter, $D_{3,2}$, volume mean diameter, $D_{4,3}$ and relative spread, span) are compared for the algorithms used.

The Tikhonov regularization method gives both, representative and statistical, diameters within 5% of those obtained for Commercial Instrument. The distribution spans are virtually

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the same for the two algorithms, however, in all the cases, the representative diameters are slightly lower when TRM is used. This is due to the fact that TRM generates volume fractions for smaller diameters. As a result, the averages variables ($D_{3,2}$ and $D_{4,3}$) are shifted to lower diameters.

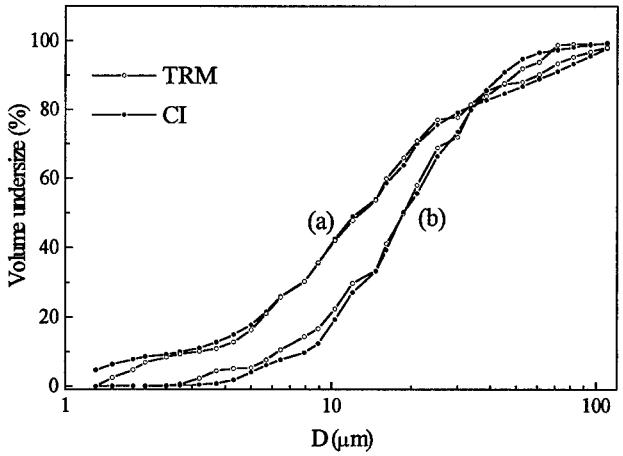


Fig. 1. Cumulative volume fraction vs. diameter for: (a) liquid aerosol and (b) slurry.

Table I. Results obtained with TRM application.

	Aerosol*		Slurry**	
parameter	TRM	CI	TRM	CI
$D_{50\%}$ (μm)	11.4	11.6	18.2	18.5
$D_{3,2}$ (μm)	4.9	5.1	12.4	13.7
$D_{4,3}$ (μm)	20.6	21.4	21.1	22.1
Span	4.9	5.1	2.2	1.8

* the matrix used is obtained applying the Fraunhofer diffraction theory.

** the matrix used is obtained applying the Mie scattering theory.

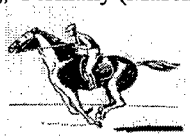
Acknowledgements

The authors wish to thank to F.J. Sempere for his collaboration. M.L. Alvarez wish to thank to the AECI for the scholarship.

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1406.
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NUCLEATION PROCESSES IN ANALYTICAL HOT LIQUID AEROSOLS

MORA J., TODOLÍ J.L., CANALS A.

Departamento de Quнmica Analнtica. Facultad de Ciencias. Universidad de Alicante. P.O. Box, 99. E-03080 Alicante, Spain.

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Keywords: Thermospray Nebulizer, Nucleation, Aerosol Characterization, Lase Fraunhofer Difraction, Solvent Nature

Studies on heterogeneous nucleation are of crucial importance in techniques such as Atomic Spectrometry since samples are usually introduced as liquid aerosols. In these techniques, the aerosol should be as fine and monodisperse as possible. Nucleation processes should be avoided in order to prevent the deterioration of the analytical results. The present survey deals with the nucleation processes taking place when the hot aerosol generated by a thermospray nebulizer1,2 passes through a cold environment. To this end the effect of surrounding temperatures and liquid nature on the aerosol characteristics have been studied.

Two different devices coupled to a thermospray nebulizer have been employed. In the first system (A), the hot aerosol was directly introduced into a cooled environment (i.e., a cooled Scott-type spray chamber3). In the second system (B), once the aerosol was generated, it was heated and further cooled (i.e., two step desolvation system4). Drop size distributions were measured by means of a model 2600c laser Fraunhofer diffraction system (Malvern Instruments, Worcestershire, UK) as stated elsewhere.4,5

System A

Figure 1 shows the median of the volume-based drop size distribution (D50) and the volume concentration (VC) of the aerosol as a function of the temperature of the spray chamber (Tsc) for the solvents studied. From Figure 1 it can be seen that Tsc hardly affects D50 values. Nevertheless, an increase in Tsc causes the VC to decrease. These behaviours can be explained in terms of droplets growth by nucleation.6 In a simplistic way, nucleation makes the total liquid volume of the aerosol to increase and the drop size distribution curves to shift to larger diameters. Nevertheless, nucleation will not change D50 values since the largest droplets are always removed. This is the behaviour observed in Figure 1. On the other hand, when Tsc is decreased a fraction of the solvent condensed on the nuclei (i.e., droplets or dry particles) could be carried by the gas exiting to the spray chamber and giving rise to VC values greater than the expected.

As regards the solvent nature, Figure 1 shows that water gives rise to the finest aerosols followed by ethanol and butan-1-ol. On the other hand, butan-1-ol is the solvent with the highest VC all along the Tsc range. This fact can be accounted for by its higher vapour pressure (Pv) that causes an increase in saturation ratio (rs) and, hence, in the intensity of the nucleation process.6

System B

Figure 2 shows the effect of the heating unit temperature (Th) on D50 and VC for water at several temperatures of the condensation unit (Tc). For a given Th value, D50 and VC values decrease when Tc is increased. This effect is more important as higher Th is. These results can be explained as follows: firstly, increasing Th causes the evaporation of the solvent and the

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amount of vapour to increase, and hence, D50 to decrease. Therefore, rs raises, making the nucleation processes more severe. In second place, the lower Tc and the higher Th (i.e., higher the solvent vapour amount), the higher rs is and, hence, the greater the extent of the nucleation process.6 Thus, for instance, at Tc < 0 ϵC, increasing Th hardly modifies D50 values, since the increase in droplet evaporation is counterbalanced by the concomitant increase in the nucleation process. At Tc > 0 ϵC evaporation is more intense than nucleation, with the result of a reduction in D50 when Th is increased.

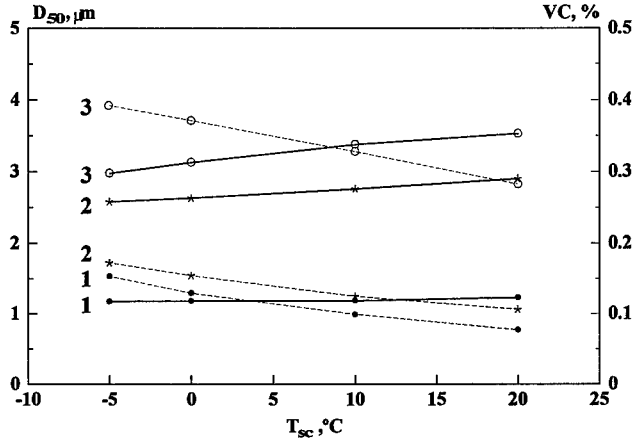


Figure1. Effect of the temperature of the spray chamber on D50 (solid lines) and VC (dotted lines), for all the solvents studied: (1) water, (2) ethanol; (3) butan-1-ol.

As regards the solvent nature, Figure 3 shows that butan-1-ol affords the highest values of D50 and VC. These results can be explained by considering that butan-1-ol generates the coarsest aerosols5 and shows the lowest Pv values (i.e., high rs values and, so, strong nucleation process). Figure 3 also reveals that aqueous aerosol are coarser than those obtained with ethanol. This unexpected behaviour can be assigned to the higher volatility of the latter.

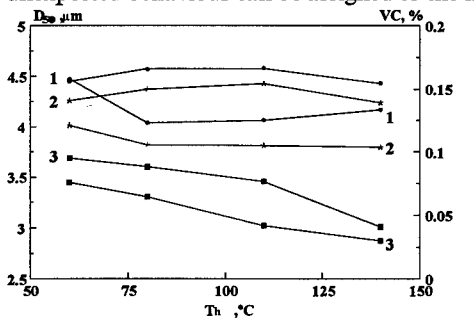


Figure 2. Effect of Th on D50 (solid line) and VC (dotted line) for different Tc: (1) -5 ϵC; (2) 0 ϵC; (3) 20 ϵC. Solvent: water.

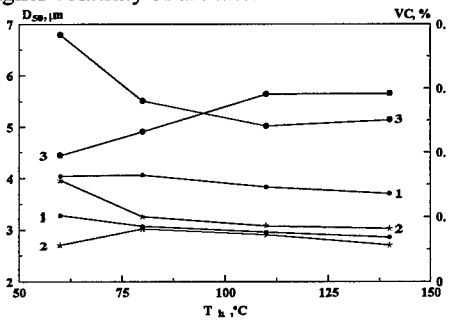


Figure 3. Effect of Th on D50 (solid line) and on VC (dotted line) for the different solvents tested: (1) water; (2) ethanol; (3) butan-1-ol. Tc = 10 ϵC.

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1424.
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KINETICS OF ISOTHERMAL CHANGES IN ELECTRIC RESISTIVITY AND LINEAR EXPANSION OF THE FAST COOLED AlSi10Mg ALLOY

SIMEUNOVIC R., MITROVIC N., JORDOVIC B.

Technical Faculty, , Yugoslavia

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Lately, interest has increased in glassy metals (MG) as an especially attractive category of metallic materials, due to their exemplary physical, chemical and technical properties. Several methods have been developed for obtaining amorphous alloys in different forms (ribbons, wires, powders). In each case the obtained structure is not ordered or it is ordered at short distances [1]. Electrical properties which change with temperature, following structural changes stand out among physical and physico-chemical properties of metallic glass [2].

In this paper the process of structural stabilization with changes in the relative specific electric resistivity and the thermal coefficient of linear expansion in dependence on temperature has been observed.

A commercial composition of the AlSi10Mg alloy in the form of ribbons 35-70 μm thick and 1-3 mm wide was investigated. The ribbons were obtained by fast cooling of the alloy melt using the melt-spinning method [3] in the Department for Amorphous Systems of the Joint Laboratory for Advanced Materials of SASA at the Technical Faculty. Measurements of the specific electric resistivity were performed using the four-point method. The same method was used for measuring isothermal changes of resistivity in regions of the exo-energy system stabilization. The coefficient of thermal expansion was measured using a dilatometer with a sensitivity of 10^{-5} m.

All measurements were performed in hydrogen flow in the temperature interval starting with the room temperature up to temperatures 50 K higher than the temperature of system stabilization.

Results of measurements of the electrical resistivity and coefficient of thermal expansion in dependence on the temperature show that structural organization takes place in the temperature interval of 450-500 K. Structural organization is accompanied by a rapid decrease of specific electric resistivity and increase of the temperature coefficient of linear expansion. An expressed correlation exists between the electrical resistivity and thermal coefficient of linear expansion.

Measurements of changes of electrical resistivity in isothermal conditions at temperatures of 473 and 498 K show that the dependence $\rho(\tau)$ has an exponential form:

$$\rho(\tau) = \rho_0 \exp(-k\tau)$$

where: ρ_0 - is the starting specific resistivity at the temperature of isotherm recording.

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Constants k_1 and k_2 of the process rate were determined from the slope of $(\Delta \ln \rho)/(\Delta \tau)$, indicating that structure stabilization takes place in two stages.

Process activation energies were determined from the known relation:

$$E = R\left[\frac{\Delta \ln k}{\Delta(1/T)}\right].$$

Obtained values for the activation energy of the first and second stage of structural stabilization are E_1=36.52 kJ/mol and E_2=24.9 kJ/mol, respectively. Corresponding rate constants were also determined. Results of investigations show that due to the high cooling rate an unstable structure with a certain organization degree of atoms at short distances and saturation of the Al solid melt is obtained. Thus, the stabilization process of the obtained structure is complex, which is shown by corresponding changes in electric resistivity and the thermal coefficient of linear expansion.

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1197.
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THE TRACE GASES IN ATMOSPHERE OVER LAKE BAIKAL.

POTEMKIN OF V., KHODHZER T.

Limnological Institute, Siberian Division of RAS, Irkutsk, Russia 664033 Ulan-Batorskaja St. 3

(First received 26 January 1998; accepted for presentation during IAS-4)

Key words: gases, atmosphere, sulphur dioxide, nitrogen dioxide, ozone.

During 1993-1996 there were conducted natural measurements of concentrations of sulphur and nitrogen dioxide and ozone in near-water layer of atmosphere. Measurements were done with the help of correlative mass-spectrometer and ozonometer M-124. The operation principle of the spectrometer is based on the measurement of relative difference of intensity of optical radiation in two sets of narrow spectral ranges which correspond to maxima and minima of absorption of investigated gas. The device calibration was regularly done by the setting of optical quartz cuvette with the certain amount of gas on the way of received radiation. The observations were carried out with simultaneous registration of meteodata and visibility distance.

Background content of gases in atmosphere over Lake Baikal in summer time is average 1-7 mkm/m*3 for sulphur dioxide and 0.5-2.5 mkm/m*3 for nitrogen dioxide.

Increased values of concentrations of sulphur and nitrogen dioxide are observed close to industrial and agricultural sources (Baikalsk, Severobaikalsk, Ust-Barguzin). High concentration of gases was observed in train and chimney of discharges of Baikalsk town with the fast decrease towards the lake which was due to wind direction along the coast. Increased values of nitrogen dioxide were observed in the region of river Selenga and Barguzin Bay (to 10 mkm/m*3).Along river Angara from Lake Baikal to Irkutsk city the concentrations of nitrogen dioxide increase, but these values are lower than accepted ones for settlements (20



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ppb). In Central Baikal these values were not registered at all.

There were observed daily concentrations during sunny days with maximum of 13-18 hours.

1431.
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EXPERIMENTAL INVESTIGATION OF DRIFT MOTION IN AEROSOLS AND HYDROSOLS UNDER PROPAGATING ACOUSTIC WAVE

YU.REDCOBORODY, S.GRINSHPUN, V.ZADOROZHNII

(First received 04 April 1998; accepted for presentation during IAS-4)

Experimental setup has been developed and mounted for obtaining of one-dimensional propagating acoustic wave in a glass waveguides filled with highdispersed water suspension (polystyrene latex (PSL) particles) or with aerosol (cigarette smoke) . It has been shown that small foreign particles (PSL particles 0.17 mcm in size), which are suspended in water, because of unidirectional drift phenomenon move at a constant rate in the wake of the acoustic wave. Laboratory experiments with water suspensions under propagating acoustic wave were executed which made it possible to calculate the foreign particles drift rate in relation to wave intensity. The experimental results are in good agreement with analytical relations for small particles entraintment effect under propagating acoustic wave at the expense of viscous forces that has been predicted and calculated by one of the authors in 1995.

It has been shown that, if wave intensity in aerosol is the same as one in the case of water hydrosol , the drift rate in aerosol is several orders greater than in hydrosol. Drift effect investigated provides the basis of vibrational method for purification of any liquids and gases from foreign inclusions of any nature with size more than 0.01 mcm (including viruses, bacteria etc.). For wave intensity of 20 W/cm2 the drift rate in water suspension is of the order of 0.01 cm/s (it is far beyond that the gravity precipitation rate, which is markedly less than 10-4 cm/s for such particles).

Since any individual microparticle follows the unidirectional drift laws, such a method is applicable for initial impurity concentrations that can be made as small as one likes. Besides, this method is comparatively energysaved (energy consumption does not exceed (0.01-0.1) kWh per litre of purificated liquid and 1 kWh per cub. m of purificated gas) and allows, conceptually, to achieve absolute purification of medium. Results obtained may be of interest for purification of air and other gases , for motor car industry (petroleum and diesel fuel purification, refining of oil in engines, etc.), and for medical and pharmaceutical industry (settling of blood red cells, purification of water etc.). The drift method may be used in order to design acoustic levitators (devices for prevention of particle sedimentation), and acoustic separators (by size), and acoustic concentrators for very small particles. It should be noted that these devices will be able to operate at high temperatures, under hostile conditions as well.



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1196.
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MATHEMATICAL MODEL OF AEROSOL ASPIRATION IN CALM AIR

KISELEV O.M., ZARIPOV SH.KH., ZIGANGAREEVA L.M.

Kazan State University Chebotarev Institute of Mathematics and Mechanics, Universitetskaya St., 17, Kazan, Republic of Tatarstan, Russia 420008 e-mail:shamil.zaripov@ksu.ru

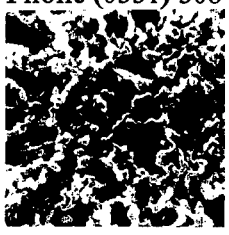
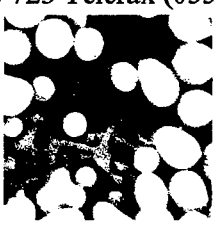
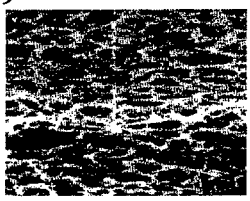
(First received 30 January 1998; accepted 4.03.98 in final form for presentation during IAS-4)

It is known that an accurate measurement of the concentration of the airborne dust in the atmosphere is often complicated by nonideality of the aspiration process. Aspiration efficiency is defined as the ratio of a measured concentration to the true one. Determination of the aspiration coefficient for a given kind of aerosol sampler is the problem of great practical interest. The review of theoretical and experimental studies on determination of the aspiration coefficient is done in [1]. The problem of aerosol aspiration by thin-walled tubular inlet in calm air is theoretically solved. For small concentrations of dispersed phase a mathematical modeling of aerosol flows reduces to the solution of two problems: determining the gas flow velocity field and then calculating the trajectories of the aerosol particles in the velocity field obtained. A case is investigated when the gas flow is steady potential axially simmetric flow of an incompressible fluid. For determining velocity distribution of the gas in the vicinity of the sampling inlet the effective numerical method is used. It is based on the boundary value problem for the streamline function in the hodograph plane. The streamline function is represented as the sum of the singular and regular components. For determining the singular component the method of small parameter is used. It allows to reduce the problem to the solution of ordinary differential equations. The regular component is found from the sequence of lincar boundary value problems. The equations of a motion of particles are also integrated in the hodograph plane. The limiting trajectory was found by the iterations method. This trajectory divides the particles that enter into the tube from those that do not and allows to calculate the aspiration efficiency. The dependencies of aspiration coefficient on Stokes number and settling velocity are constructed. The comparison of calculated data with the experimental formula from [2] is given. This work was supported by Russian Basic Research Foundation, Grant number: 96-01-00111.

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1215.

RADIATIVE FORCING AND CLIMATE RESPONSE FROM THE 1991 MT. PINATUBO AEROSOL CLOUD

STENCHIKOV G.*, KIRCHNER I., ROBOCK A.***, GRAF H-F.****

**University of Maryland, College Park, MD, US*

***Max Planck Institute for Meteorology, Hamburg, Germany*

****Rutgers University, New Brunswick, NJ, US*

(First received 05 February 1998; accepted for presentation during IAS-4)

We developed a zonal mean, monthly mean data set of stratospheric aerosol radiative characteristics for two years after the Mt. Pinatubo eruption. To calculate the aerosol parameters for the entire radiative spectrum, we combined SAGE II aerosol extinctions for 1.02 microns, provided by Larry Thomason, and CLAES/ISAMS retrieved effective radii provided by Don Grainger. This is the first global data set with vertically dependent effective radius. Using this data we calculated aerosol radiative forcing and climate response with ECHAM-4 general circulation model. We found more small aerosol particles above the 10 mb than expected for the first year after the eruption. The solar NIR heating appears to be more significant than it was found previously especially at the top of the aerosol layer, because small particles are relatively more absorbing. Ozone depletion and the QBO significantly modify the observed stratospheric temperatures. The changes in stratospheric temperature and dynamics force the tropospheric circulation from the top. The tropospheric dynamic response produces a significant portion of the climate variation especially in the winter. This dynamic response is sensitive to the stratospheric heating and sea surface temperature.

1423.
УДК 541.18

OPTICAL PROPERTIES OF NON-SPHERICAL AEROSOL PARTICLES IN RANDOM ORIENTATIONS

SUTHERLAND R.A., KLETT J.D.

US Army Research Laboratory, Atmospheric Effects Branch, White Sands Missile Range, New Mexico, USA

(First received 02 March 1998; accepted for presentation during IAS-4)

Several approximate methods for modeling the electromagnetic (em) scattering and extinction properties of non-spherical aerosol particles are presented and applied to the practical problem of modeling the composite properties of ensembles of random orientations. The random orientation distributions are themselves modeled using semi-empirical methods approximating the effects of atmospheric turbulence. Although some of the methods are applicable to arbitrary shapes we confine our attention to homogeneous cylinders, discs, and spheres for which there are some exact solutions available for comparison. Methods include the classical approaches such as the Rayleigh-Gans (RG), Anomalous Diffraction (AD), Wentzel-Kramers-Brillouin (WKB) methods (Klett& Sutherland, 1992; Lopatin & Shepelevich, 1995), and various exact and approximate solutions in the "IPHASE" collection of Evans (1996).

Most of the methods include the full vector (polarimetric) propagation and include extinction, absorption, and scattering in all directions denoted as the differential cross-section, the equivalent of the classical phase function used in optics. The particle orientation model is based upon semi-empirical relationships valid for the inertial subrange of turbulence often used to approximate the real atmosphere. Results for thin cylinders show a tendency for particles to orient in the stable fall mode (long axis horizontal) for low levels of turbulence as long as the

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particle lengths are on the order of the inner scale (ie. a few millimeters), otherwise the more usual uniform random approximation applies. The paper reaffirms our earlier assessment of the WKB method which offers a viable alternative to the more widely used RG and AD approximations and provides a significant improvement in accuracy with only a slight increase in mathematical complexity.

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Lopatin and Shepelevich (1995), Optics & Spectroscopy, 81:115-118.
Evans and Fournier, 1996, Applied Optics, 35(18):3281-3285.

1210.

GENERATION OF AEROSOLS BY THE ELECTRICAL EXPLOSION OF WIRES AT REDUCED AIR PRESSURES

SEDOI V.S.*, VALEVICH V.V.*, KATZ J.D.**

**High Current Electronics Institute, Tomsk, Russia*

***Los Alamos National Laboratory, Los Alamos, N.M, USA*

(First received 10 January 1998; in final form 5/2/98 , accepted for presentation during IAS-4)

The exploding wire method of particle production, allows us to model the high speed formation of aerosols because of the fast heating and evaporation rates inherent to this technique. The method is also of interest from the viewpoint of controlling the production of aerosols of a particular material with a specific particle size distribution at a specific efficiency.

The electrical explosion of iron, aluminum, titanium, and copper wire has been investigated in air at pressures of from 0.01 to 1 atm. In these experiments the energy density introduced into the material, w, normalized to the sublimation energy of the material, s, and the heating rate were controlled. Particle and agglomerate sizes were determined using transmission electron microscopy and laser scattering methods. The specific surface of the powder was measured by low-temperature adsorption. The phase composition was determined by X-ray diffraction.

The specific energy introduced into a material, w/s, the pressure (density) of the surrounding medium, and the exothermic effect due to oxidation reactions are controlling parameters in particle
formation.

Increasing the energy density increases the internal energy of the material, the expansion velocity and the number of condensation centers, while the final particle size decreases. With an exothermic oxidation reaction, the optimum energy density can be less than the sublimation energy of the material. As a result, metal oxides are formed. As the density of the surrounding medium is increased, the particle size decreases because of an increase in the frequency of collisions and more rapid cooling of the particles.

Electrical explosions of wires, at reduced air pressures, allows for the production of ultra-fine powders of oxides of various metals with particle sizes of less than 50 nm. The method is environmentally safe and does not require excess energy expenditures. The electrical explosion of wire at reduced pressure allows for new possibilities in the production ultra-fine powders.



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982.
УДК 541.18

BALLOON - BORNE STUDIES OF AEROSOL OPTICAL PROPERTIES OF FREE ATMOSPHERE AT ALTITUDES UP TO 30 KM IN VISIBLE AND NEAR IR SPECTRAL RANGES

LOBANOVA G.I., MIRSOEVA L.A., POPOV O.I.

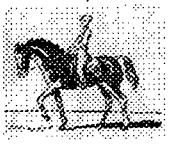
All- Russian scientific centre "SOI named after S.I.Vavilov"; Birjevaya linia, 12, St-Petersburg, Russia.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

During long period the balloon-borne experiments were fulfilled by SOI to measure spectral radiances of cloudless day sky at altitudes up to the 30 km and in the spectral region 0.4-3.2 mcm. The authors made also the balloon-borne investigations of radiance phase functions for day sky [1] and atmospheric transparency [2]. These studies allowed to get the information about altitudial and spectral dependencies of aerosol scattering factor in free atmosphere. Measuring instruments (grating spectrometers with tracking system) were calibrated absolutely in units of spectral radiance. The experiments were carried out in middle latitude region of Russia in summer. The measured values of altitude and spectral dependencies of atmospheric aerosol scattering factor were compared with literature data.

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983.
УДК 541.18

METHODS AND COMPUTATION CODES FOR CALCULATION OF BACKGROUND OBJECT RADIANCES WITH ACCOUNT OF AEROSOL SCATTERING

GRIPOST S.B., MIRSOEVA L.A., POPOV O.I., SEMENOVA V.I., VESELOV D.P., LOBANOVA G.I.

All-Russian scientific center "SOI named after S.I.Vavilov"; Birjevaya linia, 12, St-Petersburg, Russia.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

In SOI during some years the methods and computation codes for calculation of radiative characteristics of the system the Earth-atmosphere were developed in ultra violet, visible and infrared spectral ranges. The code was developed to calculate background radiances with an approach of single scattering of solar radiation for different combination of aerosol models and wide range of illumination and observation conditions in the spectral interval 1...3.0 mcm with spectral resolution 0.025 mcm. The software operates with data base including altitude (up to 100 km with a step 1 km) and spectral profiles of aerosol attenuation and scattering factors for nearground, tropospheric, stratospheric and mesospheric aerosols in different regions. The software uses C-language and operational systems Windows 3.1, Windows 95, Windows NT. The requirements to hardware are following: processor 486-DX2- 66, operative memory >4 Mb, the data base storage of hard disk - 10 Mb.

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985.
УДК 541.18

ALTITUDINAL AND SPECTRAL PROFILES OF ATMOSPHERIC AEROSOL EXTINCTION IN 0.4-12.0 μM REGION: STRATOSPHERIC BALLOON EXPERIMENTS

KISELEVA M., RESHETNIKOVA I., KAZBANOV W.

S. J. Vavilov State Optical Institute, Birjevaya 12, 199034, St.-Peterburg, Russia

(First received 10 January 1998; accepted for presentation during IAS-4)

Spectral atmospheric transmittance in the region 0.4-12.0 μm based on balloon experiments has been analysed and generalized. These experiments have been carried out up to 35 km height by authors of this report during of last ten-twelve years in different geographical regions (Russian, Kazakhstan , France) and different periods of volcanic activity. Altitudinal and spectral dependencies of atmospheric aerosol extinction in region of two atmospheric windows (0.4-0.8 μm and 8.0-12.0 μm) was considered. The influence of volcanic activity on atmospheric aerosol extinction spectra was noted. The approximate method of effective aerosol parameters and concentrations of aerosols has been developed. This method was used for the approximation of effective radius and concentrations of atmospheric aerosol particles. The comparison of data obtained in this work with modern publication ones was carried out. The influence of volcanic stratospheric aerosols on the stratospheric ozone concentration was discussed. The anticorrelation dependence ozone concentration versus aerosol extinction for level of H = 20 km was discovered.

1214.

THE IMPACT OF AEROSOLS ON SOLAR UV ACTINIC FLUX AND PHOTOLYSIS RATES

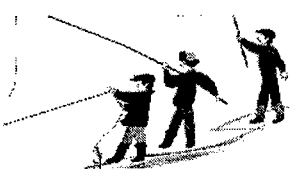
STENCHIKOV G., DICKERSON R., KONDRAGUNTA S., PARK R.

University of Maryland, College Park

(First received 04 February 1998; accepted for presentation during IAS-4)

A high mixing ratio of photochemically produced ground level ozone (photochemical smog) is the most typical characteristic of air pollution in highly populated urban regions. At the same time, the optical depth of fine aerosol particles on smoggy days can reach 2 in the near UV spectral bands. Sulfate and some organic aerosol particles scatter solar radiation back into space and cool the surface, but can increase the UV actinic flux, which is proportional to photon number-density in the atmosphere. This means that with the same number of photons arriving at the top of the boundary layer, aerosols simultaneously increase the number of reflected photons and the number of photons in the boundary layer.

Observations and theoretical calculations with MIE code and Discrete Ordinate radiative transport (DISORT) model based on observed aerosol size-number distributions show that UV-scattering particles in the boundary layer accelerate photochemical reactions and ozone production, but UV-absorbing aerosols, such as mineral dust and soot, inhibit photochemical processes.



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981.
УДК 541.18

ON INFLUENCE OF ATMOSPHERIC AEROSOL OPTICAL PROPERTIES ON RADIANCE CHARACTERISTICS OF THE EARTH IN NEAR IR SPECTRAL RANGE AT OBSERVING FROM SPACE.

VESELOV D.P., LOBANOVA G.I., MIRSOEVA L.A., POPOV O.I., SEMENOVA V.I.

All-Russian scientific centre "SOJ named after S.J.Vavilov"; Birjevaya linia, 12, St-Petersburg, Russia.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

The method and software are developed to calculate radiative characteristics of the system the Earth- Atmosphere due to reflection by underlying surface and singly scattering by atmosphere of sun radiation in the spectral range 1-3.0 mcm at observing from space. The software uses the data-base of optical characteristics of earth surface, tropospheric clouds and atmosphere. A special attention was paid to atmospheric aerosol which is the most changeable components of atmosphere. In calculations the different combinations of models for nearground, atmospheric, stratospheric and mesospheric aerosols were used. The choice of aerosol models is found to control substantially a radiance level of the system the Earth-atmosphere.

1195.

COLLECTION OF EMISSION FROM OSCILLATING DIPOLES INSIDE AN ILLUMINATED MICROSPHERE: ANALYTICAL INTEGRATION OVER A CIRCULAR APERTURE

PENDLETON J.D., HILL S.C.

US Army Research Laboratory ATTN: AMSRL-IS-EE

2800 Powder Mill Road, Adelphi, Maryland 20783-1197; dpendlet@arl.mil shill@arl.mil

(First received 29 January 1998; accepted for presentation during IAS-4)

We describe a method for analytically integrating, over a circular aperture, the emission from an illuminated microsphere containing a uniform distribution of molecules. Each molecule is modeled as an oscillating dipole with polarizability proportional to the internal (Mie) electric field at its location. The model is useful for investigating fluorescence, Raman, or other emission from excited molecules inside of small spherical droplets.

Inhalation Toxicology

AEROSOLS MAGAZINES

Editor **DR. DONALD E. GARDNER,** P.O. Box 97605, Raleigh, NC 27624-7605, (919) 870-7743, fax: (919) 870-5078, e-mail: **gardnerde@aol.com**

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Главный спонсор IAS

AEROSOL TECHNOLOGY

tel+fax :+7-095-1474361 belov@blackrat.cs.msu.su pnbelov@mail.orc.ru

АТЕСН - главный спонсор и организатор Международного Аэрозольного Симпозиума.

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IAS-4 *Санкт Петербург 6-9 июля 1998*

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7/ July /98 Аэрозольные технологии (фильтрация, производство алмазоподобных материалов, ультрадисперсрные порошки, горение диспергированного топлива, мембранные фильтры, чистые технологии ...)

В этот же день будут представлены работы по ФУЛЛЕРЕНАМ - синтез, экстракция, свойства, теория, применение, нанотрубки..

8/ July /98 АЭРОЗОЛЬ И КЛИМАТ, КОСМИЧЕСКИЙ МУСОР, АЭРОЗОЛЬ И ОКЕАН Радиоактивные аэрозоли, аэрозоли мегаполиса, вулканические аэрозоли, облака, эрозионные аэрозоли, ...

9/July/98 Последний день - АЭРОЗОЛИ И ЗДОРОВЬЕ - использование аэрозольных медикаментов, воздействие загрязнений воздуха на организм, Нормирование аэрозольной нагрузки для различных профессий, Проникновение частиц в легкие, Взаимодействие частиц с биологическими структурами...

АЭРОЗОЛЬНАЯ ТЕОРИЯ (1)- оптика аэрозолей, коагуляция, нуклеация, конденсация...ТЕОРИЯ АЭРОЗОЛЕЙ(2)- ДИФФУЗИОФОРЕЗ, ТЕРМОФОРЕЗ...Слушание докладов выдвинутых на соискание премий Российского аэрозольного общества (Две из этих премий поддержаны суммами $300 и $200 - спонсор - директор ERNAFT OIL Mr Mirlesse (Щвейцария)

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DUST AND POWDER ADHESIVENESS TESTER



The tester is designed to measure the adhevity to form durable diffucult-to-remove deposits in production equipment, in particular on lector bins. This ability is taken into account when designing dust removal plants, selecting of sedimentation elements, facilities for dust unloading and transportation.

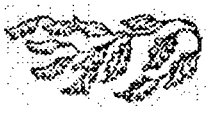
The tensile strength of a specimen of dust compacted under a 50 kPa load in a vertical zontally split. The tester design secures a strictly specified value of compressing stress in the cell error caused by dust friction on the cell walls. When the specimen is being compacted, the cell parts split apart, thus their mutual adhesion tures is prevented.

POLYMER TUBULAR FILTER



for ceaning of gases from sulphuric acid and having traces ot arsenic, selenium and sulphur oxides. It is used in mineral fertilizer production and other industries. polymer electrostatic precipitator makes it possible to save 14 t of lead, while eliminating lead soldering that is harmful for human health.

This electrostatic precipitator having a vertical gas flow is a metal housing lined with acid-resistant brick wherein receiving and curona. The receiving electrodes made of polymer are shaped as hexahedral tubes.



GAS DIFFUSION ELEMENTS FOR SULPHUR DIOXIDES

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1064.
УДК 541.18

THERMODYNAMIC INVESTIGATION OF THE ALTERNATIVE FREONS R-122 AND R-122A

VARUSHCHENKO R.M.,DRUZHININA A.I.,PASHCHENKO L.L.

Thermochemical Laboratory, Department of Chemistry, Moscow State University, 119899 Moscow, Russia.

(First receive 31 December 1998, accepted for presentation during IAS-4)

Keywords: Freons, Thermodynamics, vapour pressure, heat capacity.

This work was carried out under the program of the complex investigation of the alternative Freons by experimental and estimation methods in the wide temperature range from helium up to critical temperatures. The hydrogen containing Freons $CF_2ClCHCl_2$ (R-122) and $CFCl_2CHFCl$ (R-122a) are used as solvents and starting materials for fluoroorganic synthesis instead of environmentally unacceptable chlorofluoroethane $CFCl_2CF_2Cl$ (R-113), that destroys ozone layer in the stratosphere. The literature data on the thermodynamic properties of the hydrogen containing Freons are scarce and need to be refined.

The next properties of Freons were studied by experimental methods:
- the low-temperature heat capacities, the temperatures, the enthalpies and entropies of the phase transitions,
- the saturated vapour pressures and the enthalpies of vaporization over the moderate ("atmospheric") range of pressure,
- the densities of liquids at the room temperatures,
- IK and KP spectra of the molecules [1].

The experimental data were used as a basis for estimation of the set of properties in wide temperature range using the Clausius-Clapeyron equation and the corresponding states law.

The heat capacities were measured by adiabatic calorimetry. The apparatus consists of the automatic vacuum calorimeter, data acquisition and control system, and PC. The volume of the substance under study is about 1 cm^3. The temperature of the calorimeter is measured with the accuracy ± 0.01°K by rhodium-iron resistance thermometer [2]. The heat capacities were measured over the temperature range from 5°K to 325°K with mean accuracy ± 0.2 percent. It was found that both Freons were in the forms of glasses, supercooled liquids, partially crystalline, and liquid states. For the first time, the melting temperatures of these Freons have been determined. The thermodynamic functions {S°(T)-S°(0)}, {H°(T)-H°(0)} and {G°(T)-H°(T)} have been estimated at T = 298.15°K. The contributions to the residual entropies at T = 0 caused by disorder of configurational and conformational nature have been found on the basis of calorimetric and spectroscopic data for the both Freons. The values S°(298.15°K) for the R-122a determined by both methods are agreed in the error limits, that showed their reliability.

The saturated vapour pressures in dependence of temperature were determined by comparative ebulliometric technique over the pressure range from 11 kPa to 102 kPa. The apparatus consists of a differential ebulliometer and the manometric system [3]. The temperature of the (liquid + vapour) equilibrium was measured by means of platinum resistance thermometer at 20 fixed pressures maintained automatically by means of a mercury-contact manometer. The values of the fixed pressures were obtained by calibration of the manometer with standard substances (water and decane) for which the vapour pressures are well known. The accuracy of the temperature and pressure measurements ($\pm<0.01$°K and $\pm<2\leq6$ Pa) keeps pace with the present-day advances. The values-(pT) were treated by least-square method (LSM) using orthogonal functions. The next equations were obtained:

$$\ln(p) = A + B/T + C\ln(T) + DT, \quad (1)$$

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$$\Delta vH = R(-B+CT+DT^2)\,\Delta Z \pm \{s(\Delta_v H)+\Delta(\Delta Z)\Delta_v H\}, \quad (2)$$

$$\Delta C_p = C_p^o - C_p(liq) = R(C+2DT) \pm \{s(C_p)\}, \quad (3)$$

where ΔZ is the difference of the compression factors of gas and liquid (the value ΔZ takes into account vapour deviation from ideality). Equations (1)-(3) were employed for calculation of the normal boiling temperatures Tn.b., enthalpies of vaporization at T = 298.15°K and Tn.b., and the differences ΔC_p.

If it was possible, the enthalpies of vaporization were determined by both calorimetric and estimation methods with the accuracy ±(≤0.5 and ≤1.5) percent, respectively. The values ΔvH found by two independent methods agree within error limits, which proves their reliability. The ΔC_p differences are negative in agreement with the physical meaning of these values.

Experimental data of Freons were used for estimation of the saturation vapour pressure for the whole temperature ranges of liquid phases. To extrapolate safely the pT-values towards the triple point, they were treated simultaneously with the low temperature differences $\Delta C_p = C_p^o - C_p(liq)$ found by spectroscopic and calorimetric methods:

$$\ln\{p/p(m)\} = A + B/T + C\ln(T) + DT \quad (4)$$

$$\Delta C_p/2R = \{C_p^o - C_p(liq)\}/2R = C/2 + DT$$

where p(m) is the mean pressure within the range of pT-data. The errors of extrapolation in the temperature interval $T_{ext} \leq 100$°K are within (1 to 10) percent. The correlation of the vapour pressure and densities of liquids according to the corresponding state law (CSL) allowed us to estimate the critical parameters T_c, P_c, and V_c and to extrapolate pT-values to critical region with uncertainties (from 1 to 5) percent. The critical parameters can be used for estimation of many thermodynamic properties by the (CSL).

The thermodynamic properties of Freons and their fluorinated and hydrogen- substituted analogues were analyzed depending on the some structural parameters of the liquid phase. The conclusion was drawn that the values $\Delta_v H$, Tn.b., and T_c vary regularly in accordance with the dipole moments and the coefficients of molecular packing, that is, the parameters determining the intermolecular interaction energy and short-range order in the liquid phase, which proves consistency and reliability of the considered thermodynamic data in the series of halogenated ethanes.

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EDITORS-IN-CHIEF

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Germany

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Division of Environmental and Occupational Health
School of Public Health
University of Minnesota Box 807 Mayo
420 Delaware Street S.E. Minneapolis
MN 55455, U.S.A.

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VARIABILITY FACTORS OF AEROSOLS AND AEROIONS IN POLAR ATMOSPHERES

SMIRNOV V.V.*, RADIONOV V.F. , SHEVCHENKO V.P.*****

**Institute of Experimental Meteorology, 82 Lenin str., Obninsk, Russia 249020*

***The Arctic and Antarctic Research Inst., 38 Bering str., St. Petersburg, Russia 199397*

****Institute Oceanology, 36 Nachimov str., Moscow, Russia 117851*

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1. The complex regular measurements of the aerosol dispersity and air ion spectra mobility were proceed in the Western (Franz-Joseph Archipelago, Zigler Island, March - April 1994), Central (Laptev Sea, summer 1995) and Eastern (Wrangel Island, March - April 1985) Arctic and the Antarctic (Molodezhnaya station, January-May 1983). Aerosol size range is from 0.004 to 10 (m, as well as aeroion mobility from 0.00032 to 5 cm^2 / V. s.

2. In contrast with the Antarctic, the Arctic atmosphere is distinguished high concentrations of small size particles (D<0.1 (m). But in contrast with ecological satisfactory little cities at the Central Russia (Zvenigorod, Obninsk) the Arctic air is much cleaner, although the counting N and mass M concentration of the particles D> 0.5 (m turn out to be equal: N = 4 - 8 cm^{-3}, M = 30 - 50 (g/ m^3. For reference: at the surface air of arid zones N = 20 - 100 cm^{-3}, M = 100 - 300 (g / m^3 [1].

3. The size spectra of the polar aerosols above a snow surface is conservative with regard to the changes in relative humidity, solar and gamma-beta radiation and wind direction variations. The moderate and strong wind (U = 8 - 30 m/s) stimulates a concentration growth for coarse (D = 0,5 -1 (m) and large (D> 3 (m) particles. Fine particles (D<0.1 (m) are conservative to wind speed but the strong frost (T = -20...-35 °C) stimulates a increasing its concentration.

4. Practically independently from the weather situation and local time the size modes of D = 0.025, 0.15 and 1.5 (m are well-pronounced. Only at the strongly cooled and windless air one more mode appears between D = 0.5 and 0.9 (m. It is important to note that in the generalized size spectra of aerosols measured at the high-latitudinal Canadian Observatory Alert, the Moscow` suburb and Tadjikistan semi-deserts there are also present modes in the size area D = 0.01, 0.1 and 2-3 (m [2]. This allows us to speak about a possible similarity in the mechanisms of the formation and evolution of polar and continental aerosols in spite of significant differences in the character of the underlying surface: the continual snow cover in the Arctic, vegetation cover on the soils in middle latitudes, eroding soils on the arid zones.

5. The previous conclusion is made more convincing by the results of the measured relative spectral variations F(D) = MSD(D)/N(D), where MSD (D) is the mean square deviation of the aerosol concentration from the mean value N(D). So, the function F(D) depends very little on the wind direction. Thus, in most continental regions the aerosol concentration for cumulative fraction D = 0.1-0.3 (m fluctuates very little but for the very fine and very coarse continental aerosols the concentration fluctuations are about an order of magnitude larger [2, 3]. However, for the spring Arctic at weak winds (less than 5 m/s) the variability function F(D) for coarse particles are also small. This provides some key to the understanding the possible general mechanism of the polar-born aerosol formation - wind erosion of the snow cover and gas-aerosol conversion in very cold air.

6. As the exist presentations [4] possible to identify three mobility groups of polar ions: heavy 0.00032 - 0.001, intermediate 0. 02 - 0.2 and light 0.5 - 2.5 cm^2 / V.s. Correlation between

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concentrations of ions within the groups approximately such, either as for continents. In general event concentrations of negative and positive aeroions approximately correspond to the quasineutral atmosphere model. The main factors of variability in the concentration of aeroions are air temperature, wind speed and intensity of inversions above snow surface. Probably, it is the increase in wind speed that stimulates the known effect of contact electrization of aerosol particles at collisions with each other and the snow surface with the shift of the equilibrium toward negative charges. The largest effect on heavy aeroions is produced by stratification of the surface troposphere layer at anticyclones.

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AIRBORNE DEVICES FOR STUDY OF SUPERFINE ATMOSPHERIC AEROSOLS

SMIRNOV V.V., SAVCHENKO A.V., PRONIN A.A.

Institute of Experimental Meteorology, 82 Lenin str, Obninsk, 249020, Russia

(First received 01 February 1998; accepted for presentation during IAS-4)

Set of portable instruments for functioning in the car and aircraft laboratories for complex and operative studying the characteristics of superfine aerosols of natural and manmade origins is considered. The electrical aerosol analyser DAES-3, thermo-diffusion spectrometer of nuclei condensation Omega-3 and portable sampler PAS-3 allows to get information on concentration and dispersity, as well as on hygroscopic, electrical and chemical characteristics of aerosol particles by diameter from 0,003 to 10 (m. Total weight of set is 15 kg, power consumption is 100 w from network 220/110 V or +27 V. Commercial analogues of instruments unknown.

Separate instruments and set itself were used in the aerosol car - laboratory for control of toxic dust emissions from the Owens Lake dry bed (USA, East California, Owens Valley, springtime 1993, international project LODE [1-3]), stationary polar station for study of background aerosols (Zigler Island, Franz-Joseph Archipelago, springtime 1994, russian-austrian project Polar Spring [4]), airborne laboratory for studying a long-distant transportation of dust from the Kalmykia deserts (summer 1996 and 1997) and others [5].

The portable electric aerosol analyser DAES-3.

Principle of action: the functional unipolar charging the aerosol particles by small aeroions, charged particle selection and ion current measurement. Recommended for the concentration and size spectrum measurement of finely divided aerosols, as well as for control of weakly dusty

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atmosphere and clear rooms of purity classes 100 and 1 000.

Measured interval by the diameter D = 0,003 - 1 (m in 11 dimensioned gradations. High level of the measured concentration of particles with sizes less D = 0,1 (m is consist N = 7.10^7 1/cm^3. Resulting measurement error of concentration and size in interval D = 0,01-0,5 (m does not exceed 40 and 30%, respectively. Volume sampling flow is 100 - 250 cm^3/s, linear sampling speed is 10 m/s. Weight of the remote gauge up to 7 kg. Power consumption + 27 V, 0.7 A. Removing of sensor not less than 25 m.

In contrast with the famous electrical analyser model 3030 (Thermo - Systems Inc., USA) given instrument has the tenfold lower mass and power consumption, as well as more high sensitivity.

2. Portable aerosol sampler PAS-3.

Is kept a rotary high pressure pump, controller and electric power supply 220/110/+12 V, anemometer, barbell by the length 1 m, removable fiber and nucleapore filters, two cascade impactor for large particles (d>2 micrometer). Recommended for continuos sampling of aerosols by sizes from 0,01 to 20 (m for an evaluation of mass concentration and dispersity as well as microelement, radionuclide and PAH - analysis.

Volume sampling flow is 1000 cm^3/s. Efficiency of precipitating of particles by sizes D = 0,01 - 10 (m upon substrates more then 90 %. Total sampling error does not exceed 15%. Power consumption 220/110/+12 V, 1.7 A. Removing of sensor not less than 25 m. Total weight of sampler up to 6 kg.

Condensation activity aerosol spectrometer OMEGA-3.

Principles of action is the flow condensation rising of nuclei within the thermo-diffusion chamber and automatic sizing of water droplets by photoelectric counter. Supersaturation interval over a water 0.01-1%. An interval of measurement from of droplet sizes D = 3 - 200 (m on 8 size gradation. The concentration and size measurement error does not exceed 30 and 40%, accordingly. Optical accounting volume is equal 1 mm3. Linear speed of sampling is 6 m/s. Lighter is laser diode, wave length 0,85 (m. Weight of the remote sensor 5 kg. Power consumption + 27 V, 0,5 A.

All remote sensors runnable at the air temperature 0-40 °C, pressure 70 -100 kPa, relative humidity up 90%, as well as under the linear vibration and shock 10 g and 15 g, jolting (bumpiness) 4g during one hour.

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REGULARITIES OF LONG DISTANT TRANSPORT OF SOIL DUST

SMIRNOV V.V. *, GILLETTE D.A., NOVITSKI M.A.*, GRANBERG I.G.*****

**Institute of Experimental Meteorology, Obninsk, Russia*
***ARL/SMDL, NOOA, Research Triangle Park, N.C., USA*
****Institute of atmospheric physics RAN, Moscow, Russia*

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Main source of air contamination on terrain, removed from the desert, is wind erosion of loess similar soil. These soil most often folded by sedimentary rocks and so their distinguishes good dispersivity and high contents of different salts. Corresponding dust emission can be initiated by the moderate wind (mean speed 7-12 m/s) within many hours. In total even the moderate flows of dust materials possible to watch a significant contamination an atmosphere after removing from the dust source of the order hundred km [1].

Situation is aggravated, when wind erosion of dry and drying large pools is occurs. Aerosol products of similar emissions are characterized by the high dispersity, condensation activity, electrization and significant contents of toxic substances [2, 3]. In the available literature practically are absent quantitative data about kinetics of aerosol particle concentration and size spectra during a transportation of the dust cloud and stream. Accordingly were unclearly an possibility of theoretical description on evolution and forecasting of similar dust emissions.

In the report are analyzed results of the stationary, car and airplane measurements of dust particle spectrum and concentrations, optical depth and atmospheric electrical field along dust stream on distance to 150 km from the erosion center. Investigations were conducted in the Owens Valley, East California, USA within the framework of the international project LODE-1993, as well as in 1994 -1997 at deserts near Aral Sea, Kasakhstan and Kalmykia, Russia [1]. Areas of an wind erosion at dust source is 60 - 80 km^2. Averaged dust storm at these regions lasted approximately 3 hours, generating into atmosphere from 10000 to 50000 ton finely divided dust [4].

Optical transparency of atmosphere were measured in the wavelengths (= 0.45 - 0.65 (m by means of the photometer "Sirius-2" with Se - photosensor. Electric aerosol analyzer DAES-2 was used for the concentration and size spectrum measurement of dust particles by the diameter from 0,0032 to 1 (m. Battery -operated rotary fluxmeter was used for the measurement of electrical field tension in atmosphere in vicinity of dust stream. Possible note the following interesting results of experiments.:

On removal X = 2 - 3 km from the dust source an atmospheric electrical field E achieves values +400 - 800 V/cm, exceeding the corona threshold for sharpened objects on land surfaces (people, bestial, trees, shrubs, antenna and the like). On removal 8 - 15 km field E decreased before the zero and changed a sign. Negative field value also has a maximum E = 100 - 200 V/cm on X = 30 - 80 km. Hereinafter removals X = 120 - 150 km field falls to background value E = +(0.1 - 0.2) V/cm;

On removals from the dust source X = 30 - 40 km spectrums of dust are powerfully enriched (by factors of 20 - 100) by dust particles of respirable size fractions (D>0,5 (m).
Very high concentration of superfine dust particles (D<0.1 (m) distinguishes the dust from the bottom dry pools from sandy desert. So be basis to suppose that for the appearance at atmosphere the superfine aerosols of the mineral, saline and biological nature can be

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responsible not extensive sandy deserts, but arid wind - erosion provinces with loess - similar soil (Central and Middle - West Asia, China, Caspian Sea shore, the South - East states of USA and others);

After removals greater X = 30 - 40 km a spectrum of speck sizes is gradually transformed: total dust concentration is reduced but a contribution of middle size fractions D = 0,075 - 0,25 (m grows, i.e. natural monodisperisation of dust spectrum is occurs. Approaching a dust spectrum to the background atmospheric spectrum is observed on removal an order 100 km and more;

Before small removals X = 3-5 km the basic factor of dust stream (or cloud) dissipation is coagulation of superfine particles (D<0,05 (m) and sedimentation coarse particles, over X = 5-10 km is turbulent diffusion.

The proposed mathematical model for contaminant transport is based on the three-dimensional semiempirical equation of turbulent diffusion and the model for mesometeorological atmospheric boundary layer and adequately describes the experiment within 150 km of the seat of the dust storm. Offered asked semiempirical formulas for the estimation of the dusting and electric power of a dust source and for prediction a degrees of atmospheric contamination at region using separate photometric measurements an dust stream [5, 6].

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1218.

POSSIBILITY OF ORIENTATIONAL MELTING OF TWO-SHELL CARBON NANOPARTICLE

LOZOVIK YU. E., POPOV A. M.

Institute of Spectroscopy, Russian Academy of Science 142092, Troitsk, Moscow region, Russia

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The discovery of fullerenes gives rise the interest to other carbon nanostructures included the nanoparticles with shell structure. It is known that a melting of single cluster essentially

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differs from phase transitions in macroscopic systems.

The melting of a cluster may manifest itself as an hierarchy of transformation in shells or breaking the order between them. E.g., in 2D microclusters with Coulomb, dipole and logarithmic interaction between particles the rotational melting (i.e. rotation of "solid" shells) preceedes to melting inside the shells [1]. However, the rotational melting had not been discovered in 3D clusters.

Van der Waals interaction between atoms of neighbor shells in carbon nanoparticles is considerably weaker than valent interaction between atoms inside the shell. Therefore these nanoparticles seems to be possible candidates for rotational melting. To investigate the possibility of this phenomenon we consider the two-shell carbon nanoparticle with fullerene C_{60} as inner shell and fullerene C_{240} with icosahedral symmetry as outer shell (four different shapes of this fullerene are considered). The fullerene C_{60} is the smallest fullerene without adjacent pentagons in its structure, therefore the absence of chemical bonds between shells in this case is very probable. We describe the interaction between atoms of neighbor shells by Lennard-Jones potential. The energies of shell deformation is described in terms of deviations of bond lengths and angles between bonds from their equilibrium values.

The global and local minima of total potential energy of nanoparticle are found by optimization of three angles of relative shell orientation. The high I_h symmetry of shells leads to great number of equivalent global minima. The energies of shell deformation are also calculated. The barriers for relative rotation of shells in the nanoparticles under consideration are calculated for relative orientations corresponding to global minima of total potential energy. It is found that the obtained values of barriers for rotation are surprisingly small and shell deformation during intershell rotation does not considerably influence on the magnitudes of barriers. Moreover, these barriers are only several times greater than barriers dE_a, the differences between minimum and maximum in dependencies on angle of rotation for energy of interaction between one atom of the second shell and the whole first shell.

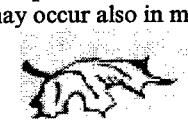
For example, for the nanoparticle with close to icosahedron shape of second shell C_{240} the barrier for rotation around fifth order axis is dE_r = 159 K. Simultaneously the maximal barrier among the barriers dE_a for individual atoms of the second shell are 22 K, i.e. dE_r \ll 240 \dE_a.

The detailed analysis shows that in the case of relative shell orientations with coincident symmetry axis of shells the second shell have several tens groups of atoms with different orientation relative the first shell. The maxima of dependencies E_a for individual atoms from different group correspond to different angles of rotation and so the dependence of total energy on angle of rotation is essentially smoothed. In the case of relative shell orientations with noncoincident symmetry axis barriers for relative rotation are very small due to incommensurability of atom positions in two shells.

The orientational melting may be considered in a sense as a two stage phenomenon. At low temperatures the relative reorientations of shells are frozen. Initially, the jump-like rotational diffusion begins with increasing of temperature. For greater temperature free rotation of shells take place.

The temperature T_1 of crossover from frozen state of nanoparticle to rotational diffusion of shells is estimated to be several Kelvin degrees. The temperatures T_2 of crossover from jump rotational diffusion to free rotation of shell is identified as the point where the two free energies of these states are equal. These temperatures are about tens Kelvin degrees. Both temperatures T_1 and T_2 are determined by the shape of second shell.

The molecular dynamics simulation of the process of nanoparticle orientational melting is performed. The obtained very small temperatures T_1 and T_2 in the two-shell nanoparticle allow us to proposed that rotation melting may occur also in many-shell nanoparticles.



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1238
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THE NONLINEAR LIDAR-EQUATION - AN INVERSE ILL-POSED PROBLEM

BOCKMANN C., BERNUTAT C., FISCHER S.

Universitqt Potsdam Institut fur Mathematik Am Neuen Palais 10 Postfach 60 15 53 144 15 Potsdam
Phone: (0331) 9771743/1500 Fax: (0331) 9771578 bockmann@rz.uni-potsdam.de

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Multispectral lidar measurements, tropospheric aerosol, multimodal aerosol size distribution, inverse ill-posed problem, regularization method, mollifier-method

The knowledge of the size distribution of atmospheric particles is of interest in many areas of aerosol research, e.g. for understanding the radiation budget of the atmosphere and for the explanation of heterogeneous chemical processes that occur in the atmosphere. The problem of determining the aerosol size distribution function n(r), by multispectral lidar measurements, belongs to the class of problems in mathematics called nonlinear inverse ill-posed problems. The best and tricky techniques of nonlinear optimization do not work there. Consequently, we have to look for a suitable regularization method to obtain reasonable approximations to n(r).

We consider two linear ill-posed subproblems, i.e. two linear first kind Fredholm integral equations, $\beta^{Aer} = K_{\pi} \cdot n$ and $\alpha^{Aer} = K_{ext} \cdot n$.

Small changes in the data function can produce very large changes in the solution, i.e. the solution n, if a solution exists, does not depend continuously on the right-hand side data functions β^{Aer} and α^{Aer} , respectively.

Since the tropospheric aerosol contains a large number of species, the model process is much more complicated as in the stratosphere. There occur aerosols with different particles, i.e. with different refractive index m. The aerosol size distribution is a multimodal one. In general the number of different particles and their refractive indices are unknown. Now we choose a suitable method to solve the two-dimensional ill-posed problem of integral equations. We propose a mollifier method. We start form the fact that in practice only a finite number of observations are possible. We choose among all n solving the equation the one with minimal norm. We select a smoothing operator $E_\gamma : X \to X$ with $w - \lim_{\gamma \to 0} E_\gamma n = n$ and determine $n_\gamma = E_\gamma n$.

If X is a function space, e.g. L^2 or Sobolev spaces $H^{-s}, s > \frac{1}{2}$, we represent E_γ by $E_\gamma n(r) = \langle e_\gamma(r;\cdot), n \rangle_X$ with a suitable mollifier e_γ, e.g. wavelet functions. The value s depends on the degree of ill-posedness, i.e. on the smoothness of the kernels.

The algorithm for reconstruction n at a specified point r from the given data proceeds in two

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steps:

1) solve the normal equation

2) calculate n, by parallel processing for different β^{Aer} and α^{Aer}, respectively

The ill-posed part of the algorithm, step 1, is independent of the data. Moreover the matrix of the linear system is independent of r and γ. The regularization parameter γ appears only on the right-hand side. The right-hand side can be compute exactly, avoiding in that way any influence of the noise in the data.
No additional or artificial discretization of the solution n is needed.We may freely select the points r where n_γ is evaluated.

1243.
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LIGHT-INDUCED EVAPORATION AND GROWTH OF AEROSOL PARTICLES

CHERNYAK V., KLITENIK O.

Department of Physics, Ural State University, Ekaterinburg 620083, Russia

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The purpose of this work is the elaboration of a kinetic theory for the evaporation and condensational growth of the particle under the effect of resonant optical radiation.

Consider a spherical nonabsorbing and non-heating particle suspended in a mixture of its own vapour and a non-condensed gas.

Could the evaporation or especially the condensational growth of the nonabsorbing particle be possible? The microscopic analysis answers in the affirmative on this question.

Let the frequency of the travelling light wave is close to the absorption line of the electronic or vibrational-rotational transition of vapour molecules. Due to the Doppler effect, only the vapour molecules whose velocity projection on the radiation
direction lies within a certain velocity range can be excited. The excited molecules change their transport properties - in particular, the collision cross section. If excited and nonexcited vapour molecules interact with molecules of the buffer gas
differently, the distribution function for the vapour molecules becomes nonequilibrium.

As a result the temperatures of the vapour and the vapour-gas mixture are different (resonant heating or cooling of the vapour). When the vapour temperature is
higher than the equilibrium temperature of the system, the droplet is evaporated. In the opposite case the condensational growth of the particle takes place.

The next reason for a perturbation of phase equilibrium is a dependence of the collision frequency of vapour molecules on quantum state. The absorbing molecules change their collision frequency. In this case the number of vapour molecules sticking
the surface of the particle per time unit is changed. As a result the dynamic equilibrium between evaporation and condensation is upset. The difference in the condensation coefficients for excited and nonexcited vapour molecules is the reason of evaporation or growth of the particle too. If the condensation coefficient of excited molecules increases then the condensation process is predominant, i.e. the growth of the particle takes place.

It has been assumed:

* The particle is exposed to the monochromatic optical radiation. A travelling light wave is absorbed by the vapour molecules in the electronic or vibrational-rotational transition from the

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ground state to an excited state. The radiation frequency is slightly detained from the centre of absorption line.

* The distribution functions of the excited and nonexcited vapour molecules and the distribution of the buffer gas molecules satisfy the Boltzmann kinetic equations.
* The evaporation coefficients for excited and nonexcited molecules are different and the effective cross sections are different too.
* Let the particle size is much smaller then the mean free path of molecules in a gaseous phase, i.e. free-molecule regime.
* The particle does not absorb the radiation; it does not change its temperature during evaporation or condensational growth.

It has been obtained:

* The expressions for kinetic coefficients, which characterise the surface and bulk mechanisms of evaporation (condensation) rate.
* The dependence of kinetic coefficients on the detuning between the radiation frequency and the centre of the absorbing line has been studied. The evaporation (condensation) rate has a maximum at exact resonance.
* The direction of the process, i.e. evaporation or growth of the aerosol particle takes place, is determined by the differences in the effective diameters of the excited and unexcited vapour molecules, in the evaporation coefficients of the excited
and unexcited molecules and by the detuning magnitude.

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NATURAL AND COSMOGENIC RADIONUCLIDES AT MT. CIMONE-ITALY

TOSITTI L., TUBERTINI O., BETTOLI M.G. , BONASONI P.

Environmental Radiochemistry Lab., Dept. Chemistry, Univ. Bologna, V. Selmi 2, 40126 Bologna, Italy
Institute of Physics & Chemistry of the Lower and Upper Atmosphere with CNR - FISBAT, Bologna, Italy

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In this work, an overview of radioactivity measurements at a mountain site (2165 m a.s.l.) representative of the free troposphere of Mediterranean basin located in the Italian northern Apennines, together with some preliminary results are presented. This area is of great interest for at least two main reasons: 1) high frequency of cyclogenetic phenomena in connection with intense stratosphere-to troposphere exchange processes; 2) the location is not directly affected by anthropic emissions, providing the opportunity of observing and identifying the drift of air masses both of European and Saharan origin. Current work includes high-volume aerosol samplings followed by gamma spectrometry of particled radionuclides, mainly Pb-210 at 47 keV and of Be-7 at 478 keV. Stratospheric intrusions have been at times detected and diagnosed by cross-check of activity values of both radionuclides and of their activity ratio with ozone and meteorological parameters which are simultaneously measured at Mt. Cimone observatory. In addition, the setup of a radiochemical procedure for the determination of cosmogenic P-32 in the same samples is in progress in order to better distinguishing between transports from the upper troposphere from those from the lower stratosphere when compared to corresponding Be-7 activity. Noble gas Rn-222 is continuously measured on a hourly basis by means of a modified lucas cell. Time series of radon activity are presented and discussed in the light of local climatology including the occurrence and description of some peculiar events observed.

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SOOT AEROSOL AND FULLERENE FORMATION IN CARBON VAPOUR CONDENSATION PROCESS

KRESTININ A.V., MORAVSKY A.P., TESNER P.A., FURSIKOV P.V.

Institute of Chemical Physics, Russian Academy of Sciences,
142432, Chernogolovka, Moscow Region, Russia

(First received 26 February 1998; accepted for presentation during IAS-4)

The very discovery of fullerenes and further studies on their formation process implied that kinetic mechanism of carbon vapour condensation has little in common with studied earlier processes of other simple substances condensation. In fact, the variation of the conditions of fullerene synthesis in an arc reactor leads to obtaining of 0 to 24wt.% of fullerenes C60+C70 in the product of carbon vapour condensation (fullerene soot).

Analysis of carbon vapour condensation process indicates that the following factors determine the kinetics: a) growth and decay reactions of carbon clusters under non-isothermic conditions, b) soot aerosol formation and growth, c) heat and mass transfer processes essentially influencing the temperature and gas phase composition. A kinetic model allowing for these factors is presented in the work. To test the model two sets of experimental data were used. These are kinetic data on fullerenes thermodecay in a shock tube [1] and on fullerenes synthesis in a carbon arc reactor [2].

The numerical analysis of the kinetic model of carbon vapour condensation lead to the following general conclusion. Under close to optimum conditions for the synthesis of fullerenes strict constraints on the kinetic scheme of vapour condensation are imposed by two factors: the high value of fullerene yield and constancy of molar ratio C70/C60 in the products of arc synthesis. In particular, the following is valid:

1) Coagulation of large clusters, for example, coalescence of cycles and polycycles, cannot be the main route to fullerenes C60 and C70. The inevitable high contribution of clusters coagulation to the soot particle nucleation would lead in that event to catastrophic fall in fullerene yield because of prevailing condensation of carbon vapour on readily formed soot particles.

2) The growth of fullerene structures ranged between C60 and C70 should proceed through insertion of C1, C2 or C5 fragments to get the main reaction route passed exactly both through C60 and C70 clusters. There slightly exists an alternative to this condition since it furnishes under mild additional restrictions both the high yield of fullerenes and constancy of the C70/C60 ratio in the products. The model employes the insertion of C2 - fragment as the main reaction route for fullerene structures growth. The decay of fullerene structures is well known to produce mainly the C2 fragment as well.

Two probable routes to perfect fullerene structures are compared in the model.
The first includes original formation of defect C60 and C70 clusters followed by monomolecular Stone-Wales type annealing into perfect molecules. The second one goes through the regular channel of fullerene growth by addition of C2 - fragment. Under some natural assumptions the value of the C70/C60 ratio obtained in calculations is almost constant and pressure dependence of fullerene yield coincides with experimental one for both routes.

The work is supported by Russian Fund for Basic Research, Grant No.96-03-34411.

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MECHANISM OF SOOT FORMATION IN PYROLYSIS AND COMBUSTION OF HYDROCARBONS

KRESTININ A.V.

Institute of Chemical Physics, Russian Academy of Sciences, Chernogolovka, Moscow Region, 142432, Russia

(First received 26 February 1998; accepted for presentation during IAS-4)

Two existing approaches to quantitative description of soot formation mechanism through <aromatic> and <polyyne> models are critically reviewed. Aromatic model considers the soot particle inception process as coagulation of polycyclic aromatic hydrocarbons (PAH). Polyyne model assumes that primary soot particles originate from fast polymerization of "supersaturated polyyne vapor". Certain experiments disagree with "aromatic" hypothesis. D'Alessio and co-workers recently discovered 3-6 nm sized transparent in visible particles in the soot zone of a premixed hydrocarbon flame. The concomitant conclusion states that primary soot particles are not giant aggregates of large condensed PAH, and the process of their formation may be faster than predicted by quantitative kinetic schemes of PAH growth and coagulation. Second, Tesner and co-workers in the studies of hydrocarbon pyrolysis discovered that admixture of acetylene to PAH decreases the soot particle number density. The opposite trend could be expected from the viewpoint of aromatic model since acetylene promotes PAH growth.

An essentially improved version of the polyyne model which details the acetylene pathway to soot particles is presented. The model is based on the idea that the fast polymerization process of polyynes C2nH2 , n=2,3,..produces primary soot particles in the form of polymeric globules. Soot nuclei arise in the model as radical centers of the polymerization process. Their irreversible growth is conditioned by the occurrence of supersaturation of a "polyyne vapor" in the reactive atmosphere. The carbonization process of primary soot particles is presented in the model as well. Its duration determines how long soot particles coalesce in the coagulation process. The computer code of the model comprises a detailed description of gas-phase and heterogeneous reactions, soot particle nucleation, surface growth and coalescence of soot particles. The principal quantities of soot formation process in hydrocarbon pyrolysis, namely, induction time, soot particle number density and soot volume fraction are available in the model. Calculations performed earlier for methane, acetylene, ethylene and benzene well agree with experiments [1-3]. The quantitative explanation of both high efficacy of PAH-molecules in soot particle nucleation and the "inhibition" of this effect by admixture of acetylene is presented in the report. Experimental results on those mixtures are crucial for understanding the main kinetic regularities of soot formation in pyrolysis and combustion of hydrocarbons.

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AEROSOL-OPTICAL CHARACTERISTICS OF THE ATMOSPHERE IN HIGH AND TEMPERATE LATITUDES OF RUSSIA

RADIONOV V.F., RUSINA YE. N.

The Arctic and Antarctic Research Institute 199397, St. Petersburg, Bering St.,38

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The features of the space and time variability of the aerosol extinction characteristics in the atmosphere of high and temperate latitudes of Russia were investigated in the regions that are not directly exposed to the influence of industrial sources. For this purpose the series of monthly means of the aerosol optical depth at a wavelength of 500 nm (AOD) and a selectivity indicator of aerosol extinction (wavelength exponent - WE) were analyzed at 13 Arctic and 6 mid-latitude stations of background atmospheric monitoring over 1972 to 1995 period.

The monthly means of aerosol optical depth in polar and background conditions of mid-latitudes of Russia are close by value and do not exceed AOD=0.25.

The variability of the aerosol optical depth within a year depends on latitude and is governed by different factors. The spring maximum of aerosol pollution recorded everywhere at the Arctic stations is a result of the increased aerosol export from the continent due to a pronounced meridian transfer in the wintertime. By the summer the Arctic atmosphere is purified and the minimum optical aerosol depth is observed in September. On the contrary, at mid-latitudes "normal" annual variations occur with AOD maximum during the spring-summer period.

At most stations under consideration there was no pronounced trend of the aerosol optical depth. A significant increase in AOD was recorded only at the mountainous North-Caucasian station Pyatigorsk-1 and at three Arctic stations (Dikson, Uyedineniya and Kotel'ny Islands).

At all background stations without exception, AOD increases with appearance of aerosol of volcanic origin in the atmosphere. The relative response value increases from South to North. Up to the present time the contribution of natural sources to aerosol pollution of the atmosphere still remains decisive.

During the period under study mean values of the wavelength exponent varied within 1.0-1.2, i.e. were by 15-23% below WE=1.3 assumed by Angstrom for average conditions. This indicates some displacement in aerosol size distribution to coarse-dispersed particles, probably, under the influence of antropogenic factors.

Like AOD, the wavelength exponent responses to large volcanic eruptions (such as El-Chichon and Pinatubo). The WE value decreases.

It was unexpected that unlike AOD, the tendencies in the change of the WE at mid-latitudinal stations turned out to be different. In particular, at two of them (Pyatigorsk-1 and Turukhansk), more clean of a special interest. However performing such experimental be related to the increased aerosol pollution in the observation regions. At most background stations in the late 1980s-early 1990s there was a transfer of the anomalies of annual means of WE to negative values. To determine the causes of this phenomenon additional studies are required.

Due to high sensibility to random errors of measurements the wavelength exponent is still badly studied and because of that it is of a special interest. However perfoming such experimental investigations will demand for high-precision spectral measurements of solar radiation.

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ABOUT DETERMINATION OF COEFFICIENTS OF ABSORPTION AND REFLECTIVITY OF MATERIAL PARTICLES FROM THE UNDERLYING SURFACE

VOZZHENNIKOV O.I., NIKONOV S.A.

Scientific Production Association 'Typhoon' Obninsk, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

As powerful computation means have become available we see reviving interest to using methods of random wanderings (Monte-Carlo), both for research problems on turbulent diffusion in complex meteorological processes and for applied problems related to calculation of material dispersion in case of regional and long-range transport. This method has been put to use by many research institutions and prognostic centres, among them Livermore National Laboratory (USA), RSMC "Obninsk" and others.

When applying this method, researchers encounter the "chronic" difficulty, namely parametrization of particles interaction with the underlying surface. To our knowledge, there is no solid research on the topic in the literature. Each research team uses its own developments in transport models which, as a rule, have not been discussed by the scientific community.

The present report describes one of possible approaches to determination of coefficients of reflectivity and absorption of material particles by the underlying surface. The approach is based on using traditional characteristics of near-surface and near-ground atmospheric layers. The sought values are determined for logarithmic near-ground layer, both for weightless and settling material. The simplest is the expression for the absorption coefficient for weightless material dispersing in the neutral atmosphere:

$$K_- = \frac{V_{g0}}{K_L + V_{g0}}, \qquad (1)$$

where V_{g0} is the velocity of dry settlement in the near-surface layer,

$K_L = \frac{\aleph U_*}{\ln h/z_0}$ is the exchange coefficient in the near-surface atmospheric layer, $\aleph \approx 0.4$ is the Karman constant, U_* is the dynamic velocity, z_0 is the roughness parameter, h is height at which the limiting conditions for the vertical flow are set.

The reflectivity coefficient can be simply calculated as:

$$K_+ = 1 - K_- = \frac{K_L}{K_L + V_{g0}}. \qquad (2)$$

In the case of settling material the reflectivity coefficient is found from the balance flow equation at the border with the surface.

For a simple logarithmic vertical wind profile characteristic of neutral stratification the reflectivity coefficient takes the form

$$K_- = \frac{W}{W + V_{g0}\left[(h/z_0)^m - 1\right]}, \qquad (3)$$

where $m = W/(\aleph U_*)$ For verification of the proposed approach we used the Monte-Carlo method of random wanderings in the velocity space. A series of experiments with the logarithmic wind profile were



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conducted. The report describes the results of comparison of modelled concentration profiles using the above defined absorption and reflectivity coefficients with exact solutions of diffusion equations for the simplest cases. The analysis suggests that this approach holds much promise in specifying the interaction of wandering particles with the underlying surface.

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ALIGNMENT EFFECTS IN NA*(3P) - C60 CHARGE TRANSFER REACTIONS

HEUSLER G. , CAMPBELL E.E.B.

Max-Born-Institut fur Nichtlineare Optik und Kurzzeitspektroskopie, Rudower Chaussee 6, 12489 Berlin, Germany

(First received 03 March 1998; accepted for presentation during IAS-4)

In a crossed beam experiment of neutral C_{60} and neutral Na charge transfer is observed when the sodium atom is excited to its 3p state. To investigate this reaction, we used an effusive sodium source and collimators to get a sodium beam. The fullerene beam was obtained from a small-sized oven. The fullerenes leave the oven through a 15 mm long tube of 1.5 mm inner diameter leading to a non-Maxwellian-Boltzmann velocity distribution.

The sodium in the interaction zone was excited to its first excited state (sodium D_2-line) using a two-mode laser. This laser is a cw dye laser emitting light at two wavelengths at 589 nm [1].

The laser was focussed to approx. 1 mm in the interaction region. The sodium atoms therefore pass through about 50-100 pumping cycles. The fluorescence light emitted by the sodium atoms was detected by a photodiode.

The interaction zone was completely surrounded by a box made from m-metal. This served as a shield to the earth's magnetic field.

The charge transfer was observed by detecting the emerging negatively charged C_{60} ions. They were accelerated from the interaction zone by an electric field. A lens allowed to focus the ions into the entrance hole of a quadrupole. In front of the quadrupole an ionizer is provided which allows electron impact ionization at variable energy. The ionizer could also be used to produce C_{60} - by electron attachment.

To investigate alignment effects, the polarization plane of the laser light was rotated continuously by a polarization rotator driven by a stepper motor. The fluorescence light and the C_{60} anion signal were registered simultaneously. A clear alignment effect could be observed and will be discussed in detail.

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1276
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COMPLEX MODEL FOR EVALUATION OF ECOLOGICAL SITUATION IN THE VICINITY OF NUCLEAR FACILITY

VOZSZENNIKOV O.I.[1]*, MOROZ'KO E.N.[1], SEMYONOVA E.V.[2]

[1] *Scientific Production Association "Typhoon", Obninsk* [2] *Moscow State University, Moscow*

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Evaluation of the influence of Nuclear Power PlantTs (NPP) releases including accidental ones is the important part of projecting organizationT work. In Russian practice, such an evaluation are performed by the different organizations, on the base of their own techniques

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and methodologies. As results, the non comparable estimation of NPP environmental impact appear.

The distinguishing feature of a model described is using of the whole complex of data available for the territory around nuclear facility(data on relief vegetation, land use, orography demographic data , etc.,),. A set of physico-mathematical submodels is proposed to perform the evaluation of the radioecological situation.

The present version of the complex model:
- is based on GIS technologies to operate with distributed data on territory;
- includes the atmospheric dispersion model capable to take into account deposition onto various surfaces;
- includes the runoff model to take into account the radionuclides washoff from the watersheds;
- is able to simulate wind resuspension of pollutants for different accidental stages.

All model parameters based on demographic , land and contamination data distribution are used average values for each cell of a rectangular grid. Diffusion fluxes between the adjacent cells could depend on the grid resolution.

RadionuclidesT transport by is described by with system of ordinary differential equations for each cell.

The complex model described was applied in the 30-km zone Novovoronezhskaya NPP to evaluate the possible environmental consequences of the accidental releases .

The evaluation results and model analysis are submitted in the paper.

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EXPERIMENTAL AND THEORETICAL STUDYING OF LANGEVIN SCHEME OF STOCHASTIC WANDERING.

ZHUKOV G.P., NIKONOV S.A.

Scientific Production Association 'Typhoon' Obninsk, Russia

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The Langevin equation, initially derived for describing the Brownian motion in the velocity space, is now successfully used for accounting for random wandering of liquid particles in modelling turbulent dispersion of material. The advantage of this approach is a possibility to adequately represent both relative and absolute diffusion. This is because the process of random wandering of particles in the coordinate space is non-Markovian, which allows going beyond the traditional K-Theory of diffusion.

The proposed work uses the numerical Langevin model of stochastic wandering to analyse results of the experiments on material dispersion from an instantaneous source in the atmospheric boundary layer (testing site of the meteorological tower, Obninsk, Russia). In these experiments, a plume was simulated by release of chaff with a low sedimentation rate (<30mm/sec). The chaff cloud was tracked using the meteorological radar, which made possible determination of relative distribution of the concentration in the cloud and calculation of the variance in chaff concentration by three directions. First results of these experiments were published in [1]. The meteorological conditions of these experiments were such that the stratification of the atmospheric boundary layer ranged from almost neutral to moderately unstable. In the experiments, the conditions of cloud expansion were: $S^2 \sim t^3$ (at $t \leq \tau_L$, τ_L is the Lagrangian time scale, L is the effective cloud width with the Gaussian approximation of concentration in it) $S^2 \sim t$ (at $t > \tau_L$). This permitted estimation of τ_L and diffusion coefficients for the meteorological conditions of the experiment. All experiments provided for

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measurements of main meteorological parameters using instruments located at the meteorological tower.

The used stochastic model was validated against the theoretical dependencies derived in [2]. Then, using the values τ_L and σ_u determined in the experiments the conditions of relative and absolute diffusion were reconstructed. Setting the initial distribution of the velocity of liquid particles to be Gaussian resulted in the absolute diffusion regime equivalent to a continuous source. It was found that the variance in distribution should be equal to the Eulerian dispersion of the medium in the release point. In this case, we get satisfactory agreement between the curves of growth of lateral dispersion of continuous jet in the IAEA methodology [3]. Given the delta-shape distribution, by the initial velocities the model simulates relative diffusion, i.e. increase in the size of the instantaneously released cloud. At large times, as follows from the theory, both regimes coincide.

For determination of the variance in meandering of the cloud in the model and in experiment the following formula was used

$$M_y = \sigma_y - S_y, \qquad (1)$$

where M_y is the variance in cloud meandering, σ_y is the absolute dispersion (which was taken from the IAEA methodology as lateral dispersion of continuous jet for experimental determination of meandering), S_y is the relative diffusion of expansion of an instantaneous cloud. For distances less than 10 km the experimental and model characteristics of meandering showed good agreement. At considerable distances, the meandering obtained by the combination method (experiment + IAEA methodology) shows higher values than the model. For example, at 30 km the variance in meandering is as large as 1 km. In our view, the obtained values are indicative of overestimation of variances in [3].

Based on the experimental data, we estimated a simple scheme to account for the vertical gradient of velocity in the model, namely

$$du/dt = -(u-\bar{u})/\tau_L + f_u(t) + G\cdot\omega, \qquad (2)$$

where u is the horizontal velocity, $\bar{u}$ is the mean horizontal velocity, f_u is the random force of the pressure gradient, G_T is the vertical gradient of velocity, ω is the pulsation of vertical velocity. It was concluded that such an account leads to overestimation of the longitudinal diffusion of the cloud. This fact can be interpreted as violation of the turbulence uniformity condition which was one of the main assumptions of the model.

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1279.
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PRODUCTION AND CHARACTERIZATION OF ENDOHEDRAL LI@C_{60}

KRAWEZ N., GROMOV A., HEUSLER G., PRAXEDES A., HERTEL I.V., CAMPBELL E.E.B.

Max-Born-Institut fur Nichtlineare Optik und Kurzzeitspektroskopie, Rudower Chaussee 6, 12489 Berlin, Germany

(First received 03 March 1998; accepted for presentation during IAS-4)

A method to produce Li@C_{60}, which has a much higher efficiency than any other available method for producing endohedral fullerene, will be presented [1]. In this method monolayers of C_{60} are continuously exposed to an intense beam of alkali ions at an energy chosen such that the ions can penetrate the carbon cage but cannot destroy it. In this way it is possible to build up a film of fullerenes of many nanometres thickness which contains a substantial percentage of Li@C_{60}. The ratio of Li^+ to C_{60} during the deposition was estimated to be 6:1 (for which the the best capture rate was found). As determined from laser desorption mass spectroscopy, this capture rate was up to 50% (i.e. equal intensity of the C_{60} and Li@C_{60} mass peak).

However, to purify the endohedral species, it was found that the best solubility was obtained for films produced at the lower Li+ to C60 ratio of 1:1 (and hence a lower content of the endohedral species). Results of the purification process using HPLC will be presented.

To characterize the endohedral species, mass spectrometry, infrared, Raman and X-ray spectroscopy investigations have been performed. Some of the results will be presented.

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1284.
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THE INVESTIGATIONS OF SPATIAL VARIABILITY FOR WIND FIELD AND ITS EFFECT ON POLLUTION CONCENTRATION NEAR THE GROUND FOR A LOCAL SYSTEM OF RADIATION MONITORING

BESCHASTNOV S.P., NAIDENOV A.V.

Scientific Production Association 'Typhoon' Obninsk, Russia

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The results of field measurements and of numerical simulation of wind field are considered along with the calculations of pollution concentration distribution from an elevated source over a heterogeneous surface in the re-gion of a local system of radiation monitoring for Obninsk, which being designated in conditions typical of middle regions of Russia. The wind spatial distributions was stu-died during simultaneous basic balloon observations and with a mesoscale nonhydrostatic model of the atmospheric boundary layer (ABL) incorporating a microrelief, a penetrable region of obstacles (a forest, bushes, a settlement, a town), albedo and roughness variations. The extent of the wind field spatial heterogeneity effect on the pollution concentration distribution from an elevated source was estimated with a numerical model of pollution diffusion.

It has been found that considerable variations in wind velocity and direction caused mainly by the influence of the obstacles region and albedo variations were observed at weak winds and convective conditions. A comparison performed has demonstrated that there exists a

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satisfactory agreement in the tendencies of wind velocity and direction spatial variations in field measurements and numerical simulation.

An analysis of numerical results of the lower atmosphere pollution has shown that the wind spatial variability influences strongly the pollution dispersion. But more crucial for the pollution concentration is the choice of a representative site for aerometeorological observations as the wind direction in the ground surface layer in the vicinity of the source may vary by $70\text{-}120^0$.

The investigation results obtained have shown that even under the conditions typical of the middle regions of Russia wind field natural variability is so high that its does not allow one to use unambiguously the data of the national meteorological network in local system of radiation monitoring. For the latter subsystems of meteorological support should be created including at least a meteorological mast near the source term.

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NUCLEATION IN THE VICINITY OF CRITICAL PARAMETERS OF THE 1,3-PROPANDIOL - CO2 BINARY SYSTEM

ANISIMOV M.P., NASIBULIN A.G., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

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Studies of a vapor nucleation have a significant interest. The reason of such interest is a fundamentally important problem of the kinetics description of the first-order phase formation. The next reason is the necessity to create the engineering computational methods for processes during homogeneous formation of a new phase takes place. The current level of research techniques for study an aerosol formation is fairly high, but there is no theory that would be suitable for the quantitative prediction of experimental results.

For the theory development it is necessary to have additional experimental facts which could be received under conditions differ from traditional nucleation studies. One of the possible direction of kinetic studies of new phase embryos formation is an experimental determination of isothermal nucleation rate in the vicinity of critical parameters of system under investigation.

The present work is devoted to investigation of 1,3-propandiol vapor nucleation in CO_2 atmosphere in a vicinity of critical temperature of the system. The particle formation by homogeneous nucleation has been experimentally studied using a laminar flow diffusion chamber technique [1].

Nucleation of this system has been investigated under the pressure range from 0.10 MPa to 0.30 MPa and in the broad interval of temperatures. The nucleation rate was measured in the range of 6 orders.

During our studies it was established the influences of critical temperature of gas-carrier (critical parameters of CO_2: T_{cr} = 304.2 K, P_{cr} = 7.39 MPa) on the vapor nucleation rate. The analysis of critical activities, a, at the constant vapor nucleation rate, J, on nucleation temperatures showed that the CO_2 mole fraction increase (CO_2 partial pressure) entails the drop of the critical temperature. The mole fraction increase of CO_2 skews of the critical temperature of the system to the critical temperature of the pure carbon dioxide. These experimental results do not have the explanation from the standpoint nor one of existing

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nucleation theories. The same behavior in the vicinities of critical point of nucleated system it was earlier found by us in other systems [2,3].

Using experimental nucleation rates versus 1,3-propandiol vapor activities, the number of molecules in embryos was evaluated [4]. It was established the influence of critical parameters on a size of critical embryos.

The influence of gas-carrier pressure on the nucleation rate was detected.

The experimental results were compared with the classical nucleation theory [5] and self-consistent theory [6]. It was found essential deflection from the theoretical models of description of nucleation process.

Thus, the formation of a new phase in the 1,3-propanol - CO_2 system under investigation should be interpreted as binary vapor nucleation.

Acknowledgment

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1288
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1,3-PROPANDIOL - SULFUR HEXAFLUORIDE VAPOR NUCLEATION IN THE VICINITY OF CRITICAL TEMPERATURE

ANISIMOV M.P., NASIBULIN A.G., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

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The history of the nucleation theory began about a hundred years ago. As a result of its rapid development, the classical theory of nucleation was created [1,2] in 1940's. However, it may hardly be considered as universal theory, because of it's coincidence with experimental results only within a narrow range of temperatures and supersaturations for definite classes of substances. The theory of phase transitions includes a number of unjustified assumptions, which do not make allow to describe of such small clusters. Although researchers tries to describe properties of embryos by using the microscopic approach the development of the new phase formation knowledge necessitated rejection of the use of the different thermodynamic corrections within the framework of the classical model. When the size dependencies of the surface tension and density of nuclei was taken into account [3,4] and the inherent degrees of freedom were considered in the statistical sum for a nascent cluster [5], agreement between theoretical predictions and experimental results became even worse.

In order to make the theory consistent, we must revise all its foundations. The role of the gas-carrier during nucleation should be analyzed, too. From the standpoint of the existing

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theory, this gas does not participate in the formation of critical embryos but only serves as a medium that maintains isothermicity of the nucleation processes. To create a more accurate theory and gain a better understanding of the processes that take part during aerosol formation, qualitatively new experimental results are required.

The present work is devoted to investigation of the critical temperature influence on nucleation phenomena. It is known, a chemical potential of a condensed phase has some peculiarities at a temperature of second-order phase transitions. The Gibbs's free energy of a critical embryo of a condensed phase and therefore vapor nucleation rate must feel temperature behavior of the chemical potential near the phase transition.

For this purpose, we selected experimental conditions in the vicinity of critical temperature, because they are suitable for exerting an inactive influence on the nucleating system at the level of intermolecular interaction and for studying the results of this influence.

As the object of our study, we selected 1,3-propandiol and as the carrier gas, we used sulfur hexafluoride (T_{cr} = 318.7 K, P_{cr}= 3.76 MPa).

The particle formation by homogeneous nucleation has been experimentally studied using a laminar flow diffusion chamber technique [6]. **During our studies the following results were received:**

1. Experimental dependencies of the nucleation rate on the activity of the investigated substance vapors under different pressures of the gas-carrier are measured;
2. Influence of critical parameters on the nucleation rate, size and composition of critical nucleus are found;
3. Dependency of critical system temperature and nucleation rate on the pressure of gas-carrier are detected.

The received experimental results point that the formation of new phase from vapors of the substance under investigation in the atmosphere of gas-carrier should be interpreted as binary nucleation.

Acknowledgment

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MEMBRANE FILTER TEL +7-(095)-9431498 FAX +7-(095)-1461356, 2302660 The elements proposed for production are favourably distinguished by their improved characteristics: higher strength, reliability, easy handling.

In the developers' opinion, the project is promising because of shortage in Western markets of cerment filtering materials from zirconium which has successfully been used in items applied in the atomic industry as one of the most promising corrosion-resistant materials to be used for filtration of aggressive liquids at high temperatures, and relatively low cost of production of source materials in Russia, production of zirconium, titan-based cermet membrane filtering elements and other materials with a high corrosion resistance for macro- and microfiltration of liquids Realization of the project will permit to solve the problems of maintenance of foreign-made filtering devices which have been imported in big quantities to Russia and other CIS countries, and, simultaneously, to begin promotion of these products to the international market.

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1295
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CONTRIBUTION OF SOIL BACTERIA IN AIR-PLANKTON OF URBAN ENVIRONMENT

L.V. LYSAK, N.N. SIDORENKO

Moscow State University, Department of Soil Science

Vorobyevy Gory, 119899, Moscow, Russia tel./fax +7 095 / 939 0989 E-mail: klofs@glasnet.ru

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Thanks of its heterogenesis soil provides the existence of different microorganisms, some of them is absorbed on soil particles and other are in water film, capillaries and soil solution. In this connection it should be noted as "the bank of microorganisms or a gene pool of microworld" (Zvyagintsev *et al.*, 1992). This property is a principal biospherical function of soil. Soil bacteria get to the atmosphere and transfer by air to great distances. This is a principal way of its moving all over the earth.

The aim of our work was the investigation of bacterial complex (BC) of soil and connected substrates (litter, leaf fall and phillosphere) contribution in formation of air-plankton of urban environment (Pushchino, Moscow region). The samples were analyzed by sedimentation on the surface of special nutrient medium which allows to count more than 40 genera of soil bacteria. The studies were carried out on three areas with different human impact: in the centre of town (CT), inside an urban public bus and in a suburban forest plot in 1994-96 in different seasons. The quantity and diversity of BC of soil and connected substrates were investigated simultaneously.

Obtained results were processed by modern approaches of synecology. The following regularities were revealed:

— more than 20 genera of soil bacteria were detected in air-plankton composition; the strains of genus Streptomyces, Bacillus, Arthrobacter, Rhodococcus, Cellulomonas, Micrococcus, Pseudomonas, Xanthomonas and family Enterobacteriaceae and the gliding bacteria are predominated;

— the maximum quantity and diversity of BC of air-plankton were revealed in the samples of CT and urban public bus; the minimum quantity were in the samples of forest plot;

— considerable changes of quantity of air-plankton by seasons were observed; the maximum index was registrated during spring and summer and the minimum one was in winter;

— the high degree of connection between frequency of some genera from upper lay of soil, litter and leaf fall and genera from the lowest lay of air was emerged;

— the maximum frequency of dominance in BC of air-plankton were determined for such genera of bacteria: Bacillus, Arthrobacter, Rhodococcus, the gliding bacteria (the center of the town); Rhodococcus, family Enterobacteriaceae (the urban public bus); Streptomyces, Arthrobacter, the gilding bacteria (the forest plot)

— fast-growing species of bacteria with short lag-phase were dominated in CT and urban public bus.

The increasing of quantity of genus Rhodococcus and family Enterobacteriaceae in the samples of air from CT and urban public transport are worthy of notice because of their pathogenic, toxigenic and allergenic properties.

Obtained results suggest that contribution of soil bacteria and litter in formation of air-plankton is considerable. The bacteria connected with man are important for composition of air-plankton of anthropogenic habitats.

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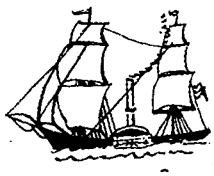
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Сотрудничающий центр ВОЗ по медицине труда
105275 Москва, проспект Буденного, 31 Факс 366 05 83 Тел. 365 02 09
The W.H.O. Collaborating Centre In Occupational Health
31, Prospekt Budennogo. 105275, Moskow, Russian Federation
FAX: *7-095*-366 05 83 TEL: *7-095*-365 02 09



1346.
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ULTRA-FINE POWDERS OF METALS, PRODUCED BY EVAPORATION-IN-FLOW TECHNIQUE.

JIGATCH A.N., LEYPUNSKY I.O., KUSKOV M.L., VERZHBITSKAYA T.M.

Institute of Energy Problems of Chemical Physics RAS.

117829 Russia Moscow B-334, Leninsky pr-t, 38, bd.2 E-mail ajigatch@chph.ras.ru

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A generator to produce the plum of ultra fine powders of metals and/or metal oxide with concentration as great as 10^{10}:10^{13} 1/cm^3 is proposed. Ultra fine powders of metals and metal oxides were produced, using evaporation-in-flow technique from the free-levitating drop, suspended between the coils of HF-inductor (this technique is a further improvement of Gen-Miller technology [1]). The powders of Ag, Cu, Ni, Al, either Al_2O_3 and NiO with juvenile particle surfaces and particle sizes within the range 5:200 nm were generated in inert gases (He, Ar) or in a mixture of inert gas with oxygen.

Particle samples were trapped directly from the gas flow by electron microscope grids (for TEM evaluations), by silicon plate (for electronography investigations) or by perforated stainless foil boats -- for adsorption and TPD/MS (temperature programmed desorption with mass-spectrometric analysis of desorbed products) experiments.

Electron microscopy investigation of particles size and shape were carried out using Philips EM 430 ST microscope to evaluate the dependence of particles array structure parameters on particle size. The analysis of structure characteristics for particles of different sizes were carried out by means of electronographic techniques too.

Probe gas technique with further TPD-MS analysis were used to investigate the dependence of active surface sites concentration and energy characteristics on particle sizes.

The dependencies of average particle sizes on gas flow parameters (the flow speed, inert gas pressure and gas type) and the drop temperature and size were evaluated. It was found, that the average particle size decreases with the decrease of the drop temperature (the drop temperature increases sharply with the increase of its size under the device conditions being constant), the flow speed increase and the gas pressure decrease. Helium as the carrying gas generates less particles, than argon. The nucleation kinetics in particle formation was investigated. Naturally, characteristics of all these dependencies are determined by a character of the evaporated metal.

The particles of the following minimal size parameters were generated and investigated:

Pair: "carrying gas - metal"	Average particle size <R>
Al – He	2.8
Al – Ar	7.0
Ag – He	4.7
Ag – Ar	10
Ni – Ar	3.7
Cu – Ar	14

Particle size distribution was found to obey logarithmically normal law with ?R/<R>=1. The shape of particles was near the spherical one, but the less particles was edged and had the shape with the fifth order of symmetry. Twins and more complex particles assembles were observed too.

The experiments on adsorption such probe gases as carbon dioxide and water vapour were carried out. It was found, that energy characteristics of adsorption active sites on the surface of ultra fine (<r><10 nm) and relatively "rough" (<r>~100 nm) differs from each other

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significantly. E.G., maximum of TPD curve splits to "two-headed" shape and moves towards higher temperatures for "ultra fine" particles both for water and for carbon dioxide on the surface of silver.

These probe gas adsorption showed less reactionability of cold metal particles surface, than it might be expected.

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1349.
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NANOSTRUCTURE CERAMIC OXIDE SYNTHESIS FROM THE AEROSOL

MILOSEVIC O.*, MANCIC L.*, NIKOLIC N.*, RISTIC M.M.**

**Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Yugoslavia*

***Center for Multidisciplinary Study, University of Belgrade, Yugoslavia*

(First received 20 March 1998; accepted for presentation during IAS-4)

The aerosol spray pyrolysis method was applied for submicrometar to nanosized ceramic oxide powder synthesis using a wide range of compositions. Particles formed by homogeneous or heterogeneous nucleation from aerosol generated by twin fluid and ultrasonic atomizers, the later operating at 1.7 and 2.5 MHz. Recent research has focused on controlled powder synthesis, with the purpose of ensuring control over particle purity, shape and size distribution. X-ray diffraction, infrared spectroscopy, differential scanning calorimetry, particle size analysis, scanning and transmission electron microscopy were used for particle characterization. Tailoring of the powder size, morphology, chemical and phase composition was possible by controlling the solution and process parameters. Control of the mechanisms of droplet generation, coagulation and evaporation/drying stages enabled the production of different particle morphologies. In the case of twin fluid derived powders the appearance of hollow spheres with a complex surface structure composed from primary crystallites is dominant. Nanosized and submicronic dense spherical particles are obtained ultrasonically. Control over the particle size and shape uniformity as well as structural homogeneity in multicomponent systems is established by maintaining the aerosol density below 10^8 droplets/cm^3. The phenomenon of funicular agglomeration in submicronic multicomponent powders was explained by the mechanisms of particle formation and interparticle sintering in the presence of a liquid phase. Assuming that a certain particle morphology forms during the first stage of spray pyrolysis, the empirically obtained particle size and morphologies were discussed in the context of the modeling of evaporation stage. The developed model gives a good description of phenomenon of mass and heat transfer and is in agreement with the obtained experimental results and numerical prediction.



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1350.
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CONSOLIDATION OF ULTRADISPERSED POWDERS SYNTHESIZED FROM AEROSOLS

NIKOLIC N., MILOSEVIC O., MANCIC L.

Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Yugoslavia

SRECKOVIC T., MARINKOVIC B., RISTIC M.M.

Centre for Multidisciplinary Studies, University of Belgrade, Yugoslavia

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The development of novel materials eventually leads to an expansion of new methods for the synthesis of powders with the desired properties. A rising increase of research for the applications of materials with the characteristics of the ultradispersed structures is evident. Polycrystalline ultradispersed oxide powders were synthesised from aerosols by the spray pyrolysis and freeze-drying method. X-ray diffraction, differential scanning calorimetry, infrared spectroscopy and scanning electron microscopy were used for particle characterisation. The obtained submicronic and nanostructured powders were reactive, homogeneous, high-purity and with a narrow particle size distribution. Consolidations of powders up to high densities were performed through the compacting of dispersed powders and sintering of the obtained compacts in order to achieve materials with the improved properties. Nonisothermal sintering process was analysed using dilatometric data. The sintered pellets were characterised with XRPD, SEM and BET method. The obtained results were discussed in terms of particle morphology.

1353.
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CALCULATION OF ANISOTROPIC SCATTERING OF SOLAR RADIATION IN ATMOSPHERE (MONOENERGETIC CASE).

ÀRISTOVA E.N., GOLDIN V.YA.

Institute for Mathematical Modelling of RAS

(First received 01 January 1998; accepted for presentation during IAS-4)

The strong anisotropic scattering, including scattering with forward-peaked indicatrix (small angle scattering), is very important at the solar radiation transport in atmosphere containing aerosols. In the paper, a method of radiation transport calculation at strong scattering anisotropy is developed. And scattering indicatrix is used without approximation, directly, for example according the data from [1].

Radiation intensity in the method is represented as a sum of three components: 1) non-scattered solar radiation, including specularly reflected from the Earth surface one (analytical solution), 2) small angles scattered direct solar radiation and its specularly reflected part (with multiple scattering); (high-accuracy representation of this component with real indicatrix is obtained), 3) all the rest radiation, the method of calculation of which is based on our papers [2,3].

The method makes it possible to consider also real anisotropy of reflection from the Earth surface [2]; because of lack of data ,we restricted ourselves by linear combination of specular and diffusive reflection.

The results of calculation of several problems in monoenergetic case for plane approximation of atmosphere are presented.

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Problems for different angles of incidence of solar radiation in cloudless atmosphere as well as at presence of cloudiness are considered. An appearance of "inner boundary conditions" for radiation intensity at inner and outer cloud boundaries as natural consequences of complete solving the problem in non-homogeneous medium is interesting.

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1356.
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REMOTE SENSING OF FOREST FIRES AND THE DIRECT RADIATIVE FORCING OF FIRE SMOKE

LI Z.

Canada Centre for Remote Sensing, Ottawa, Canada

(First received 10 March 1998; accepted for presentation during IAS-4)

Smoke aerosols produced by fires modify the earth's radiation budget. The direct impact is referred to as direct radiative forcing (DRF). Until now, studies dealing with the DRF of fire smokes have focused on the top of the atmosphere in tropical regions. This study investigates atmospheric DRF due to smoke from boreal forest fires. The presentation include two parts. Part I deals with the detection of forest fires by satellite. Part II is concerned with the determination of DRF by fire smoke.

A fire detection algorithm was designed to monitor active fires using individual AVHRR images across the Canadian boreal forest zone. It takes advantage of information from multi-channel AVHRR measurements to determine the locations of active fires on satellite pixels of about 1 km^2 under clear sky or thin cloud conditions. Daily fire maps were obtained showing all fires across Canada except for those obscured by thick clouds. This was achieved by first composting all the AVHRR scenes acquired over Canada and then apply the fire detection algorithm. 480 Canada-wide NOAA/AVHRR daily mosaics from 1994 to 1996 during the fire seasons were processed. Composting the daily fire spots permits a nation-wide view of the total burned area in a month, season or any specified period, in addition to providing information on the timing and development of fires. The total area of burning across Canada is estimated to be approximately 4.9, 7.1 and 1.6 million hectares in 1994, 1995 and 1996 respectively. The peak of burning also varies considerably from one year to another ranging from June to August, and so does the spatial distribution of fires. In general, conifer forests appear to be more vulnerable to burning and tend to grow bigger than deciduous forests.

By virtue of a satellite retrieving algorithm for estimating surface absorbed photosynthetically active radiation (APAR) over the visible wavelengths (400-700 nm), the DRF caused by smoke can be distinguished from the radiative effects of other agents. The algorithm was first validated under a range of sky conditions: clear, smoky and cloudy days. It was found that the estimated fluxes are in good agreement with surface observations for both

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clear and cloudy days. For smoky days, the estimates are generally greater than the observations. With aerosol corrections, the two fall again into a good agreement. This finding suggests that smoke DRF can be determined simply as the difference between observed and estimated APAR without correction for aerosol. Following this method, instantaneous, daily and monthly mean DRF values due to smoke were calculated. At the peak of the burning season, in July 1994, monthly mean atmospheric DRF was as high as 26.0 Wm^{-2}. This is quite a significant amount in comparison to the total forcing of -76.7 Wm^{-2} at the surface by both clouds and smoke, and to the monthly mean APAR flux of 132.6 Wm^{-2}.

1357.
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URBAN-MARINE AND MINERAL-DUST AEROSOL PROPERTIES, RADIATIVE EFFECTS AND CLOSURE STUDIES OVER THE ATLANTIC OCEAN: AN OVERVIEW AND SELECTED RESULTS FROM TARFOX AND ACE-2

RUSSELL P. B.[1],LIVINGSTON J. M.[2],SCHMID B.[3],HIGNETT P.[4],DURKEE P. A.[5],HOBBS P. V.[6], GASSO S.[6], HEGG D.[6],STOWE L. L.[7],BATES T. S.[8], QUINN P. K.[8],HAMILL P.[9],

[1] NASA Ames Research Center, Moffett Field, CA 94035-1000 USA

[2] SRI International, Menlo Park, CA 94025 USA

[3] Bay Area Environmental Research Institute, San Francisco, CA 94122 USA

[4] United Kingdom Meteorological Office, Meteorological Research Flight, DRA Farnborough, Hampshire, GU146TD, UK

[5] Naval Postgraduate School, Monterey, CA 93943-5114 USA

[6] University of Washington, Seattle, WA 98195 USA

[7] NOAA/NESDIS, Office of Research and Applications, NSC, Washington, DC

[8] NOAA-Pacific Marine Environmental Laboratory, Seattle, WA 98115 USA

[9] Physics Department, San Jose State University, San Jose, CA 95192 USA

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Aerosol effects on atmospheric radiation are a major source of uncertainty in understanding the past climate and predicting climate change. To help reduce this uncertainty, the 1996 Tropospheric Aerosol Radiative Forcing Observational Experiment (TARFOX) and the 1997 second Aerosol Characterization Experiment (ACE-2) measured the properties and radiative effects of anthropogenic aerosols over the Atlantic Ocean. TARFOX focused on the urban-industrial haze plume flowing from the eastern United States over the western Atlantic, whereas ACE-2 studied aerosols carried over the eastern Atlantic from both European urban/industrial and African mineral sources. These aerosols often have a marked influence on the top-of-atmosphere radiances measured by satellites. However, the accurate derivation of both optical depths and radiative flux changes, or radiative forcing, from the satellite-measured radiances remains a difficult challenge for the wide range of aerosol types and properties present.

In TARFOX, sensors and samplers on four aircraft, land sites, and ships measured optical depth spectra, aerosol composition, microphysics and optical properties, and radiative fluxes during many overpasses by different satellites. Closure studies show that the aircraft-measured flux changes agree with those derived from the aerosol measurements using several modeling approaches. Essential to obtaining this agreement is modeling the aerosols as moderately absorbing--i.e., having midvisible single-scattering albedo between about 0.90 and 0.95. These values are in accord with the aircraft measurements of (1) aerosol absorption and scattering

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coefficients, (2) unexpectedly large carbonaceous fractions of aerosol composition, and (3) unexpectedly large aerosol humidification factors.

In ACE-2, European urban-marine and African mineral-dust aerosols were measured by sunphotometers on the Pelican aircraft and the Research Vessel Vodyanitskiy, and by sensors on NOAA satellites. We present a comparison of the optical depths derived from the NOAA-14 satellite data with those measured by our fourteen- and six-channel sunphotometers. We find that the excellent agreement for urban-marine aerosols is degraded when African dust is present. Using the sunphotometer data during ascent and descent of the aircraft, we also obtain extinction profiles for separated layers dominated by African dust and urban-marine aerosols, respectively. The extinction profiles allow us to obtain size distributions for both these aerosol types, showing the distinctive differences between them. These optical depth and size spectra are combined with model complex refractive index spectra to calculate radiative flux changes induced by the different aerosol layers. By combining solar beam transmission measurements in the 0.94-micron band with those at neighboring wavelengths, we also determine water vapor columns and profiles, which are shown to agree well with aircraft in situ measurements.

1362.
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MODE ANALYSIS OF OSCILLATORY NUCLEATION IN VAPORS

FISENKO S.P.

A.V. Luikov Heat & Mass Transfer Institute , National Academy of Sciences 15 P. Brovka St.,220072, Minsk, Belarus E-mail: fsp@hmti.ac.by

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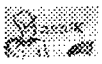
The simulations of heat and mass transfer processes related with kinetics of the phase transitions received new impact from applied research related with novel material production based on a nanoparticles [1]. The homogeneous nucleation is the first stage of nanoparticles creation at vapors mixture.

High rates of a nucleation and nanoparticles growth lead to a depletion effect of vapor density at nucleation zone. In some cases this effect brings to stop of the nucleation process which is extremely sensitive to the supersaturation value. The diffusion mechanism restores the vapor density at nucleation zone in some time if new phase particles have been removed from nucleation zone. Finally, nucleation and particles growth is repeated. Such process is called oscillatory nucleation. It's clear that oscillatory nucleation impacts greatly on the productivity of a devices for nanoparticle production.

The physical and mathematical model of oscillatory nucleation is developed to simulate some parameters of an this process . The mathematical model includes integro-differential equation of the mass transfer processes with source related with growth and motion of a nanoparticles. It have been shown that heat processes have small influence on oscillatory nucleation if pressure carrier gas is much larger the partial vapor pressure. The evolution of the moving source are described by the systems of ODE.

$$\partial_t n(x,t) = \partial_x (D(x)\partial_x n(x,t) - I(R(z(t)), < n(z(t)) >, t) \qquad (1)$$

where n(x,t) is the vapor density, <n(x,t)> is the average vapor density in a spatial domain occupied by nanoparticles, D(x) is a vapor diffusion coefficient, I is general form of moving source, z is the position of the center of mass of a nanoparticles clouds, R(z(t)) is the average radius of nanoparticles. The value of I is directly proportional the number density of nanoparticles.



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$$\frac{dz}{dt} = v(R, < n(z(t)) >) \qquad (2)$$

where v is the velocity of nanoparticles. The drag force, gravitational force and thermophoretic force influent on the velocity value.

$$\frac{dR(t)}{dt} = L(R)[< n(z(t)) > - n_e(z(t)) >] \qquad (3)$$

where $n_e(z(t)$ is the saturated vapor density, L is the known function of Knudsen number.

The theory is illustrated by an example of oscillatory nucleation in diffusion cloud chamber. The spectral variant of Galerkin's method is used for investigation this mathematical model. Results of numerical simulation of oscillatory nucleation are presented. The mass transfer processes are calculated in one-dimensional approximation. In particularly, for oscillatory nucleation at microgravity environment are considered. The comparison of experimental results (Fourier spectra of nanoparticles production rate) and theoretical calculation of the frequencies of oscillatory nucleation are discussed.

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1363
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CHARACTERISTICS OF AEROSOL AT THE NORTHERN OKLAHOMA

KATO S.[1], CHARLOCK TH.P.[2], CLOTHIAUX E.E.[3], LONG C.L.[4], CHARLES N.[5] MACE C.N.[5], ACKERMAN T.P.[3]

[1]. Hampton University, Hampton, Virginia, U.S.A.

[2]. NASA Langley Research Center, Hampton Virginia, U.S.A.

[3]. The Pennsylvania State University, University Park, Pennsylvania, U.S.A.

[4]. NOAA/ARL/SRRB, Boulder, Colorado, U.S.A.

[5]. University of Utah, Salt Lake City, Utah, U.S.A.

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Recent studies indicate that theoretical computations of the diffuse component of downward shortwave irradiance significantly exceed measurements at the surface under clear-sky conditions. This discrepancy leads to the uncertainty in estimating the total surface irradiance under clear sky condition. Because aerosol optical properties are temporally and spatially variable, uncertainties in the optical properties of aerosols contribute to uncertainties in irradiance computations.

To investigate the possible role of aerosols in this discrepancy at the Atmospheric Radiation Measurement site in northern Oklahoma, U.S., we relate ground-based measurements of direct and diffuse broadband irradiance, as well as aerosol spectral optical thickness, to meteorological parameters such as relative humidity, wind speed, and wind direction. When available, we analyze lidar backscattering returns for information about the aerosol profile.



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1373.
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CONCEPT OF POLARIZED LIGHT SCATTERING MATRIX CORRECTNESS

GERMOGENOVA T.A., KONOVALOV N.V., PAVELYEVA E.B.

Keldysh Institute of Applied Mathematics, Russian Academy of Sciences,
Miusskaya Sq. 4, Moscow, Russia, 125047

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The polarization effects play an essential role in the radiative transfer in oceans, in atmospheres of the Earth and of planets, in astrophysical objects. The contemporary experimental facilities are able to fix the polarization value beginning with the thousandth fraction of percent. The polarization effects registration results in the sharp increase contents and size of an accessible information. It permits to interprete and understand more deeply the physical processes in real objects, to obtain qualitative and quantitative characteristics of the scattering substance nature.

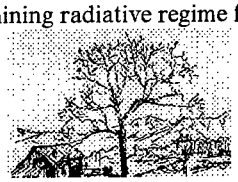
In our report some aspects of transfer theory and numerical methods relating to the polarized light transfer in scattering and absorbing media are considered. The conception of the non-negativity of polarized scattering matrices is the base of developed theory.

The key moment of this theory is the Stokes cone introducing. This cone is the set of Stokes vectors satisfying some inequalities in four-dimensional real vector space. Those inequalities imply from a physical analysis of Stokes parameters, characterizing the polarized light. The matrix, transforming linearly the Stokes vectors is named nonnegative, if any Stokes vector is transformed also into Stokes vector.

Almost complete absence of the information on scattering matrices for real physical objects is the obstacle to the successful solution of the polarized transfer problems. The scattering matrices, which are measured experimentally or obtained numerically, are always determined with errors and are not nonnegative. Thus, the main problem of the polarized transfer theory is a problem to develop a physical correctness (non-negativity) criterion for scattering matrices, to check and correct the known scattering matrices.

We formulate in report the necessary and sufficient conditions of the non-negativity of polarized scattering matrices in the form convenient for practical use.
The correction algorithm for polarized scattering matrices which are not non-negative is proposed and discussed. It is based on the combination of the well-known methods for extremal problems: methods of the steepest gradient descent, Gelfand-Cetlin method of "ravines" and local step search. Our correction algorithm has been developed and realized in FORTRAN codes. The experimental matrices of radiative scattering by the natural ocean waters have been studied. We found them to be incorrect at the scattering angles near 0 or 180 degrees, where the measurement accuracy is low. These matrices have been corrected.

Numerical transport methods and Monte-Carlo methods require a very large calculation time in problems for optically thick media. It is naturally to use in those problems the asymptotic approaches developed in traditional (scalar) transfer theory. Our investigations in this direction are based on the analysis of characteristic equation taking into account the polarization effects. In general suppositions we have investigated the structure of the characteristic equation spectrum and establish base properties of the main eigenvalue and corresponding eigenfunction, determining radiative regime far from irradiated boundaries.



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1379.
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TIME DYNAMYCS OF THE DISPERSE COMPONENT OF THE BIPHASE LASER ACTIVE MEDIUM

LETFULLIN R.R., MELIKHOV K.G., IGOSHIN V.I.

Lebedev Physics Institute of Russian Academy of Sciences (Samara Branch), Novo-Sadovaya St. 221, Samara 443011, Russia, Tel.:+7(846 2)341481, Fax:+7(846 2)355600, E-mail: fian@ssu.samara.ru

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Heterogenius chemical active systems, consisting from disperse particles of metal or their compounds suspend in gas mixtures, present a significant interest for getting the high concentrations of free atoms (active chemical reaction centres) in the quantum electronics for making the active medium of lasers. So, for instance, disperse phase forms a base of the active medium variety of lasers on metal vapours [1], as well as in under development the pulsed chemical oxygen-iodine [2] and fluorine-hydrogen [3,4] lasers.

Main defect of lasers on the biphase active medium is a quick degradation of the disperse component and, consequently, small lifetime of the active medium with given characteristics. Ever changing with time of the disperse phase properties lead to worsening the output features of laser, or to breakdown of laser generations in general. Regrettably, in the laser studies on disperse medium was not conducted analysis of degradation processes of the biphase active medium, and not determined possible limits of changing the aerosol parameters, for which laser generation on such scheme impossible. In particular, small lifetime existence of given working mixture of a HF-laser with disperse phase insufficient for preparing of master generator and initiating a laser in the experiment, can be one of the possible reasons that hitherto experimentally not received its generation.

This work is devoted to detailed studying the processes of disperse component degradations of the active medium of pulsed chemical oxygen-iodine and HF-lasers, considered with provision for coagulation [5] particles, their gravitation precipitation and electrostatic scattering.

The range at most-possible parameters of the disperse component, under which possible generation of pulsed chemical oxygen-iodine and HF-lasers, is determined from laser-chemical kinetics and the aerosol optics analysis, calculated by diffraction Mie theory [6]. For a HF-laser a radius of aluminium particles must falls within $r_0 = 0.09 \div 0.4$ μm, but their concentration, accordingly, $N_0 = 10^9 \div 10^7$ cm^{-3}. In the case of a pulsed chemical oxygen-iodine laser on biphase active medium must satisfy parameters: radius of iodine particles $r_0 \le 0.04$ μm at concentrations $N_0 \ge 10^6$ cm^{-3}, or radius of iodine particles $r_0 = 1 \div 5$ μm under their concentrations, accordingly, $N_0 = 4 \cdot 10^4 \div 8 \cdot 10^3$ cm^{-3}.

It's shown that main contribution to disperse component degradation of the active medium of lasers contributes a process of Brownian coagulation, changing by precipitation for big particles.

Take as a criterion of active medium optical transparency for laser radiation a condition $I_{sca}/I_0 << 1$, where I_{sca} and I_0 - intensities of scattering and incident radiation, most possible value of time of existence of the biphase active medium of said lasers was evaluated. So, for instance, for a HF-laser the maximum scattering of radiation on $\lambda = 3.3$ μm correspond to the size of the aluminium particles $r = 0.6$ μm, consequently, chosen by us criterion will be executed, if in result distribution on sizes N(r) practically particles of specified radius are absent. Coming from this, and considering all processes, which is leading to the diligence of

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aluminium aerosol in the active medium of a HF-laser, it was determined that condition $N(r = 0.6\ \mu m)/N_0 << 1$ is good executed only for a time $t \leq 250$ seconds ($r_0 = 0.05\ \mu m$, $N_0 = 2 \cdot 10^9\ cm^{-3}$). For pulsed chemical oxygen-iodine laser a time of existence large iodine aerosol within said restrictions is equal $t \approx 180 \div 260$ seconds and defined by high precipitation the particles.

Obtained results in the article allow to give concrete recommendations on a time of preparations and of the biphase active medium of pulsed chemical oxygen-iodine and HF-lasers with given parameters.

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1391.
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MODELING THE ATMOSPHERIC CYCLE AND THE RADIATIVE EFFECT OF SAHARAN DUST

BALKANSKI Y.[1], GUELLE W.[1], SCHULZ M.[2], CLAQUIN T.[2,1], MARTICORENA B.[3], BERGAMETTI G.[3], CHAZETTE P.[1], PELON J.[4]

[1] *Laboratoire des Sciences du Climat et de l'Environnement, Unite mixte CEA-CNRS, CE Saclay Bat 709, F-91191 Gif-sur-Yvette, France.*

[2] *Institut fÜr Anorganische und Angewandte Chemie, Universitat Hamburg, Germany*

[3] *Laboratoire Interuniversitaire des SystXmes Atmospheriques, Universite Paris XII, Creteil, France.*

[4] *Service d'Aeronomie du CNRS, 4 Pl. Jussieu, F-75252 Paris, France.balkansk@lsce.saclay.cea.fr*

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Recent advances in the physical description of the source of mineral aerosol together with global aerosol transport model that describe the size distribution of aerosols have allowed for a considerable improvement in the description of the atmospheric cycle of dust. Here, we present several years of simulation of Saharan dust transport using analyzed winds from the European Center from Medium Range Forecasts (ECMWF). We compare the results of the model with several types of observations:

* Meteosat geostationnary satellite
* Ground measurements of aerosol concentration
* Lidar profile obtained during the Sofia-Astex-Mage experiment near the Azores

The agreement found between the seasonal variations of mineral concentrations at 3 sites: Barbados Island (13°10'N, 59°30'W), Sal Island (16°40'N, 22°55'W) and IzaЯa (28°20'N, 16°29'W), suggests that the transport and principal removal processes are well represented in the model. Furthermore, on a shorter time scale, most of the episodic events of dust transport from the Sahara are captured by the model. We also examine the Lidar profiles that give us precise information about the vertical distribution of this aerosol which main features are captured in the simulation. Concurrently to the Lidar measurements, radiative measurements estimated the flux at the top of the atmosphere. These encouraging results have lead us to estimate the direct radiative impact of the mineral aerosol over Northern Africa and the

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Northern Atlantic. The top of the atmosphere net radiative effect over the region averages less than 1 Wm-2 over the region of study but the distribution of the forcing shows a very large contrast between warming exceeding 20 Wm-2 over Africa and cooling exceeding 10 Wm-2 over the Eastern Equatorial Atlantic Ocean.

1399.
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GAS-DISPERSED SYNTHESIS OF THE METAL OXIDES NANOPOWDERS

POLETAYEV N.I., ZOLOTKO A. N., VOVCHUK J.I., FLORKO A.V., ALTMAN I. S.

Institute Combustion, Odessa State University, Odessa, Ukraine

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At this work the possibilities of obtaining the metal oxides nanopowders are considered by the combustion methods. The gas-dispersed synthesis (GDS) method is based on combustion of dust clouds of metal particles in a laminar plume (it can be premixed plume - like Bunzen's burner or nonpremixed two-phase plume - like Burke-Shuman's diffusion burner). The obtained powders are well desagregated, have the spherical morphology, narrow gradation, average size of particles - 0.04 -0.1 microns. To obtain pure oxide powders of Al, Zr, Ti, Fe, Mg etc. by GDS method it is necessary to use not less pure microdisperse metal powders which are frequently obtained from the appropriate oxides. However, unique properties of obtained nanopowders, and also the technological virtues of the method GDS (very low expenditure of energy, has one stage, ecological cleanness) do a line-up an oxide - metal-oxide quite acceptable for a commercial production. The method GDS allows also to obtain multicomponent oxides by burning mechanical mixtures of powders of metals and their alloys.

The influence of basic macroparameters of a plume (fuel and oxidizer concentration, metal particles dispersion) and also thermal structure of the combustion zone on disperse and phase characteristics of the combustion products have been investigated by experiment for aluminum. For the definition of temperatures of condensed and gas phases in combustion zone the spectral methods were employed and for the analysis of the combustion products the disperse and x-ray- methods were used. It is shown, that nanopowder of alumina (average size of particles 0.04-0.07 microns, y-crystal phase), which properties depend little on variation of parameters of synthesis, accounted for no less than 99.5 mass persents of the products. The rest (- 0.5 %) compose the oxide particles, which sizes are about fuel sizes.

For powders of the high-boiling metals, such as Fe, Zr, Ti it is proved the possibility of their gas-phase combustion (under the temperatures of gas and condensed phase in combustion zone, which is lower than temperature of the metal boiling) with formation of oxide nanopowders of these metals (average size of particles - 0.02-0.05 microns). Zr, Fe, Ti particles burn heterogenetically in two-phase plumes with a low content of oxygen in carrying gas flow with generation oxide particles, which sizes are of the order of particles sizes of the initial fuel. Increase of oxygen concentration in particles dust clouds of these metals (more than 40-50 %) result in sharp increase of yield nanopowder fraction of the combustion products, i.e. intensification of gas-phase reactions.

On the bases of the obtaining results it is initiated an attempt to mechanism of formation and growth of particles of a condensed phase in combustion, with the supposition about the heterogeneous mechanism of condensation. Calculated value of an average size of oxide particles and its dependence on dust clouds parameters are obtained. The comparison of experimental and theoretical outcomes is produced which has confirmed a validity of the accepted supposition.

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DETAIL APPROACH TO DESCRIPTION OF NANOOXIDES CONDENSATION GROWTH DURING METALS COMBUSTION

ALTMAN I.S.

Institute of Combustion, Odessa State University, Odessa, Ukraine

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As it is known the nanooxides are the main part of the products of the metals gas phase combustion. Description of the processes of the condensation growth of oxides has great applied (for the gas-dispersed synthesis) and general theoretic importance. Existing now condensation models describe nucleation and don't pay enough attention to kinetics of the nucleus condensation growth. As a rule it's considered that condensation is proceeded in quasi-equilibrium regime. But the recent author's experimental investigations (with Yu.L.Shoshin) show the essential non-equilibrium of nanooxides optical characteristics during their condensation growth. This causes interest to consideration of detail mechanism of processes accompanying condensation growth.

In this work the growing oxide particle is considered as the aggregate of two non isothermal subsystems - system of electrons and system of phonons. It is shown that the processes of the gas molecules adsorption and desorption are nonreversible during condensation growth of particle. The energy of these processes is transferred through two different channels. The system of kinetic equations describing the heat transfer between electrons and phonons subsystems and the evolution of the adsorption and desorption energy is formulated. The analysis of probable solutions of this system shows that in the oxide particles having some size the electrons system becomes cool. This leads to decrease of adsorption rate and therefore to the stopping of the oxides condensation growth. The obtained result apparently explains the absence of large oxide particles at the products of metals combustion (when there is the gas-phase combustion).

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1401.
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ULTRAFINE TIO2 PARTICLES SYNTHESIS BY COMBUSTION OF TITANIUM DUST IN O2+N2 (PREMIXED AND SEPARATED REAGENTS JETS)

SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

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The experiments with laminar premixed flame of titanium dust / (oxygen+nitrogen) mixtures stabilized on 2.5cm diameter Bunzen-type burner was carried out. These experiments have demonstrated for the first time that at high oxygen concentrations the titanium particles' burning can be partly in gas phase regime with formation of considerable quantity of utrafine oxide. When oxygen volume concentration in dust/gas mixture was 40% the part of ultrafine titanium oxide was about 30% from the whole oxide quantity. The increase of oxygen volume concentration above 40% lad to flame slipping into dust feeding system.

To settle the problem of safe titanium dust burning with pmpose of ultrafine titanium dust

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production the combustion of thin titanium dust jet with separate reagent and oxidizer flows was experimentally studied. Vertical titanium dust / nitrogen laminar jet was formed using electrodynamical dust dispersing system. Dust jet diameter was 1-2mm. The outlet hole of dust supplying system was surrounded by concentric tube with diameter 15mm trough which oxygen was supplied. Oxygen volume spending was much more than nitrogen volume spending. In case of low dust flow velocities the flame stabilized in outlet hole. When dust flow velocity was gradually increased suddenly flame out took place and flame stabilized in distance 10-50mm from outlet hole, depending on dust flame velocity. By wariating of dust flow velocity it was possible to establish stable distanced flame at dust mass concentrations 0.3-10kg/m . The ratio of distance between flame and outlet hole to dust jet diameter reached 0 times at dust jet diameter 1mm. It is believed that the main reason of distanced flame stabilization is diffusional dissipation of nitrogen from a dust jet, which lead to increase of flame propagation velocity along the dust jet when retiring from outlet hole. Estimated oxygen volume concentrations in the axis of dust jet near the flame front was 20-90% depending on experimental parameters. Therefore, inspite of separate reagents feeding, the flame in fact was premixed or, at high dust concentrations, of intermediate premixed-diffusion type. The part of ultrafine titanium oxide was more than 80% from the whole oxide quantity.

The proposed method of ultrafine titanium oxide synthesis is safe and eliminates the problems of conductive heating of a burner and thermophoretic storage of ultrafine oxide on parts of the burner. Probably this method can be used also for ultrafine zirconium oxide synthesis as the parameters of zirconium and titanium burning are close.

1402.
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SYNTHESIS OF ULTRAFINE ZnO PARTICLES IN DIFFUSION (ZnO DUST+ PROPANE)/O_2 FLAME

SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

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In the present work the method of ultrafine zinc oxide synthesis by burning zinc dust/propane mixture is proposed. The concentric burner with separated fuel and oxidizer flows was used to obtain a laminar flame. The zinc dust / propane mixture was created by electrodynamical dust dispersing system which provided laminar flow with dust concentrations 0.1-10 kg/m3 . The pure oxygen as an oxidizer was used. The structre of obtained diffusion flame was studied experimentally. Two brightly luminous zones formed during combustion: yellow inner zone and distanced on 0.5-1.5 cm outer zone which color changed from blue to green and yellow by gradual increasing of dust concentration. Experiments with focused He-Ne laser beam scattering have shoved the presence of condensed phase only behind the inner luminous zone (initial zinc particles) and in- and beyond outer zone (zinc oxide particles). When a small water droplet was inserted between luminous zones a bright radiance appeared near and under the droplet which looked like "flame" of the same color as outer zone. The radiance evidently was caused by zinc oxide vapor condensation due to cooling by water evaporation. Analogous radiance appeared when thin jet of cool nitrogen was blown between zones. The results recounted above lead to the next conclusions about the flame structure. Zinc particles completely evaporated and zinc vapor oxidized in common diffusion front with propane (inner luminous zone). The outer luminous zone is the zone of zinc oxide vapor condensation.

The increase of dust concentration in zinc/propane jet led to the increase of zinc oxide particles mean diameter. The changirig of color of zinc oxide condensation zone can be

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explained by disproportional growth of radiance' self-absorption by oxide particles for different wavelengths. Because of specific spectral dependence of zinc oxide emissivity this effect must lead to nonuniform increase of radiation towards the short wavelength end of the spectrum.

The zinc oxide powders obtained at low dust concentrations haven't shown luminescence when UV irradiation, but powders obtained at high dust concentrations have shown yellow luminescence. It is believed that high heat release in condensation zone in second case provides long residence time of zinc oxide particles at high temperatures. The excess oxygen introduced into zinc oxide particles in high-temperature post-condensation zone is responsible for the luminescence.

The proposed method of ultrafine zinc oxide synthesis doesn't require external energy sources. The laminar regime of burning provides approximately uniform conditions of oxide particles growth. The method provides a simple way to regulate the mean diameter of oxide particles by regulation of zinc dust concentration.

1403.
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REGIONAL AEROSOL MODELLING WITH A EULERIAN MODEL

INGMAR J ACKERMANN, HEINZ HASS

FORD RESEARCH CENTRE AACHEN

DENNEWARTSTR.25 D-52068 AACHEN GERMANY ph.:49 241 9421 205 e-mail:

iackerma@ford.com

(First received 30 March 1998; accepted for presentation during IAS-4)

The particulate matter suspended in the troposphere is strongly linked to numerous air pollution problems. Aerosol particles serve as cloud condensation nuclei and therefore influence the chemistry and spatial distribution of precipitation. In case of evaporating clouds the cycling of aerosol particles through clouds leads to a physically and chemically modified aerosol system. Heterogeneous processes within as well as on the surface of particles have the potential to modify the concentration levels and the spatial distribution of most acidic and photochemical air pollutants found in the atmosphere. Due to their light scattering properties aerosol particles have a strong impact on the radiative budget of the atmosphere. This in turn might effect the photochemistry by changing the photolysis rates of important reactions. Additionally submicrometer particles can be inhaled and therefore might be a cause for adverse health effects.

Hence, a more accurate modelling of air pollution has to consider atmospheric aerosol processes. In contrast to gas phase substances it is not sufficient for an aerosol to predict the chemistry of the system to capture the effects mentioned above, since these are additionally influenced by the physical characteristics of the particle population, e.g. number and size of the particles or mixing degree and phase state. Therefore this paper describes an approach to model particle formation, transport and deposition with respect to aerosol chemistry as well as aerosol dynamics for the use in regional chemistry transport models.

The Modal Aerosol Dynamics Model MADE for Europe has been developed from the Regional Particulate Model (RPM, Binkowski and Shankar, 1995), adapted for European conditions and implemented into the Eulerian chemistry transport model EURAD (EURopean Air pollution Dispersion model, Hass et al., 1995; Ackermann et al., 1995). The size distribution of the submicrometer aerosol is represented by two overlapping intervalls (modes) assuming a lognormal distribution within each mode. Coagulation is treated within each mode as well as between the modes. Aerosol mass can be increased by direct emission of particles, the formation of new particles from the gas phase (nucleation) and by growth due to condensation.

In previous versions aerosol chemistry was restricted to the sulfate-nitrateammonia and

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water system. Since secondary organics comprise a major portion of the atmospheric aerosol we will describe the extension of MADE to organic substances in the aerosol phase. This allows to study the formation of secondary organic particles, their impact on the size distribution of the aerosol population and the response of the gas phase chemistry to the formation of particles on a regional scale over Europe.

Addtionally we will describe the extension of the model towards a more complete coverage of particle chemistry -by adding elemental carbon, primary organics and PM2.5- and particle size range -by adding the coarse mode aerosol particles. New developments to incorporate aerosol-cloud interactions in the model will also be presented.

The simulations will be performed with a prototype version of the aerosol code from the USEPA-Models3 system, thus providing a test case for this new community model platform. Results will be presented for an episode in July 1994 for an European domain and subdomains nested into this grid with a finer resolution.

1416
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THE MODIFICATED PETRYANOV'S FILTER FOR DIRECT RADIOMETRY OF ALPHA-RADIONUCLIDES IN AEROSOLS

NEKRASOV V.V.*, OGORODNYKOV B.I.*, SURIN N.M.**

** Karpov's Physical-Chemistry Instto, 103064, Russia, Moscow, Vorontcovo pole, 10*

nekrasov@cc.nifhi.ac.ru

*** Institute of Oceanology, RAS, 117218, Russia, Moscow, Nachimovskiy prospect, 36*

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Polymeric fiber materials - Petryanov's filters (PF) - are frequently used at the quantitave analysis of radionuclide contents in aerosol. These filters have high effeciency of catching of aerosol particles of any sizes [1,2]. The average thickness of filtering materials at all analytical filters does not surpass 3-3.5 mg/cm2, i.e. does not exceed rundown of alpha-particles with energy 5MeV. This circumstance eases the factor of absorption of alpha-particles in volume of filter, though and it is not enough. The decision of the problem is some simplified by use of specially developed many-layer filters, containing layers from superthin fibre. In this layer the absorption of alpha-radiation is relatively not large and occurs under known law, enabling to calculation quantity of radionuclides, accumulated by the filtering material [3]. However and in this case the direct reception of energy spectrum of sample is rather problematic. Frequently analytical PF are used for enrichment of sample with its subsequent analysis by traditional radiometric methods in a combination with preliminary chemical allocation and concentrating . Thus significant errors connected with correct account of losses at chemical allocation are appeared. At radiometry of samples with low-activities the liquid scintillators are usually applied (to realize of spherical-geometry experiment). In this case the error called by the account of solubility of sample in used scintillator is added. Moreover, the similar method is practically not aplicable for control of concentration of short-living radioactive isotopes. New type of filtering material, enabling to conduct accumulation of sample and radiometry of alpha-active aerosol without processing of sample and practically in spherical-geometry, are developed on the basis of PF by the authors of the present message. The proposed approach consists in transfer of radioactive emission of sample in optical emission directly in the filter material. The optical emission (radioluminescence, excited by alpha-particles) is not weakened by polymeric material and can be registered by standard photoelectronic devices.

The proposed material can be used in the complex analysis of radioisotope composition of accumulated sample by methods of alpha- beta- gamma-coincidence spectrometry. Record sensitivity can be obtained in this case. For example, the accounts show, that at selection of

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sample in course of 1000 seconds with pumping rate 3 cm/s the sensitivity on 241Am will be 2x10-15 Ci/m^3.

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1425.
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SEASONAL VARIATION OF AEROSOL DEPOSITION FROM BIOGENIC SULFUR GASES IN REMOTE MARINE ATMOSPHERE AT AMSTERDAM ISLAND IN THE SOUTHERN INDIAN OCEAN

NGUYEN B. C.*, MIHALOPOULOS N., SCIARE J.*, BABOUKAS E.****

**Laboratoire des Sciences du Climat et de l'Environnement. DSM/LSCE Unit Mixte de Recherche CEA-CNRS. Bât 709 - Orme des Merisiers 91191 - Gif-sur-Yvette Cedex. France.*

***Department of Chemistry, University of Crete, P.O. Box 1470, GR- 71409 Heraklion, Greece.*

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Biological activity of phytoplankton and zooplankton in surface seawater, over 3/4 of the Earth's surface, releases about 15 to 40 Tg S/year (1 Tg=10^{12}g) of DMS into the atmosphere . This gas rapidly oxidizes in the atmosphere to give methane sulfonic acid (MSA), dimethylsulfoxide (DMSO) and sulfur dioxide (SO^2) which subsequently reacts to form non sea-salt-sulfate (nss-SO_4^{2-}) . These aerosols (MSA, DMSO and nss-SO_42-) can act as cloud condensation nuclei (CCN), influencing albedo and therefore the Earth's climate.

Due to its importance in atmospheric chemistry, considerable effort has been made in the last few years to better understand the seasonal variation in DMS and its oxidation products. We present results of simultaneous measurements taken over a 2 to 4 year period in order to assess whether there is a link between oceanic and atmospheric DMS, atmospheric SO_2, and wet deposition of MSA, DMSO and nss-SO_4^{2-} .

A continuous record of SO_2 in the atmosphere (1989-1990) and of MSA and non-sea-salt-sulfate (nss-SO_4^{2-}) in rainwater and DMS at the ocean surface and in the atmosphere (1987-1990) were performed at Amsterdam Island (37+S 77+E) . Covariations are observed between the oceanic and atmospheric DMS concentrations, atmospheric SO2 concentrations, wet deposition of MSA, nss-SO_4^{2-}. A comparable summer to winter ratio of DMS and SO_2 in the atmosphere and MSA in precipitation were also observed. During the last 2 years from December 1995 to February 1997, measurements of MSA and DMSO in rainwater were also performed. DMSO concentrations ranged from 7.0 to 369 nM, with a distinct seasonal variation. The mean concentrations during the summer and the winter periods were 90 nM and 25.6 nM respectively. The observed DMSO seasonal cycle is in line with the observations of DMS in the atmosphere and MSA in rainwater, measured simultaneously during the reported period.

However, the summer to winter ratio of DMSO is significantly lower than that observed for DMS and MSA. The DMSO to MSA ratio and its observed seasonal variability are also presented. The implications on the biogenic sulfur cycle are discussed.



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1426.
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INFLUENCE OF DYNAMIC ATMOSPHERIC CONDITIONS ON THE CONCENTRATIONS AND PARTICLE SIZE DISTRIBUTION OF THE MARINE AEROSOL

ZIELINSKI T., ZIELINSKI A., PISKOZUB J.

Institute of Oceanology, Polish Academy of Sciences

ul. Powst. Warszawy 55, 81-712 Sopot tymon@iopan.gda.pl

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Keywords: Aerosol, Size distribution, Concentration, Coastal area, Breaker zone.

This paper presents the results of research, which started in 1992, and has been dedicated to determination of aerosol dynamics in the marine boundary layer over coastal areas of the southern Baltic under various hydrometeorological conditions by means of the lidar method. In the marine boundary layer over the breaker zones of the southern Baltic aerosol size distribution function and aerosol concentration depend on wind speed, direction and duration. The results obtained indicate that for northerly winds it can be assumed that the particles which occur in the marine boundary layer above the breaker zones of the southern Baltic are marine aerosols. In the other cases, especially with southerly winds the particles are a mixture of marine aerosols and particles of the land origin. With southerly winds the aerosol concentrations, masses and fluxes in the marine boundary layer above the breaker zones are significantly higher than in the case of northerly winds and also they do not differ substantially with offshore distance, even though the wind speeds are lower than the southerly winds. It was revealed that in the case of northerly winds the breaker zone could be easily distinguished from aerosol concentrations, masses or fluxes which were higher when compared with these of the open sea. In the case of southerly winds it is not as easy to determine the range of the breaker zone because the mean concentration of aerosols is constant along the sounding path. Also, the aerosol concentrations are higher in the case of southerly winds even though the wind speeds are lower for theses winds.

The lidar method allows for determination of variations of aerosol size distribution function, aerosol fluxes and their residence times as a function of two different formulae for roughness length coefficient including developing roughness and fully developed roughness, diverse sea bottom types with various slopes and different weather conditions with changing wind velocity, direction and duration.

The procedure has been verified experimentally on several types of Baltic Sea bottoms and it allows for the good estimation of aerosol dynamics in the coastal zone provided that wind conditions and the sea bottom type are known.

1428.
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PLUTONIUM RELEASE FRACTIONS FROM ACCIDENTAL FIRES

VLADIMIR KOGAN AND PHIL M. SCHUMACHER

Battelle Memorial Institute Columbus, Ohio, USA

(First received 02 April 1998; accepted for presentation during IAS-4)

Open literature and technical reports covering airborne releases of plutonium and plutonium-simulating contaminants during combustion of radioactive metals themselves and during fires in processing and waste storage facilities were reviewed.

Examination of the literature has identified three major sources of contamination which

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may be released during a severe accident at nuclear facilities:
1) Release by oxidation of plutonium metal,
2) Release by combustion of contaminated solid waste materials stored in the facility, and
3) Release by combustion of contaminated flammable process liquids, or evaporation of contaminated non-flammable liquids.

Based on the information gathered in this study, airborne releases from oxidation of metallic plutonium were grouped into three general categories. These categories include plutonium oxidation at a range of temperatures not exceeding plutonium ignition point, exothermic combustion of plutonium leading to its melting, and an explosive-like dissemination of plutonium resulting in formation of airborne plutonium particles and their subsequent violent combustion.

Combustion of contaminated solid waste materials appears to present a significant contamination hazard, because of the quantity of contaminated wastes stored in nuclear facilities, and because of the large fraction of contamination that can be released during a solid waste fire. Experiments have shown that up to 50 percent of the radioactive contamination can become airborne during combustion of a typical waste material, if the material is burning in the convective plume of the fire. A large fire may also cause bursting of waste storage drums exposed to direct flames.

Airborne release parameters are presented in terms of airborne release fractions (ARF) and respirable fractions (RF) for various contaminated combustible solid materials involved in a fire:
1) Rubber (polychloroprene or latex)
2) Polystyrene resin
3) Polymethylmethacrylate
4) Paper (cellulose) and mixed waste
5) Mixed waste in 55-gal drums

All releases from burning contaminated solid materials are conservatively assumed to be in the respirable size range. However, since plutonium oxide contaminant is a refractory material unaffected by fire, its original RF, if known, should be used.

Potential releases from flammable liquids are less significant, because of the lower releases expected. Nevertheless, the risk of contaminant releases associated with combustion of kerosene-like flammable liquids, such as during a jet-fuel fire caused by a crash of an airplane, will continue to be of significant concern.

With the potential for high release fractions, uncertainties associated with any release parameter needed for the environmental impact calculations become also extremely important. It is shown that major uncertainties are associated with the considerable amount of scatter among the reported ARF and RF data. Much of this scatter is due to the experimenters' desire to investigate a variety of test conditions in a limited-scope study. These variables include use of plutonium or a simulant, chemical form of the contaminant, its size distribution, its amount and application procedure, type of combustible material, flow conditions, and many others. Even when experimenters took great care to achieve reproducible fire conditions, order of magnitude variations in contaminant release were observed. The physical arrangement of the contamination and combustible material can also affect test results.

The health effects of the released contamination are strongly dependent on the size distribution and composition of the aerosol. Respirable contaminated particles present the greatest hazard to the surrounding population. Aerosol from solution tends to be mostly respirable, and a conservative estimate requires a relatively large respirable fraction for this contamination form. In many experiments involving combustible materials, the total mass distribution of the released aerosol was measured, which may not provide correct information

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regarding the size distribution of the contaminant aerosol.

1429.
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SOOT AEROSOL IN THE LOWER STRATOSPHERE: ABUNDANCE AND CLIMATIC IMPLICATIONS

PUESCHEL R.F., STRAWA A.W.

NASA Ames Research Center, Moffett Field, CA 94035-1000. Phone:650.604.5254. Fax:650.604.3625. Email: rpueschel@mail.arc.nasa.gov

(First received 31 March 1998; accepted for presentation during IAS-4)

Soot aerosol has been of interest in connection with a proposed commercial supersonic fleet that would more than double the direct injection of aircraft emissions into the lower stratosphere. We determined an average surface area of soot aerosol of (4.6+2.7)e-3 μm^2 cm^{-3} in the northern hemisphere when approximating soot particles by equivalent spheres. Accounting for the fractal nature of soot increased this value 20-fold. The abundances in the southern hemisphere were lower by one order of magnitude. The data were compiled from fourty Ames wire impactor aircraft samples from pole to pole, between 0 and -200 degrees western latitude, and between the tropopause and 20 km altitude

A "decadal" average value of (2-5) μm^2 cm^{-3} for the total aerosol was derived from the 1979-1981 and late 1984-1990 SAM/SAGE satellite data sets [1] which exclude the major El Chichon effects but include at least seven other volcanic injections. That's why this "decadal" average exceeds by one order of magnitude a "background" value that we derived from our in situ samples in agreement with satellite observations [1] in 1979.

In order to compute the optical properties of the stratospheric aerosol, we applied the Maxwell-Gannett function to determine a "gray" refractive index of 99% by mass of sulfuric acid/water droplets that are mixed externally with 1% by mass soot particles. The single scatter albedo of this mixture is close to 0.98 at mid-visible, and about 0.94 at near-infrared wavelengths. In contrast, a pure sulfuric acid/water aerosol has a single scatter albedo of one at mid-visible, and of 0.98 at near-infrared wavelengths. Pollack [2] concluded that impurities reducing the single scatter albedo to 0.98 or less at solar wavelengths would change the sign of climate forcing from cooling to heating. Thus it appears that increased emission of soot aerosol into the stratosphere by a proposed supersonic or enlarged subsonic commercial fleet could prove problematic.

[1] Hitchman, M., M. McKay, and C. R. Trepte, A climatology of stratospheric aerosol. J. Geophys. Res. 99, 20689, 1994.

[2] Pollack, J. B., et al., Radiative properties of the background stratospheric aerosol and implications for perturbed conditions. Geophys. Res. Lett. 8, 26, 1981.

RAS

INTERNATIONAL AEROSOL SYMPOSIUM *IAS-4*

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TITLE OF SESSION **AEROSOL MEASUREMENT**

Chair Prof. **LEONID M. LOGVINOV** *(01.09.44)*

Fax 7-8462- 357356 phone 7-8462- 357079 onil16@lib1.ssau.ru

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1436.
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A COMPUTER CODE SYSTEM ATRAD FOR EFFICIENT PRECISE CALCULATIONS OF ATMOSPHERIC RADIATION.

SHILKOV A.V., SHILKOVA S.V.

Institute for Mathematical Modelling of the Russian Academy of Science, Moscow

(First received 30 March 1998; accepted for presentation during IAS-4)

The report is devoted to computer code system ATRAD (ATmospheric RADiation) for numerical calculations of atmospheric radiation transfer in climate studies. Mathematical methods for numerical modelling are submitted. Calculation results are presented.

A specificity of the Earth atmosphere and connected problems are the following: A)Heterogeneity of altitude profiles of optically active gases. B)Very large number of molecular absorption lines (resonances) (10E4 - 10E5). C)Presence of cloud layers where the optical thickness with respect to absorption and scattering at particles changes sharply and temporal varying of cloudiness and aerosols.

The existing computer codes, solving these problems, are divided on poles apart:

1) "Line - by - Line" calculations of radiation spectra. These codes provide precision control at all stages of transport equation solving and use real microscopic cross-sections of radiation scattering and absorption as a data. Their disadvantages are large calculation time and difficulties at change of calculation variants.

2) "Semi empirical methods and codes" applying in climate studies. These methods are economical and permit the fast change of variants. Their disadvantages are the using of roughened model optical constants for wide spectrum parts as a data and precision uncontrollability.

The System ATRAD, being developed by the authors, has "Line - by - Line" calculation precision (1) and "Semi empirical methods and codes" efficiency (2). The data are microscopic cross-sections of radiation scattering and absorption (HITRAN - 92). The integration of these two qualities is achieved by application of a number of mathematical methods.

For the molecular absorption heterogeneity problem (A) solving, a procedure of energy scale division at resonance carriers is proposed. We call a pooling of spectrum intervals, at which absorption lines of gas "t" lie, a resonance carrier of gas "t". For the Earth atmosphere, it is enough to divide the energy scale at three carriers: H20, C02 and 03. The radiation transfer calculations are made independently inside the boundaries of each carrier.

For the problem (B) solving, method of Lebesque averaging of radiation microscopic cross-sections and intensity with respect to photon energies is used. The averaging is performed over energy points with equal absorption. So there are practically no precision losses. As a result, instead of transport equation calculations in 10E5 - 10E6 spectrum points, we solve the averaged transport equation in 10 - 10E2 conventional spectrum units.

For the problem (C) solving, quasi diffusion schemes and schemes with quasi analytical interpolation with respect to space variable were developed. Quasi diffusion schemes have given the fast and precise solution of transport equation with prevailing scattering and strong temporal varying of particle concentrations. Schemes with quasi analytical interpolation with respect to space variable have given the fast and precise solution of transport equation with presence of cloud and aerosol layers where the optical thickness of cells changes sharply. These schemes don't require space mesh retirement and/or model consideration of cloud layers. Schemes are constructed on the base of analytical solving transport equation inside uniform cells, then connection of conditions at cell boundaries and reconstruction of the solution in the whole region.

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The numerical calculation results, showing the efficiency of ATRAD Code System in comparison with "Line - by - Line" calculations are presented.

The work is done at the financial maintenance by ISTC (project N115-95).

1443
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PHOTOINDUCED GENERATION OF H_2O_2 IN WATER/HYDROCARBON EMULSIONS CONTAINING C_{60}

NADTOCHENKO V.A.*, KIWI J. **

**Institute of Chemical Physics in Chernogolovka, Russian Acad of Sciences Chernogolovka, Mos reg 142432.*

*** Institute of Physical Chemistry II, EPFL. Lausanne II, Switzerland, 1015.*

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Photoexcitation of natural or artificial pigments in the air saturated water solution could lead to the formation of H_2O_2. This process plays important role in the mechanism of the pigment bleaching under the light and in the redox oxidation of organic compounds in the contaminant or natural waters. The main goal of this study is to test the photoinduced generation of H_2O_2 sensitized by C_{60}. C_{60} is not dissolved in the water therefore the hydrocarbon/ water emulsions were tested. Basic photophysical and photochemical properties of C_{60} are well studied. Triplet excited C_{60} is quenched by air oxygen with the efficient production of the singlet excited oxygen. In the presence of the electron donor molecules the quenching of the triplet excited C_{60} by donor with the formation of the C_{60} anion radical is possible. The following oxidation of C_{60} by air oxygen should produce the O_2 radical. The formation of H_2O_2 should be expected due to the following redox processes involving reactions of singlet oxygen or O_2 radical.

There were studied the water/thoulene and water/hexane emulsions. There was used solutions of hydrocarbon saturated by C_{60}. The Sun-test lamp was used for the excitation. The concentration of H_2O_2 was measured by iodometric titration technique. Aniline, triethanolamine, phenol, oxalate were tested as electron donor quenchers. As control experiments were performed the measurements of H_2O_2 formation in: a) complete emulsion solution containing C_{60}, donor, oxygen in dark; b) emulsion solution containing donor, oxygen without C_{60} under the light; c) emulsion solution containing C_{60}, oxygen without donor under the light; d) emulsion solution containing C_{60}, donor without oxygen under the light.

The results can be summarized as following:

a) there is observed photoinduced generation of H_2O_2 in the complete emulsion solution containing C_{60}, donor, oxygen under the light.

b) there is no or negligible small formation of H_2O_2 in the control experiments;

c) there is observed the growth of H_2O_2 concentration during 4 hours. After that the growth is stopped. Long time excitation during 24 hours leads to the H_2O_2 degradation.

d) there is observed the degradation of C_{60} after 3-5 hours.

e) maximum of H_2O_2 concentration depends on the donor. This value achieves to 10 M.

Qualitatively the properties of C_{60} as a photosensitizer of H_2O_2 is close t the properties such most efficient sensitzer as dye methelene blue. The optimization of the efficiency the H_2O_2 formation relative the absorbed light energy is possible.

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1014.
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ON SECONDARY RESUSPENSION RADIONUCLIDES INCOME INTO ATMOSPHERE AFTER

VASILYEVA K.I., VOSZHENNIKOV O.I., NIKONOV S.A., FOSTER K. (*), BURKOV A.I., MOROZKO E.A.

Typhoon (*), LLNL

(First received 16 December 1997; accepted for IAS-4)

The parametrizations for a resuspension factor and a resuspension rate as functions of the time after an accident, wind velocity and roughness parameter are developed based on existing experimental and theoretical data. For taking into account the dependence of resuspension process on moisture content of soil and on anthropogenic activity it is introduced the empirical factors. The comparison of resuspension factor and resuspension rate calculated with use parametrizations shows good coincidence with experimental data. The correlation coefficient for them is equal 0.9.

1293.
УДК 541.18

NON DESTRUCTIVE EXAMINATION BY TXRF (TOTAL REFLECTION X-RAY FLUORESCENCE) OF AIR NUCLEOPORE FILTERS

CICARDI C., GALLI A., MILAZZO M.

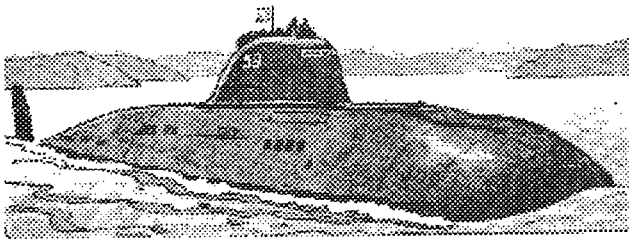
Instituto di Fisica Generale Applicata Via Celoria 16, Milano 20133

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Some multielement analysis of airborne particulate on nucleopore filters have been performed using the method of TXRF which allows non destructive examination as well as PIXE analysis, but is obtained in much more simple and economic way.

Quantitative analysis is based on comparison with Fly Ash Standard BCR CRM 038 and we found agreement with PIXE results.

Possible influence of aerosol particle diameter in quantitative analysis is been investigated at present.



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1440.
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THE RESULTS OF EXPERIMENTAL RESEARCH OF THE FOREST FIRES INFLUENCE ON THE RADIOACTIVE CONTAMINATION OF ENVIRONMENT AND THE ASSESSMENT OF DOSES TO FIRE FIGHTERS

KADYGRIB A.M.*, KASHPAROV V.A.*, LUNDIN S.M.*, PRISTER B.S.*, PROTSAK V.P.*, LEVCHUK S.E.*, YOSCHENKO V.I.*, GARGER E.K., KASHPUR V.A.**, TALERKO N.N.****

** Ukrainian Institute of Agricultural Radiology, Kiev, Ukraine*

*** Institute of Radioecology of UAAS, Kiev, Ukraine*

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The experimental researches of the resuspension and the transfer of radioactive substances during the dry grass and forest fires were carried out in Polessje district of Kiev region at the experimental sites 50x150 m and 100x200 m respectively. The concentration of radionuclides in the elements of meadow and forest biocaenosis as well as the total contents of radionuclides were measured for both sites. The density of contamination with Cs-137 of the meadow biocaenosis was 4.8 MBq/m^2 with the part of radioactivity localised in plants 0.01%. The density of contamination with Cs-137 of forest biocaenosis was 0.9MBq/m^2 with the part of radioactivity localised at the ground surface about 96%. The values of airborne concentration, dispersal composition and deposition intensity of radioactive aerosol (RA) at the different distances had been obtained at the different phases of fire. The main meteorological parameters had been measured.

The experiments in laboratory were carried out in order to assess the parameters of wind resuspension. The dependence of resuspension intensity on the wind velocity was investigated using the aerodynamic pipe. The ash of samples collected in 30-km zone and burned at the temperature 600 C was used to model the fire products. The dispersal composition of RA and the release of radionuclides during the burning of the samples of forest biocaenosis in a chamber were measured. It was shown that after the burning of pine-needles (the most important flammable material in pine forest) the main part of Cs-137 activity in aerosol is associated with the particles of aerodynamic diameter less than 1.8 mm which are much less than the ash particles (>5 mm). Visual analysis of impactor cascades shown that this activity is associated with the tar particles evaporated as a result of pineneedles burning.

Such parameters of RA transfer in atmosphere as the resuspension coefficient, resuspension and deposition velocity at the different distances (15-270 m) from the source had been calculated using the data obtained in experiments on dry grass and pine forest fires.

Using the obtained data a mathematical model of RA transfer in atmosphere was verified. The calculations for the different scenario of fire were performed. It was shown that the wind transfer of radionuclides is not significant even for the hardest scenario of fire - it produces the contribution to the density of contamination of surrounding areas about 10^{-6} of its background values.

The spatial distribution of average RA concentration during the fire shown that the RA transfer in atmosphere was caused both by the convective and the unconvective transfers. The superposition of these transfers results the formation of an ununiform aerosol concentration field with a sharp minimum of concentration at the distance about 100 m from the source and with two maximums of concentration - in close vicinity of the source and at the distance several kilometres.



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Both the dynamics of RA concentration and the dispersal composition depend on the distance from the source and the phase of fire. For instance, at the distances 10-300 m and the wind velocity 1-2 m/s the concentration of Cs-137 at the phase of active fire is two orders of magnitude higher than its background value, one order of magnitude higher at the smoulder phase and several times higher at the post-fire phase.

Human respiratory tract dosimetric model recommended by ICRP (Publication 66) was used for the assessments of doses caused by the inhalation intake of RA by fire-fighters. Using the data on RA dispersal composition it was shown that its variability during the fire does not cause the significant changes of 137Cs dose coefficient. Its median value calculated for the 1-year effective equivalent dose (EED) caused by acute intake is $1.53*10^{-8}$ Sv/(Bq*hour/m^3). Due the estimated high solubility of RA the 1-year EED from acute intake reaches up to 90% of 50-years EED. For the wide range of scenario of the forest fires outside the 30-km zone the estimated contribution of inhalation dose into total dose does not exceed several percents. The presence of radionuclides of transuranium elements in the forest fire radioactive release (which is possible for the fires inside the exclusion zone) can result an increasing of the inhalation dose up to the values higher than an external irradiation dose.

1292.
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PHOTOSTIMULATED CONVERSIONS OF METHANE ADMIXTURES IN THE AIR MEDIUM

MUSTAFAEV I. *, MAMMADOVA I. **

**Ecological Society of "RUZGAR", 124/128 G.Garayev ave. 370119 Baku, Azerbaijan*

*** Sector of Radiation Researches, Azerbaijan Academy of Sciences, 31-a H.Javid ave 370143 Baku, Azerbaijan*

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Methane emissions into the atmosphere as a results of natural and industrial processes constitute about 50 mln tonnes in a year. Owing to high diffusion abilities methane easily spreads to the middle and upper layers of the atmosphere and takes part in photostimulated physico-chemical reactions. Under certain conditions the participation of methane in this processes may considerably influence on the rate and direction of chemical reactions, and at the end make contribution to decomposition of ozone layer, "greenhause effect", formation photochemical smog and etc.

The results of investigation of kinetics and mechanism of vacuum-ultraviolete photostimulated conversions of methane in the air medium are conducted in this paper. Obtaining of informations on kinetics in this reactions allows to predict the influence of methane admixture on chemical processes in the atmosphere.

Experiments were carried out at ranges of changes concentration of methane in the air 0.01 -99,5 % , total pressure of gasephase mixture are 0,04 - 100 kPa and irradiation time 10 - 300 minutes. As a sources of VUV -radiation the Kr and Xe rezonanse lamps were used.The wave lenght of VUV- radiation were 123 nm and 147 nm and the radiation flow was 4-4,5 10^{15} quant/s. As a index of processes are determined rate and quantum yields of formation H_2, CO, C_2H_4, C_2H_6, O_3, also decomposition of methane admixture. It is established, that at the dependence on wavelength and methane concentration in the air medium, methane is decomposed to direct and indirect processes:

C_4H + radiation _____ CH_2 + H_2 (or CH_3 + H) (1)

C_4H + O (D) _____ CH_2O + H_2 (or CH_3O +H) (2)

Such as under radiation with wave length 123 nm and [CH_4] more than 0,1 % reaction (1)

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dominate from (2), being at the 147 nm and [CH_4] less than 99,5 % atoms O(D), formed at the photochemical decay oxygen are of vitial importance in photochemical methane decomposition processes. It has been shown, that at the methane concentrations [CH_4] more than 0.05 % in the air medium occurs sharply decrease of photolitical ozone concentration at the expense of decrease of its generation rate at the presences of methane in processes of radiation absorption and in the reaction with precursors of ozone. At the changes of methane concentration in the irradiation mixture 0.1-51 % the quantum yields of ozone are changed at limits 0,35- 10^{-4} molec/quant at the 123 nm wave length radiation and 0,4- 10^{-3} molec/quant at the 147 nm.

As results of analysis are obtained ratio of constants rates of reactions:

$O(P) + CH_4 _____ CH_3 + OH$ (a)

$O(P) + O_2 _____ O_3 + M$ (b)

Finding that K_a/K_b = 942.8 .These results satisfactorly correspond with changes literature datas.

Given kinetical scheme of happened reactions of methane mixture with air under VUV-radiation.The kinetical schemes include 161 reactions of 41 particles. At the basis this kinetical scheme are calculated kinetics for formation stable products (H_2, CO, O_3, C_2H_4, C_2H_6, NO_x, aldehydes, alcohols, organic acids and etc) and the activity intermediate particles (O, H, CH_3, CH_2, OH, X* and etc). The calculation dependence of yields these products at the wide changes ratio components and irradiation time are obtained.Comparisons of calculation and experimental results on formation O_3, CO, H_2 were carried out.The satisfactorly (to 20 %) agreement among these results is observed.

The discussion of experimental and calculation results are adduced.

1296.
УДК 541.18

MODEL OF OPTICAL WEATHER IN THE SURFACE ATMOSPHERIC LAYER AND ITS AEROSOL SECTION

PHILIPPOV V.L., MAKAROV A.S., IVANOV V.P.

The Federal Research & Production Centre The State Institute of Applied Optics Kazan, TR 420075 RU

(First received 03 March 1998; accepted for presentation during IAS-4)

Keywords: Atmospheric attenuation, optical weather, optoelectronic systems

The paper concerns one of the important aspects of usage and development of IR optoelectronic systems for remote geophysical measurements, namely the problems of optical atmospheric radiation attenuation modelling with allowance for considerable daily, seasonal and regional features of its aerosol component. The material originality is stipulated by a provided opportunity to present quantitatively spectral values of radiation attenuation components under any weather conditions in the most variable part of the atmosphere, i.e., in the lower troposphere at a height up to 5 km. The authors have determined an interrelation (to be predicted and expressed in terms of mathematical relations) between meteorological situation parameters, i.e., weather conditions in the agreed-upon sense, and optical atmospheric properties. It enabled to use the term "optical weather" in the paper title.

The model structure consists of sections determining the environmental properties under the conditions of clear cloudless atmosphere, in different aerosol states (haze, fog, dust, smoke) and in falling the hydrometeors (rain, snow, drizzle).

Some results are compared with measurements known from European OPAQUE Programme publications.

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Reference

Philippov V.L., Makarov A.S., and Ivanov V.P. Optical Weather in the Lower Troposphere (Empirical Method of Calculating the IR Radiation Attenuation). Kazan. Press House. 1997, p.230.

1306
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SYSTHESIS OF HIGHLY DISPERSED PRECURSORS FOR C60 PHOTOPOLYMERIZATION

LAVROV V.V., ARKHANGEL'SKII I.V., SKOKAN E.V.

Moscow State University, Department of Chemistry, Moscow, 119899 Fax: (095) 939-0198, E-mail: skokan@thermo.chem.msu.su

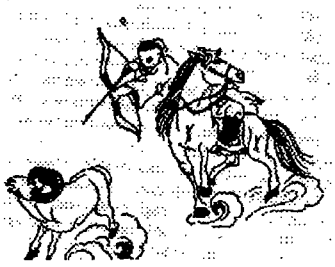
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Since the polymerization of fullerene molecules was observed, this phenomenon was intensively studied. The most efficient and studied types of polymerization are photochemical and pressure-induced. However, only the quenching technique, applying high-temperature and high- pressure treatment allow to obtain bulk quantities of polymerized fullerenes.

As the polymerization mechanisms are not enough studied, it was proposed that the products of photopolymerization and pressure-induced polymerization are the same. But according to Woodword- Hoffmann theory of 2+2 cycloaddition reactions photochemical process, representing photoexcitation and pressure-induced process at elevated temperature, representing thermal excitation have different mechanisms and should result in different products.

In the current paper some techniques for photochemical polymerization of small C_{60} particles are described. These techniques make possible to produce macroscopic amounts of polyfullerene C_{60} by UV-irradiating of water suspensions, soles and powders. Therefore methods for solid state analysis, i.e. XRD, NMR and DSC can be used to characterize samples. Precursor samples were prepared using several methods: grinding in a ball mill, lyophylisational drying of frozen solution, precipitation from saturated solutions and joint condensation of C_{60} and liquid media vapor. Every type of dispersed precursor consist of small particles, less then 0.5 -7 in diameter and are actually free of oxygen, which photochemically react with C60 molecules. Fullerite, used for preparation of precursors, was carefully purified of solvent admixture. Polymerized samples appear to be insoluble in toluene and after heating revert to pristine C_{60}. Preliminary experiments were performed to study how oxygen affect polymerization process.

Samples of polyfullerene C_{60} were studied by means of IR, Raman and UV - spectroscopy, X- rays diffraction, ^{13}C NMR, differential scanning calorimetry, HPLC, tunneling electron microscopy and mass-spectrometry. New spectral features consistent with the change in bonding due to polymerization are reported. Thermal behavior of polymerized samples was studied and enthalpies of depolimerization were determined.



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1309.
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MECHANICAL PHENOMENA AT SHOCK AND DESTRUCTION OF METAALLIC NANOPARTICLES STUDIED BY MOLECULAR DYNAMICS SIMULATION

POKROPIVNY V.V.*, SKOROKHOD V.V.*, POKROPIVNY A.V., KRASNIKOV Y.G.****

** Institute for Problems of Materials Science, 252142 Ukraine, Kiev, Krzhyzhanovsky str.3*

*** Moscow Institute of Physics and Technology, 141700 Russia, Dolgoprudny, Institutsky str.3*

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The processes of iron nanoparticles shock are computer simulated at the atomic level by molecular dynamics technique. The correlation between the structure transformation and variations of energy and force of adhesion, adhesive bond number, viscosity of contact is analysed. The adhesive-vibratory effect is observed. Acoustic and optical phonon spectra for vibrations of mass centres and single atoms are calculated.

Velocity dependent change of atomic mechanisms of shock interactions is discussed. During a shock with small velocity the joint action both the adhesive forces and impact pressure leads to joint dynamically steady vibratory and translation movement. At higher velocity, when the atomic processes of relaxation and shock occur simultaneously, vibrations are shown to transform into inelastic flow, amorphization and fracture of nanoparticles. At a near-sound velocity the particles are shown to smash into splinters.

The concept of new devices is proposed based on the resonance principle of powders compacting and coating activation by means of ultrasound treatment synchronized with shock influence.

The problems of interatomic potentials design and development of this technique for nitride and boride (TiN-TiB2) nanoparticles are discussed.

1311
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MICROBIAL BIOMASS AS FACTOR OF STABILITY OF EARTH ATMOSPHERE COMPOSITION

POLYANSKAYA L.

Moscow State University, Departament of Soil Science, Tlel+fax +7(095)9390989

Vorobyevy Gory, 119899, Moscow, Russia; E-mail: pol@soil.msu.ru

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Soil and atmosphere gas change plays a part in the determining atmosphere composition along with volcanic activity, photosynthesis and human impact. Conservation of reduced carbon in soil carries contribution in oxygen component stability of atmosphere. Activity of soil microorganisms has influence on contents combinations N, P, S in atmosphere. Living and dead microorganisms get constantly in atmosphere as result of wind erosion from the upper layer of soil. The number of microorganisms is the important factor of microbiological activity of soil.

Model and field studies of microbial communities allowed to describe seasonal dynamic of number and biomass of soil microorganisms as a whole and different systematic groups and populations. The vertical distribution of microorganisms along the whole profile in the main soil types is studied for the first time. It is shown by the method of epiluminiscent microscopy that the soil microorganisms are widely distributed over the soil profile. The observed results are contradictory to the previous concept about sharp decrease of microbial number at the depth of the profiles. The maximum microbe number and biodiversity in all soil types are

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proper to forest litters. The total amount of microbial biomass by luminescent microscopy studing are considerably above in soil horizons and measured by tens of tons per ha.

The method for account of the microbial biomass in soils was devised. According to this method was conducted the assessment of microbial boimass in the profile of the main soil types. The biomass of soil microorganisms was found to be very sizable. Microbial biomass composes from some units (grey forest soil) to several tens of tons per ha (soddy podsolic soil, chernozem, chestnut soil).

The biomass of mycelium and spores of fungi predominates in the investigated soils and reaches of 88-99 per cent of total microbial biomass. The proportion of procaryotic microorganisms ranges from 1 to 12 per cent depending on the soil type. The predominance of fungi biomass over the bacterial biomass leads to conclusion that the fungi play a main role in destruction of plant debris. The scarce of binding nitrogen commonly occuring in soils becomes clear in spite of sufficient quantity of nitrogen-fixing bacteria. The fungi perform the destruction of main part of plant debris, but they cannot fix nitrogen.

The soils are distinguished by number of microbial biomass and the character of its distribution along the soil profile and in time. The seasonal and interyears dynamic of number of procaryotic and eucaryotic microorganisms in soils was demonstrated. The moisture of soil is one of the main factor which is responsable for these changes. The proportion of microbial biomass carbon is very significant in reserves of organic matter carbon in soil as a whole. The most part of fungi biomass in all soil horizons is viable. Is was revealed that the viable cells of fungi are more in forest litters.

Every soil is characterized by a specific indices of microbial number and quality. The reserves of organic matter connects with favourable conditions for microbial activity and are not determined by deficiency of microorganisms in soil. The indices of microbial biomass and diversity may be used as a criteria for evaluation of ecosystem capability to support the resistance. The large values of these indices are indicative of the stability of the soil-microorganisms-phithocenosis system and is one of the factors of stability of earth atmosphere.

1291.
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MODELLING OF GAS PHASE REACTIONS IN POLLUTED AIR, INITIATED BY IONIZING IRRADIATION

GURBANOV.M.A.

Sector of Radiation Research of Sciences , Azerbaijan , Baku

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The comparative simulation and experimental kinetic stydy of products forming was carried out under the impact of ionizing irradiation on air (System 1) and air containing admixtires SO_2 , H_2 , CO_2 , NO_x , CH_4 , C_2H_2 (System 2). The kinetic scheme including 124 elementary reactions was taken into consideration.

– It's established that in the kinetic curves of azone and nitrogen oxide maximums are observed , their yields make up - 1 mol.\100 ev. In presence of humidity (-2%) the formation of nitrogen acid takes plase with yield of 0,5 mol.\100 ev (System 1).

– The comparison of kinetic ozone formation curves indicate maximum gliding of O_3 conrentrations in presence of admixed molecules and decrease of radiation yield of O_3 formation in this case (System 2).

– Nitrogen and sulpur acid yields are defined by presence and content of humidity , as well as oyher admixed molecules in irradiated mixtures.

The presented scheme includes variety of reactions ability of nitroge atoms N , N (D) and

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N (P) in relation to the molecules of components and molecular interactions of end products - N0x , O_3 , SO_2 , as well as clusterization of ions N_2 + , H_2O + , O_2 + and others.

The role of irradiated gas phase reaction on the formation of aerosols in atmosphere is discussed.

1341.
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THE METHODICAL APPROACHES TO BIOLOGICAL INDICATIONS OF AIR WASTES OF THE ENTERPRISES OF A MICROBIOLOGICAL INDUSTRY

OMELJANETS T.G., ARTUCH V.P., GANEVA S.L.

Ukrainian Scientific centre of hygiene, 50, Popudrenko str., Kiev-94, Ukraine, 253660

(First received 20 January 1998; accepted for presentation during IAS-4)

The enterprises of a microbiological industry are a source of biological pollution of air. The biological factors of pollution, which offer danger to health of the person, are: viable microorganisms-producents, dead microorganisms, substance of a protein nature, which include enzymes, protein fragments of microbial structures. The whole this complex of biological wastes have the potential danger for the health of the workers of the microbiological industry and for the population, living in a zone of an location of the enterprises.

The products of microbial synthesis can cause the diseases of the skin, respiratory tract, allergic diseases etc. [Omelyanets T.G., 1994; Omeljanets T.G., 1997; Nemurya V.I., Nikitina Yu.N., Spazhakina G.N., 1986; Bruevich T.S., Zaharov G.A. ., 1978]

Qualitative variety biological pollution of air at the enterprises of a microbiological industry and in adjoin territories defines originality of the approaches to the control of biological pollution. The widest application was receive the methods of determination of microorganisms-producents. Is developed a number of samplers with subsequent sowing of the samples of air on a suitable agar culture medium and incubation. At an estimation of microbial pollution of air in a working zone of the enterprises we used samplers - Krotov, multicascade impactor "MB-2", sampler "PAB -1", MD8 (firm "Sartorius").

The most convenient and informative at these researches is air- sampler MD8 with use of gelatin filters of Sartorius AG. The application of gelatin membrane filters of a large diameter (80mm) enables realizations of isokinetic pick out the samples and possibility to work at large speeds throughput of air, not breaking of laminar flow. Due to this the periods of a sampling are reduced, that promotes preservation of viability of microorganisms and germination them when adhere the filters to the agar surface with nutritious media. An adjustable air flow ricte allows to determine quantity of microorganisms in various rooms at both large and minimum pollution.

However, mentioned methods allow to determine only live microorganisms, for identification them a lot of time is required. During period, which necessary for determination of microbial pollution, the situation in a factory can by a radical image change, especially at supernumerary (emergency) situation. Therefore, not underestimating importance of such estimation, to the present time well fulfilled, it is necessary to note necessity of application express and complete (with due regard for all biological factors) characteristic of a condition of pollution in any necessary interval of time.

To the protein substances are believed just as pure protein, and the substances, in structure of which, in this or that form, enter protein. Despite an improbable variety, inherent in this class of combination, determination of they usual in most of cases is based on peculiarities of structure, which is typical for proteins in general. At existing practice a method

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is applied, in a basis of which is combined biuretic colour reaction and Folin's reaction on aromatic aminoacids. By other words, is determined not individual protein combination, but total protein. Thus, basic problem - determination of specific protein connection which can be the reason of a various sort of diseases is not carried out. Taking into account the fact, that great bulk of biological wastes can be tolerant in relation to organism of the person, the traditional method of determination of the total protein cannot be used at the hygienic control. Especially it concerns to the enterprises, where a plenty of various products of microbial synthesis is made, which include enzymes, antibiotics, vitamins, aminoacids etc.

The absence of methods of determination in air of specific protein combination promoted that the hygienic rules for many potentially dangerous wastes of a protein nature were established on total protein.

It is natural, the urgent need for methods differentiatial of determination of the protein combinations for the purposes of hygienic reglamentation and control will inevitably change an existing situation, as it becomes a brake in development of certain directions of biotechnology. The decision of these problems can be supplied by methods of the immunochemical analysis (IFA) [Braun T., Klein A., Zsindely S.,1992; Zherdev A.V., Dzantiev B.B.,1996]. To the present of time bases of the immunoenzyme analysis are developed. The brief list of advantages of use of a method of the immunoenzyme analysis for determination of the protein contain substances in air includes unique specificity in a combination to high sensitivity, high stability of reagents, simplicity of methods of registration, variety of objects of research - from the lowmolecular combination up to bacteria and viruses. Extraordinary the wide sections of problems, connected to variety of conditions of application IFA, causes development of an extremely plenty of variants of this method [PP.Tijssen, 1985 Yu Hao,1996; Burkin M.A., Sviridov V.V., Yakovleva I.V.,1996]. It enables to develop methods, which can be used as for the simple answer to a question "yes" or "not" there is no whether exceeds required substance a level of extreme allowable concentration (EAK)(dot-varsion of ELISE), and for the exact determination its quantity with high sensitivity and accuracy.

Large experience in creation reagents for IFA is at the moment saved, criteria which they should satisfy to reach necessary sensitivity are known, basic laws of reaction antigen-antibody in a solution and in a firm phase are investigated, that allows to purpuse-full optimize conditions of realization of the analysis [R.A.Mariuzza, V. Phillips, R.J. Poljak, 1987].

The high sensitivity IFA is reached also due to use of various physical methods of registration of enzyme activity: photometric, fluorometric, and also bio- and luminescent methods.

The reaction of interaction antigen-antibody can be considered as a particular case of linkage of lygands with macromolecular receptors. In a basis of interaction common principles any of biomolecular reaction lay. A product of biomolecular reaction, in this case, is a complex antigen-antibody. The immunity reaction is described the same kinetic and thermodynamic parameters, as any process of the formation of combination [H.M.Geysem, J.A.Tainer, S.J.Rodda, T.J.Mason, H.A.Alexander, E.D. Getzoff, R.A. Lesner,1987].

We offer to consideration a particular case of application of technology IFA for development of a method of determination the wastes of a protein nature at the production of the fodder additive, enriched by lisin. As producent at the production of the fodder additive bacteria Brevibacterium were used. To peculiarities of industrial conditions at microbial synthesis, as well as in this case, it is necessary to relate the circumstance, that at the enterprise in parallel come true of a several technological processes, and many of them are also sources of protein pollution of a working zone. Hence, the application of traditional methods of determination of total protein in these conditions is not expedient. By the basic requirement to a method of determination fodder protein in air in conditions of enterprise is strong specificity

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and selectivity on a background rather expressed pollution by diverse protein combinations. Practically unique, known for a today's day, the method of specific determination of individual protein combinations or of a complex of protein combinations, caused by use certain producents and conditions of it's inoculation and processing can be only a method, which based on use of the immunoenzyme analysis.

For reception of specific serum the immunization of rabbits was made, basically, by standard methods [G.S. Bailey, 1984]. As immunogen was used an extract of a final product - powder-like substation, which is hydrolisat of producents. The fodder additive, dressing by lysin, contained up to 12 % protein. An initial solution of immunogen contained 100-150 mg/ml protein of the fodder additive. For immunisation consecutive used complete and incomplete Freid's adjuvant (CFA). On a final stage of immunisation in a solution of immunogen entered methyebumin. It is known, that polipeptides and proteins with molecular weight more than 5000 is effective immunogen. The chromatographic analysis of the fodder additive has shown, that the large part of protein substances is large polipeptides.

For relative increase of concentration of antibodies used gamma-globulin or Ig G - fractions of immunity serum. The titre of antiserum was established by a method of immunoprecipitation.

Determination the antigene made by a competitive method with use of labelled antispecific of antibodies [Neizotopnue metodu immunoanaliza, VINITI, 1987]. We used enzyme-like immunosorbent (ELISA).

Estimation the concentration of an antigene carried out by using the calibrate diagram. The definition of the total protein in a working zone and adjacent to a zone made by a traditional method and has shown pollution 25-45 mg/ml$^{\times \triangle}$

Results of determination of the lisin-containing fodder additive have shown, that the contents it in air makes 3-5 % from common protein pollution of air of a working zone. Traditional methods of determination of protein would not allow to define such quantity individual specific protein product, which is the lisin-keeping fodder additive.

The method of the immunofermental analysis can be used also as express for determination in air of quantity of microorganisms-producents, not dependent from that live it is or dead. Thus the determination take a few minutes, while the microbiological method requires a few days (from 1 up to 14 depending on a sort of microorganisms).

To lacks of this approach it is necessary to relate the fact, that in each particular case reception of specific antibodies is required and the developed method can be applied, at the best, only in conditions of realization of the particular production.

The certain difficulties exist also and at a choice and standartisation of antigenes of protein compound, which are used for development of a method.

In the last years the attention of the researchers is involved the methods with use of biosensors.

Attempts of development of biosensors devices for determination of protein, based on use proteinases and field transistors are made [Biloivan O.A., Dzyadevich S.V., Soldatkin O.P.,1997].. One of advantages of biosensors is their high expressivety of determination. But the mentioned type of biosensors have a lack of tradicional methods - nonspecificity. The combination high specificity, selectivity, sensitivity and expressivety is possible only, on our sight, to embody in development of the biosensore device on the basis the field transistor in a combination with specific antibodies [Kalab T.,1995].. With the help of such devices the continuous control wastes is basically possible. These possibility, as a whole, determine a common direction of methodical development, which should ensure hygienic reglamentation and control of biopollution in the near future.



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1226
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AEROSOL CEMENT PARTICLES NUMBER CONCENTRATION LIDAR STUDIES

LAKTYUSHKIN G.V., PRIVALOV V.E., SHEMANIN V.G.

Kuban State Technological University, Novorossiysk Department, Novorossiysk, Russia

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Cement particles back scattered Mie radiation intensity dependence on particles number concentration in range of 10 - 1000 cm^{-3} at YAG-Nd second harmonic laser wavelength of 532 nm has been experimentally studied on laboratory bistatical aerosol lidar type [1]. Back scattered radiation was collected by 0.12 m diameter mirror receiving telescope and recorded through 532 nm interferential filter with peak transmission of 64 % and halfwidth of 2.4 nm on PMT FEU - 79. PMT signal was inputed by special controller to IBM PC Pentium 100 RS-232 port. The cement particle air flow was created by particles generator [1] and its concentration and velocity continuously controlled by laser Doppler anemometer [2]. It is getting that back scattered Mie radiation intensity has linear growth with particles number concentration. Measured results treatment allowed to determine by known lidar constant [1] back scattered cross section for concentration unit is equal to $(3.2 + 0.5)\ 10^{-6}\ m^{-4}$. For these results testing lidar equation as in [3] computer simulation has been fulfilled with our experimental conditions. This lidar equation parameters for our case had the next values: h, R = 7.5 m for recording time duration of t_d = 50 nc, A_2= 0.008 m, K_2 = 0.495 at 532 nm wavelength (measurement result), laser pulse energy E_0 = 10 mJ, laser pulse duration t_L = 10 ns, ranging distances R = 7.5 - 15 m, PMT type FEU-79 photocathode spectral sensitivity values at wavelength of 532 nm have been taken from [4] and it is equal to 0.92, atmospheric transmission values have been calculated as in [3] with extinction coefficient k value from [4] and for wavelength of our interest is 160 m^{-1}.

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Back scattering Mie radiation power computer simulation have been made with above described data for the ranging distances from 7.5 to 15 m as aerosol particles back scattering coefficient function. The determined power values P(7.5) have been used for particles back scattering coefficient concentration dependence calculation with FEU-79 sensitivity experimental data. All the results both measured and calculated are exhibited in Table 1.

N, cm^{-3}	E(7.5), mJ	$(\frac{\partial\sigma}{\partial N})\ 10^6$ m^{-4} sr. C	P(7.5), W C	σ, m^{-1} C	$(\frac{\partial\sigma}{\partial N})\ 10^6$ m^{-4} C	$(\frac{\partial\sigma}{\partial N})10^6$, m^{-4} sr.
100	15.5	3.7 +-0.5	0.523	296	2.96	2.1 +-0.6
150	21. 7			415	2.77	
270	24.8			474	1.76	
350	31.0			593	1.69	
500	37.2			711	1.42	

Calculated results were pointed by C in this Table 1, all the other were experimental results. These calculation results confirm the cement aerosol particles number concentration vesus back scattering coefficient linear dependence. Therefore, the such a type aerosol lidar can serve as an instrument for cement aerosol particles number concentration ranging measurement.

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1056.
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MULTIPARAMETRIC OPTICAL STUDY OF BIOLOGICAL AND OTHERS DISPERSE SYSTEMS

BEZRUKOVA A.G.

St. Petersburg State Technical University, St. Petersburg, 195251 RUSSIA bezr@psb.usr.pu.ru

(First received 21 December 1997; accepted for presentation during IAS-4)

Multiparametric optical assay (MOA) can provide further progress in studies of complex disperse systems such as our water and air.

MOA includes the nondistructive analysis of dispersions by different optical methods such as refractometry , absorbance, fluorescence, light scattering (integral and differential, static and dynamic, unpolarised and polarised). Taking into account optical theory and results of study can help to elaborate methods for on-line optical control of complex systems.

Our research has investigated different disperse systems : proteins, nucleoproteins, liposomes, lipoproteids, viruses, lipid emulsions, bloodsubstitutes, latexes, liquid crystals, cells with various form and size, metal powders, barytes, kaolin, kimberlite clay, zeolites and mixtures - liquid crystals with surfactants, liposomes and viruses, mixtures of clay with cells and others, samples of different waters and air sediments, etc., by various optical methods.

One of the most vital problems is development of MOA for on-line environmental control for dangerous impurities - metals, oil, viruses, bacteria.

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1435
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THE PULSE CLEANING BEHABIOURS OF GROUP CANDLE FILTER IN A HOT BENCH UNIT

Choi J.-H.*, Seo Y.-G.*, Jeong H.**, Chung J.**

*Dept. Chem. Eng. Gyeongsang National University, 900, Gazwa dong, Chinju 660-701, Korea
**Korea Electric Power Research Institute, Taejon 305-380, Korea

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Ceramic candle filters have been widely studied for the application in the advanced coal power plant because of their high filtering efficiency. High collection efficiency is especially important to control the micron particulates which causes the erosion and abrasion of gas turbine in the IGCC and PFBC. Because the filtering volume decreases as the face velocity increases, the operation at high face velocity is very beneficial for any filtering system, while keeping pressure drop low, maintaining collection efficiency high, and sustaining candle life. Pulse jet cleaning is one of the methods to improve the performance of the candle filter. A reliable cake removal and keeping the constant residual pressure drop are essential for the long term operation of the pulse jet cleaning filter. Several factors affect on the reliability of candle filter, including operation conditions, dust properties and the conditions of candle. Some experimental aspects on the pulse operation of candle filter were investigated in this study.

Hot gas stream was prepared with an oil burned exhaust gas in which fly ash from a conventional coal power plant was fed. The aerodynamic mean average size of the particulate was 23 micrometer. And the accumulative volume fraction less than 10 micrometer was 45.9%. Careful attention has to be paid during the mounting of filter element because of the element failure from the thermal and mechanical stress, while preventing the dust leak through the gaskets. The disc typed-spring was used to absorb those stresses. There were no dust leak through tube sheet and on mechanical troubles. The collection efficiency was maintained above 99.9%. The pressure drop through the temporary dust cake can be estimated by the measurement of the pressure drop developed after the pulse cleaning at each stage. Under the steady state operation at the constant in temperature, pressure, and face velocity the pressure drop across the dust cake was linear with the change of time because the concentration increases linearly from the constant accumulation. The pressure drop rate was linear with the change of dust concentration and showed a quadratic increase with the change of face velocity. So the pressure drop across the temporary dust cake could be understood well by Lippert's equation. And overall pressure drop across the filter element was well expressed by Darcy's law. Usually, stable value of dimensionless permeability lies between 0.4 and 0.45 for commercial filter element, which reaches after more than 100 hours. So the data we obtained shows only its trend in the short term of experiment. The determination of the suitable conditions for the pulse cleaning is very important for the long term operation. The forces between particles and the filter element is key factors of cake stickiness. The shock pressure difference during pulse jet is the main force to destroy the stickiness. And the cake detachability depends on the pulse amount. Experimental variables which can control the pulse amount are the pulse reservoir capacity, pulse nozzle size, pulse duration, and nozzle design.

The durable base line pressure drop is allowed up to about 1000mmH2O in commercial application. So the pressure drop rate should be lower than 0.002. More than 1 sec was suitable at this condition. We could expect much more pulse effect after a certain duration. The effect of cycle duration at given pulse pressure and pulse duration. The state at which the pulse cleaning is impossible after all when the cycle duration was extended step by step. The fail in cleaning occurred within 1 hr if rR is more than 0.3. The maximum cycle duration decreased sharply as

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the face velocity increased. In the case the face velocity was more than 4 cm/sec, pulse cleaning was impossible even though the cycle time was less than 2 min. The cleaning effect of two different pulse modes, the collection and the dispersion one were compared. There was not significant different between them. The sequential pulse cleaning with the pulse cycle of 5 seconds after 15 min of long interval was carried out in the collection pulse mode. But the effect was almost similar with that from the regular cycle duration of 5 min was applied in the dispersion mode.

In summary, bench scaled high temperature ceramic candle filter was operated to observe the pulse events. The total pressure drop across the tube sheet was monitored during the pulse jet. The cleaning behaviors were explained well by Darcy's law and the equation proposed by Lippert, et al. The prediction of long term durability of the filter element could be estimated by the pattern of the increase in the base line pressure drop. The pulse duration has a minimum value at a certain condition. The maximum cycle duration was affected much by the face velocity. The operation results at unsteady state shows that the pulse mode was not important on the cleaning effect.

1360
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COMPOSITION OF AEROSOLS IN THE MARINE BOUNDARY LAYER IN THE RUSSIAN ARCTIC

V.P. SHEVCHENKO*, A.P.LISITZIN*, R.STEIN, A.A.VINOGRADOVA***, V.V.SMIRNOV****, V.N.LUKASHIN***

** P.P.Shirshov Institute of Oceanology of RAS, Moscow, Russia; e-mail: vshevch@geo.sio.rssi.ru*

*** Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany*

****Institute of Atmospheric Physics of RAS, Moscow, Russia*

*****Institute of Experimental Meteorology, Obninsk, Russia*

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Traditionally riverine input was assumed to be the main geochemical pathway of terrestrially and anthropogenically derived compounds from their sources top the aquatic environment, but there is much evidence that atmospheric inputs contribute significantly to marine areas. Numerous studies have shown that aerosols in the Arctic are of importance for atmospheric chemistry and climate. But up to now aerosols of the Russian Arctic were studied little.

In 1991-1997 during 10 expeditions 126 samples of aerosols have been collected by nylon meshes and by filtration of air through Whatman-41 and AFA-HA in the Laptev, Kara, Barents and Norwegian Seas. Aerosol size distribution has been measured by PC-218 photoelectrical particle counter.

In general, there is a much greater number of small particles (with sizes from 0.5 μm to 2 μm) in comparison to large particles. Over the open water an increase of the wind velocity stimulates the concentration growth of coarse (>5 μm) particles in the spectrum. This could testify the input of sea salt particles from the sea surface microlayer by wind and the importance of these particles for the chemical composition of marine aerosols. In ice-covered areas we find an increase of concentrations of fine particles (from 0.5 μm to 2 μm), especially at low temperature. It can be explained by formation of ice microcristals.

In August-October 1993, the mass concentration of the coarse fraction of the Kara and Barents aerosols which are not soluble in water, varied from 0.02 to 0.48 $\mu g/m^3$ (0.15 $\mu g/m^3$ in

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average); in the Laptev Sea concentration of insoluble aerosol particles was 0.04-0.09 μg/m^3 at the end of July 1995. These values are similar to those measured in the North Atlantic (Duce et al., 1991). In most of samples organic matter (fibers of vegetation, pollens, diatoms) and mineral particles are the main component. Content of organic carbon varies from 7.54 to 26.9 % (17.6 % in average).

The mean concentrations of most of the chemical elements are within limits known from literature for other Arctic regions. Concentrations of heavy metals in our samples are higher than in the Antarctic and the remote ocean regions, but they are much lower than those from seas in highly industrialized regions. Temporal variations of the element concentrations are caused by various air masses coming to the studied area. The increase of concentrations of some elements in remote areas covered by ice could be explained by resuspension of particles from sediment-laden sea ice.

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1385.
УДК 541.18

THE INFLUENCE OF AEROSOL ON THE FLUXES OF SOLAR RADIATION IN THE ATMOSPHERE, CLOUDS AND ON THE EARTH SURFACE.

E.M. FEIGELSON, I.A. GORCHAKOVA, O.A. SHILOVTSEVA.

Obukhov Institute of Atmospheric Physics, Russian Academy of Atmospheric Physics, Russian Academy of Sciences. Moscow State University. Address: 3, Pyzhevsky, Moscow, 109017, Russia. Tel: 7-095-9511347; Fax: 7-095-9531652 e-mail: Gor@omega.ifaran.ru

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1388
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AIR QUALITY AND ITS HEALTH CONSEQUENCES IN CENTRAL BALIKESYR TOWN

TALAT KOC

Department of Geography Education, Balykesir University, Necatibey Education Faculty. Balykesir, TURKEY.

(First received 03 April 1998; accepted for presentation during IAS-4)

INTRODUCTION: Air pollution is one of the important problems specifically of towns. Recently, the problem of air pollution is rapidly growing in the central Balykesir town.

One of the important negative effects of air pollution is the increase in health problems. For example, upper respiratory diseases are the most common related to the low levels of air quality. This study takes this problem into consideration and investigates the relationship between the air quality and the number of patients who register for upper respiratory problems

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in the period of 1990 and 1995. The aim of this study is to draw attention to the relationship between the two mentioned above and relate deaths.

DATA: Among the elements of air quality only sulphur dioxide (SO_2) and particule matters (PM) are measured in the central town. This measurement is done by the Laboratory of Public Health and the Directorate of Environment. For the air quality research, the average values of SO_2 and PM are taken into consideration. These values were weekly and yearly between 1990 and 1995. For the problems of health research, weekly number of patients who were applicant to the health units in the central town and suffer from upper respiratory diseases were investigated. Nevertheless, the problem of not being able to determine the number of patients who lived in the central town was emerged. Therefore, this problem needs to be considered in mind.

METHOD: In Balykesir central town, air quality and Number of Patient Applicants (NPA) values are investigated in the six year period of 1990-1995. Changes related to time in the air quality and NPA values and relationships between the two are attempted to find out with the help of correlation coefficient.

RESULTS: There have been found obvious fluctuations in the air quality and NPA values in Balykesir central town (Figure: 1: NPA values and linear trend; 2: SO_2 values and linear trend and 3: PM values and linear trend). While in the warm period, air quality increases and NPA values decrease; in the cold period air quality decreases and NPA values increases. Table show the relationship of 59% and 78% between the NPA values and SO_2 and PM values.

There is a tendency to increase in the SO_2 and PM values in the period of 1990-1995. While the average SO_2 value of 70 $\mu g/m^3$ in 1990 increased 86% in 1995 and reached to 130 $\mu g/m^3$; the value of 44 $\mu g/m^3$ PM increased 61% and reached to 71 $\mu g/m^3$. With parallel to the changes in air quality, while the weekly total of NPA was in 819 in 1990, it reached to 1718 with a 110% increase rate. Zaim's work (1997) which reported better air quality standards in big cities of Turkey in the period of 1990-1993 is invalid for the Balykesir central town. Figure shows the changes in air pollution and NPA values with regard to time and tendency lines. While the tendency of increase for the NPA is $y= 3.3 x + 739.4$, for SO_2 is $y= 0.2 x + 79.7$ and for PM is $y= 0.1 x + 47.6$. The correlation coefficient for NPA and SO_2 is 70%; for NPA and PM is 65% in the 1990-1995 period (see table).

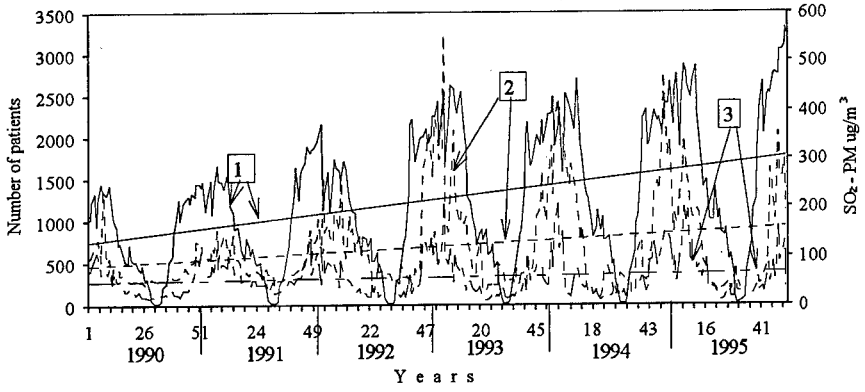
DISCUSSION: As well as other studies this research also showed that there is a close relationship between the air quality and human health. It was noted earlier that in many cities in Turkey as well as in Balykesir only SO_2 and PM values are measured. However, in addition to these values, other air quality parameters should be measured in order to prepare a base for the more detailed research.

The effects of air quality on health come out in short or long term. Upper respiratory problems may be due to air quality as well as other factors. The results of SO_2 and PM values and relationship with the NPA values which reach 78% in a year is a confirmation of this effect. As well as yearly changes in the air quality the changes in the period of a year also show the close relationship between the air quality and NPA values (see table).

EVALUATION: Balykesir central town is one of the settlements which have low levels of air quality due to the effects of physical environment (Koc, 1997). There is more negative tendency in the air quality when the 1990-1995 period is taken in to consideration. Therefore, there is need to prevent the negative effects of air pollution.

One of the most important consequences of air pollution is its negative effects on human health. Particularly, upper respiratory system and the patients who suffer from related diseases are the most effected in the short run. In Balykesir, there have been found that there is a close

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relationship between SO_2 and PM values and the number of patient applicants (NPA). There might be deaths in the continuation of decrease in the air quality and in the case of strong reverse movements of air. It should be noted here that there is a need to study the reasons detail behind the deaths.

Although there is the need for cities to allow a good environment to live in, Balykesir, is difficult to say, has a good air quality environment. If the increase in air pollution continues, Balykesir like many cities which have this problem, disasters related to the air pollution should be expected. Therefore, it is suggested that detailed studies should be on the way for a better environment in Balykesir.

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Correlation coefficient (%) between number of patients and SO_2 - PM		
Years	SO_2	PM
1990	67	73
1991	71	73
1992	63	70
1993	75	74
1994	71	59
1995	78	60
1990-1995	70	65

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1412.
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PORTABLE CORRELATED OPTICAL DETECTOR FOR EXPRESS REMOTE ANALYSIS OF POLLUTING SUBSTANCES IN ATMOSPHERE

V.V.NEKRASOV*, D.R.GASANOV*, A.T.PORTYAN*, N.V.RYJAKOVA*, N.M.SURIN**

** Karpov's Physical-Chemistry Research Institute, 103064,Russia, Moscow, Vorontcovo pole, 10*
nekrasov@cc.nifhi.ac.ru

*** Institute of Oceanology, Russian Academy of Sciences, 117218, Russia, Moscow, Nachimovskiy prospect, 36*

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One of the global problems of environment protection is anthropodenic polluting of atmosphere. Effect of polluting of atmosphere is a destruction of ozone layer of the Earth that leads to change of climate and to worsenning of an ambience of dwelling.

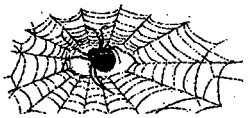
Practically in polluting of atmosphere two formind components participate - aerosol and gas. These components base in the dynamic balance. In the different layers of atmosphere chemical and photochemical reactions with their participation constantly run. For getting complete information on occurring in atmosphere processes, it is necessary to be able to measure chemical composition of gas and aerosol components.

In this reporting prospects of using portable correlated optical detectors for express remote analysis of gas composition of different layers of atmosphere are discussed. Correlated optical detectors are capable to find in atmosphere vapours of different chemical compounds - ozone, oxide of nitrogen, sulphur, carbon and others. These instruments ensure a finding of polluting on distances before several tens of kilometers. Correlated optical detectors possess high selectivity to analyse components, as far as they exclude an influence of any admixture on results of measurements, spectra of which weakly correlate on the structure with the analysed component. As sources of sounding radiating it is possible to use both artificials sources of the light, and natural sunshine, diffused by the celestial sphere or reflected from the surface. This is particularly important for problems of ecological monitoring. Correlated detectors are perspective for using in the composition of apparatus complexes unceasing monitoring of atmosphere in real-time and express making of the large-scale distribution cards and vertical stratifications of analysed components.

Perspective of using of correlated optical detectors is demonstrated on the example of measurements of distribution of dioxide of nitrogen in atmosphere. In the course of studying of distribution of oxides of nitrogen in different regions it is installed that alongside with industrial objects and motor transport, sources of arrivals of nitrogen oxides in atmosphere are agricultural regions. This effect is stipulated by the decomposition nitratecontained fertilizers, not adopted by plants [1]. Contribution of this source is weakly taken account into evaluations of general background p olluting of atmosphere. The situations, when such sources can contribute an essential contribution to polluting of atmosphere and destruction of ozone layers of the planet, are presented wholly real [2].

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1281
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ON A CONTRIBUTION OF WIND SHEARS INTO HORIZONTAL DISPERSION OF POLLUTION PLUME FROM A CONTINUOUS POINT SOURCE

BESCHASTNOV S.P., NAIDENOV A.V.

Scientific Production Association 'Tiyphoon' Obninsk, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

Pollution dispersion in the vicinity of a point source is governed, as is known, by turbulent diffusion, at average distances it is controlled by diffusion and wind shears. According to this empirical formulae for calculating horizontal dispersions depending on an pollution source in its vicinity involve only the terms considering turbulent diffusion, at large distances shear components are added. Empirical formulae [1] can be mentioned for a remote zone as an example. This and other formulae obtained by other authors have not been yet widely verified experimentally. Therefore, the goal of this work is to estimate with a diffusion numerical model an effect of wind shears on the magnitude of horizontal dispersions under different conditions and to validate the parametrization shear components used now practically.

In limited case at long diffusion times one may reduce from the empirical formulae and semiempirical diffusion equation the following relations:

$$\sigma_x^2 \approx a_x \left(\frac{\partial V}{\partial z}\right)^2 \sigma_z^2 t^2 \quad \text{and} \quad \sigma_y^2 \sim a_y V^2 \left(\frac{\partial \varphi}{\partial z}\right)^2 \sigma_z^2 t^2, \qquad (1)$$

where V is the velocity module, φ is the wind direction, t is time. In [1], as in most other works, $a_x = a_y = 1/3$. Pasquill [2] propose to use the coefficient by the order of magnitude less: $a_y \sim 0{,}03$. In a limited case of a horizontally homogeneous atmosphere the model equations for dispersions are reduced for large distances from source to: $\frac{\partial \sigma_\alpha^2}{\partial t} \approx 2 K_z \left(\frac{\partial p_\alpha}{\partial z}\right)^2$, (2)

where $p_\alpha = \bar{x}, \bar{y}$ are the co-ordinates of the cloud gravity centers; $\sigma_\alpha^2 = \sigma_x^2, \sigma_y^2$ are dispersions. Using the relation $d\,p_\alpha = d\left(t u_\alpha\right)$ describing a variation of the cloud gravity center with time, one may obtained (1) from (2). An analysis of the numerical results obtained has shown that at large distances from a pollutant source comparable estimates of dispersions can be obtained only when the coefficient a_x and a_y are decreased, as in [2]. The model estimates of dispersion σ_y^2 appeared to be in satisfactory agreement with the Gifford dependence [3] generalising different experimental data. An analysis of the data available and their comparison with the model estimates of dispersions made it possible to refine the range of possible values of a_x, a_y depending on the diffusion conditions with the account of simplifications of (1) in practice.

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1359.
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PROBLEMS OF THE DIESEL PARTICULATES ASSESSMENT AND REDUCTION

KUTENEV V.F., ZVONOW V.A., KORNILOV G.S.

Russian Diesel Institute, phone 7-095-1541301 fax 94430030

(First received 23 March 1998; accepted for presentation during IAS-4)

The diesel engines are being largely applied as power units for various vehicles since they have the highest thermal efficiency in comparison with the other heat engines and are capable to provide a wide range of power output. However, in re cent times air pollution caused by the diesel exhaust gases of the motor vehicles has created a serious problem in the developed countries.

The major toxic pollutants of the diesel exhaust include nitrogen oxides and particulates. The diesel particulates consist of solid and liquid particles of various composition. The solid particles of soot formed during the fuel combustion have also an electric charge. To assess the emission of the diesel particulates the following methods at present are widely used:

— measurement of smoke of the diesel exhaust;

— measurement of specific mass emission of the particulates per a unit of work done.

The most widespread smokemeter is of a light extinction type (opacimeter). The opacity of the exhaust gas in a measuring chamber of the device is determined by means of the loss of intensity of a light emitting source. In the actual operating conditions smoke measurements are made at increased revolutions of the idle mode of an engine and at free accelerations.

The mass emission of the automobile diesel particulates is determined on the basis of bench tests results carried out under the 13-mode test cycle that corresponds to actual operating conditions. The particulates are collected by means of a filter from the exhaust gas that has been preliminary diluted with air and cooled (to the temperature lower that 52oC) in a special tunnel.

In the Russian State Research Centre NAMI a set of devices has been developed to measure a smoke level of the diesel exhaust mass emission of diesel particulates. The portable microprocessor smokemeter IDP-2 is designed for smoke measurements of diesel powered automobiles under actual operating conditions. A power supply of the device is from an accumulator of 12V. The stationary microprocessor smokemeter IDS-3 is intended for smoke measurements during bench tests of a diesel engine and has a remote control.

Both of the mentioned smokemeters have microprocessors, software of those ensures the following: statistical processing of smoke measurements data; an automatic adjustment of the device; a self mulfunction diagnosis.

Metrological features of the smokemeters comply with the international standards. The portable smokemeter IDP-2 has been undergone the state acceptance tests and has been certificated for application in Russia. The stationary smokemeter IDS-3 is being prepared for the acceptance tests and certification. A prototype of the minitunnel for mass assessment of the diesel particulates is passing various types of laboratory tests. In comparison with minitunnels being in use it has the following distinctive features:

— an advanced system of the isokinetic gas sampling from an exhaust pipe of diesel engines designed on the basis of a swirl valve;

— advanced designs of gas flow meters and pressure measurement devices.

The minitunnel as a whole and its separate systems are designed to comply with the international standards. To reduce diesel particulate emission measures to modify the combustion in side the cylinder or to trap particles by means of special filters incorporated in the engine exhaust system are applied.

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A prototype of the electromechanical filter based on combination of mechanisms of electrostatic precipitation of the particles and their trapping by filtration has been developed in NAMI centre. Preliminary tests of the filter have confirmed it's high trapping efficiency (over 80%) at very low pressure drop.

At present thorough investigations of the filter are being carried out.

1225.
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SOLID PARTICLES CONCENTRATION OPTICAL MEASURING INSTRUMENTS ON THE BASIS OF INTEGRATED LIGHT SCATTERING METHOD APPLICATION FEATURES

PAVEL V.CHARTY, VALERY G. SHEMANIN

SPA "Stromecology", Novorossisk, Russia

(First received 15 February 1998; accepted for presentation during IAS-4)

Integrated light scattering on particles method is one of optimum methods due to a number of the characteristics sold in solid particles concentration in technological gases automatic measuring instruments. IVA-3M concentration automatic measuring instrument realizing this method [1] was developed and is made at SPA "Stromecology" in Novorossiysk. Actual task is the place for control choice at gaspipe because the particles concentration measurement by this device is carried out practically in one point (measuring volume is about 30 cm^3), instead of the whole gaspipe cross section. In cases, when it is possible to suggest distribution of particles concentration is more or lesser constantly, satisfactory recalculation of the whole section concentration have to make by results of one-point measurement [2].Ideal for the particles control are the vertical lines gaspipe, which lengths as the minimum on the order exceed their cross sizes [2].

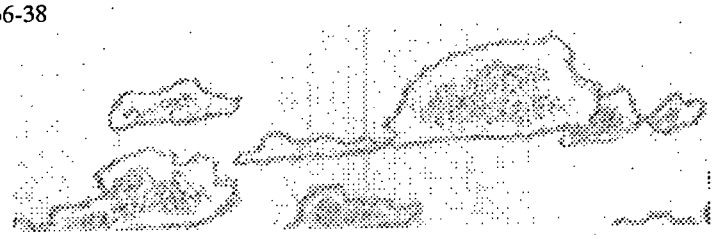
In real operation conditions it frequently fails to choose close to an ideal condition for this instrument installation. Therefore the experimental work on influences of the various factors on IVA-3M instrument calibration characteristics is necessary for adequate results of measurement getting with this automatic device.

Comparative measurements results of concentration of solid particles in technological gases in the industrial enterprise conditions in a wide range variation of the basic technological parameters are given in the present work. IVA-3M instrument calibration characteristics have been received for various installation sites and the recommendations for concentration of firm particles in technological gases optical measuring instruments constructed on the basis of integrated light scattering method practical application have been formulated.

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1267
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BERILLIUM AEROSOL: HIGH DANGER YET POSSIBLE PREVENTION OF HARMFUL EFFECTS

N. KHELKOVSKIY - SERGEEV

RAMS Institute of Occupational Health, Moscow, Russia

(First received 20 February 1998; accepted for presentation during IAS-4)

Beryllium (Be), its oxides and alloys are applied in power and space technologies, aviation, and other branches of industry In Russia more then 300 plants were primary consumers of Be during the most favourable period of economic development.

Be aerosols are inflammable and explosive, they are extremely toxic (1 class of danger, 0.001 mg/m is the MAC value for the air of working zone, 0.0001 mg/m is the MAC value for the ambient air, they are allergenic and carcinogenic). Acute and chronic respiratory pathologies may develop when Be aerosol penetrate to the body. The most severe and difficult to be cured is berylliosis that may progress long after the ceise of the contact.

Toxicity of Be was found in the middle of the 30 - s in Russia, Germany and Italy. The peak morbidity level fell on the 50 - s and the 60 s when production sharply increased, safety measures were not developed at that moment. About 1500 cases of the disease were registered in Russia and the USA, however, the figure should be considered as a diminished one because the register impairments due to berylliosis was developed in Russia only in the 80 - s, besides, actually no cases of non - occupational berylliosis were found in Russia (while in the USA up to 11% of cases were registered in the highest levels of morbidity). At present acute cases were eliminated though single chronic cases can be revealed, however, potential danger still exists.

Be human effects were most thoroughly studied in the RAINS Institute of Occupational Health. Cytotoxicity and allergenic manifestations that cause immune impairment lay the basis of Be human effects. When in the organism, Be may cause local macrophage - neutrophyl response, it impairs cell membranes, penetrates to the cells, leads to hydrolyst and hematoxic factors. It also breaks in cell nucleus the synthesis of protein and provokes the synthesis of autoantigens. As a strong chemical allergen, Be may cause specific reaction. Cytotoxic, allergic and immune processes develop simultaneously, prevalence of any of them depends on the level of exposure and the type of compounds. Of particular importance is the genetic predisposition, or increased sensitivity to Be, as an allergen, on a genetic level, acquired pre disposition developed due to severe endocrine shifts because of chronic pathologies, injuries, surgery, deliveries, etc., is also important.

According to the classification of the IARC Be is referred to 2 A carcinogens.

Safety measures have been well developed. In Russia the greatest number of maximum adminittable levels and concentrations have been established for Be: they are for the air of working zone, ambient air, water basins, for skin surface of hands, equipment, tools, and production, for individual protective clothing, etc. Engineering, construction ventilation measures on work hygiene and environmental protection have been developed including specific fine diagnosis methods. The main criterion of safety is strict observance of hygienic requirements.

Big Be processing enterprises have been built with regard to helpful consultations of experts of the Institute, long-term follow - up periods of working conditions, environmental protection showed that Be in the concentration in the air could be lower then the standard values. No diagnosis of berylliosis have been put during two decades of follow - up periods using immunological, physiological, roentgenological and clinical methods.

Along with all the mentioned facts, many problems concerning Be are still unsolved:

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1. Long - term follow - up periods with regard to the health are to be continued concerning long - term Be effects, both of active contingents, and those whose contacts have been ceized, at MAC level and lower which will complete the work on hygienic MAC approbation;
2. Necessary is the research of Be carcinogenic effects in cohorts exposed to it at MAC level and lower;
3. Regarding individual sensitivity in the development of berylliosis, adequate seems improvement of tests for medical examinations, pre work identification of risk groups, development of recommendations on ceisure of Be contacts;
4. System of Be monitoring in industry is necessary including the wastes; development of hygienic requirements is necessary to eliminate Be branches;
5. As more then 93% of Be goes to the atmosphere with coal burning at thermal power stations, advisable with be health study of workers, environment, and nearby residents if coal with high Be content is used,.

This question has not been studied so far in full.

1209.
УДК 541.18

PRODUCTION OF SUBMICRON AEROSOLS BY THE EXPIRING WIRE METHOD

V.S. SEDOI, V.V. VALEVICH, AND L.I. CHEMESOVA

High Current Electronics Institute RAS, 4 Akademichesky Ave., Tomsk 634055, Russia.

(First received 15 February 1998; accepted for presentation during IAS-4)

The major characteristic in production of aerosols is the thermal energy Introduced Into the material. Depending on the energy density, the state of the explosion products can vary from liquid to plasma, and the sizes and properties of' the particles formed depend on their states.

The distribution of the energy density over the sample Is also important. The uniformity of heating is provided in the fast electrical explosion mode. The fast explosion is characterized by the following conditions: the energy introduced into the material exceeds its heat of vaporization, and the heating time is shorter than both the time of the action of the capillary forces and the time required for development of magnetobydrodynam ic sausage-type Instabilities. Comparing the characteristic time for a given process with the heating time, one can write the corresponding similarity criteria. From these criteria the conditions for uniform heating have been obtained.

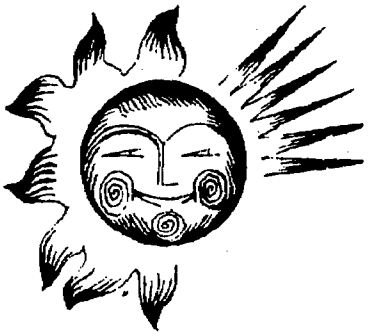
The uniform heating conditions impose restrictions on the heating rate. The heating rate is a significant factor in the production of submicron metal aerosols.

Under the uniform heating conditions, the production and properties of powders based on copper, aluminum, titanium, iron, tungsten, indium, and other metals were investigated. The specific surface area of powders was measured by the low- temperature adsorption method. The shape and size distributions of particles were determined with electron microscopes. The phase composition was determined using X-ray diffraction and electron diffraction methods. Analytical chemistry methods were also used to determine the chemical composition of samples.

With rather low energy consuraptibns, under the conditions of uniform Joule heating, ultra-fine powders having narrow size distributions and a count median diameter of 4-SO nm have been produced.



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Institute for Microstructural Sciences

National Research Council

Research Station:

M-50, Montreal Road
Ottawa, Ontario
K1A OR6

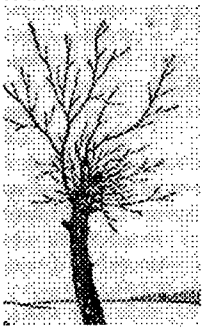
Fields of Research:

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Contact: Dr. P.H. Dawson Director General (613) 993-9369

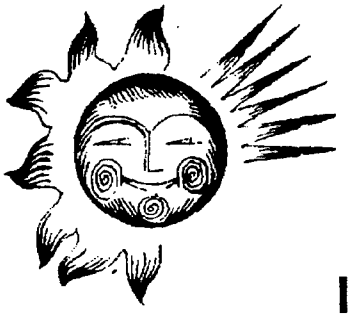
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1265.
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FORMATION OF FULLERENES AND THEIR ISOMERS

YU. E. LOZOVIK, A. M. POPOV

Institute of Spectroscopy, Russian Academy of Science, 142092, Troitsk, Moscow region, Russia

(First received 13 February 1998; accepted for presentation during IAS-4)

Since the discovery of fullerenes the explanation of their formation mechanism is one of the most interesting and puzzling problems in fullerene science. In our review report we consider various models for fullerene formation: assembling from graphite sheets, assembling of other clusters, models of 'nautilus' and 'fullerene road' and different ways of annealing from clusters with other structure (See also [1]). Two contradictory facts should be explained.

A set of experimental data shows than fullerenes easily form from hot carbon clusters of arbitrary structure and size during their annealing. Nevertheless, only few fullerenes (C60, C60, and several other) are abundant.

It was proposed that in typical conditions of are discharge or during laser ablation for mation of fullerenes takes place through following stages: firstly carbon clusters form in hot unequilibrium plasma and after that these clusters anneal in cooler regions of plasma and transform to fullerenes. However, this model explains only the first of two mentioned above facts and therefore needs in further assumptions to develop corresponding scenario.

The only assumption which is in agreement with the mentioned theory was suggested: the selection of abundant fullerenes takes place after the fullerene formation. Here we carry out the detailed analysis of experimental facts concerning this problem. We propose that abundant fullerenes selection is mainly due to reactions of molecule C2 insertion into fullerene and molecule C2 emission by fullerene [1]. Therefore the relationship of rates of these two channels of fullerenes interconvertion determines a set of abundant fullerenes. Namely, for fullerenes C28, C32, and C84, the constant of reaction of molecule C2 insertion is small; for fullerenes C36, C44, and C76, the constant of reaction of molecule C2 emission is small; and for the most abundant fullerenes C50, C60 and C70 both constants of reactions are small in comparison with that for fullerenes of neighbour size. The experimental conditions where microcluster insertion or emission by fullerenes or both processes take place are discussed.

The constants of reactions of molecule C2 insertion and emission are determined by local structure of fullerene area where the reaction take place. Therefore these constants may be different for fullerene isomers with different local structure. Thus we believe that observation only one isomer of fullerenes C60 and C70 and a few number of isomers of some other abundant fullerenes may be explained by selection with the help of these reactions.

This work was supported by the grants of Russian Foundation of Basic Research, Pro grams "Fullerenes and atomic clusters", "Surface atomic structures" and "Physics of nanos tructures".

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1319
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AEROSOLS ELECTRODYNAMIC PARAMETERS INVESTIGATION: IMPORTANCE FOR A NUMBER PHENOMENON

SERGEY BERESNEV AND ALEXANDER STARINOV

Department of General and Molecular Physics, Uhral State University, Ekaterinburg, 620083, Russia E-mail: sergey.beresnev@usu.ru, alexander.starinov@usu.ru

(First received 02 March 1998; accepted for presentation during IAS-4)

The rapt of attention is now given to questions connected with dynamics of heating, evaporation, destruction and movement of aerosol particles under the influence of directed electromagnetic radiation, both solar radiation and powerful laser radiation. The theory of the droplet evaporation in the field of directed radiation is now known to solve three interconnected essential problems. First, it is necessary to determine heat sources distribution of the electromagnetic origin within a particle. Second, the solution of the heat-conduction equation (considering conditions of heat exchange with environmental gas of course) allows finding out temperature distribution within the drop volume. And third, it is necessary to analyze processes a heat- and mass-transfer in gas environment using the kinetic theory. The problem of aerosol particle movement under photophoretic force action seems to partition similarly. Thus complex character of aerosol problems does not allow ignoring either electrodynamical or kinetic part of the solution.

The droplet evaporation time in a radiation field is well-known to depend on absorption factor J0 which can be obtained as a function of the particle parameters, such as complex refraction index, size and form.

Following two approximations restrict most of all recently published theoretical investigations of droplet evaporation (their review is given in the monograph [1]). According to the first one the heat sources distribution within particle is considered to be homogeneous. One of the other restrictions is the usage of hydrodynamic approximation at the description of process heat- and mass-transfer in a gaseous phase. Such theories are applicable only for small Knudsen numbers, where it is enough to consider the steam diffusion and thermal conductivity of gaseous mixture processes only. So it is clear, to avoid the first restriction in numerical solution we ought to give a main attention to the precision of the electrodynamical parameters. That is not trivial task, due the complexities of theory even for spherical homogeneous particles. Recently, certain progress has been achieved in kinetic part of evaporation problem solution [2,3] also. These newly appeared theories allow to use them to analyze kinetics of evaporation aerosol particles in the whole range of Kn, taking into account optical, heat and kinetic properties of a particle and a gaseous phase.

The electrodynamical part of problem can be solved on the basis of the Lorenz-Mie theory [4] for scattering and absorption of electromagnetic radiation by a spherical or elliptical particle (one or some layers). Though problem of scattering and absorption is known to be solved for a long ago, numerical results and therefore possibilities for analyzing have been received recently because of development of computer facilities [5,6,7]. Calculation complexities make it difficult to achieve exact numerical results thus the represented results are the most often incorrect or reflect qualitative view only. The main results of an electromagnetic part of aerosol problems are following: the factor of absorption Jo, asymmetry factor of the temperature distribution on a surface of a particle J1 (it is for the first time appeared in [8]), in general, J-L factors, and a source function of radiation B. So the precise values of J0 are very important in problems of droplet evaporation because quantitatively determine evaporation time of a drop as shown above. Value J1 specifies the angular non-uniformity of the heat sources at particle surface and

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appears in a photophoretic problem [8] and determines both a direction and magnitude of photophoretic force and the particle movement velocity. Thereby it is necessary to calculate J1 as exactly as possible, but its precision limits with evaluation time. Our algorithm allows to get 18 decimal signs and guaranteed correct values for the whole range of diffraction parameter and complex refractive index. It is known, the main difficulty of such calculation is getting so-called Mie coefficients which define magnitudes of J1. Because of Mie series for these electrodynamic parameters converge too slowly so the maximal precision of Mie coefficients is necessary. Precision of our method is approached by combination of the best sides of Lenz and Bohren-Huffman algorithms taking ito account possibilities to evaluate some types of non-spherical particles. Logarithmic derivation and basic mathematical functions was calculated with continued fractions method, besides the criterion of the number items in series was modified too. In detail this theory of photophoresis for the whole range Kn is written in [9].

The analysis of mentioned electrodynamic parameters have been already carried out [7], but the most of the investigations concern the abstract dependence of B on dimensionless radius R and non-existing refraction index n and the absorption index k. Probably these dependencies are not related to reality, at least because values n and k for really substances are interconnected with Kramers-Kronig equation. We've carried out the systematic analysis of values J0 for aerosols of various substances types [10] taking into account the aerosol classification given at [11]. Rather simple half-empirical formula describing average (the factor of absorption for small particles is known to have a so-called ripple structure at its dependence on R) behavior of values J0 offered for various types of substances. For the first time the similar formula was offered by Shifrin [12]. But, due to the method of its construction it is suitable only for water-containing aerosols and describes only bottom bound of true values J0 [10]. The Shifrin's formula upgraded by us is now suitable for solid aerosol particles also. The systematic analysis of factors of next orders J2 , J3 (which apparently make more exact of values mentioned above J0 and J1) is now being conducted.

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1013.
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INSTABILITY OF A CHARGED DROP FREELY FALLING IN THE ATMOSPHERE

KOROMYSLOV V.A., SHIRYAEVA S.O.

Yaroslavl State University, Physical Faculty,
Sovetskaya 14, Yaroslavl, 150000, Russian, Ph. (0852) 22 - 23 - 25 Shiryaeva S.O.

(First received 21 October 1997; accepted for presentation during IAS-4)

The problem of dispersion of a charged drop which is freely falling in surrounding media presents significant interest in connection with the numerous applications in various sections of physics of aerosol systems. The instability of a large charged drop freely falling in media resulting from joint action of a sheer flow on the drop - media interface and its own charge results in deformation of aerosols distribution function of the sizes and charges of drops. In this connection the problem of finding the critical conditions of instability of a charged liquid drop, moving with constant speed in a dielectric media presents interest.

Solving the system of the electrohydrodynamic equations we received, that the charged drop is capable to undergo instability in a flow of a liquid or gas. It is accompanied by emission of heavily charged daughter micro droplets. The parents drop have a subcritical charge due to instability to self own charge. It is possible due to a superposition of two above listed instabilities. The drop can undergo instabilities of two types: aperiodic and oscillatory, depending on the relation of a drop and media density, the quantity of charge and velocity of a media flow. The aperiodic instability can be realized by deformation to extended spheroid, then a drop break up on two parts of the comparable sizes (at small velocity of a flow) or deforms to the parachute form which break up on set of fine and a several large drops (at high velocity of a flow).

1037.
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SIZE DISTRIBUTION OF RADIOACTIVE PARTICLES RESUSPENDED IN THE CHERNOBYL AREA

GARGER E.K.*, TSCHIERSCH J.**

** Institute of Radioecology UAAS, Tolstoy St. 14252033 Kiev, Ukraine,*
*** Institute of Radiation Protection GSF-National Research Center for Environment and Health D-85764 Neuherberg, Germany*

(First received 4 November 1997; accepted for presentation during IAS-4)

Size distribution measurements of particulate radionuclides were performed at two sites in the Chernobyl 30 km zone using several cascade impactors. The results obtained in the period September 1986 till June 1993 were discussed in regard to the general assumption in inhalation dose assessment of a log-normal activity size distribution. At Zapolie (a site 14 km far from the Chernobyl reactor) in 91 % of all measured distributions a bimodal distribution was observed. In most cases the medians were in the ranges 4 μm and 20 μm - 30 μm. According to soil

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granulometric data this finding was explained by superimposing two processes: local resuspension and advective transport of radioactive aerosol from highly contaminated territories. The mean air concentration showed an increasing part of inhalable particles with the years since the accident. In 1993 the inhalable fraction was about 48 % of the total concentration. At Pripyat, a site situated within a highly contaminated area, unimodal types of size distributions were predominant with the median diameters in the range 5 μm - 10 μm for ^{137}Cs. For the three nuclides ^{137}Cs, ^{144}Ce and ^{106}Ru very similar types of distributions were observed. Apparently the radioactive aerosol was of fuel origin. During a forest fire at a distance of 17 km, the main part of radioactivity was measured to be associated with to submicrometer particles with median diameters in the range 0.28 μm - 0.50 μm.

1087.
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COLLECTIVE ELECTROMAGNETIC AND HEAT EFFECTS IN AEROSOL SYSTEMS TWO AEROSOL INTERACTED PARTICLES–CONTINUOUS MEDIUM

UVAROVA L.A.*, KRIVENKO I.V., SMIRNOVA M.A.****

** Moscow State Technological University "Stankin", 101104, Moscow, Vadkovsky str., 3a,*

*** Tver State Technical University, 170026, Tver, Af. Nikitin emb., 22*

(First received 10.10.97; accepted for presentation during IAS-4)

In this paper we investigated collective effects, conditioned by the electromagnetic and heat interaction in placed in continuous medium two aerosol particles system. There were solved the system of stationary Maxwell equations for two spherical absorptive particles and heat equation with heat source, initiated by electromagnetic radiation:

$$\nabla^2\mathbf{E}_j + k^2\varepsilon_j\,\mathbf{E}_j = 0, \quad \nabla^2\mathbf{H} + k^2\,\varepsilon_j\mathbf{H}_j = 0,$$

$$\nabla\mathbf{D}_j = 0, \quad \nabla\mathbf{B}_j = 0,$$

$$\nabla(\chi_j\,T_j) + q_j = 0,$$

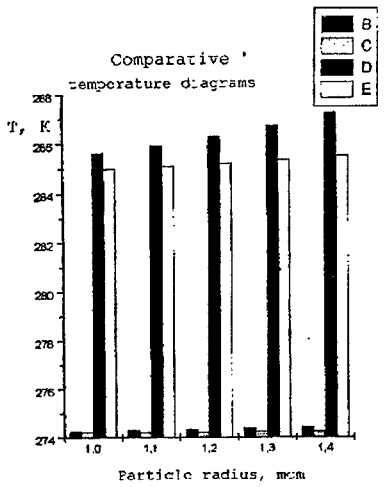
$$q_j = 4\pi n_j\,m_j|\mathbf{E}|^2 I/(n_3\lambda), \quad j = 1, 2.$$

Here are: $k = 2\pi/\lambda$, λ - electromagnetic wavelength, $\varepsilon = \varepsilon^{*} + i\varepsilon^{**}$ - complex dielectric permittivity, T - temperature, χ - coefficient of the heat conductivity, χ = (T), q - the density of the heat source, n - refractive parameter, m - adsorption coefficient, I - intensity of the initiative radiation, the indexes j = 1, 2 are related to the first and the second particles accordingly, the index j = 3 - to the surrounding medium, $\varepsilon_3^{**} = 0$, $q_3 = 0$. Using the received analytic solutions for the electric and magnetic vectors in the form of the infinite system of linear algebraic equations [1] there were received a program for the calculation of the densities q_j in the each particle and the temperatures T_j. By means of carrying out computations there were varied the radii of the particles r_j, the interparticle distance, the intensity of radiation I, wavelength, optical and heat characteristics. In the picture there are presented as a primer the diagrams, received on the basis of the carrying out computations for water drops. There were assumed, that =10.6 mcm, r_1=1 mcm, r_2=1 — 1.4 mcm, the temperature of the undistorted by the presence of the particles atmosphere T_0 =273 °K, the intensity of initiative radiation I_1, I_2 , $I_1=10^6$ W/m^2, $I_2=10^7$ W/m^2.

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The rectangles are shaded at the pattern and accords the following cases: 1) B, C for $I=I_1$ и $I=I_2$, accordingly, there were there were taken into consideration the electromagnetic and heat interactions; 2) D и E, $I= I_1$ и $I= I_2$ accordingly, there were taken into consideration only electromagnetic interactions of the particles (the computation of the temperature was carrying out for single particles on the basis of the found from the electrodynamics problem heat sources densities) was hold haw for the single particles. At the ordinate axis there are put the values of the temperature at the surface of the first particle. Since, in general, the surface temperature of the particles T_{sj} depends on the surface point $M^{(j)}$, then there was computed T_{s1} in the point $M_o^{(1)}$ with the coordinates $\xi = r_1$, $\eta = \pi$ in bispherical coordinate system for the clarity. The value T_{s1} was determined with the consideration of Knudsen layer influence.

The represented diagrams are illustrated the increase of the heat interaction caused contribution with the rise of the second particle radius (it goes to 13% for r_2=1.4 mcm, if $I= I_2$, and to 28%, if $I=I_1$).



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1062.
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A PROGRAM TO STUDY THE EFFECT OF AEROSOLS ON ATTENUATING THE SOLAR RADIATION IN TAIWAN (1994)

CHUNG-MING LIU ET AL.

Department of Atmospheric Sciences, National Taiwan University, Taipei, Taiwan, R.O.C. liucm@ccms.ntu.edu.tw

(Received 8 February 1997)

Aerosols are effective on scattering the solar radiation. The surface aerosols would hence affect the local visibility and attenuate the solar flux. This project intends to gradually set up observation program in Taiwan to analyze the effect of surface aerosols on the solar radiation field. In the first few years, we have selected the Tainan area for study. It is because that the

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area is flat and with a uniform distribution of air pollutants. Climatological data show that during September - April, Tainan was dry and clear, with a prevailing northerly, poor visibility and high levels of PM10, i.e. aerosols with diameter < 10mm; whereas during May-October, this area was wet and cloudy, with a variable wind, good visibility and low PM10 levels. Hence, we have selected the autumn, winter and spring seasons as the target period for the future intensive study period.

During February - March 1995, instruments were set up at Tainan-Yukang Meteorological Station to measure the surface solar flux, the aerosol composition and the aerosol optical properties. The Solar Spectrum System set up by the Yankee Environmental Systems, Inc., was used, which contains a automated multifilter rotating shadow-band radiometer (MFR-6) to measure the solar intensity in 415, 500, 600, 665, 862 and 940nm with an interval of 10nm each. Meanwhile, a TSP (Total Solar Pyrheliometer) was set up to provide a standard total solar flux dataset to be intercompared with those estimated by MFR-6. The data acquisition system is YESDAS-2. Meanwhile, a sky video-taping system was set up in along with a ceilometer, to assist in the determination of the clear-sky condition. Only the data collected during a clear-sky condition, will be used to study the effect of local aerosols on the attenuation of the solar flux. Otherwise, the scattering effect by cloud particles on the solar radiation is far more important than that by aerosols.

A Scanning Mobility Particle Sizer (SMPS), TSI model 3934, was set up to determine the number spectrum of aerosols with diameter between 0.025 -Ц 0.5mm, which was then compared with the number spectrum data collected simultaneously by a PMS probe for aerosols with diameter of 0.1 -Ц 10 mm. Meanwhile, an Integrating Nephelometer, TSI model 3563, was set up to determine the light scattering coefficient (m-1) of aerosols. The instrument is sensitive enough to measure the scattering coefficient as low as to 10-7m-1, and can provide the total and the backward scattering coefficient of aerosols in the band of the red, green and blue color, respectively.

In order to determine the composition of aerosols, a GBM-2000H high volume sampling system was set up to collect the aerosol samples. The filter used was Whatman 41 (20x25 cm). Since only a Hitachi Z-8100 polarized Zeeman AAS was available during the experimental period, only the concentration of the elements of Al, Fe, Mn, Na, Mg, Zn, and Pb were determined. The data of Pb, Na and Al were used as an indicator of the anthropogenic, marine and crustal influence.

Currently, the datasets collected during February-March 1995 are still under detailed analyses. A preliminary report to the National Science Council with a project ID no. NSC84-2621-M002-037 is available form the author. The whole research team contains: Chung-Ming Liu, Fei-Jan Lin (Institute of Oceanography, National Taiwan University), Chung-Teng Lee (Graduate Institute of Environmental Engineering, National Central University) and Hsiu-Wu Chang (central Weather Bureau).

1264.
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PHASE EVOLUTION OF ATMOSPHERIC CLOUDS." NEW CONCEPTION BASED ON EXPERIMENTAL DATA

ANATOLY N. NEVZOROV

Central Aerological Observatory, Dolgoprudny, Moscow Reg., 141700 Russia cloud@adonis.iasnet.ru

(First received 24 February 1998; accepted for presentation during IAS-4)

The present knowledge of two-phase microstructure and phase evolution of clouds at negative temperatures being basically a priori, is in poor general agreement with the factual

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evidence and is only weakly progressing under limited possibilities of field experiment. Representative comprehensive measurements performed in the late 80s with the CAO aircraft instrumentation have revealed a. series of new unexpected peculiarities of phase and disperse composition of such cold clouds:

I. In clouds consisting of only supercooled water drops as commonly accepted, actually ice fraction is usually detected with particles less than 20 to 30 mkm in size and up to tens of thousands per a litre in concentration.

2. Bath purely ice and mixed, by definition, clouds integrated here as ice-containing clouds (ICC), equally practically always carry liquid droplets up to tens and hundreds micrometers in size. The liquid phase in ICC persists at temperatures down to at least - 55°C. As to mass and numerical content, the droplet 5 action is comparable' with ice one and exhibits positive spatial correlation with this.

3. Just listed represents the complete set of' signs of. condensation equilibrium between both condensed phases in mixed clouds which include almost without exception all ICC. As this takes place, in all ICC the relative air humidity proves to be lower than saturated relative to liquid water.

4. It is found from the comparison of magnitudes of microphysical parameters determined through the use of different physical methods, that the substance of ICC liquid droplets has the refractive index between 1.8 and 1.9 and hence the density 2.1-2.2 $g.cm^{-3}$, and the evaporation heat about 550 J/g at - 30'C. It is important to add thereto that the known phenomenon of coloured gloria on a mixed cloud top can be elementarily interpreted as the first-order bow formed on big enough spheres having the refracting index close to 1.83.

The conclusion is justified from all sides that the liquid droplets in ICC are comprised not of usual supercooled water, as it is generally agreed, but of a specific amorphous phase of water, or A water. This water state is distinguished by the absence of intemolecular hydrogen bonds, and is known from laboratory experiments as both solid and melted amorphous ice. The amorphous water has the vitrification/softrening temperature 135 K and the flowability limit at about 150 K (-120'C). In melted state, this is capable of spontaneous crystallization with transforming to usual ice I.

The analysis of great totality of both known and newly obtained experimental facts, based on the fundamentals of the physical chemistry, leads to the following conclusions.

Having the lowest condensation enthalpy of all condensed phases of water, the A-water can nucleate only though direct condensation from vapour. At the same time, A-water plays the genetic role of an intermediate phase, or polymorphous substance of two-step phase change in ice deposition processes by the Ostwalds rule. This statement is confirmed by the existence of quasi-liquid transition layer on the surface of ice particles, responsible as such for the condensation equilibrium between ice and A-water particles. At the absence of active crystallization centre in a nucleus of condensation of A-water, it stays in metastable form of liquid droplet.

The permanent coexistence in ICC of droplets of A-water and ice particle;. in comparable concentrations being by orders different from these of the known ice-forming nuclei, suggests the universal dominant role of the mechanisms of condensation and partial ciystallization of A-water in formation of ICC. Essential independence of average concentrations of both ice and liquid particles of temperature, including lower than -40oC (gives the indication of' uniformity of microphysical processes forming ICC microstructure.

It was found in recent years that the icing of water clouds can be resulted from not only commonly accepted freezing of supercooled droplets, but also from their evaporation accompanied by regeneration of former nuclei of condensation of ordinary water into the secondary ice forming nuclei. As follows from our data this evaporation-reactivation



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mechanism forms the nuclei of both condensation and subsequent crystallization of A-water and is far more productive in ice generation than the freezing mechanism. The abundance in the atmosphere of cloudiness layers with vapour supersaturation relatively to ice implies that the A-water condensation nuclei are usually absent in dry air, and possible obligatory condition for their natural generation is the intermediate condensation of ordinary water.

In a water cloud, the secondary nuclei are capable to be collectively generated under the lowering of environmental humidity, sufficient for though the smallest droplets to evaporate. The originated thereon particles of A-water and ice are first very slowly growing to sizes of order of 20 mkm. This just gives the most real explanation of many-hours lifetime, as observed, of supercooled water clouds which are in fact in unstable "latent-mixed" state. As the gravitational fall of growing particles accelerates, the slowest molecular diffusion mode of Bergeron phase re-condensation converts to increasingly fast convective mode, completed by the avalanche-type process of full evaporation of ordinary water with vapour deposited on A-water and ice particles (Bergeron -Fiodeiseo process in extended sense).

The terminal stage of the phase evolution of a cloud, called above ICC, is the equilibrium three phase system. The utilitarien definition of ICC may be either or both colloidally stable mixed cloud and "quasi-ice" cloud in which a part of disperse ice stays in the metastable form of intermediate liquid condensate.

The content of A-water in ICC averages between 60% and 80% of total water content at all temperatures down to -55oC. The droplet effective diameters vary in most cases within the limits 20 mkm and 100mkm. The droplets of A-water have as a whale a dominant impact on diverse optical properties of ICC, far from excluding cirrus clouds even at temperatures lower than -40'C.

The conclusions suggested are deduced solely from the analysis of wide totality of reproducible observational evidence and experimental data as well as of scientific fundamentals. These not only refine the basic conceptions of the physics of cold clouds but also put forward comprehensive explanations for numerous poorly understandible phenomena involved.



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ON SPRAYING OF ELECTRIFIED CAPILLARY JETS

GERTSENSHTEIN S.YA., LYAKHOV A.G., NEKRASOV I.V.

Institute of Mechanics, MSU 119899 Moscow, Michurindki prospekt, 1

(Received 16 December 1997)

Main attention in this work will be given to experimental study of features spraying of a charged aerosol near the unexposed surface. The charged aerosol produced on initiation of corona discharge and subsequent deposition of ions generated in the corona discharge on independently formed drops of aerosol.

The experimental setup consisted of a corona electrode, a high-voltage (10 - 30 kV) power supply, an aerosol generator, a grounded electrode, a grid, and an object for spraying (a rectangular plate and so on). The aerosol generator was constructed according to the model of an atomizer and produced an aerosol jet whose speed considerably exceeded that of the ion wind near the corona point.

The studied object comprised two Getinaks plates covered on one side by copper foil with dimensions 300 mm * 50 mm. The plates were installed so that the foil was on the outer (relative to each other) surface of the plates. The plate-to-plate clearance (2 mm) prevented electrical contact between the plates when they were wetted. Charges collected by the plates leaked out

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through the resistors, and the voltage across them was measured by an electronic voltmeter. The water collected by the plates drained down and was directed to the measuring vessels.

In particular, the experiments were carried out when the water consumption q=1.6 cm³/s, the spraying, period was 30 s, the air consumption was equal to 1.4 l/s, and the voltage was varied in the range 0 - 26 kV.

We also carried out quantitative measurements of the current feeding the needle, the currents through both plates, and the water flows falling on these plates.

The currents run off the unexposed I1 and front I2 surfaces is relation to the water consumption q and needle voltage E are given.

Exchange of Getinaks plates for a fine-mesh wire netting, which intersected the entire cross section of the jet, led to a similar decrease of the charge carrying away by the jet when the water consumption was increased from 0.8 to 1.6 cm³/s. The amount of water draining off he plates was determined using the measuring vessels. The ratio of water amount fallen on the unexposed surface to that on the front surface Q_1/Q_2 is shown there as a function of the needle voltage.

One of the significant results of this work is that the spraying efficiency is independent of water consumption (within the limits of experimental accuracy). As mentioned above, with an increase of q the needle's feeding current does not change, and the current flowing off the plate actually slightly decreases.

A relationship was also studied between the ratio Q_1/Q_2 and angle of the jet incidence on the plate surface. It is shown that at angle < 45 grad. the ratio Q_1/Q_2 does not change significantly, and at angle = 60 grad. this ratio noticeably increases.

One of the most interesting investigations of this work concerns a study of the distribution of sprayed substance over the unexposed surface of a plate.

It is easy to see that the interests of spraying falls to the center approximately exponentially.

Also the results of new effective way of charged aerosol generating are presented. Aerosol is generated on oscillating string with small drops of liquid exposed in high voltage field.



1315
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KINETIC THEORY OF DIFFUSIOPHORESIS OF AEROSOL PARTICLES IN A BINARY GAS MIXTURE

V.G.CHERNYAK, S.A.SERESNEV, S.A.STARIKOV

Department of Molecular Physics, Ural State University, Ekaterinburg, 620083, Russia

(First received 02 March 1998; accepted for presentation during IAS-4)

Concentration gradients of the chemical species in a gas mixture are known to cause movement of aerosol particles. The particle motion is commonly termed "diffusiophoresis", and the force producing this motion is known as "diffusion force" [1]. This phenomenon, which cannot be described within the ordinary continuum theory, may find various technological applications, one of which will be the separation and collection of small particles (micron- and submicron-sized).

The theory of diffusiophoresis has been developed previously' only for particles whose radius was either much smaller or much larger than the mean-free path of the gas molecules. The analysis covering the regime of an intermediate Knudsen number, i.e. the transition regime, is an important but difficult problem in aerosol microphysics. A few studies have been made in the transition regime based on kinetic theory treatments (one of these theories is the method of giant molecules [2]). The aim of this work is the elaboration of a consistent gas-kinetic theory for the diffusion force, friction force, diffusiophoretic velocity and the study of

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their dependencies on the properties of an aerosol particle and binary gas mixture. Consider a spherical particle placed in an infinite expanse of binary gas mixture with a low concentration gradients along OZ axis. As the concentration gradients are very low, the velocity distribution functions for the binary gas mixture can be linearized. This allows to split the problem (the diffusion force problem and the friction force problem). The particle surface temperature and the temperature of a gas mixture are the same (and constant). Let us use the Lorentz's and the Rayleigh's vapour-gas mixture approximations when the vapour concentration is small, and the molecular mass of the vapour is much less or much larger than the molecular mass of background gas.

The problem is solved in a steady-state formulation on the basis of the linearized McCormack model kinetic equation [3] under the boundary conditions of Maxwell's type (diffuse reflection type). The integral-moment method of solution for arbitrary values of Knudsen number is employed. The set of integral moment equations for macroparameters was solved by the Bubnov-Galerkin method. Numerical calculations of the diffusion force, friction force and diffusiophoretic velocity for the extensive range of Knudsen numbers are carried out. The results obtained are compared to the known theoretical [2,3] and experimental [4,5] data.

This work was supported by the Grant for Scientific Research (No. 96-01-00756) from the Russian Foundation for Basic Research (RFBR).

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1317
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DIFFUSIOPHORESIS OF AEROSOL PARTICLES AT ARBITRARY KNUDSEN NUMBERS: APPLICATION OF THE SHERMAN'S METHOD

S.A.BERESNEV, A.S.PASECHNICK

Department of Molecular Physics, Ural State University, Ekaterinburg, 620083, Russia

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Concentration gradients of the chemical species in a gas mixture are known to cause movement of aerosol particles. The particle motion is commonly termed "diffusiophoresis", and the force producing this motion is known as "diffusion force" [1], This phenomenon, which cannot be described within the ordinary continuum theory, may find various technological applications, one of which will be the separation and collection of small particles (micron- and submicron-sized).

The theory of diffusiophoresis has been developed previously only for particles whose radius was either much smaller or much larger than the mean-free path of gas molecules. The analysis covering the regime of an intermediate Knudsen number, i.e. transition regime, is an important but difficult problem in aerosol microphysics. A few studies have been made in the



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transition regime based on kinetic theory treatment (one of these theories is the method of giant molecules [2]).

The strict and consequent approach to the problem should be based on the decision of the Boltzmann equation (or appropriate model kinetic equation of rather high order) with adequate boundary conditions for the distribution function on a particle surface. The first stage of the problem decision at such level is presented in the report of V.Chernyak, S.Beresnev and S.Starikov "Kinetic theory of diffusiophoresis of aerosol particles in a binary gas mixture" (where the results for the small concentration of one species are obtained). The solution of the problem for arbitrary concentration of species encounters a number of serious difficulties of computing character (one of them necessity for accounts every time to set parameters of a specific binary mixture).

The aim of this report is the attempt of reception of estimated results (with an error no more than 10 %) for the friction force, diffusion force and difFusiophoretic velocity for the arbitrary concentration of species in a binary gas mixture in the whole range of Knudsen numbers on the basis of a so-called Sherman's method [3] (interpolation method allowing on the known decisions in free-molecular and hydrodynamical limits to receive results in the intermediate regime).

Note, that the Sherman's method for phoretic problems in case of gas mixtures is used, apparently, for the first time.

The received results are compared with known theoretical and experimental data. The high efficiency of the developed technique is shown. The received expressions can be useful for the practical estimations of diffusiophoretic behaviour of aerosols in binary gas mixtures.

This work was supported by the Grant for Scientific Research (No. 96-01-00756) from the Russian Foundation for Basic Research (RFBR).

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1448.
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GLOBAL CHANGES OF COMPOSITION AND TEMPERATURE OF THE ATMOSPHERE CAUSED BY SULFUR DIOXIDE DISCHARGES INTO ENVIRONMENT

DYOMINOV I.G.[1], ZADOROZHNY A.M.[1], ELANSKY N.F.[2]

[1] Novosibirsk State University, Novosibirsk, 630090, Russia;

[2] Institute of Atmospheric Physics, RAS, Moscow, 109017, Russia

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A two-dimensional zonally averaged model is used to examine global changes of composition and temperature of the troposphere and stratosphere caused by sulfur dioxide discharges into environment, which are due to the mount Pinatubo eruption and regular flights of supersonic aviation in the period of 1990 - 2015. The model self-consistently calculates diabatic circulation, temperature, and distribution of 45 gas constituents and distribution of condensed particles in a sulfate aerosol layer. To adequately represent the main features of



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sulfate aerosols of the atmosphere with sizes in an interval $0.0064 < r < 5.2$ microns, a rather complete scheme of photochemical changes of sulfur compounds has been used along with the most important microphysical processes including nucleation, condensation, evaporation, and sedimentation. To take into account gas component sinking on aerosol particles surface, six heterogeneous chemical reactions are used. The calculations are made for the latitudes from the North to South poles at altitudes from 0 to 50 km. It is shown that megaton discharges of sulfur dioxide in the atmosphere during the Pinatubo eruption result in significant changes of temperature, gaseous and aerosol composition of the troposphere and stratosphere. For example, by the end 1991 we have in tropics (30°N - 20°S) at altitudes of 22 - 24 km a -2.5-3.5K increase in temperature, while at altitudes of 5 - 8 km a -0.8-1.0K decrease in temperature. It is caused by the intense absorption of solar radiation by aerosol particles from powerful eruptive stratospheric clouds. These clouds play a role identical to that of polar stratospheric clouds leading to form the ozone hole. At the surfaces of particles forming these clouds comparatively inactive HCl and $ClONO_2$ transform itself into more active chlorine components. In -100 days after eruption this results in a 5-7% decrease in total ozone at latitude of 35°N-25°S. An autumn transport of eruptive aerosols to higher latitudes brings about a significant variation of ozone in the polar region. This effect is most pronounced over Antarctic where the spring 1992 decrease in total ozone receives a 15 - 18% addition in comparison with 1991. It is the result of the sharp decrease of the ozone at the heights of 11 - 13 km and 17 - 28 km. Powerful discharges of sulfur dioxide from the Pinatubo eruption significantly increase the aerosol optical thickness of the stratosphere. This leads to a -0.28K decrease in monthly mean global temperature at the Earth's surface by the end of 1992.

Calculations of global impact by regular flights of 500 supersonic aircraft on gaseous and aerosol composition of the troposphere and stratosphere are carried out with the two values of nitrogen oxide emission index ($EI(NO_x)$), 15 g and 5 kg of NO_2 equivalent per 1 kg of fuel. Emission index for SO_2,H_2O, CO, CO_2 and CH_4 are adopted to 0.4; 1230; 1.5; 3160 and 0.2 g per 1 kg of fuel. Averaged global fuel consumption is 80 megaton a year. The ratio of a mean speed of flights to the sound velocity (Mach number) is 2.4. Calculations are carried out with account taken for SO, injection into the atmosphere from aircraft engines as well as without this injection at all. Three kinds of sulfur compounds emission are used: as gas (100% SO_2), as gas/particles mix (90% SO_2 Grid 10% SO_2 converts into aerosol particles), and as 100% particles. The size of sulfate particles is taken to be 0.01 microns.

It is shown that it is necessary to take into account the processes involving atmospheric aerosol particles in order to be able to adequately estimate global change gaseous composition of the atmosphere by regular flights of supersonic aviation. Thus, consideration of heterogeneous surface processes on particles of background ($EI(SO_2)=0$) sulfate aerosol layer leads, in the entire region, to a significantly lower ozone destruction than consideration of only gas-phase reactions. It is the result of heterogeneous conversion of NO_x($NO+NO_2$) into HNO_3 leading drastic weakening of destructive effects of the nitrogen cycle on ozone.

Thus aerosol sulfate particles are a buffer in the atmosphere, that is, weaken the effects of aviation on the ozone layer. When sulfur dioxide injection by supersonic aviation is present, such a buffer characteristic of sulfate aerosols significantly depends on the kind of sulfur compounds emissions, NO_x emission index value, and odd chlorine background content. The kind of emission of sulfur compounds defines a character of changes of effective surfaces of sulfate aerosols.

The results of self-consistent model calculations show that without SO, emission ($EI(SO_2)=0$) the impact of aircraft exhausts on a background value of sulfate aerosol surface density is hardly noticeable. This fact allows us to take into account only sulfur compounds emission for estimation of supersonic aviation impact on the sulfate aerosol layer of the

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atmosphere. This estimation gives a significant (about 35%-50%) increase of aerosol surface density in the lower Northern stratosphere following sulfur compounds injection in the gaseous form (100% SO,). Gas/particle (90% SO_2/10% particles) mix gives a still more significant increase (up to 75%). When all SO, converts into sulfate particles, the latter causes a catastrophically great (-100% - 200%) increase in aerosol surface density in a wide range of latitudes (90°N - 20°S). All these effects are caused mainly by increased H_2SO_4 content and nucleation, condensation, and coagulation.

In light of all the above results, estimates of global ozone changes by 2015 due to regular flights of supersonic aviation show that for the two examined chlorine background contents (3 ppbv and 2 ppbv) sulfur injections accompanying those of nitrogen oxides lead to a decrease of prognostic depletion of total ozone in the Northern Hemisphere. Thus, for NO_2 and SO_2, emissions from aircraft engines anticipated in near future (that is, with $EI(NO_x) = 15$ and with $EI(SO_2) = 0.4$) sulfate aerosol layer is a buffer in the atmosphere of the Northern Hemisphere for every kind of sulfur compounds emission, that is, it leads (due to heterogeneous and microphysical processes) to the weakening of impact of regular flights of supersonic aviation on the ozone layer of the atmosphere.

3377.
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DEVELOPMENT AND METROLOGICAL QUALIFICATION OF THE RADIOACTIVE ISOTOPE DUST-METER IKAR

BALAKHANOV M.V., BOLSHAKOV V.A., KUDRJASHOV V.V., PETROV A.A., SEVASTJANOV V.D., SOLNYKOV V.V.

GP "VNIIFTRI", IPKON RAS, SKB IRE RAS, Moscow

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An operative and exact checking of the air dustiness level are necessary for the raising of air disdusting efficiency on factories, where technological processes are accompanied to the generation of dust. Herewith follow to use such concentration's measurement method, which is less subjected to influence of material and dispersity dust's composition, since stuff and technology of its processing on the concrete factory are not known beforehand and can change over a wide range. Only a radioactive isotope measurement method possesses specified characteristics from known indirect methods of a dust concentration's evaluation in midair. It is based on the measurement of the beta-particle attenuation in a layer of dust, precipitated on the filter from the given volume of dusted air. This circumstance does the radioactive isotope dust-meter preferred not only at the measurement of dust concentrations in midair of a working area, as well as at an environmental ecological monitoring on dust factor.

One of the important conditions of undertaking the responsible measurements is a possibility to metrological qualifications (type approval tests) and to checks of instruments, realizing chosen method. Herewith two approaches are used. In first, master samples of material are used for the check and qualifications. In the event of the measurement of dust concentrations it is practically impossible to create a sample of the standard polluting air because of instability of an aerodispersive air-dust system. In the second approach, simulators or so named equivalent measures are used, which are objects that are distinguish from a measure, but have alike or equivalent influence on measuring instrument elements. However under such approach it is necessary strictly to prove those attenuation laws using in the beta particle's radioisotope method are the same or are like at the accuracy to the constant factor in the layer of dust particles and in the equivalent measure.

A radioactive isotope method of measurement of a dust concentration in midair is based on

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the filtration of known volume of polluting air and the following determination of sediment on the filter mass of dust on beta radiation attenuation in it.
A theoretical analysis of the a beta radiation which is absorbing in such nonevent dust layer has show that attenuation in it is always less, than in equal on the mass even film, but law of absorbing is distinguish by presence of transfer factor in the power of the exponent. In this case it is important so named uniformity of the sensitivity of the measuring system, defined by the form of a radiation intensity sharing and by an efficiency of registrations on the area of a spot. Developed by authors constructive decisions have ensure the uniformity of this sensitivity and have reduce inaccuracy of measurement.

The experimental check was made with using dust with different disperse and material compositions, it has show fairness of developing theoretical positions, has confirm a coincidence of theoretical and experimental transfer factors (a transition from dust to the film from such material), when ensuring uniformity of the sensitivity on the area of a dust preparation.

The studies have show the equivalence of a light beta radiating absorption in a dust layer on the filter and in nylon films, imitating such layer, that allows to use last as equivalent measures at qualifications and check of radioactive isotope dust-meters.

The carried studies have allow to develop and design a dust-meter, in which the radioactive isotope method of measurement is realized to concentrations of midair dust. At the measurement of concentrations a dust-meter executes subsequently a measurement of volume of air, pumped through the filter by the built-in in the instrument pump, and then a measurement of the precipitated on the filter dust mass herewith. Volume of air is defined on the number of swings of pump, but mass of a dust setting-on the attenuation of light beta radiation in the getting dust spot (on the correlation of number of pulses, registered by the detector of radiation before and after pumping of polluting air through the filter). A filtering tape NEL-3-25 is used as a filter, a source, containing the carbon-14 isotope-as a source of beta particles.
In measuring block of the dust-meter occurs a processing of the received information and its calculation to mass concentrations.

Calculation is executed automatically and on the indicator panel of the dust-meter is flashed a numeric value of a dustiness in the sampled air.

A value of a transformation factor is individually for each instrument (for different copies of instruments this difference is not great), The factor is defined in the process of its adjustment and written in the dust-meter's passport.

A dust-meter adjustment and check are realized by using the equivalent measures that were made from a nylon film. Measures present disks from a nylon film at the thickness 3, 10 and 20 micrometers, bolt in special holders, which locate in the process of adjustment or checks on the imitating dust spot filtering tape. The equivalent measures pass a qualification under their fabrication. The qualification of the measure is concluded in specifically exact measurement of their mass (balances are used with inaccuracy of measurement 1 - 3 mkg) and in determination of their area (on disk's diameter measurement's results with inaccuracy 2 - 3 mkm).

The dust-meter defines automatically in the process of measurement a necessary time for drawing of polluting air through the filtering tape. This is reached by comprising of the composition of instrument of micromanometer, defining swing of pressure on filtering tape in the air selection process. At the achievement of definite value of a pressure difference, corresponding to a dust spot shallow density of 2 - 3 mg/cm2, micromanometer gives a signal, which stops a working pump. This technical decision has allow us automatically to prevent an overflow of a filter by dust, under which possible garbling an exponential law of absorbing a beta radiating and to avoid a significant inaccuracy in the dust concentration measurement's



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results. A technical feature of the developed express-dust-meter IKAR is given below:

Limits of measurement, (mg/m3) -- 05 - 500.	Mass, not more, kg -- 2,2.
Inaccuracy of measurement, %, not more -- 25.	Performance-industrial.
Times of measurements, not more, minutes -- 15.	

A showing of an instrument do not depend on the change of disperse and material compositions of dust. Metrological qualification of instrument was carried out by VNIIFTRI on the special stand, that allow us to define the main forming inaccuracy of measurements. Master equivalent measures of shallow density of nylon films' type PET-KE were independently qualified on the mass shallow density on the VNIIFTRI's radiometric complex of the State special standard of the neutron fluency and flow density units. At the thickness of films 5, 10 and 20 mkm the shallow densities were measured, accordingly, equal to 0,517-0,519; 1,75-1,80 and 2,94-2,95 mkg/cm2. The measurement inaccuracy of the films shallow density of master equivalent measures formed a value not more 0,5% under confidential probability 0,95.

1376.
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EQUIPMENT FOR MEASUREMENTS AND TESTING OF AIR CONTAMINATION AND CERTIFICATION OF CLEAN ROOMS

BALAKHANOV M. V., GRITSENKO A. P., KOCHERGA V. G., TROTSENKO N.P.

GP "VNIIFTRI"-State Enterprise "All Russian Research Institute of Physical-Technical Radiotechnical Measurements" by Gosstandart of Russia

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Clean rooms (CR) are required for realisation of the high-tech. in which parameters of all technological environments are testing. Air environment is tested on one of the main parameter. a particle aerosol contamination. As an effect, the amount of a processing, a sending and a recording information about parameters of controlled environments has increased sharply. This has led to the creation and the introduction into practice a new generation of the checking-measuring equipment- computer systems for air environment monitoring in clean rooms. On these reasons a need of association into the computer network a number of autonomous instruments becomes a main condition to fulfil requirements of standards on the testing and the certification of clean rooms. These instruments, which are used for measurements and quaiifications, are anaiysers of the contamination of air, sensors of temperature, pressures, moisture and etc.

A short description of instruments developed in VNIIFTRI is given below: an autonomous counter of aerosol particles "Monitor A-33". having channel for the association in the computer network, and a computer system "Monitor - C" for monitoring and testing the air contamination in CR's. Instrument "Monitor A-33" is a photoelectric particle counter, which principle of action is based on the analysis of light radiation, scattered by aerosol particles when a sampling air is pumped through the illuminated measuring volume.

This instrument consists of an optical block, a pneumatic block and a block of electronics. A halogen tube was used as the radiating source in the optical block. The design of the optical block ensures a reliable checking of aerosol particles with sizes equal and more than 0.3 pm. The pneumatic block ensures a pumping of air through the aerosol chamber and a regulation of its consumption within range from 1 to 3 litre per a minute. The microprocessor block of electronics executes a collection, a processing and a displaying of a measuring information.

The base model of the counter "Monitor A-33" has the following features:

* a number of channels for the simultaneously registering of the aerosol particles - 4;



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* sizes of particles in the channels: >=0,3μm, >=0.5μm, >=1μm, >=5μm;
* a volumetric consumption of air sampling for the analysis - 1 litre per a minute;
* an indication of measurement results is numerical, on a built-in 7-sign indicator pa dimensionality of results is a number of particles per a cubic meter of air;
* time of one measurement (sampling) - from 1 minute to 9 hours (will be assign by an operator from the keyboard of the instrument);
* an additional information that is given on the numerical indicator panel in the process of measurement: current time of measurements, a number of particles in each channel for a current time, a checking information on states of working instrument:
* an RS-232C interface for the relationship with external PC;
* the instrument has a built-in block of the optical channel calibration;
* a power supply of an instrument is from industrial network 220 V 50 Hz,
* gabarit sizes - 360x300x120 mm.

Built-in RS-232C interface allows remote control (up to 100 m) by the regime of working instrument and to interchange by the measurement information with an external PC. A special software enables to unite in the computer network up to 256 instruments of given type just through COM1 port by using the standard computer analysis facilities, a performing and an archiving of a measurement information.

Parameters of the base instrument models (a threshold value of sizes of particles in channels and volumetric consumption of air) can be changed at the request of the customer.

Base model has a number of modifications and in particular model "Monitor A-33/MAC" is intended for undertaking the measurements in areas with a microbiological contamination control and is adapted to requirements of GMP rules. There are developments with autonomous (storage) by power supply and in the safety explosive performance.

A specified computerising measuring system Monitor-C consists from following elements: an IBM PC/AT computer, a network adapter. a multiplexor and aerosol measuring sensors. As sensors two-channel photoelectric particle counters are used, each counter has a built-in power supply unit and a pneumatic block. All sensors have built-in blocks of remote calibration of optical channels, operated by PC.

Measuring sensors are united with the multiplexor by means of wire communication links at the length to 100 m. A specially designed controller on 64 measuring channels (32 two-channel sensors) serves as a multiplexor. The multiplexor allows to send on the PC up to three independent commands per each sensor and to take from them up to three signals about their functional condition together with the transmission of a measuring information.

The PC interchanges by signals with the multiplexor through the network adapter-a standard 32 ranks parallel interface. It is installed on PC charge in any free slot and is united with PC through ISA bus. The application of a parallel interface has allow to avoid the using of the microprocessors in sensors and in the multiplexor at the pre-processing of a measuring information and switching of testing and control signals and to entrust these functions on PC software. These enable greatly to simplify a hardware part of the measuring system and greatly to reduce its cost. A questioning of the measuring sensors, a checking and a mode control of their work, a collection, an analysis, a keeping and a presentation of all accumulated signals is realised by means of special software with a using of the standard PC facilities in a suitable for the user type.



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IR-ACTIVE MODES OF FULLERENE GROWN ON SILVER

V.I.IVANOV-OMSKII, E.K.KUZNETSOVA, S.G.YASTREBOV AND G.A.DYUZHEV

A.F.Joffe Physical-Technical Institute RAS, St Petersburg, Russia, 194021

(First received 30 March 1998; accepted for presentation during IAS-4)

We report on the charge transfer from metal substrate to the fullerene film produced b vacuum evaporation of pure C60 on metal substrates. Intensity of four main absorption bands in IR spectra attributed to IR-active modes of C60 oscillations was measured as functions of the C60 film thickness. Fullerene films were deposited both onto glas substrates covered with Ag and KBr substrate. Ellipsometrical measurements were don at 632.8 nm wavelength. Optical and IR spectra were performed in 0.25-25 mkm spectrs range. Measurements of absorption intensity for specific optical bands appearing in U' and VIZ spectral wavelength ranges and ellipsometrical studies showed that film thickness varied within the range from hundreds to several thousands of nanometers. Dependence of intensities of four mmn IR absorption bands of C60 deposited on silver as a function of the deposition time is shown in the Figure. It was found that in the case when the film thickness is of 150 nm (2 minutes of deposition) the intensity of four the bands of fullerene deposited on KBr are much more intensive than ones for the film deposited onto silver. Increasing the thickness up to 300 nm (4 min of deposition), the absorption intensity increases correspondingly. A pronounced departure of relative ratio of high and low frequency absorption band intensities for fullerene deposited onto KBr and silver substrates was found. For films thicker than 1000 nm no difference between the bands of fullerene deposited on metallic and dielectric substrates was observed. This effect is discussed in the frames of electron screening mechanism of IR-induced oscillations of the fullerene, which causes the suppression of the IR-absorption bands.

Electronic phenomena appearing at the metal/fullerene interface are considered as a possible reason to arise electron concentration in thin fullerene films, which is necessary for the electromagnetic screening.

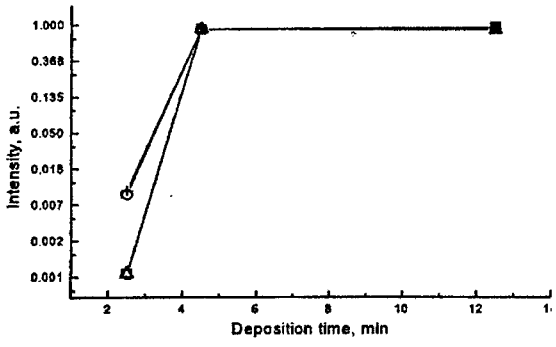


Figure. Dependence of intensities of four main IR absorption bands of C60 deposited on silver vs the deposition time. Crosses stand for 527 cm^{-1} mode, squares stand for 577 cm^{-1}, triangles stand for 1429 cm^{-1} mode, circles stand for 1183 cm^{-1} mode.

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1453.
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DIAMOND NANOCLUSTERS NUCLEATION IN AMORPHOUS CARBON MEDIA

V.I.IVANOV-OMSKII AND S.G.YASTREBOV

A.F.Ioffe Physico-Technical Institute RAS, St.Petersburg, 194021, Russia

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Keywords: amorphous carbon, diamond nucleation, copper, phonon spectroscopy

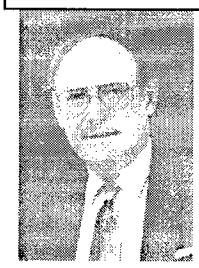
We report on observation of copper-assisted nucleation of diamond nanoclusters in amorphous carbon films. Ultradispersed copper was introduced in the bulk of amorphous carbon by plasma co-sputtering of copper and graphite on silicon substrates at 200' C, using a planar DC magnetron in argon-hydrogen (80% Ar and 20"/,' H,) plasma. It was possible to grow films with thickness from O. 1 to 2.0 μm. The copper nanosize clusters (-3 nm) are responsible for the enhancement of copper activity as a catalyst of diamond nucleation. As a. result temperature of diamond nucleation decreases from 800-900" C in conventional HTHP industrial process to 200" C in this work. Diamond nucleation was monitored by the measurement of IR-absorption at the diamond two-phonon frequencies. Anomalously high two-phonon absorption observed in this experiments allowed to increase the sensitivity of the method even in the case of very thin films (See figure). The application of the two-phonon spectroscopy to detection of diamond nucleation on the copper background in thin amorphous carbon films is important, because the close coincidence of the diamond lattice parameters with those of copper hampers application of diffraction methods.

We will demonstrate experimentally that, owing to an anomalous enhancement of two-phonon absorption, it becomes competitive with the traditionally used Raman detection of diamonds in the actual case of tiny diamond crystals immersed in the amorphous carbon matrix. Moreover two-phonon absorption bands may be considered to be real fingerprints of diamonds, owing to the impossibility of any imitation. Mechanisms of the two-phonos absorption arnplification are discussed in the frames of electrodynamics of media containing nanosize inclusions of conductive phases of various shapes (spheres, plates, needles and so on). It is assumed that local field induced in the vicinity of diamond nanocrystal is responsible for observed arnplification of absorption in the actual IR frequency range, Prime novelty: Observation of high activity of ultradispersed copper as a catalyst of diamond nucleation

RAS

INTERNATIONAL AEROSOL SYMPOSIUM IAS-4

July 6-9, 1998 S.PETERSBURGH RUSSIA



TITLE OF SESSION CLEANING OF GASES

Chair Prof. LORBER KARL E. *(03/02/45)*

Fax 0043-3842-4610352

phone 0043-3842-4610351

Director of Institute fur Entsorgungs und Deponietechnik

Montanuniversitat Leoben

Peter-Tunner-Strasse 15 A-8700 Leoben Austria

Languages: German, English, Spanish, French

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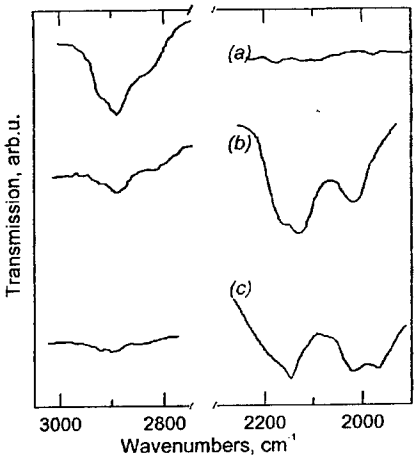


Fig. Fragments of double pass transmission spectra: curve (a) is for an amorphous carbon film (thickness = 0.8 p.m); curve (b) for an a-C:H:9%Cu film (thickness 0.8 pm); and curve (b) for a CVD diamond film (thicknes 320 p,m).

Acknowledgments:

This work was supported by Russian Foundation for Basic Researchs grant N 97-02 18110 and in part by the US Department of Defense.

1454.
УДК 541.18

THE ULTRAVIOLET RADIATION OF BACTERIA UNDER PULSE LASER INFLUENCE

A.M.AGALTSOV, A.N.BORDENIOUK, V.S.GORELIK.

P.N.Lebedev Physical Institute of Russian Academy of Science. 117924, Moscow, Leninskiy pr. 53.

(First received 30 March 1998; accepted for presentation during IAS-4)

The observing of the second ultraviolet radiation of the simplest microorganisms under influence of pulse ultraviolet laser affection is reported. As a source of laser radiation was used copper vapour laser, producing pulse radiation in visible spectrum region (wavelengths 510.5 and 578.2 nm) with average power 4 W and pulses repetition frequency 10000 Hz. The duration of laser pulses generation was 20 ns and their peak power 10000 W. The non-linear optical (ADP) crystal was placed after laser. The crystal was cut out so, that sinhronization conditions were performed for mixed emission compound with wavelength '271.2 nm. So, exciting pulse at laser radiation was at average ultraviolet spectrum region (271.2 nm) and was absorbed by micro-organisms by resonance manner.

For the investigations were chosen bacteria "Bacila Thurin giensis" in 0.9% NaCl aquatic solution, Shtamm War Purstake under T.C. 09.05.096.73-84. The samples were preparated in concentration range from 100 cell/ml to 100000 cell/ml. Besides bacteria, the spectra of the second radiation appearing under affection of ultraviolet exciting radiation in hard GTF hell and in saturated aquatic solution of tryptofane were studied for comparing.

The samples were placed in quartz cuvette with plane-parallel optical windows made from QU-1 glass. The second radiation was observed under 90- degree angle and was registered with small monochromator of MUS-type and rate Photomultiplier PEA-106. Accumulation time of useful signal was defined with computer control program in every fixed location of monochromator lattice. Electronic amplifier with control strob-pulse was used for performing temporary analysis. The strob-pulse duration was 30 ns and his location on temporary scale has

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been changed with delay line in range 0-200 ns.

As a result of performed analysis of bacteria in aquatic media, we founded that in second radiation spectrum, side by side with sharp peak (271.2 nm) of exciting radiation was present intensive maximum with wavelength 301.2 nm, corresponding to Raman scattering in water and also there was the wide band in more longwavelength region. Location and shape of this band changed in dependence from bacteria concentration and also from delay time of strob-pulse in relation to exciting pulse radiation.

When the delay was absent the range of the second radiation spectrum (resonance fluorescence-RF) for the sample of low concentration (100 cell/ml) was 310-410 nm. Simultaneously, in observed side by side with wide band were present sharp splashes. Their intensity was higher than that of noise signal. The RF spectrum moved to longwave region with increasing of bacteria concentration. Particualy, for the bacteria sample solution (under condition of high bacteria concentration, the short wavelength ultraviolet radiation should be re-radiated by aromatic amino-acids, for example as tryptofane. As a result of this, the second radiation maximum should be moved to violet region. This effect we have really observed in our experiments.

The investigated ultraviolet radiation of microorganisms may be close to mitogenetic radiation, predicted by A.G.Gurvich and stipulated by exciting of DNA as s result of metabolic processes (look [1,2]).

So, performed experiments showed, that method of resonance pulse laser influence per aquatic samples of microorganisms allows us to fulfil its diagnostics and concentrational analysis.

This work was supported by RFFI-project N 97-02-16404

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1483.
УДК 541.18

MODELING OF ATMOSPHERIC TRANSPORT OF AEROSOL

VLADISLAV KATKOV

Institute of Engineering Cybernetics, National Academy of Sciences, Belarus, Minsk

katkov@newman.basnet.minsk.by

(First received 19 March 1998; accepted for presentation during IAS-4)

Despite of sarcophagus, covering damaged reactor on Chernobyl Nuclear Power Plant, the emission of radionuclides in an atmosphere continues, as well as repeated their transport owing to destruction of an underlying surface with realization of agricultural works, wood fires, melioration, construction etc. Besides the growth of cities, development of industrial manufacture, chemical processing of raw material, use of fertilizers in an agriculture and other factors require creation of adequate mathematical models for forecast of pollution transport on territory of Byelorussia and for estimation of consequences of this process.

For this reason several regional models of pollutants transport by wind have been developed in Institute of Enfineering Cybernetics which are taking into account the following factors: presence of turbulent boundary layer of an atmosphere, washing out of pollutants by atmospheric precipitation, polydispersness of radionuclides, various type of an underlying

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surface and some other. The model, created in USSR in Institute of Experimental Meteorology, was taken for a basis of our approach [1].

The three-dimensional equations of diffussion transport of each fraction were used for the description of volume concentration changes of radionyclides. The wind field is proposed known. On the top boundary the condition of complete absence of particles flow was put, on a underlying surface the partial absorption of radionuclides was taken into account, and on lateral sides the condition of absence of a flow of particles was put.

The wind field can be set in model by any of three manners: (1) in geostrophic approximation through geopotential; (2) as the values measured on an irregular network of meteostations, and (3) as the values of speed or geopotential received after the objective analysis or the weather forecast. The calculation of speed on a regular grid is realized with a special procedure of interpolation, one of variants which is described in [4].

For the numerical decision of the equations one of implicit difference scheme was used [3]. The program has been written in language C++ and works under Windows 95. The program execution on three day forward requires several minutes on the PC Pentium with frequency 100 MHz. The model is easily set up on new regions by change of the appropriate geographical map. There is an opportunity of reception a demonstration movies. The comparison of results of modeling of Chernobyl accident for ten days with the real data shows their satisfactory coincidence [2].

The model can be used for forecast development of various hypothetical situations of extreme character and estimation of their consequences for a nature and economy of Republic.

*) The research described in this publication was made possible in part by Grants № MW 9000 and MW 9300 from the International Science Foundation and Byelorussian Government.

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1012.
УДК 541.18

ON A STABILITY OF CAPILLARY OSCILATIONS OF HEAVILY CHARGED ELLIPSOIDAL DROP

SCHUKIN S.I., GRIGOR'EV A.I., BELONOJKO D.F.

Yaroslavl State University, 150040, Yaroslavl, av. October, house 17 "D", sq. 28, Ph. (0852) 222325

(First received 21 October 1997; accepted for presentation during IAS-4)

The study of the equilibrium forms and stability of charged drops presents significant interest for physics of a liquid-droplets aerodispersion systems. The research of charged drop stability at a big deformations to oblate and prolate spheroids is one of scantily explored of questions. In this research both these questions are incorporated at study of stability of triaxial heavily charged ellipsoidal drop, which is carried out on the basis of a principle of

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the minimum potential energy of closed system. The purpose of the given work is research of charged ellipsoidal drop stability and laws of realization their instability to there own charge. The numerical analysis of expression for potential energy of a heavily charged drop, which has the form of triaxial ellipsoid, shown, that the charged spherical drop is stable in relation to indefinitely small distortion of the form at $W < 4$. A Rayleigh parameter is determined by the relation of a square of the drop charge to the volume of the drop and the interface tension coefficient. The dependence $U = U(x)$ in a range of meanings of the Rayleigh parameter $3.546 < W < 4$ has two minimum: at $x = 1$ and at $x > 3$. Thus the rather big influence can results in a bifurcation of the drop form. The spherical drop is unstable when the Rayleigh parameter meanings $W > 4$.

The condition of a drop as fattened spheroids of rotation is unstable at any meanings of Rayleigh parameter: the energy of such drop at $W < 4$ is more, than spherical drop and it have spontaneous evolution. The drop, which has the form of fattened spheroids of rotation at $W > 4$, is extended on one of directions, which are perpendicular of symmetry axis. Thus it passes to the form triaxial ellipsoid, and then extends to ellipsoids of rotation, which energy is minimum.

1030.
УДК 541.18

SOME RESULTS OF THE INVESTIGATION OF TWO-PHASE JETS

KOSTIUK V.V., LEPESHINSKY I.A., IVANOV O.K., ZUEV YU.V., RESHETNIKOV V.A., VORONETTSKY A.V., TSIPENKO A.V.

125871 Moscow, Volokolamskoe shosse, 4, MAI, NII NT MAI.

(First received 5 November 1997)

The results are presented concerning the theoretical and experimental work of a joint group of research workers engaged in the two-phase flow investigation performed at the Chair of Air-Breathing Engine Theory (201), MAI, and the Research Institute for Low Temperatures, MAI.

The detailed comparison of the results, obtained according to the Prandtl-Abramovich first order model and its modified version, with the results obtained according to a number of the sufficiently widespread "K-E' models and the stochastic model (SSF), was performed. The results of modelling were compared with the experimental results. For an axisymmetrical jet, the Prandtl-Abramovich model is - after corresponding modification - fully acceptable and the results obtained using this model don't differ greatly from the results obtained using "K-E" and SSF models. This permitted to carry out the investigation of vaporization and concentration processes taking into account the drop coagulation and disintegration in the jet using the model of first order.

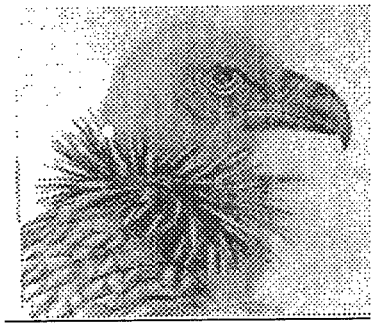
As a result of theoretical investigation, it was reviewed that on the turbulent characteristics of phase of the two-phase monodisperse water-air jet with gas temperature phase transition, the drop volume concentration in the jet initial cross-section, the air humidity and the diameter of initial part of jet exert an influence.

The computational and experimental work, carried out by the group of research workers, permitted to pass to solving a number of practical problems. In particular, the range of two-phase jet was investigated in the interests of fire-men. Also in the interests of some subdivisions of the Chair, the added gas mass determination problem, arising in the process of designing the ejecting devices (for instance, the jet engine ejector nozzles), was solved.

At present, the greatest attention in the research group is given to the work connected with the coating the part and coupling them together using for this purpose the solid particles accelerated in the flow. As a accelerating gas any gas can be used, including the air. The particles of sputtered material have a low temperature and isn't liable to be oxidized.

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AEROSOLS 1998 volume 4a No.11



MEMBRANE FILTER

A project to set up production of zirconium, titan-based cermet membrane filtering elements and other materials with a high corrosion resistance for macro- and microfiltration of liquids

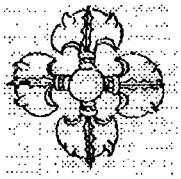
Realization of the project will permit to solve the problems of maintenance of foreign-made filtering devices which have been imported in big quantities to Russia and other CIS countries, and, simultaneously, to begin promotion of these products to the international market.

The developed technology permits to produce porous materials with the void size from 50-80 to 5-10 mcm (without a selective bed) and up to 0.3-0.6 mcm (with a selective bed).

The geometrical sizes: length is up to 600 mm, diameter is from 6 up to 80 mm.

The elements proposed for production are favourably distinguished by their improved characteristics: higher strength, reliability, easy handling. In the developers' opinion, the project is promising because of shortage in Western markets of cerment filtering materials from zirconium which has successfully been used in items applied in the atomic industry as one of the most promising corrosion-resistant materials to be used for filtration of aggressive liquids at high temperatures, and relatively low cost of production of source materials in Russia.

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3404.
УДК 541.18

URBAN-MARINE AND MINERAL-DUST AEROSOL PROPERTIES, RADIATIVE EFFECTS AND CLOSURE STUDIES OVER THE ATLANTIC OCEAN: AN OVERVIEW AND SELECTED RESULTS FROM TARFOX AND ACE-2

RUSSELL P.B.[1], LIVINGSTON J.M.[2], SCHMID B.[3], HIGNETT P.[4], DURKEE P.A.[5], HOBBS P.V.[6],GASSO S.[6],HEGG D.[6],STOWE L.L.[7],BATES T.S.[8],QUINN P.K.[8],HAMILL P.[9]

[1]*NASA Ames Research Center, Moffett Field, CA 94035-1000 USA*
[2]*SRI International, Menlo Park, CA 94025 USA*
[3]*Bay Area Environmental Research Institute, San Francisco, CA 94122 USA*
[4]*UK Meteorological Office, Meteorological Research Flight, DRA Farnborough, Hampshire, GU146TD, UK*
[5]*Naval Postgraduate School, Monterey, CA 93943-5114 USA*
[6]*University of Washington, Seattle, WA 98195 USA*
[7]*NOAA/NESDIS, Office of Research and Applications, NSC, Washington, DC*
[8]*NOAA-Pacific Marine Environmental Laboratory, Seattle, WA 98115 USA*
[9]*Physics Department, San Jose State University, San Jose, CA 95192 USA*

(First received 23 March 1998; accepted for presentation during IAS-4)

Aerosol effects on atmospheric radiation are a major source of uncertainty in understanding the past climate and predicting climate change. To help reduce this uncertainty, the 1996 Tropospheric Aerosol Radiative Forcing Observational Experiment (TARFOX) and the 1997 second Aerosol Characterization Experiment (ACE-2) measured the properties and radiative effects of anthropogenic aerosols over the Atlantic Ocean. TARFOX focused on the urban-industrial haze plume flowing from the eastern United States over the western Atlantic, whereas ACE-2 studied aerosols carried over the eastern Atlantic from both European urban/industrial and African mineral sources. These aerosols often have a marked influence on the top-of-atmosphere radiances measured by satellites. However, the accurate derivation of both optical depths and radiative flux changes, or radiative forcing, from the satellite-measured radiances remains a difficult challenge for the wide range of aerosol types and properties present.

In TARFOX, sensors and samplers on four aircraft, land sites, and ships measured optical depth spectra, aerosol composition, microphysics and optical properties, and radiative fluxes during many overpasses by different satellites. Closure studies show that the aircraft-measured flux changes agree with those derived from the aerosol measurements using several modeling approaches. Essential to obtaining this agreement is modeling the aerosols as moderately absorbing--i.e., having midvisible single-scattering albedo between about 0.90 and 0.95. These values are in accord with the aircraft measurements of (1) aerosol absorption and scattering coefficients, (2) unexpectedly large carbonaceous fractions of aerosol composition, and (3) unexpectedly large aerosol humidification factors.

In ACE-2, European urban-marine and African mineral-dust aerosols were measured by sunphotometers on the Pelican aircraft and the Research Vessel Vodyanitskiy, and by sensors on NOAA satellites. We present a comparison of the optical depths derived from the NOAA-14 satellite data with those measured by our fourteen- and six-channel sunphotometers. We find that the excellent agreement for urban-marine aerosols is degraded when African dust is present. Using the sunphotometer data during ascent and descent of the aircraft, we also obtain extinction profiles for separated layers dominated by African dust and urban-marine aerosols, respectively. The extinction profiles allow us to obtain size distributions for both these aerosol types, showing the distinctive differences between them. These optical depth and size

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spectra are combined with model complex refractive index spectra to calculate radiative flux changes induced by the different aerosol layers. By combining solar beam transmission measurements in the 0.94-micron band with those at neighboring wavelengths, we also determine water vapor columns and profiles, which are shown to agree well with aircraft in situ measurements.

1328.
УДК 541.18

DUST GENERATOR QUARTZ

ZVEREVA N.S.

Russia, Noginsk, tim@noginobladm.msk.su. tel.+7-(09651)42200

(First received 02 March 1998; accepted for presentation during IAS-4)

Dust generator "Quartz" is used for highly accurate dozing the particles of different mono- and polidisperse powdered materials (quartz, corundum, metal oxides, carbon black, metals, minerals, silica, pigments, abrasives, catalysts, adsorbents, cement, starch, etc.) into the gas flow.

Generated aerosol helps to control protective and explorative properties of filters and dust removal devices.

Dozing small-size particles is a technically difficult task. Main deficiencies of known generators are irregularity powder dozing and narrow concentration range of generated dust.

Aim of generator developing is achievement of high proportionality powder dozing in wide dust concentration range , including fine-dispercional disposed to aggregation powders.

Dust generator "Quartz" was successfully researched in laboratories and industrial conditions.

Specification

Feed of powder into gas flow, mg/min	3-1000
Reproducibility ,%	3-5
Range of particle size powder to be dispersed, mcm	0,5-1000
Pressure of gas flow, kg/sm2	1,1+0,1
Carrier Gas Flowrate Range ,liters/min	40-100
Period of continuous operation	unlimited
Power Requirements	220,240 VAC; 50-60 Hz; less than 250W
Concentration of generated dust mg/m3	20-1000
Overall dimensions, mm	370x270x280
Weight ,kg	8,0

No support for device installation. It is maintained by one operator.

Dust generator "Quartz" may be used for:

– research of dust capacity and effectiveness of filtration dust removal devices;
– monitoring environmental pollution of air;
– dozing of fine-dispersion powders in chemical industries, powder metallurgy, biology, pharmacology;
– calibration of pollution control equipment.
– inhalation toxicology studies in medicine, agriculture and other fields.

Main structural elements: bunker with powder and special stirrer; disk conveyer of particles; device for powder feed decrease; nozzle of high gas flow; control panel with feed blocks.



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Any anticorrosive explosion-proof desiccated gas (pressure 1-5 MPa) is used as gas-carrier.

Generator is the unique device in Russia. It provides high precision and reproducibility at low feed (about few mg/min) of particles of different powders with both wide and narrow range of particles sizes (0,5-5000mcm) and it is one of the most powerful tools for successful aerosol research.

The device is distinguished from similar ones by high reliability under long service life and by easy of operation.



1024.

УДК 541.18

SYNTHESIS OF NANOSTRUCTURED MATERIALS FROM AGGREGATES PRODUCED BY A PULSED ARC GAS AGGREGATION CLUSTER SOURCE

MILANI P.[1], PISERI P.[1], BARBORINI E.[1] BOTTANI C.E.[2], FERRARI A.[2], BASSI A.LI.[2]

[1] *INFM-Dipartimento di Fisica, Universita' di Milano, Via Celoria 16, 20133 Milano, Italy*

[2] *INFM-CESNEF, Politecnico di Milano, 20133 Milano, Italy*

(First received 03 December 1997)

Cluster beams are a versatile tool which is assuming an increasing importance for the synthesis of nanocrystalline materials. The use of clusters as elemental building blocks can open new routes towards the creation of an entire new class of architectures and nanostructures.

The ability of structuring materials on a nanometer-size scale depends critically from the control of the precursors and of their interaction to form more complex structures. The use of aerosol techniques is a viable way for the production of macroscopic quantities of precursor clusters.

Molecular beams techniques, coupled to sources based on efficient aggregation phenomena, can unfold the opportunity of controlling parameters such as size, composition and kinetic energy of the aggregates. The availability of well characterized cluster beams will help in the study of cluster coalescence processes and reorganization after the deposition which are still largely unknown.

Here we will present and discuss the synthesis of nanocrystalline thin films by the deposition of a supersonic cluster beams. In order to meet the requisites necessary for thin film deposition we have developed a Pulsed Arc Gas Aggregation Cluster Source (PAGACS) for the production of intense and stable ionized and neutral cluster supersonic beams. Laser photoionization and mass spectrometric techniques have been used to characterize the source, the cluster mass distribution and energy.

The PAGACS has many analogies with arc discharge apparatus for the production of fullerenes and nanotubes, with this source nanocrystalline carbon thin films have been produced have by ballistic consolidation of carbon cluster supersonic beams and characterized in their structural and electronic properties in order to correlate them with the precursors and post-deposition treatments.

Structural properties and the mesoscopic elastic response of the films were measured by Scanning Electron Microscopy, Raman and Brillouin light scattering. SEM and Raman spectroscopy show that the film are a low-density porous network of nanometer-size particles. The nature of the films is essentially graphite-like with a large number of distorted bonds. The values of bulk modulus and shear modulus were estimated from the shifts of both surface and bulk phonon peaks measured by Brillouin spectroscopy. On a mesoscopic scale, the shear

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modulus is in the range of that of crystalline graphite, whereas the bulk modulus and the Poisson's ratio are significantly different.

The presence of nanotubes and ordered polyhedral particles embedded in a disordered matrix has been detected by Transmission Electron Microscopy.

1058.
УДК 541.18

DIRECT RADIATIVE FORCING AT THE SURFACE BY SMOKE AEROSOLS DETERMINED FROM SATELLITE AND SURFACE MEASUREMENTS

LI Z., KOU L.

Canada Centre for Remote Sensing 588 Booth Street Ottawa, Canada K1A 0Y7

(Received 16 December 1997)

Direct radiative forcing (DRF) of aerosols is an important climatic parameter measuring the influence of aerosols on earth's climate. Observational studies of aerosol DRF usually suffer from a shortage of in-situ measurements of aerosol optical properties. This study introduces a new approach to determine surface DRF due to fire smoke under any sky conditions using satellite and surface measurements.

The method requires no observation of aerosol optical properties. It is based on a satellite inversion algorithm which retrieves surface net solar radiation in the visible spectrum (400-700nm). The algorithm was first validated under a variety of sky conditions ranging from clear, to smoky and cloudy skies. The accuracy of retrieval is found to be primarily affected by absorbing aerosols such as smoke. With the measurements of aerosol optical thickness, the effect can be well accounted for. Without correction for this effect, the difference between observed and estimated APAR is a good estimate of DRF due to aerosols. Over the remote boreal forest region in western Canada where this study is conducted, fire activities dominate the variation of aerosol loading during the summer season. Following this concept, instantaneous, daily and monthly mean DRF due to smoke aerosols are computed. The monthly mean DRF caused by smoke reaches a maximum value of -26.0 W/m^2 during the period of active burning in July 1994, as compared to the total radiative forcing of -76.7 W/m^2 due to the combined effect of both smoke and clouds in the same month and region.



1032.
УДК 541.18

FUNCTION OF DISTRIBUTION OF FULLERENE SOOT PARTICLES

BELOV N.N.[1], SIMANCHEV S.K. [2], TOKAREVSKIKH A.V. [2]

[1] *Aerosol Technology LTD,* BELOV@TEHNO.MMTEL.MSK.SU *tel/fax 7-095-1474361*

[2] *Karpov Institute for Physical Chemistry , e-mail: simanch@cc.nifhi.ac.ru*

(First received 15 September 1997; accepted for presentation during IAS-4)

Function of distribution of «fullerene soot» was obtained for interval of diameter of particles from 0.04 to 0.4 mkm. Function was approximated by five theoretical law.

Obtained firstly in the Kratshmer's laboratory new modification of carbon - fullerenes [1] are in the focus of many experimental and theoretical studies throughout the world. Range of using of fullerenes is increased, continuously new interesting properties are found. Also interest in soot are increased. This soot is obtained during vaporization of graphite into inert gas by different ways. It is show that the powder of activated carbon, prepared from waste of fullerenes production (fullerenes was extracted from such soot by organic solvent) favorably compares with commercially accessible activated carbon as adsorbent for removal of organic

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pollutes from one-component systems [2]. It is very important to know the function of distribution of soot particles in studies of thermophoresis, rate of sedimentation of soot particles and etc. The function of distribution was obtained for soot, generated in argon, under pressure 150 Torr [3]. In this article the function of distribution of soot, generated in helium under pressure 150 Torr is obtained.

The «fullerene soot» was generated by Kratschmer's method with some modification. The process was proceeded in the plasmochemical reactor for fullerene synthesis of «Aerosol Technology» firm. The construction of reactor is follow. The chamber of synthesis was 55 mm X 260 mm vertical cylinder with cooling water jacket. The cylinder may be disconnected in two same parts. The 10 mm hole was in face-end of upper part. The ballast 2100 cm^3 chamber was connected to reactor through this hole. The pressure in reactor was increased not more 10% due to ballast bulk. Anode - graphite 6 mm rod. Its primary length - 210 mm. Cathode - graphite 40 mm ∅ 9 mm cylinder. Electrodes was situated perpendicularly to axis of chamber at 70 mm from lower face-end. The rate of erosion of anode was 3 g/min. (4-5 cm/min.) under pressure of helium 150 Torr. Current was 110 A, voltage - 25 V. The function of distribution is the paramount characteristic of disperse system. There is a need to measure the grate number of particles for better description of function. So it was measured 300 particles (interval of diameters was from 0.04 to 0.4 mkm). The subsequent measurements did not change the functions of distribution noticeably. The photos was made by electronic microscope JSM-35CF of firm GEOL. Then photos was magnified by graphical computer program PhotoFinish. Data were approximated by five functions by program Mathcad PLUS 5.0 of firm MathSoft. Results of approximation are shown on fig. 1.

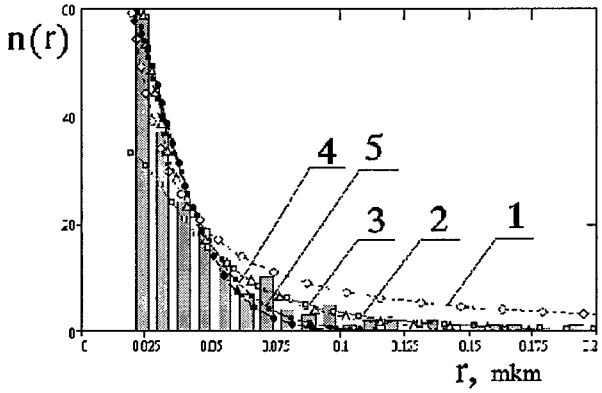


Fig.. 1. Function of distribution of soot (diameter of particles from 0.04 to 0.4 mkm was measured) . Histogram - empirical data,
1 - Junge's law,
2 - Kolmogorov's law,
3 - Chrgiane-Mazin's law,
4 - Best's law,
5 - Litvinov's law.

Junge's law:

$$n(r) = c\, r^{-k},$$

here c = 0.377, k = 1.3, r - radius of particles.

Kolmogorov's law:

$$n(r) = \frac{A}{\sqrt{2\pi}\,\sigma r} \exp\left(\frac{-\ln^2\left(\frac{r}{r_0}\right)}{2\sigma^2}\right),$$

here A = 1.684, = 0.79, r_0 = 0.0349.

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Best's law:

$$n(r)=\frac{A\,k\,r^{k-4}}{\pi c^{k}}\exp\left(-\left(\frac{r}{c}\right)^{k}\right),$$

here A = 9.994Ч10^{-4}, k = 2.41, c = 0.109.

Chrgiane-Mazin's law:

$$n(r)=A\,r^{2}\exp(-b\,r)$$

here A = 1.208 106, b = 105.794.

Litvinov's law:

$$n(r)=A\exp\left(-b\,r^{\frac{3}{2}}\right),$$

here A = 100.809, b = 160.357.

Thus, coefficients of functions of distribution are found for interval of diameter of particles from 0.04 to 0.4 mkm. It is shown, that soot consist of particles less than 0,4 mkm. It is visible, that average size of soot, prepared in helium, is roughly in one order more as comparison with prepared in argon soot.

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1202
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EXPERIMENTAL RESULTS OF HIGH TEMPERATURE FILTRATION AND DUST CAKE ANALYSIS BY CERAMIC CANDLE FILTER

JIN DO CHUNG [1], JOO HONG CHOI [2], C. KANAOKA [3]

[1] Hoseo Univ., [2] Gyeongsang Univ., [3] Kanazawa Univ.)

Baebang-Myun, Asan, Chungnam, 336-795, Korea, Dept. of Environmental Eng. Hoseo Uuiversity, E-mail:jdchung@dogsuri.hoseo.ac.kr, Tel: 82-418-40-5463, Fax: 82-418-40-5460, contact person Prof. Jin Do Chung.

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Keywords: High Temperature Dust Removal, Ceramic Candle Filter, Pressure Drop, Dust Cake, Darcy Eqn.

A number of gasification systems are approaching commercial readiness for use in integrated gasification combined cycle(IGCC) power plants. The primary advantages of IGCC systems are higher energy conversion efficiency and superior environmental compliance when compared to all other coal-based power generation options. In an IGCC system, particulate matters must be removed before the raw gas is burned in the gas turbine to protect the turbine blade and to control particulate matters emissions. It is also important to note that the particulate matters removal process must be carried out by incorporating high temperature gas cleanup for optimization of IGCC system. In an IGCC system, hot gas is introduced to the combustor at about 430 ^o C and a pressure of typically 25 bar. The gas temperature is much

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lower than the PFBC system, which is operated at about 800-900 ^o C and 10 - 15 bar. Advanced cyclone, cross flow filter, granular bed filter, electrostatic precipitator, and candle filter have been developed for particulate matters collection on the advanced coal power generation system. Ceramic rigid filters and granular bed filter among them have the best potential.

A ceramic candle filtration system has been operated under the high temperature in order to obtain the design data for a pilot unit of integrated gasification combined cycle(IGCC) and high temperature gas cleanup facility.

A candle elements of 0.5m length were mounted on the tube sheet by using the specially designed filter holder. The compressed air was used for the stream gas carrying dust injected from a screw feeder and heated by an electrical heating unit. The compatibility of the filtration system involving element mounting technology was checked. Some operation results were obtained. The behaviour of the pressure drop, the pulse cleaning events, and the dust cake of the filter element were investigated in this study.

In this paper, collection and release mechanisms of dust on and from a rigid ceramic porous candle filter are studied by measuring the evaluations of pressure drop and dust layer thickness during filtration, and time behaviour of pressure inside and outside the element after the injection of compressed cleaning air and the movement of released dust.



1242.
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CHEMOJET MOTION OF SOLID PARTICLES IN AEROSOLS

MELIKHOV I.V., VEDERNIKOV A.A., SIMONOV E.F., BERDONOSOV S.S., BOZHEVOL`NOV V.E.

Chemistry Department of Moscow State University, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

Aerosols fill up the interstellar space (1) and Earth atmosphere (2). Therefore it's important to investigate the nature of the motion of aerosol particles in the surrounding gas. For aerosols in which particles mass and gas composition don't vary the motion of aerosol particles have been studied in detail [3]. However, in most natural and technogenic aerosols particles tend to evaporate or coarsen,[absorb or give off gases [4-6]. Thus a question arises of how the velocity of aerosol particles will change as a result of some physicochemical process initiated in it.

Experimental data we have obtained(7-9) show that the particle motion speeds up if the particle takes part in a physicochemical process (sorption, oxidation, catalysis) causing a change of its mass or gas composition. This phenomenon which we called chemojet motion is due to space-time heterogeneity of the interaction between the particle and the gas, more specifically to the differential of the process intensity on different faces of the particle and to process rate fluctuations on each face.

For the purpose of quantitative description of the motion caused by a physicochemical process we introduce chemojet intensity of gas (vapour) impact on the particle $\vec{F}_R$ and corresponding velocity of its motion $\vec{V}_R$:

$$\vec{F}_R = \int_S \left(\vec{J} - \vec{J}_0\right) dS; V_{Rj} = \sum_{l=3}^{3} \lambda_{jl} \left(\vec{F}_R \vec{e}_l\right)$$

where $\vec{J}$ and $\vec{J}_0$ are impulse flows transferred by gas molecules through the particle surface S under or without the process, respectively; V_{Rj} is component of the chemojet motion velocity;

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γ_{jl} are components of the particle mobility tensor; $\vec{e}_l$ is the unit vector of the co-ordinate system.

Velocity $\vec{V}_R$ was defined in special cylindrical reactor in which it was possibly to look on trajectory of particles falling down in gas. The chemojet motion of particles in the size range a=1-50 μm was investigated. The particles were in fact the agglomerates of smaller particles thus having not only surface but also volumetric heterogeneity. The experiment was set up as follows. Reactor was filled up by gas-reagent and termostated. Through a small hole in the reactor lid we injected particles which were then falling down and in 0,1-5 s reaching the bottom of the reactor, where the exact point of landing was marked. After several hundred particles had been injected we determined the co-ordinates and size of each particle on the reactor's bottom.

The distance L between the particle's mass center and the injection point projection of the reactor's bottom was considered horizontal shift of the particle in time t_k, hence $V_j=L/t_k$ represented the radial component of particle's velocity. The time t_k was calculated from the equation for a vertically moving particle adjusted for the vertical chemojet shift. In each experiment the gas composition and its temperature were approved to remain constant during the trial.

The particles were first injected in the reactor filled by non-reacting (background) gas with density and viscosity characteristics close to those of the gas-reagent.. Under these conditions we determined the average velocity $<V_{Bj}>$ of particles in the absence of any interaction with the gas. Then we estimated the average rate $<V_j>$ in the gas-reagent as well as the average radial component of the chemojet motion velocity $<V_{Rj}>=<V_j>-<V_{Bj}>$. The values $<V_{Bj}>$ were found to be close to the results calculated for the non-reacting particles. However, $<V_{Rj}>$ values were found to be sufficiently high to conclude that the presence of the chemojet motion of solid particles in the laboratory reactor was fully confirmed by the experimental data. It was discovered that trajectory of each particle twisted at large t_k but particles group motion became chaotic. It allows us to suggest that if we moved from the laboratory reactor in our model to an unrestricted aerosol we could still detect a chaotic chemojet motion characterized by diffusion coefficient

$$D=\frac{1}{3}\sum_{j=1}^{3}\left[\gamma_{jj}^2\int_0^{\infty}A_{jj}(\tau)d\tau+<V_{Rj}^2>\tau_{\pi}\right]$$

where $A_{jj}(\tau)$ are terms of the fluctuations correlation matrix Z_k for time shift τ. D calculation for crystals in the size range 1-10 μm which are growing in supersaturated vapour in accordance with most widely accepted current theory of growth led to value 3-4 orders higher than in the case of the Brownian diffusion. It was shown that observation for motion opens new possibilities in the important field of in situ process studies on an individual solid particle.

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1271.
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AN EFFECT OF SOURCE TERM IMPURITY CLOUD CENTER RANDOM WALKS ON IMPURITY CONCENTRATION FLUCTUATIONS

VOZZHENNIKOV O.I., ZHUKOV G.P., SVIRKUNOV P.N.

Scientific Production Association "Typhoon", Obninsk

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It is well known that turbulence has a double effect on impurity cloud dynamics in the atmosphere. The pulsations of the total spectrum typical scales of which do not exceed the cloud sizes result in cloud expansion; the pulsations of larger scales (up to the external scale) induce random walks of the cloud center. The latter must give rise to impurity concentration fluctuations, that may appear to be significant at calculations of exposure doses under pollutants emergency releases.

The goal of the paper is in studying probability characteristics of an impurity concentration caused by the impurity cloud center random walks mentioned.

The Gifford model should be used as a theoretical basis in the frames of which the fluctuations of the cloud center are described by the Gaussian distribution:

$$f(y', z') = (2\pi M_y M_z)^{-1} \exp\left(-\frac{y'^2}{2M_y^2}\right)\left(\exp\left(-\frac{(z'-h)^2}{2M_z^2}\right)+\exp\left(-\frac{(z+h)^2}{2M_z^2}\right)\right) \qquad (1)$$

where M_z^2, M_y^2 are the cloud center dispersions along the vertical and cross horizontal directions, h is the source height.

For the concentration distribution in the cloud the Gaussian model will be used as well. In particular, the exposure dose (integral over time and concentration) at the surface denoted as q_n is determined by the expression:

$$q_n = \frac{Q}{\pi S_y S_z \bar{U}} \exp\left[-\frac{(y-y')^2}{2S_y^2}-\frac{z'^2}{2S_z^2}\right] \qquad (2)$$

where Q-is the amount of the impurity released; S_y^2, S_z^2 are the dispersions of the concentration within the cloud; y', z' are instantaneous random co-ordinates of the cloud center.

In view of (2) and (1) for the distribution probability density of q_n one can obtain an expression:



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$$f(q_n)=\frac{S_y S_z}{q_n^* M_y M_z}\cdot\left(\frac{q_n}{q_n^*}\right)^{\beta^2-1}\exp\left(-\frac{y^2}{2M_y^2}-\frac{h^2}{2M_z^2}\right)\cdot\sum_{k=0}^{\infty}I_{2k}(B_1)I_k(B_2)\cos(2k\phi) \qquad (3)$$

where

$$q_n^*=\frac{Q}{\pi S_y S_z \bar{U}},\quad \beta^2=\frac{1}{2}\left(\beta_y^2+\beta_z^2\right);\quad \beta_y^2=\frac{S_y^2}{M_y^2};\quad \beta_z^2=\frac{S_z^2}{M_z^2};$$

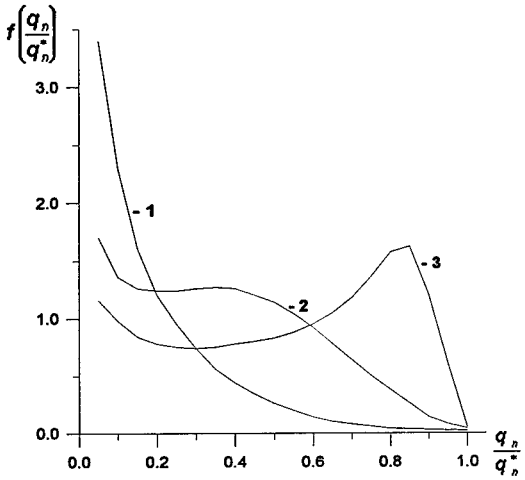
$$B_1=r\sqrt{y^2\frac{S_y^2}{M_y^4}+h^2\frac{S_z^2}{M_z^4}};\quad B_2=\frac{1}{4}\left(\beta_z^2-\beta_y^2\right)r^2;\quad r=\sqrt{2\ln\left(\frac{q_u^*}{q_u}\right)};\quad \phi=\arctg\frac{hS_z}{yS_y}\frac{M_y^2}{M_z^2},$$

$I_k(x)$- are the modified Bessel's functions.

The first moment q_n (mean over the cloud center random positions) has the form of:

$$<q_n>=\frac{2Q}{\pi\sigma_y\sigma_z\bar{U}}\exp\left(-\frac{y^2}{2\sigma_y^2}-\frac{h^2}{2\sigma_z^2}\right) \qquad (4)$$

To calculate the distribution function $f(q_n)$ the experimental data on S_z^2 and S_y^2 were involved [1], along with the data for σ_y^2 and σ_z^2. from [2]. The calculation results coincide with the experimental conditions [1] for h=300m, i.e. weakly unstable stratification.



The figure gives the graph for $f(q_n)$ for different distances from the source term:

1) 5km;
2) 10km;
3) 30km.

As the calculations have shown, at the points of the nearest zone a great uncertainty in the q_n values takes place, and an average value of $<q_n>$ is not at all representative for the assessment of real concentrations. Here for the calculations of the pollutants impact one should use the probability calculations with $f(q_n)$ with the inclusion of more general risk conceptions. This fact should be taken into consideration when calculating exposure dose rates under emergency releases.

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1289
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DETERMINATION OF SURFACE ENERGY OF CRITICAL EMBRYOS

NASIBULIN A.G., SHANDAKOV S.D., ANISIMOV M.P., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

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New experimental results on the vapor nucleation such as an influence of total pressure (background gas) on the nucleation processes [1-5], oscillatory nucleation [6-7], etc. has been presented recently. These results need to revision of main positions of the nucleation theory. One of the theory problem is a surface energy estimation uncertainty. The energy of new phase formation of critical embryo in the classical theory is a third part of the total surface energy of critical embryos. However, application of microscopic surface tension for critical embryo is doubtful, because of too small associates which have significant fluctuation even in thermodynamic equilibrium. Moreover, the sense of surface energy is impossible to understand. We can say only about excess of embryo's energy in comparison with the same number of molecules of a bulk condensed phase.

The present work shows that excess of embryo's energy Θ (or surface energy) may be received from experimental dependencies of critical vapor activity a (or supersaturation) on temperature T, when nucleation rate J. It could be shown that

$$\Theta = -n\,kT^2 \left(\frac{\partial \ln a}{\partial T}\right)_J , \qquad (1)$$

where n is the number of molecules in critical embryo, k is Boltzmann constant.

This result may be obtained using first and second nucleation theorems [8] and the criterion of the right description of nucleation rate experiments, following from the partial derivative theory for function of two variables such as:

$$-\left(\frac{\partial \ln a}{\partial \ln J}\right)_T \cdot \left(\frac{\partial \ln J}{\partial T}\right)_a \cdot \left(\frac{\partial T}{\partial \ln a}\right)_J = 1 \qquad (2)$$

On base of Eqs.(1-2) the values of surface energy of critical embryos was experimentally determined. We used experimental results of glycerin vapor nucleation rates in atmosphere of helium and argon in the vicinity of glycerin melting temperature and experimental results for binary system of glicerin-SF_6 nucleation near the critical temperature of this system. Obtained experimental results were compared with Fisher's drop model, where surface energy is $\Theta_{drop} = 4\pi\sigma r^2$ ..

The influence of gas-carrier pressure, melting point of condensate and critical temperature of binary system on the values of surface energy was established.

The reasons of the droplet model and the experimental surface energy deflection are

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discussed.

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1374.

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EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER IN REGULAR FLOW OF MONODISPERSE DROPS

ANKUDINOV V. B. , KLYONOV M. G. , MARUHIN U. A. , OGORODNIKOV V. P.

Moscow Power Engineering Institute (Technical University).

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The importance of investigation of heat transfer in the flows of monodisperse drops is connected with development of untraditional monogranulation technique. This technique is based on phenomena of forced capillary breakup of liquid jet [1]. One needs to optimize cooling rate of drops in the process of producing of monodisperse spherical granules [2]. It's difficult to solve this problem because of absence of methods of heat transfer coefficient calculation. So , it's necessary to obtain experimental data on heat transfer from the flows of monodisperse drops.

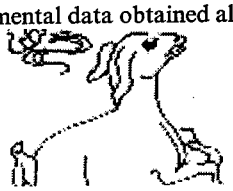
For this purpose experimental unit was designed, which make it possible to investigate heat transfer from regular flow of monodispers drops in a wide range of working parameters.

Vacuum oil is used in it as a working liquid. The unit is provided with two types of generators. This allowes one to produce both the hollow and ordinary drops with diameter range 50 - 3000 mkm.

For keeping temperature of oil in the generator constant the termostabilization system on the base of highly precise temperature regulator was designed. This system provides constant temperature with deviation no more than 0. 1 K.

A thermocouple detector for measurements of drops temperature in the flow was designed. In it the flow of monodisperse drops has transformed in a continues flow and than the oil temperature has measured. The temperatures is measured by copper- constantan thermocouples. The heat transfer coefficient is determined from heat balance equation for drop.

Designed investigation method allowes one to determine heat transfer coefficient with the error no more than 20%. The experimental data obtained allowes one to analyze heat transfer



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from monodisperse drop flow.

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1384
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DMS OXIDATION IN A NON-REMOTE LOCATION

BARTHELMIE R.J. [1] , **PRYOR S.C.** [2]

[1] *Climate and Meteorology Program, Indiana University, Bloomington IN 47405 USA*

[2] *Dept. of Wind Energy and Atmospheric Physics, Rise National Laboratory, Denmark.*

(First received 27 February 1998; accepted for presentation during IAS-4)

The role of biogenic sulfur (S) emissions in the chemistry of the marine boundary layer is important because of the potential climate feedback mechanism of aerosol sulfate formation. Most previous studies, both experimental and numerical, have focused on the remote marine boundary layer where the hydroxyl radical addition or abstraction reactions are the most important pathways for dimethyl sulfide (DMS) oxidation. However, it has also been suggested that the nitrate oxidation pathway is important in less remote locations (Yvon et al., 1996).

We examine spatial aspects of the relative importance of DMS oxidation pathways and discuss the implications for the relative abundance of various DMS oxidation products in coastal locations. An amended version of the DMS mechanism of Hertel et al. (1994) has been implemented in the Inorganic and Secondary Organic PARTicle model (ISOPART) (Pryor and Barthelmie, 1998), a lagrangian model in which gas and aerosol chemistry are fully coupled. Evaluation of this mechanism in the remote marine atmosphere suggested that it is conservative in its conversion of DMS to sulfur dioxide and non-sea salt sulfate but produces relatively large concentrations of methyl sulfonic acid (MSA) and methane sulfinic acid (MSEA) (Capaldo and Pandis, 1997).

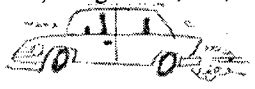
In this application to the Lower Fraser Valley (southwestern British Columbia/northwestern Washington State). comparatively high concentrations of N compounds means that abstraction by the nitrate radical is the dominant oxidation pathway, except where trajectories originate and terminate over the ocean. During the simulation period the inclusion of DMS emissions and chemistry increases sulfur dioxide concentrations in the domain by up to 28% and sulfate concentrations by up to 10%. Further results will be presented showing the spatial variability of DMS chemistry in response to meteorology and emissions patterns, and the contribution of biogenic S emissions to secondary aerosol concentrations.

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1390
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THE ROLE OF AEROSOLS IN DRY DEPOSITION TO COASTAL WATERS

PRYOR S.C.[1], BARTHELMIE R.J.[1,2], GEERNAERT L.L.S.[2], ELLERMANN T.[3], PERRY K.D.[4]

[1] *Climate and Meteorology Program, Indiana University, Bloomington, IN 47405, USA.*

[2] *Dept. of Wind Energy and Atmospheric Physics, Rise National Laboratory, DK.*

[3] *Dept. of Atmospheric Environment, National Environmental Research Institute, DK.*

[4] *Crocker Nuclear Laboratory, University of California at Davis, CA, USA.*

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Model calculations of N deposition to seas around Denmark indicate that roughly 1/3 of total N enters via atmospheric pathways and 3/5 of the total atmospheric deposition derives from aerosol matter (Hertel, 1995). Measurement and modeling of aerosol dry deposition is confounded by the myriad of processes which determine the deposition velocity. However, it is known that aerosol diameter is critical and it has been suggested that hygroscopic growth close to the surface plays an important role in determining deposition fluxes (Slinn and Slinn, 1980). Aerosols also play a key role in determining the gaseous flux due to heterogeneous chemistry on aerosol surfaces (particularly reaction of HNO3 with NaCl to yield aerosol $NaNO^3$ and HCl vapor).

Herein, we examine the role of aerosols in dry deposition processes using size segregated and chemically speciated aerosol measurements collected during April and May of 1997 on the Swedish Island of Ostergarnsholm in the western Baltic under the Air-Sea Exchange Process Study (ASEPS). Aerosol size distributions (Dp: 0.5 - > 20 pm) were measured continuously using a TSI aerodynamic particle sizer. Size resolved aerosol measurements for chemical analysis were undertaken using a 10 stage Micro-Orifice Uniform Deposit Impactor (MOUDI) (Size segregated Dp: 0.056 - 18 pm) and a 3 stage Davis Rotating Universal-size-cut Monitoring (DRUM) impactor (Size segregated $D_,$: 0.069 - 2.5 pm). Aluminum foil substrates (47 mm) coated with silicon spray were used in the MOUDI to facilitate analysis for N species (Zhuang and Huebert, 1996). The sampling period was 24 hours in duration except during periods of extreme weather when filters were exposed for 48 hour periods. The filters were analyzed by ion chromatography for NO^-, SO_4^{2-}, Cl^-, Na^+, NF_4^+, Ca^{2+}, K^+, Mg^{2+} and MSA (methane sulfonic acid) using a solution of oxalic acid. A greased mylar impaction substrate was used for the DRUM impactor and was analyzed for Na through U using PIXE analysis to provide 6 hour average concentrations. In addition to the two impactors, filter samplers were also used to give bulk composition data for NO3-, SO42-, Cl-, Na+ and NF^{4+}.

The implication of these data is that NH^{4+} is principally present at $(NH4)2SO4/NH_4HSO_4$ in the fine faction of the aerosol, while significant amounts of NO3- are associated with larger aerosols. These data will be used with algorithms from Slinn and Slinn (1980) to estimate dry deposition of N-compounds based on the 24 hour average aerosol data. Note: It is acknowledged that the temporal resolution for the aerosol data is not ideal for this purpose,

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data are to be collected on a shorter time scale during the summer of 1998 in order to facilitate this analysis. Our investigations shows the molar ratio of Na^+ to Cl^- (by aerosol diameter and sampling day) and shows that during the first portion of the study, when the meteorological conditions were dominated by cyclone passages and measured HNO_3 concentrations were low, the molar ratios on the stages with large sea spray contributions were close to 1. Later in the sampling period when ridging dominated the meteorological conditions and observed HNO3 concentrations increased, the molar ratio on stages 2-6 increased providing some evidence for volatization of HCl vapor from sea salt aerosols (note this is also the period of highest aerosol NO^{3-}). These findings and other analyses related to calculation of N deposition will be discussed along with issues relating to measurement considerations.

Acknowledgements

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1397
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KINETICS OF FREE VOLUME CHANGES OF THE $FE_{89.8}NI_{1.5}SI_{5.2}B_3C_{0.5}$ AMORPHOUS ALLOY

MARICIC A.[1], RADIC S.[2], RISTIC M. M.[3]

[1] *Technical Faculty, , Cacak Yugoslavia*

[2] *Institute of Technical Sciences of SASA, Knez Mihailova 35, Beograd, Yugoslavia*

[3] *Serbian Academy of Sciences and Arts, Beograd, Yugoslavia*

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Changes of physical properties of amorphous alloys (AMA), under the influence of external parameters (temperature, magnetic field, mechanical strain) have been the subject of a great number of papers published up to now [1,2,3]. The correlation between thermal, kinetic, electrical and magnetic effects during the crystallization process in non-isothermal and isothermal conditions have been investigated for different amorphous alloys based on iron. In this paper the kinetics of the change of free volume of the $Fe_{89.8}Ni_{1.5}Si_{5.2}B_3C_{0.5}$ amorphous alloy in temperature regions about 100° lower than the crystallization temperature was determined using the DSC method [1]. Measurements were performed of linear expansion of the amorphous ribbon in isothermal conditions at temperatures: t_1=370, t_2=400 and t_3=450°C.

In these temperature regions the structural relaxation process takes place, decreasing the concentration of frozen defects of the vacancy type to a size characteristic for the metastable

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state at the given temperature. This process leads to a redistribution of atoms at shorter distances compared to the selected ones. So, this is an activating process and it occurs significantly faster at the temperature close to the glassification temperature..

The rate at which the unstable amorphous structure approaches the metastable structure at a certain temperature $T<T_g$, is proportional to the degree of instability.

If the difference $V-V_0$ determines the degree of instability, where V and V_0 are values of the free volume for the amorphous and metastable state at the temperature T, respectively, then:

$$\frac{d(V-V_0)}{dt} = -\frac{1}{\tau}(V-V_0) \qquad (1)$$

where τ is the relaxation time, which characterizes defect mobility, whose diffusion movement determines how the amorphous alloy approaches the metastable state.

So,

$$\frac{V(t)-V_0}{V(0)-V_0} = \exp\left(\frac{1}{\tau}\right) \quad (2) \text{ or } \quad V(t)-V_0 = A\exp\left(\frac{1}{\tau}\right) \qquad (3)$$

where: $\tau = \tau_0 \exp\left(\frac{E}{kT}\right)$ (4)

Exchanging relation (4) in (3) and a double logarithm gives the dependence:

$$\ln\left[\ln(V(t)-V_0)\right] = \ln B\frac{E}{kT}$$

where E is the activation energy.

The experimentally obtained dependence $\ln[\ln(V(t)-V_0)]$ on T^{-1} is linear, and the activation energy was determined as E=90 kJ/mol from the tangent of the slope. The value obtained is approximately two times higher than the activation energy of diffusion for the amorphous alloy $Fe_{80}B_{20}$ investigated in [4]. However, though both alloys are based on iron their composition is essentially different. Values of the process rate constant were determined at the temperatures of 370, 400 and 420°C.

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RAS

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TITLE OF SESSION MEASUREMENTS OF AEROSOLS

Chair. PROF MIKHAILOV OLEG MIKHAILOVITCH

(19.12.38)



Phone 7-812-2189952
Fax 7-812-2183720
Russian Scientific Optical Center named by Vavilov
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Professor of Moscow University of Publishing

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1398.
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EXPERIMENTAL STUDY OF ULTRA-FINE MGO PARTICLES DURING THEIR CONDENSATION GROWTH NEAR THE BURNING MAGNESIUM PARTICLE

ALTMAN I.S., SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

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The nanooxides synthesis during combustion causes interest for study of condensation processes, which are accompanying the gas- and vapor-phase metal combustion. The satisfactory experimental information about condensation growth of nanooxides during combustion does not exist at present. It is known in dust flames the metal particles may burn individually. That's why, possibly, condensation in burning metal dust takes place as if it was during combustion of single metal particle.

In this work the method of study of ultra-fine condensed products during combustion of single metal particle is proposed. The method is based on the synchronous two-dimensional laser scanning of the region near the burning particle and one-dimensional scanning of radiation emitted by system. The method allows to obtain information about local extinction caused of ultra-fine products of combustion and about of nanooxides emission characteristics. The method is used for study of properties MgO ultra-fine particles forming during combustion of magnesium particle with radius r - 1 nm.

It is shown that the creating of ultra-fine oxides take place only in thin zone with width - 100 pm on distance - r from the magnesium particle surface. The upper experimental estimation for time of the MgO particles condensation growth is obtained. The conclusion is done: there are growing and ungrowing MgO particles in condensation zone; radiation is emitted by growing ultra-fine particles only. The optical characteristics of growing MgO particles are essentially nonequilibrium. The experimentally estimated time of their relaxation to equilibrium value is about 5 ms.

The obtained results can materially change the existing conception of the processes of the particles condensation growth from the gas.

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1419.
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METHODOLOGICAL ASPECTS OF ESTIMATING THE MICROBIAL AEROSOL PARAMETERS INDOORS

VOROBEYCHIKOV E.V., GRANSTREM K.O., IVANOV V.P., KURTZER G.M.

St.-Petersburg I.I.Mechnikov State Medical Academy,

Fax: (812)-5431571, paa@infopro.spb.su

(First received 02 April 1998; accepted for presentation during IAS-4)

In practically unventilated enclosed spaces, the estimation of the concentration of a microbial aerosol and its space-and time distribution, as well as the prediction of the pulse of the concentration (dose) of microbial bodies getting into human body or on various surfaces is a complicated methodological task.

The current experimental contact methods of estimating the concentration of the microbial aerosol based on impacting of particles, as a rule, introduce additional turbulence into the studied medium and have a great error of measurements of the order 50%. Application of non-

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contact methods of study (i.e. optical, laser, electric induction etc.) are based on the dependence of the parameters of the utilized physical field energy on the concentration of particles requires the development of a special procedure that will provide the estimation of non-stationary quantitative characteristics of the microbial aerosol in space and time coordinates with high precision and confidence.

Theoretical investigations of the estimation of aerosol concentration, concentration pulse, and particles sedimentation density include deterministic and stochastic mathematical models which have a good correlation with the experimental data of the distribution of aerosol in an open half-space. In this case, during calculations, a model of a point pulse source of aerosol is used, and the equation of turbulent diffusion is solved with the help of the given conditions at the beginning and end. The probabilistic method is based on spatial distribution of particles which is generally assumed to be Gaussian by three spatial coordinates.

As applied to unventilated enclosed spaces, the deterministic approach has a number of drawbacks because no exact solution of the equation of turbulent diffusion has been found, while possible corresponding estimates of the parameters by means of a simplified approach, for example, substitution of the room boundaries for aerosol sources or run-off are highly approximate which leads to great errors. Besides, it is practically impossible to interpret the obtained estimates because the quantitative parameters of the internal sources and their spatial and time characteristics alter inadvertently which is not considered in this approach. The impact of casual values of the quantitative parameters of the sources requires additional procedures of averaging the estimates with the corresponding laws of distribution.

When estimating the parameters of aerosol, the application of the probabilistic approach is determined by a possibility of justified adoption of the laws of spatial and time distribution of particles in the room. From physical point of view, under such conditions probabilistic and statistical description of the distribution of aerosol is more justified. It should be assumed that in the absence of regulated air flows in unventilated space of the room, the probability of finding aerosol particles in any region depends only on the volume of this region, but not on its form and position in space, whereas the number of particles present in non-overlapping areas is an independent random value. In this case, the distribution of aerosol particles present in a particular area can be described by the law of Poisson.

Application of the law of Poisson to estimate the concentration, concentration pulse, and microbial bodies sedimentation density requires the knowledge of the mean concentration of microbial aerosol in this room. Low precision of the experimental estimates of this parameter actuates the development of probabilistic mathematical models to relate the mean concentration of aerosol to the main factors in the room (the number of sources and their capacity, room volume and age, viability of microorganisms, etc.) which affect a given value. For this purpose, the application of the methods of multivariate statistical analysis, i.e. regression analysis and the analysis of variance, the method of main components, etc. is suggested.

Along with the prediction of the concentration pulse on the basis of the distribution of Poisson the actual problem of visualizing the spatial distribution of aerosol in real time is pressing. This necessitates the study of spatial and time interval of the correlation of aerosol concentration with subsequent application of these data for the development of the system of microbiological monitoring the air in the rooms of various designation.

Experimental studies of the concentrations of microbial aerosols have been performed, real ranges of concentrations and dispersion composition of particular species of microorganisms most often encountered in practically unventilated enclosed spaces have been shown. Data on concentrations at various values of factors affecting the variability of quantitative characteristics of microbial aerosols have been obtained. On the basis of experimental data, the

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estimates of concentration pulse, of the density of sedimentation of microorganisms onto surface have been presented, as well as predictive probabilistic models to evaluate the value of the aerogemic mechanism of dissemination of opportunistic microbes under specific conditions have been designed.

1470
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CORRELATION OF E.COLI LIPID PARAMETERS WITH CELL SURVIVAL IN AEROSOL.

GLUSHCHENKO N.N., BOGOSLOVSKAYA O.A., OLKHOVSKAYA I.P.

Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences Leninskii prosp, 38, b.2, Moscow, Russia. Fax.: (095)1378258, E mail: nnglu@chph.ras.ru

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Viability of airborne and lyofilized microorganisms bears on the search of methods for men, animals and plants airborne infections control and, on the other hand, deals with stability, survival and storing of bacterial cells being used for lyofilized vaccines for men, animals and plants immunisation. Lipids are known as a most labile cell structure. Taking into account the role of lipids in the activity of eucariotic and procaryotic cells, we assumed that composition and physicochemical parameters of cell lipids could play an important role in bacterial capacity for survival in the air .

We have found that cell viability in aerosol correlate with cyclopropane acids contents increase, with palmitic acid via palmitolic acid ratio, and might be described with the following equations: lnB = -6,31+2,25ln((17:0+(19:0) - for cyclopropane acids with correlation coefficient 0,81; and lnB = -3,95+3,37ln(16:0)/(16:1(7) - for palmitic acid via palmitolic acid ratio with correlation coefficient 0,86, where B is cell viability in aerosol.

Lipid composition to a large extent is conditioned with lipid physicochemical characteristics,i.e., antioxidant properties, lipid viscosity, oxidizing capacity of lipids.

We have disclosed that cell lipids exhibit antioxidant activity (AOA) and AOA of lipids got from various E.Coli strains vary in the limits differing in 1,5-2 times. Chemiluminescence method enabling to detect antioxidant (AO) contents and antiradical activity (ARA) in cell lipids was used to confirm antioxidants' presence in E.Coli lipids. Antioxidants of E.Coli lipids appeared to vary in contents and ARA.

ARA of E.Coli cell lipids was (3.9-4.6)(105 l/mol(s and in the order of magnitude appeared to be close to ARA value of the wellknown natural antioxidant- (-tocopherol. Acting quotient of antioxidants in E.Coli cell lipids was 0.10-0.16%, lipids from aerosolresistant bacterial straines having higher AO contents, ARA and AOA values than lipids from other strains.

We have revealed that cell lipids of various E.Coli strains differed in lipid peroxidation (LPO) products concentration, minimum LPO products being detected in aerosol resistant strains.

We determined oxidizing capacity of lipids and calculated the ratio of easy- and hardly-oxidizable lipid fractions (cardiolipin:phosphatidylcholine).

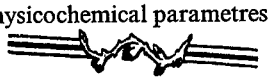
Lipid oxidizability was estimated from the data about fatty acids composition, chemiluminescent curves and double bonds number per one carbon atom in fatty acid chain. Lipids from tested bacterial strains appeared to differ in double bonds numbers and the minimum values were found in aerosolresistant E.Coli strains.

The existence of the LPO regulating system enables to change physicochemical parameters of cell lipids in a specified mode and to affect E.Coli cells survival. Synthetic antioxidants are the agents modifying lipid AOA. Introduction of antioxidants (Fenozans and Ionol) in the

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E.Coli incubating medium increased cell survival. Fenozan-1 increased cell survival 1.5times, Fenozan-22 - 1.8 times, Ionol - 2.1 times that of untreated samples.

Thus we have proved that physicochemical parametres of lipids of various E.Coli strains correlated with their capacity for survival in the air, i.e.,viability of the airborne bacteria in each group of strains was proportional to lipids AOA and inversely proportional to oxidation products contents. Inverse correlation between viability and double bonds number in E.Coli cell lipids was common for all strains tested. Introduction of antioxidants in the grows medium changed the viability of airborne E.Coli cells. Our data demonstrate the opportunity to modify the viability of airborne bacteria with control on physicochemical parametres of cell lipids.



1471
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ENVIRONMENTAL DAMAGE OF FLY ASH FROM THERMOELECTRIC POWER STATIONS FOR THE LIVING ORGANISMS - MODELLING WITH ULTRADISPERSED METAL POWDERS

GLUSHCHENKO N.N., BOGOSLOVSKAYA O.A., OLKHOVSKAYA I.P.

Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences Leninskii prospect, 38, b.2, 117829, Moscow, Russia. Fax.: (095)1378258, E mail: nnglu@chph.ras.ru

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As statistic data show, hundreds thousands tons of industrial fly ash and aerosols pollute the atmosphere. Industrial fly ash contains a great variety of inorganic compounds, including such elements as Mn, Cr, Cu, Ni, Pb, Hg, Cd, V etc., effecting negatively on the people health.

The data of laboratory studies form the base for the correct estimation of heavy metals damage for the human being. So our colleges from the Rostov University tested ecological situation in the vicinity of the Novocherkassk's coal power station (Rostov-on-Don) and showed that the zone of extreme metal content in the atmosphere sediments was within 3 km area from the station, Sb, Cs, Ni, Co, Cd, Hf, La concentrations exceeding the fone contents by 10-20 , Sr, Mo, Eu, U - by 5-8 fold. Biogeochemical analysis had shown that the Ti, V, Cr concentrations in plants in 60-280 times exceeded fone values, and Ni, Cu, B contents were 3-8 times larger than fone. Copper contents in wheat grown as far as 5 km distance from the powers station in 1,5 times exceeded the safe level. Ti, V, Cr, Ni, Zr, Ba contents in grain were 4-60 times larger than mean fone values. We have studied dispersivity, chemical composition and solubility of fly ash samples. Particles with size 0-5 micron appeared to present 41% of total amount. Particles of fly ash consisted from SiO_2, Al_2O_3, Fe_2O_3 and trace elements Pb, Zn, Cu, Mn, Cr, Ni, Cd etc. Washout analysis with different solvents (2N HCl or ammonia-acetate buffer, 200C, 7 days incubation) showed the following sequence of elements contents in the rinsing fluids: Fe (83%)>Cr>Ti>Ni>Mn>Pb>Zn>Cu=Co. The fly ash toxicity was similar to iron ultradispersed powder (UDP) toxicity. We suggest UDP metals for modelling of ecological effects of environmental pollution with fly ash of thermoelectric power station wastes. The specialties of UDP's administrated in the organism are: 1) a prolonged action on the biological targets due to a gradual dissolution in biofluides and 2) a great variety of ionic forms of metals as well as metal complexes with biochelators. The size of metal UDP particles are similar to fly ash particles. So the use of UDP metals allows us to estimate the contribution of individual components of fly ash to total biological effect. We studied the action of fly ash components on the growth of inoculated melanoma B-16. Zn(100mg/kg), Ag(10mg/kg), Al(10mg/kg), Cu(10mg/kg) appeared to stimulate tumor growth up to 35% in comparison with untreated tumor mice. Zn (5 mg/kg), Cu (0,1 mg/kg), Fe (2 mg/kg) did not affect melanoma B-16 growth. We have studied the effect of UDP metals on the life time of AKR-mice a model of

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spontaneous carcinogenesis. The total doses were close to the greatest tolerance doses. It was found that Cu and Zn UDP administration reduced animal's life up to two times. Radioactive aerosols are known to include a non-radioactive components such as Fe. The contribution of a non-radioactive constituents was studied in experiments with simultaneous action of radioactivity and Fe UDP. It was found that a combined effect of Fe UDP in doses (0,5-1,0) mg/kg and fractionated irradiation (1Gr and 2Gr, total dose 8Gr) decreased the lifetime of the irradiated mice by 1,5-2 fold. The investigation of total effect of iron UDP and fractionated irradiation of mice showed that essential changes took place in the system of cyclic nucleotides: in thymus (a radiosensitive organ) c-AMP contents decreased in two times, in liver (a radioresistent organ) c-AMP changes were less pronounced.



1474.
УДК 541.18

THE BASIS OF MECHANISM FOR SYNTHESIS THE PROTECTIVE COATS DEPOSITED WITH LOW-TEMPERATURE SUPERSONIC SUPERSONIC HETEROGENEOUS FLOW

NIKITIN P.V.

Moscow Aviation Institute 4, Volokolamskoye shosse, 125871, Moscow, Russia Phone: (095) 158-49-30
Fax: (095) 158-29-77, 158-42-77 E-mail: alt@tk.mainet.msk.su

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In the report are described the behavior basis of formed surface coats produced by means of the Low-Temperature Gas Dynamic Method (LTGDM) developed in Moscow Aviation Institute (MAI). It is shown that particle kinetic energy level plays main role in process of substrate coating formation. The required value of particle kinetic energy is depended on the coating type and itsprognozing properties.

Particles kinetic energy detrmines the level of plastic deformation of the particle and the substrate. During the collision between the high-velocity particle and the substrate there is generated in the volume of interaction zone the train of shock waves which causes a number of the physical-chemical transformations, for example, an extremal rize of pressure and temperature level in the collision zone, quick-flowed processes of heat-, mass-exchange,
deformation hardening processes, etc. Complex action of the factors furthers more intensive dislocation density growth, that creates the necessary conditions to form chemical and mechanical bonds and consequently causes high adhesion and cohesion coat characteristics.

With help of Arrenius equation rising as the mathematical model of the topo-chemical reactions kinetics there was done as analysis of possible processes of coat formation as evaluation attempt of a main values of pressure and temperature levels in contact area of particle and substrate. It was showed that under conditions of very high collision pressure level, realizable in the contact zone one can produce satisfactory performance of cohesion and adhesion coat strngth (up to 65% of the monolitic material) even under room temperature of substrate conditions. The performance will be significantly rise if the substrate has a small preliminary heating.

In paricular, there is revealed by means of metalography and X-ray diffraction methods the significant (up to twice and more) rise of micro-hardness if coat in comparison with the initial material micro-hardness. The micro-hardness rising is stayed stabil even after prolongated annealing coat under temperature of recrystallization of the used materials. There is confirmed the coating and transitional layer influence on the substrate material specmen static strength,

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for instance, by means of the experiment it is discovered that the strength limit of copper specimens with the NbC+NiAl coats of thicness of 60 microns at the temperature of 20 K will be rised up to 20%., the reology limit is rised up to 2,58 times, the elastic module is rised up to 57%. These characteristics are rised at the temperature of 300 K up to 52%, up to 3,69 times, and up to 57% accordingly.

1476.
УДК 541.18

LOW-TEMPERATURE GAS DYNAMIC METHOD OF DIFFERENT COATINGS DEPOSITION ONTO THE SURFACES

NIKITIN P.V., ANDREEV N. A., PROROKOV S.M., SMOLIN A. G.

Moscow Aviation Institute, 4, Volokolamskoe Shosse, 125871, Moscow, Russia, phone 7-095-158-4930, fax 7-095-158-2977 e-mail alt@tk. mainet. msk. SU.

(First received 06 April 1998; accepted for presentation during IAS-4)

This work will describe the analysis of Low-Temperature Gasdynamics Method (LTGDM) developed in Moscow Aviation Institute (MAI), method physical content, the process, accompanying its implementation and its potential capabilities for science and manufacturing.

Utilization of the traditional methods for production of structural materials is always related to large energy expenditures. First of all it is explained by the low efficiency of installations implementing these methods. Due to that during last decade the so-called non traditional methods were under development. Among them are flame and gaseous flame metallurgy, biometallurgy, chemiometallurgy etc. These methods have essential increased efficiency of energy utilization for production of a material mass unit. For example, utilization the electrical arc and high frequency plasma generators for heating in metallurgy allowed to increase efficiency up to 60%. On the basis of these installations application the wide range of different technological operations were developed and introduced to the industry. They allows to sharply increase quality of products together with decreasing of energy expenditures and production duration.

Among these technologies the special role is played by the gas dynamic methods. For example, the gas dynamic plasma methods are widely developed. Namely, for the first time in the industrial metallurgical practice the plasma technology allowed to solve the problem of compatibility barrier for different metals and their derivatives. Mobility and simplicity of this technologics in combination with high heating level of initial products (several thousand degrees) gave a chance to create materials with the principally new properties (inter metallides, metallic ceramics etc.). But having mobility and simplicity the gas dynamic plasma method has a number of disadvantages related first of all to utilization of high temperature (plasma) flow.

Later, the method of detonation deposition of coating was developed. In realization this method is simpler and less expensive the plasma one. It is based on utilization of detonation process at the instant burning (blast) of the flammable gases such as acetylene, propane etc. Method of detonation coating deposition refers to the class of high temperature gas dynamic methods. As the plasma one, the detonation method utilizes the gaseous products of blast as the gas carrier with addition of the working medium : air, water vapor, nitrogen etc. The obtained mixture together with the powder portion are heated during blast and are transported at high velocity to a position to produce coating.

Therefore in this method the particles accumulate two types of energy: heating up to the plastification temperature or even to the temperature of melting, and kinetic energy in the course of acceleration by the gas-carrier. The both type of energy play decisive role in shaping of coating.

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Together with many advantages the detonation methods has the serious drawback. Due to high temperature (several thousand degrees) the gas-carrier has strong chemical agressivity. This worsens the coating quality and requires special conditions for its liquidation.

The method of low-temperature gas dynamic coating deposition, developed at MAI (Russian patent N2082823) is the development of the cold gas dynamic method of Novosybirsk's Institute of Theoretical and Application Mechanics (USSR Pat. N 161878) and is logical advancement of plasma and detonation methods.

There is developed a new gas dynamic method (LTGDM) for synthesizing of multicomponent materials with the necessary predicted properties. The method is based on the use of supersonic heterogeneous (two-phase) flows .The main idea of this method is that new materials are synthesized as a result of high-speed (M > 1) two-phase flows impact with a barrier (a substrate) . A composition of the material is "taken" from a necessary (in order to get the necessary properties) quantity of chemical elements or chemical elements compounds (metals, oxides, carbides, nitrides and others) as powders with a dispersity from 10 up to 50μm. A necessary spectrum of heterogeneous powders constituted in corresponding mass fractions is premixed in the special gas dynamical mixers. So the obtained mixture being in aweighted state in gas flow accelerates in supersonic nozzle up to a computed speed for a given compound. Initial temperature of the particle carrier gas (stagnation temperature) is so selected that the exit nozzle particles speed would correspond to a computed one but their temperature and static carrier gas temperature wouldn't exceed 20-50 % of the particle material melting temperature. So, in order to get a carrier gas speed exceeding speed of sound in two times, initial temperature doesn't exceed 300°C at pressure 0.5-1,0 MPa. As a result, solid particles acceleration takes place in cold gas flow what excludes particles oxidation and there fore, allows to use air as a carrier gas.

NTGDM will allow to realize super fast technologies without considerable energy costs. For example, it takes several tenths fractions of a second for obtaining of intermetallic material layer Ni Al of a thickness 1 mm by means of CGDM, while using a standard chemical-thermal technology a transition zone of a thickness 60 microns is formed in ovens during 9 hours at temperature ≈ 700°C.

In the laboratory there is developed an effective technology for a production of metal-ceramic materials for the account of additional energy supply during a process of a material synthesis caused by a presence of exothermal chemical reactions in a process of high-speed particles interaction with a substrate.

The use of such method allows to form carbides coatings, borides ones, oxides ones, silicides ones and others, refractory compounds on a substrate.

The obtained types of metal-ceramic materials can be widely used in new technologies owing to high thermal or mechanical properties.

There is simultated a process of the new materials coating and synthesis by the numerical methods, the two-phase flows structure and the properties of these materials are studied using the modern methods of a diagnostics, such as : laser velocimetry and particle measurements diagnostics, X-ray spectrum microanalysis, contact auto radiogram, high-resolution auto radiogram and others.

RAS

INTERNATIONAL AEROSOL SYMPOSIUM *IAS-4*

July 6-9, 1998 **S.PETERSBURGH RUSSIA**

TITLE OF SESSION **BURNING & COMBUSTION OF AEROSOLS**



Chair. **PROF PUKHLII VLADIMIR A.** *(May 5 1939)*
Phone 7-095-9095629
Address: 127349 Moscow Muranovskay 17-147
Professor of Moscow Aviation Institute
Director of AO AEROTEKS - Moscow 127349 Leskova 8

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HOKOSAWA MIKRON CORPORATION
INTERNATIONAL SALES DIVISION
No. 9, 1-chome, Shodai Tajika, Hirakata-shi, Osaka, 573 Japan.
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IAS-4

Sankt-Peterburg, RUSSIA

6-9 July 1998

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IAS-4 BOARD

Conference Chair Professor . BELOV NICK.N. Phone/fax 7-095-1474361
Email: belov@tehno.mmtel.msk.su

⇒ *Professor* ALBERT ARKING *fax 410-516-7933 arking@aa.gsfc.nasa.gov* NASA, USA

⇒ *Professor* IRINA P. ARSENTIEVA *phone 7-095-1266477, fax 7-05- 3611446* Metalurgy University, Moscow , Russia

⇒ *Dr.* AMNON BIRENZVIGE *Fax: +1-410-671-1912; E-mail: axbirenz@cbdcom.apgea.army.mil* US Army Science Foundation, USA

⇒ *Professor* JOSE LUIS CASTILLO *Tel: +34-91-3987122; Fax: +34-1-3986697; E-mail: castillo@apphys.uned.es.* Universidad Nacional de Educacion a Distancia, Madrid Spain;

⇒ *Academician Professor* GEORGY M. CHERNYAVSKY *tel.-7-095-4295311 Fax -7-095-4202275 Morozov@cpi.rssi.ru* Russian Space Institute, Moscow

⇒ *Dr.* HSU-WEN CHIANG *Tel: 204-753-2311, ext. 3083 Fax: 204-753-2455 e-mail: chianghw@aecl.ca* Atomic Energy of Canada Limited Pinawa, Manitoba,Canada

⇒ *Professor* JIN DO CHUNG *Tel-82-418- 405463 fax 82-418- 405460* Gyeongsang National University, South Korea

⇒ *Professor* YEVGENII K. GARGER *Tel-044-2205313 Fax -044-2209346 garger@garger.pp.kiev.ua* Institute of Radioecology (Ukraine Sci.Academy), Ukraine

⇒ *Academician Professor* KIRILL YA. KONDRATIEV *Tel.7-812-2317773 fax 7-812-2307994* Russian Center of Ecological Safety , S. Petersburgh

⇒ *Professor* LEONID M. LOGVINOV *Tel.-7-8462-357356 Fax.7- 8462- 357356* Samara Aerospace Academy, Russia

⇒ *Professor* KARL E. LORBER *Tel- 43.- 3842 -4610350 fax 43-3842 - 4610352 enttech@grz08u.unileoben.ac.at* Montanuniversitat Leoben, Austria

⇒ *Professor* OLEG M. MIKHAILOV *Tel.7-812-2189952, fax-7-812-2183720* State Optics Center of Russia, S. Peterburgh

⇒ *Professor* EVGENY A. PERMYAKOV *Tel.7-095-9245749, Fax7-0967-790522 Permyakov@ibp.serpukhov.su* Institute of Biological Devices, Puschino, Russia

⇒ *Academician Professor* MOMCILO RISTICH *Tel. 38- 11-187-144/147 fax 38-11-182-825 risticm@mi.sanu.ac.yu* University of Belgrade, Yugoslavia

⇒ *Professor* MICHAEL E. SCHLESINGER *schlesin@uiatma.atmos.uiuc.edu* University of Illinois at Urbana-Champaign, USA

⇒ *Professor* HISANORI SHINOHARA *nori@chem2.chem.nagoya-u.ac.jp* Nagoya University, Japan

⇒ *Dr.* JOCHEN TSCHIERSCH *phone 49-89-31872763, fax 49-89-31873363* GSF - Forschungszentrum fur Umwelt und Gesundheit, Germany

⇒ *Professor* VIKTOR V. VLODAVETS *Tel. 7-095-3313452* Russian Aerosol Society, Moscow

⇒ *Dr.* ALAN WEINSTEIN *Tel.44-171-5144964, fax 44-171-7236359, aweinstein@onreur.navy.mil* Naval Research Europe, London, UK

⇒ *Academician Professor* VLADIMIR YE. ZUEV *Tel.- 3822- 258737 Fax-3822-259086 zuev@iao.tomsk.su* Institute of Atmospheric Optics, Tomsk , Russia



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TENTATIVE LIST OF ATTENDEERS OF IAS-4

Last string is direction of scientific interests

ACKERMANN ,INGMAR J
Phone: +49-241- **9421205**
Fax: +49-241- **9421301**
E-Mail: **iackerma@ford.com**
Address: D-52068 Aachen. Germany Dennewartstr. 25
Institute:Ford Forschungszentrum Aachen
Aachen **Germany**

ATMOSPHERIC AEROSOLS & CLIMATE

ALTMAN ,I.S.
Institute:Institute of combustion
Odessa **Ukraine***Powders* ==========

ALVAREZ ,M. L.
Institute:Institute of Materials and Reactive for Electronics
Gavana **Cuba** *Aerosol characterisation* ==========

ANDREEV ,EVGENIYI PAVLOVICH
Phone: +7-812- **2189946**
Fax: +7-812- **2188179**
E-Mail: **irina@tks-opt.spb.ru**
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov St.-Petersburg **Russia**

Environment ==========

ANDRONOVA ,NATALIA G.
E-Mail: **Natasha@uiatma.atmos.uiuc.edu**
Institute:University of Illinois at Urbana-Champaign
Urbana **USA**

ATMOSPHERIC AEROSOLS & CLIMATE

ANISIMOV ,MIHAIL PROKOP'EVICH
Phone: +7-38422- **268697**
Fax: +7-38422- **258989**
E-Mail: **anisimov@aerosol.kemerovo.su**
Address: Rukavishnikov Str. 21, 650610 Kemerovo Russia
Institute:Kemerovo Scientific Center of Russian Academy of Science Kemerovo **Russia**

Nucleation of aerosols ==========

ANKUDINOV ,VASILIYI BORISOVICH
Phone: +7-095- **3627552**
Institute:Moscow Power Engineering University
Moscow **Russia**

Heat- & mass transfer in disperse systems

APOSTOL ,MARIAN
Phone: +40-1- **7807040/3213**
Fax: +40-1- **4231701**
E-Mail: **apoma@theor1.ifa.ro**
Magurele-Bucharest MG-6, POBox MG-35, Romania
Institute:Institute of Atomic Physics
BUKHAREST **Romania** *Fullerene*



==========

ARGUCHINTSEV ,VALERIYI KUPRIYANOVICH
Phone: +7-3952- **462622**
E-Mail: **root@lin.irkutsk.su**
Address: P.B.4199, Irkutsk 664033, Russia
Institute:Polytechnic university of Irkutsk
Irkutsk **Russia**

AIR ==========

ARGUCHINTSEVA ,ALLA VYACHESLAVOVNA
Phone: +7-3952- **460333**
E-Mail: **root@lin.irkutsk.su**
Address: P.B.4199, Irkutsk 664033, Russia
Institute:Limnological Institute
Irkutsk **Russia**

Dispersion of pollution in air ==========

ARISTOVA ,E.N.
Phone: +7-095- **2509803**
Fax: +7-095- **9720723**
E-Mail: **mageiko@kiam.Ru**
Institute:M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Moscow **Russia**

Radiation balance of the atmosphere ==========

ARKING ,ALBERT
Phone: +1-301- **2992478**
Fax: +1-301- **2992479**
E-Mail: **arking@aa.gsfc.nasa.gov**
Address: Johns Hopkins Road, Laurel, Maryland, 20723-6099
Institute:Johns Hopkins University
Baltimore **USA**

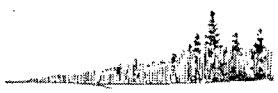
Optical properties of the aerosols ==========

AVAKYAN ,SERGEYI VAZGENOVICH
Fax: +7-812- **2183720**
E-Mail: **AVAK@soi.spb.su**
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov
St.-Petersburg **Russia**

Aerosol characterisation ==========

BALAHANOV ,MIHAIL VALENTINOVICH
Phone: +7-095- **5359359**
Fax: +7-095- **5359349**
E-Mail: **balah@ftri.extech.msk.su**
Institute:SE VNIIFTRI
Moscow **Russia**

Aerosol characterisation ==========



Copyright 1998 © by Aerosol Technology Ltd. Phone/Fax: +7(095)1474361 EMAIL: belov@tehno.mmtel.msk.su

BALKANSKY ,Y.
Phone: +33-- **69087725**
Fax: +33-- **69087716**
E-Mail: **balkansk@lsce.saclay.cea.fr**
Address: CE Saclay BBt 709, F-91191 Gif-sur-Yvette. France
Institute:Unit mixte CEA-CNRS
Gif-Fur-Yvette **France**

ATMOSPHERIC AEROSOLS AND CLIMATOLOGICAL PROBLEMS. ==========

BARTHELMIE ,REBECCA
Phone: +1-812- **8554083**
Fax: +1-812- **8551661**
E-Mail: **rbarthel@othello.ucs.indiana.edu**
Address: Bloomington, IN47405
Institute:Indiana University
Bloomington **USA**

Monitoring of the environment ==========

BELONOZHKO ,DMITRIYI FEDOROVICH
Institute:Yaroslavsky State University
Moscow **Russia**

Electrical charged aerosol particles ==========

BELOV ,NIKOLAYI NIKOLAEVICH
Fax: +7-095- **1474361**
E-Mail: **Belov@tehno.mmtel.msk.su**
Address: 119285 Moscow 2-Mosfil 21-117
Institute:Aerosol Technology LTD
Moscow **Russia**

Bacteria & viruses ==========

BERESNEV ,SERGEYI ANATOL'EVICH
Phone: +7-3432- **228330**
Fax: +7-3432- **616778**
E-Mail: **Sergey.Beresnev@usu.ru**
Address: Ekaterinburg 620083
Institute:Ural State University
Ekateinburg **Russia**

Electrodynamical properties of the aerosols ==========

BESCHASTNOV ,S.P,
Institute:Institute of Experimental Meteorology SPA Typhoon
Moscow **Russia**

Dispersion of pollution in air ==========

BEZRUKOVA ,ALEKSANDRA GENNADIEVNA
Phone: +7-812- **5557413**
Fax: +7-812- **5557413**
E-Mail: **bezr@psb.usr.pu.ru**
Address: 195251 Sankt-Peterburg, Politehnicheskaya 29
Institute:St. Petersburg State Technical University
St.-Petersburg **Russia** *Bacteria & viruses* ==========



BIRENZVIGE ,AMNON
Phone: +1-410- **6712469**
Fax: +1-410- **6711912**
E-Mail: **axbirenz@cbdcom.apgea.army.mil**
Address: ERDEC SCBRD-RTE APG, MD 21010, USA
Institute:US Army laboratory
Aber Prv Grd **USA**

Bacteria & viruses ==========

BOECKMANN ,CHRISTINE
Phone: +49-331- **9771743/1500**
Fax: +49-331- **9771578**
E-Mail: **bockmann@rz.uni-potsdam.de**
Address: Am Neuen Palais 10 Postfach 60 15 53 144 15 Potsdam
Institute:Universitat Potsdam
Potsdam **Germany**

Lidars ==========

BORDENYUK ,ANDREYI NIKOLAEVICH
Phone: +7-095- **2636368**
Institute:Moscow State Technological University
Moscow **Russia**

Bacteria & viruses ==========

CASTILLO ,JOSE L.
Phone: +34-1- **3987122**
Fax: +34-1- **3986697**
E-Mail: **castillo@apphys.uned.es**
Address: C/ Senda del Rey s/n 28040 Madrid, Spain
Institute:Universidad Nacional de Educacion a Distancia
MADRID **Spain**

Moving of aerosol particles ==========

CHECHIK ,OSKAR SAMUILOVICH
Phone: +7-812- **2514332**
Fax: +7-812- **1643274**
E-Mail: **Chechik@Chech.USR.PU.Ru**
Institute:VNF VAPA
St.-Petersburg **Russia**

latex ==========

CHERNYAK ,VLADIMIR GRIGOR'EVICH
Phone: +7-3432- **228330**
Fax: +7-3432- **615978**
E-Mail: **Vladimir.Chernyak@usu.ru**
Address: Ekaterinburg 620083
Institute:Ural State University
Ekateinburg **Russia**

Evaporation of particles by laser radiation ==========

CHOI ,J.H.
Phone: +82-591- **7515387**
Fax: +82-591- **531906**
E-Mail: **jhchoi@nongae.gsnu.ac.kr**
Address: 900 Gazwa-Dong, Chinju, Korea, 660-701
Institute:Gyeongsang National University
Chinju **South Korea** *Filtration of the aerosols*

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CHUNG ,JIN DO
Phone: +82-418- **405463**
Fax: +82-418- **405460**
E-Mail: **jdonchung@dogsuri.hoseo.ac.kr**
Address: 900 Gazwa-Dong, Chinju, Korea, 660-701
Institute:Gyeongsang National University
Asan **South Korea**

Filters ==========

DEMINOV ,IGOR G.
Phone: +7-3832- **397101**
Fax: +7-3832- **397101**
E-Mail: **dyominov@phys.nsu.ru**
Address: Pirogova Str., 2 Novosibirsk, 630090
Institute:Novosibirsk State University
Novosibirsk **Russia**

ATMOSPHERIC AEROSOLS AND CLIMATOLOGICAL PROBLEMS. ==========

DESPA ,FLORIN
Phone: +40-1- **70807040/3213**
Fax: +40-1- **4231701**
E-Mail: **despa@theor1.ifa.ro**
Address: Magurele-Bucharest MG-6, POBox MG-35, Romania
Institute:Institute of Atomic Physics
BUKHAREST **Romania**

Fullerene ==========

EVSIKOVA ,LYUBOV' GEORGIEVNA
Phone: +7-812- **2188063**
Fax: +7-812- **2183720**
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov
St.-Petersburg **Russia**

Aerosol characterisation ==========

FEYIGELSON ,EVA MIHAYILOVNA
Phone: +7-095- **9511247**
E-Mail: **gor@omega.ifaran.ru**
Institute:Institute of Atmospheric Physics
Moscow **Russia**

Radiation balance of the atmosphere ==========

FISENKO ,SERGEYI PAVLOVICH
Phone: +375-0172- **685222**
Fax: +375-0172- **322513**
E-Mail: **fsp@hmti.ac.by**
Institute:A.V.Luikov Institute for Heat and Mass Transfer
Minsk **Belorus**

Nucleation of aerosols ==========

GALLI ,ANNA
Address: Via Celoria 16, Milano 20133
Institute:Instituto di Fisica Generale Applicata
Milano **Italy** *Fullerene* ==========



GARGER ,EVGENIYI KONSTANTINOVICH
Phone: +7-044- **2205313**
Fax: +7-044- **2209346**
E-Mail: **garger@garger.pp.kiev.ua**
Address: 14 Lev Tolstoyi Str., Kiev-33, 252033, Ukraina
Institute:Institute of Radioecology (Ukraine Sci.Academy)
Kiev **Ukraine**

Generation of the aerosol flows ==========

GEERNAERT ,GERALD L.
Phone: +45-46- **46301101**
Fax: +45-46- **46301214**
E-Mail: **GLG@dmu.dk**
Address: P.O. Box 358, DK-4000, Roskilde, Denmark
Institute:National Environmental Research Institute
Roskilde **Denmark**

Aerosol and health ==========

GERMOGENOVA ,TATYANA ANATOL'EVNA
Phone: +7-095- **2507861**
Fax: +7-095- **97207737**
E-Mail: **Germ@kiam.ru**
Institute:M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Moscow **Russia**

Aerosol Optics ==========

GERTSENSHTEYIN ,SEMEN YAKOVLEVICH
Phone: +7-095- **9395136**
Fax: +7-095- **9390165**
Address: Moscow State University, GSP Moscow 119899, Russia
Institute:Moscow State University
Moscow **Russia**

Generation of the aerosol flows ==========

GLUSCHENKO ,NATAL'YA NIKOLAEVNA
Phone: +7-095- **9397937**
Fax: +7-095- **1378258**
E-Mail: **nnglu@ chph.ras.ru**
Institute:Institute of Novel Energetical Problems
Moscow **Russia**

Bacteria & viruses ==========

GOLDSTEIN ,NAUM
Phone: +49-3329- **660120**
Fax: +49-3329- **660200**
E-Mail: **GLtechnology@t-online.de**
Address: Kastanienweg 23, D-14532 Stahnsdorf, Germany
Institute:Goldstein & Lewin technology GmbH
Stahnsdorf **Germany**

Aerosol and health ==========

GRIGOR'EV ,ALEKSANDR IVANOVICH
Phone: +7-0852- **3339268**
Fax: +7-0852- **354777**
E-Mail: **grig@univ.uniyar.ac.ru**
Address: 150000 Yaroslavl', ul. Sovetskaya, d.14
Institute:Yaroslavl State University
Yaroslavl **Russia**

Electrical charged aerosol particles ==========

Copyright 1998 © by Aerosol Technology Ltd. Phone/Fax: +7(095)1474361 EMAIL: belov@tehno.mmtel.msk.su

GRIPOST ,SVETLANA BORISOVNA
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov
St.-Petersburg **Russia**
Aerosol characterisation =========

GURBANOV ,MUSLIM
E-Mail: **ruzmk@rad.dl.ab.az**
Address: , 31-a H.Javid ave 370143 Baku, Azerbaijan
Institute:Sector of Radiation Researches
Baky **Azerbaijan**
Radioactive aerosols =========

HAMILL ,PATRICK
Phone: +1-408- **9245241**
Fax: +1-408- **9242917**
E-Mail: **hamill@light.arc.nasa.gov**
Address: San Jose, California 95192, USA.
Institute:San Jose State University
San Jose **USA**
Atmospheric aerosols =========

HELKOVSKIYI ,NIKITA ANDREEVICH
Institute:Institute of Occupational Health RAMS
Moscow **Russia**
Radioactive aerosols =========

HEUSLER ,GERO
Phone: +49-30- **63921218**
Fax: +49-30- **63921229**
E-Mail: **heusler@mbi-berlin.de**
Address: Rudower Chaussee 6 12489 Berlin
Institute:Max-Born-Institut
Berlin **Germany**
Fullerene =========

HODZHER ,TAMARA VIKTOROVNA
Phone: +7-3952- **460502**
E-Mail: **khodzher@lin.irkutsk.su**
Address: P.B.4199, Irkutsk 664033, Russia
Institute:Limnological Institute
Irkutsk **Russia**
Atmospheric aerosols =========

IVANOV-OMSKIYI ,V.I.
Institute:Physics and Technological Institute named Ioffe
St.-Petersburg **Russia**
Fullerene =========

KADUGRIB ,ALEKSANDR MIHAYILOVICH
Phone: +7-044- **2667531**
Fax: +7-044- **2664502**
E-Mail: **ROOT@INRAD.KIEV.UA**
Address: 255205 Kievskaya obl., pgt.Chabanu, ul Mashinostroiteleyi 7, Ukraina
Institute:Ukranien Institute of Agriculture Radiology
Kiev **Ukraine**
Aerosol & forest =========



KAMESHKOV ,GENNADIYI BORISOVICH
Phone: +7-812- **2189946**
Fax: +7-812- **2188179**
E-Mail: **Irina@tks-opt.spb.ru**
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov
St.-Petersburg **Russia**
Aerosol characterisation =========

KATKOV ,VLADISLAV LEONIDOVICH
Phone: +375-0172- **685296**
Fax: +375-0172- **318403**
E-Mail: **katkov@newman.basnet.minsk.by**
Address: Surganov Street 6 Minsk, 220012 Belarus
Institute:Institute of Engineering Cybernetics
Minsk **Belorus**
Dispersion of pollution in air =========

KATO ,SEIJI
Phone: +1-757- **8647042**
Fax: +1-757- **8647996**
E-Mail: **kato@aerosol.larc.nasa.gov**
Address: Mail Stop 420 NASA Langley Research Center Hampton, Virginia 23681-0001U.S.A.
Institute:Hampton University
Hampton **USA**
ATMOSPHERIC AEROSOLS AND CLIMATOLOGICAL PROBLEMS. =========

KISELEV ,OLEG MIHAYILOVICH
Phone: +7-8432- **387525**
Fax: +7-8432- **380994**
E-Mail: **kiselev@niimm.kazan.su**
Address: Ul. Universitetskaya 17, Kazan, Tatarstan, Russia 420008
Institute:Chebotarev Institute of Mathematics and Mechanics at Kazan University
Kazan **Russia**
Aspiration of the aerosols =========

KISELEVA ,MARGARITA SERGEEVNA
Phone: +7-812- **2189900**
Fax: +7-812- **2183720**
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov
St.-Petersburg **Russia**
Optical properties of the aerosols =========

KOC ,TALAT
E-Mail: **tkoc@zambak.balikesir.edu.tr**
Institute:Balikesir Universtity
BALIKESYR **Turkey**
Aerosol and health =========

KOGAN ,VLADIMIR
Phone: +1-614- **4247970**
Fax: +1-614- **4244185**
E-Mail: **koganv@battelle.org**
Institute:Battelle Memorial Institute Columbus
Columbus **USA**
Radioactive aerosols =========

Copyright 1998 © by Aerosol Technology Ltd. Phone/Fax: +7(095) 1474361 EMAIL: belov@tehno.mmtel.msk.su

KONONENKO ,VADIM LEONIDOVICH
Phone: +7-095- **9361727**
Fax: +7-095- **1374101**
E-Mail: **chembio@glas.apc.org**
Address: 107082 Moskva ul.Bakuninskaya, 38/42-132
Institute:Institute of Biochemical physics of RAS
Moscow **Russia**

Optical properties of the aerosols ==========

KOROMUSLOV ,V.A.
Phone: +7-0852- **222325**
Fax: +7-0852- **354777**
E-Mail: **polya@univ.uniyar.ac.ru**
Address: 150000 Yaroslavl', ul. Sovetskaya, d.14
Institute:Yaroslavl State University
Yaroslavl **Russia**

Electrical charged aerosol particles ==========

KRESTIN ,ANATOLIYI VASIL'EVICH
Fax: +7-096- **5153588**
E-Mail: **kresti@icp.ac.ru**
Address: 142432 Chernogolovka, Moscow Region, Russia
Institute:Institute of chemical physics /Chernogolovka/
Moscow **Russia** *Fullerene* ==========

KROTKOV ,NIKOLAY A.
Phone: +1-301- **7945075**
Fax: +1-301- **4411853**
E-Mail: **krotkov@hoss.stx.com**
Address: 4400 Forbes Blvd., Lanham, MD 20706-4392;
Institute:Raytheon STX Corporation
Lanham **USA**

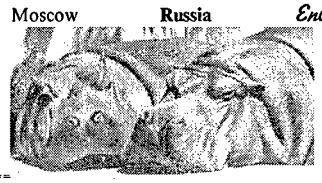
Space investigations ==========

KUCHEROV ,ARKADIYI NIKOLAEVICH
Phone: +7-095- **5564807**
Fax: +7-095- **5564337**
E-Mail: **ank@dept.aerocentr.msk.su**
Address: 140160 MO, g.Zhukovskij-3
Institute:Central Aerohydrodynamic Institute named after N.E. Zhukovsky Moscow **Russia**

Optical properties of the aerosols ==========

KUDRYAVTSEV ,ILYA ALEKSANDROVICH
Address: 443086 Samara Moskovskoe sh 34
Institute:Aerospace University of Samara
Samara **Russia** *Aerosol characterisation* ==========

KUTENEV ,VADIM FEDOROVICH
Phone: +7-095- **1541301**
Fax: +7-095- **9430030**
E-Mail: **root@gncnami.extech.msk.su**
Address: 125438 Moskva Avtomotornaya ul 2
Institute:Automobil Institute
Moscow **Russia** *Environment*



==========

LAVROV ,VITALIYI VLADIMIROVICH
Phone: +7-095- **9395248**
Fax: +7-095- **9391240**
E-Mail: **rftrst@cityline.ru**
Address: Moscow State University, GSP Moscow 119899, Russia
Institute:Moscow State University
Moscow **Russia**

Fullerene ==========

LEPESHINSKIYI ,IGOR' ALEKSANDROVICH
Phone: +7-095- **1584063**
Fax: +7-095- **1582977**
E-Mail: **aet@tk.mainet.msk.su**
Institute:Institute of Low Temperature
Moscow **Russia**

Two-phase flows ==========

LETFULLIN ,RINAT RIFGATOVICH
Phone: +7-8462- **340536**
Fax: +7-8462- **355600**
E-Mail: **root@fian.samara.su**
Address: Novo-Sadovaya St. 221, Samara 443011, Russia
Institute:Samara Branch of P.N.Lebedev Physical Institute
Samara **Russia**

Optical properties of the aerosols ==========

LI ,ZHANQING
Phone: +1-613- **9471311**
Fax: +1-613- **9471406**
E-Mail: **li@ccrs.emr.ca**
Address: 588 Booth Street Ottawa, Canada K1A 0Y7
Institute: CANADA CENTRE FOR REMOTE SENSING
Ottava **Canada**

Aerosol & forest ==========

LIU ,CHUNG-MING
E-Mail: **liucm@ccms.ntu.edu.tw**
Address: Taipei, Taiwan
Institute:National Taiwan University
Taipei **Taiwan**

Optical properties of the aerosols ==========

LOBANOVA ,GALINA IVANOVNA
Phone: +7-812- **2189946**
Fax: +7-812- **2188179**
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov
St.-Petersburg **Russia**

Aerosol characterisation ==========

LOGVINOV ,LEONID MITROFANOVICH
Phone: +7-8462- **357356**
Fax: +7-8462- **357356**
E-Mail: **onil16@lib1.ssau.ru**
Address: 443086 Samara Moskovskoe sh 34
Institute:Aerospace University of Samara
Samara **Russia**

Optical properties of the aerosols ==========

Copyright 1998 © by Aerosol Technology Ltd. Phone/Fax: +7(095) 1474361 EMAIL: belov@tehno.mmtel.msk.su

LORBER ,KARL E.
Phone: +43-3842- **4610350**
Fax: +43-3842- **4610352**
E-Mail: **enttech@grz08u.unileoben.ac.at**
Institute:Montanuniversitat Leoben
Leoben **Austria**

Filtration of the aerosols =========

LUSAK ,LYUDMILA VYACHESLAVOVNA
Phone: +7-095- **9392217**
Fax: +7-095- **9390989**
E-Mail: **Klofo@glasnet.ru**
Address: Moscow State University, GSP Moscow 119899, Russia
Institute:Moscow State University
Moscow **Russia**

Bacteria & viruses =========

MAKAROV ,ALEKSEYI SERGEEVICH
Phone: +7-8432- **743572**
Fax: +7-8432- **741803**
Address: 420075 Kazan'
Institute:THE FEDERAL RESEARCH & PRODUCTION CENTRE THE STATE INSTITUTE OF APPLIED OPTICS - THE FNPTS GIPO
Kazan **Russia**

Optical properties of the aerosols =========

MARICIC ,ALEKSA
Fax: +38-- **3242101**
Institute:Institute of Technical Sciences of the Serbian Academy of Sciences and Arts
Yugoslavia *Powders* =========

MELIHOV ,I.V.
Phone: +7-095- **9393449**
Fax: +7-095- **9328846**
E-Mail: **gorba@radio.chem.msu.ru**
Address: Moscow State University, GSP Moscow 119899, Russia *Institute*:Moscow State University
Moscow **Russia** *Moving of aerosol particles* =====

MIHAYILOV ,OLEG MIHAYILOVICH
Phone: +7-812- **2189952**
Fax: +7-812- **2183720**
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov St.-Petersburg **Russia**

Aerosol characterisation =========

MILANI ,PAOLO
Phone: +39-2- **2392248** *Fax:* +39-2- **2392487**
E-Mail: **PMILANI@mi.infn.it**
Address: Via Celoria 16, Milano 20133
Institute:University of Milano
Milano **Italy** *Fullerene* =========



MILOSEVIC ,OLIVERA
E-Mail: **oly@itn.sanu.ac.yu**
Address: Belgrade, K.Mihajlova 35/IV, Yugoslavia
Institute:Institute of Technical Sciences of the Serbian Academy of Sciences and Arts
Belgrade **Yugoslavia**

Powders =========

MORA ,JUAN
Phone: +34-6- **5903777**
Fax: +34-6- **5903464**
E-Mail: **juan.mora@ua.es**
Address: Box 99, 03080, Alicante, Spain
Institute:Alicante University
Alicante **Spain**

Nucleation of aerosols =========

MUSTAFAEV ,ISLAM
E-Mail: **ruzmk@rad.dl.ab.az**
Address: 124/128 G.Garayev ave. 370119 Baku, Azerbaijan
Institute:Ecological Society of RUZGAR
Baky **Azerbaijan**

Photochemical reaction =========

NADTOCHENKO ,VIKTOR ANDREEVICH
E-Mail: **nadto@icp.ac.ru**
Institute:Institute of Chemical Physics of RAS
Chernogolovka **Russia**

Fullerene =========

NASIBULIN ,A.G.
Phone: +7-38422- **233145**
Fax: +7-38422- **233195**
E-Mail: **aerosol@cphis.kemgu.kemerovo.su**
Institute:State University of Kemerovo
Kemerovo **Russia**

Nucleation of aerosols =========

NEKRASOV ,VIKTOR VASIL'EVICH
Address: 10, ul.Vorontzovo Pole, Moscow 103064, Russia
Institute:Karpov Institute of Physical Chemistry
Moscow **Russia**

Radioactive aerosols =========

NEVZOROV ,ANATOLIYI NIKOLAEVICH
Phone: +7-095- **4086058**
Fax: +7-095- **5763327**
E-Mail: **cloud@adonis.iasnet.com**
Address: 3, Pervomayskaya, Moscow Reg., Dolgoprudnyi, Moscow Reg.141700, Russia
Institute:Central Aerological Observatory
Dolgoprudnii MR **Russia**

Cloud =========

NGUYEN ,BA CUONG
Phone: +33-1- **69088503**
Fax: +33-1- **69087716**
Address: CEN Saclay 91198 GIF SUR YVETTE CEDEX France
Institute:CENTRE DES FAIBLES RADIOACTIVITES
PARIS **France**

Aerosol and ocean =========

Copyright 1998 © by Aerosol Technology Ltd. Phone/Fax: +7(095)1474361 EMAIL: belov@tehno.mmtel.msk.su

NIKITIN ,ANATOLIYI IL'ICH
Phone: +7-095- 1584930
Fax: +7-095- 1582977
E-Mail: alt@tk.mainet.msk.su
Address: 123458 Moskva Tallinskaya ul 20-373
Institute:Moscow State Aviation Institute (Technical University)
Moscow Russia

Aerosol technologies ==========

OMELYANETS ,TAISIYA GRIGOREVNA
Fax: +7-044- 5599090
Institute:Ukrainian Scientific Hygienic Center
Kiev Ukraine

Bacteria & viruses ==========

OSAWA ,EIJI
E-Mail: osawa@cochem.tutkie.tut.ac.jp
Address: 1-1 Hibarigaoka, Tempakucho, Toyohashi, Aichi 441-8122, Japan.
Institute:Toyohashi University of Technology
Aichi Japan

Fullerene ==========

PENDLETON ,J. DAVID
E-Mail: dpendlet@arl.mil
Address: 2800 Powder Mill Road, Adelphi, Maryland 20783-1197
Institute:US Army Research Laboratory
Adelphi USA

Optical properties of the aerosols ==========

POKROPIVNÛYI ,VLADIMIR VASIL'EVICH
Phone: +7-044- 6346109
E-Mail: pokr@ipms.kiev.ua
Address: 252142 Kiev, Ukraina, Krzhizhanovsky, 3
Institute:Institute for Problems of Materials Science
Kiev Ukraine

Powders ==========

POLETAEV ,N.I.
Institute:Institute of combustion
Odessa Ukraine

Powders ==========

POLYANSKAYA ,LYUBOV MAKSIMOVNA
Phone: +7-095- 9390989 *Fax:* +7-095- 9390989
E-Mail: pol@soil.msu.ru
Address: Moscow State University, GSP Moscow 119899, Russia
Institute:Moscow State University
Moscow Russia *Bacteria & viruses* ==========

POMINOV ,EVGENIYI IVANOVICH
Address: 443086 Samara Moskovskoe sh 34
Institute:Aerospace University of Samara
Samara Russia *Aerosol characterisation* ==========



POPOV ,ANDREYI MIHAYILOVICH
Phone: +7-095- 3340881
Fax: +7-095- 3340886
E-Mail: popov@isan.troitsk.ru
Address: 142092,Troitsk M.O.
Institute:Institute of Spectroscopy of RAN
Moscow Russia

Fullerene ==========

PRYOR ,SARA
Phone: +1-812- 8555155
Fax: +1-812- 8551661
E-Mail: spryor@indiana.edu
Address: Bloomington, IN47405
Institute:Indiana University
Bloomington USA

Filtration of the aerosols ==========

PUESCHEL ,RUDOLF F.
Phone: +1-650- 6043625
Fax: +1-650- 6043625
E-Mail: RPUESCHEL@mail.ARC.NASA.gov
Address: MOFFETTFIELD, CA 94035-1000
Institute:NASA Ames Research Center
USA

Aerosol in stratosphere ==========

RADIONOV ,VLADIMIR FEDOROVICH
Phone: +7-812- 3521951
Fax: +7-812- 3522688
E-Mail: aaricoop@sovam.com
Address: 194021, Sankt-Peterburg, 2-yi Murinskiyi, 28
Institute:The Arctic and Antarctic Research Institute
St.-Petersburg Russia

Radiation balance of the atmosphere ==========

REDKOBORODÛYI ,YURIYI NIKOLAEVICH
Phone: +7-044- 2160906
E-Mail: REDCO@AOKU.FREENET.KIEV.UA
Address: Observatorna 3, Kiev-53, 254053,UKRAINE.
Institute:Astronomical Observatory of Kiev University
Kiev Ukraine *Aerosol acoustics* ==========

RUSSELL ,PHILIP B.
E-Mail: PhilipRussell@gmgate
Address: MOFFETTFIELD, CA 94035-1000
Institute:NASA Ames Research Center
Moffett Field USA *Aerosol and ocean* ==========



SEDOYI ,VALENTIN STEPANOVICH
Phone: +7-3822- 258348
Fax: +7-3822- 259410
E-Mail: sedoi@hcei.tomsk.su
Address: 634055 Tomsk pr Akademicheskij 4
Institute:Institute of High Current Electronics
Tomsk Russia *Metallic particles* ==========

Copyright 1998 © by Aerosol Technology Ltd. Phone/Fax: +7(095)1474361 EMAIL: belov@tehno.mmtel.msk.su

SEO ,TAEWON
Phone: +82-571- **505756**
Fax: +82-571- **8411630**
E-Mail: **dongjin@anu.andong.ac.kr**
Address: 388 Songchun-Dong, Andong, Kyungpuk, 760-749, Korea
Institute:Urban centre of the housing grants
Andong **South Korea**

Filtration of the aerosols =========

SHEMANIN ,VALERIYI GENNAD'EVICH
Phone: +7-86134- **53749**
Fax: +7-86134- **51764**
E-Mail: **valery@cons.kccc.kuban.su**
Institute:Kuban State Technological University, Novorossiysk Department
Nivorossisk **Russia**

Lidars =========

SHEVCHENKO ,VLADIMIR PETROVICH
Phone: +7-095- **1247737**
Fax: +7-095- **1245983**
E-Mail: **apl659lfgi@glas.apc.orp**
Institute:Institute of Oceanology of RAS
Moscow **Russia**

Aerosol and ocean =========

SHILNOV ,ALEKSANDR VIKTOROVICH
Phone: +7-095- **2509803**
Fax: +7-095- **9720723**
E-Mail: **SergePol@KIAM.RU**
Institute:M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Moscow **Russia**

Radiation balance of the atmosphere =========

SHINOHARA ,HISANORI
Fax: +81-52- **7892962**
E-Mail: **nori@chem2.chem.nagoya-u.ac.jp**
Address: Nagoya, 464 Japan
Institute:Nagoya University
Nagoya **Japan**

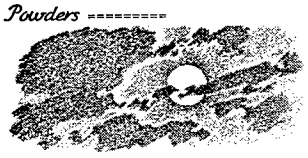
Fullerene =========

SHOSHIN ,YU.L.
Institute:Institute of combustion
Odessa **Ukraine**

Powders =========

SIMEUNOVIC ,RADOJKO
Phone: +38-318- **3226503**
Fax: +38-318- **3242101**
Institute:Institute of Technical Sciences of the Serbian Academy of Sciences and Arts
Yugoslavia

Powders =========



SMIRNOV ,VLADIMIR VLADIMIROVICH
Phone: +7-08439- **71701**
Fax: +7-08439- **2552225**
E-Mail: **vsmirnov@obninsk.ru**
Institute:Institute of Experimental Meteorology SPA Typhoon
Obninsk **Russia**

Aerosol and ocean =========

STENCHIKOV ,GEORGIY L.
Phone: +1-310- **4055370**
Fax: +1-310- **3149482**
E-Mail: **gera@metosrv2.umd.edu**
Address: College Park, MD 20742
Institute:University of Maryland
College Park **USA**

Radiation balance of the atmosphere =========

SUTHERLAND ,ROBERT
E-Mail: **rsutherl@arl.army.mil**
Address: New Mexico, USA
Institute:White Sands Missile Range
USA

Optical properties of the aerosols =========

TALIJAN ,NADA
Phone: +38-11- **3370412**
Fax: +38-11- **3235255**
E-Mail: **CMM@elab.tmf.bg.ac.yu**
Address: Njegoseva 12, 11000 Belgrade, Yugoslavia
Institute:Institute of Chemistry, Technology and Metallurgy
Belgrade **Yugoslavia**

Powders =========

TERENTEV ,VLADISLAV EVGENEVICH
Phone: +7-812- **2180082**
Fax: +7-812- **2183720**
E-Mail: **Leader@soi.spb.su**
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov
St.-Petersburg **Russia**

Optical properties of the aerosols =========

TOPORKOV ,VLADIMIR SERGEEVICH
Phone: +7-3832- **647130**
Fax: +7-3832- **328831**
E-Mail: **toporkov@vector.nsk.su**
Institute:Russian State Scientific Biological Center VECTOR
Novosibirsk **Russia**

Bacteria & viruses =========

TOSITTI ,LAURA
Phone: +39-51- **259569**
Fax: +39-51- **259456**
E-Mail: **laurat@ciam.unibo.it**
Address: V.Selmi 2 40126 Bologna
Institute:University of Bologna
Bologna **Italy**

Radioactive aerosols =========

Copyright 1998 © by Aerosol Technology Ltd. Phone/Fax: +7(095) 1474361 EMAIL: belov@tehno.mmtel.msk.su

TSCHIERSCH ,JOCHAN
Phone: +49-89- 31872763
Fax: +49-89- 31873363
E-Mail: Tschiersch@gsf.de
Address: Ingolstaedter Landstr.1 D-85764 Neuherberg
Institute:GSF - Forschungszentrum fur Umwelt und Gesundheit
Munchen **Germany**

Radioactive aerosols =========

TSIPENKO ,ANTON VLADIMIROVICH
Phone: +7-095- 1584063
Address: 105187 Moskva IZmajlovskoe sh 47-77
Institute:Moscow State Aviation Institute (Technical University)
Moscow **Russia**

Two-phase flows =========

UVAROVA ,LYUDMILA ALEKSANDROVNA
E-Mail: uvarova@stanmat.mian.su
Address: 170026, Tver, nab. Af. Nikitina, 22
Institute:Moscow State University STANKIN
Tver **Russia**

Optical properties of the aerosols =========

VARUSCHENKO ,RAISA MIHAYILOVNA
Phone: +7-095- 9395396
Fax: +7-095- 9328846
E-Mail: varushch@thermo.chem.msu.su
Address: Moscow State University, GSP Moscow 119899, Russia
Institute:Moscow State University
Moscow **Russia**

Spray of the liquids =========

VESELOV ,DMITRIYI PETROVICH
Phone: +7-812- 2189946
Fax: +7-812- 2188179
Address: 199034 S.-Peterburg, Birzhevaya liniya, d.12
Institute:Russian Scientific Optical Center named by Vavilov
St.-Petersburg **Russia**

Aerosol characterisation =========

VOROBEYICHIKOV ,E.V.
Fax: +7-812- 5431571
E-Mail: paa@infopro.spb.su
Institute: St.Petersburg I.I.Mechnikov State Medical Academy
St.-Petersburg **Russia**

Bacteria & viruses =========

VOZZHENNIKOV ,OLEG I.
Address: 82 Lenin Avenue, Obninsk, Kaluga Region, 249020 Russia
Institute:Institute of Experimental Meteorology SPA Typhoon
Moscow **Russia**

Dispersion of pollution in air =========

WICK ,CHARLES
Phone: +1-410- 6713321
Fax: +1-410- 6126783
Address: ERDEC SCBRD-RTE APG, MD 21010, USA
Institute:Edgewood Research Development and Engineering Center
Engewood Area **USA**

Bacteria & viruses =========



ZELINSKY ,TYMON
E-Mail: tymon@iopan.gda.pl
Address: ul. Powst. Warszawy 55, 81-712 Sopot
Institute:Institute of Oceanology , Polish Academy of Science
Warszawa **Poland**

Aerosol and ocean =========

ZHIGACH ,ALEKSEYI N.
Phone: +7-095- 9397927
Fax: +7-095- 1378258
E-Mail: ajigatch@chph.ras.ru
Address: 117829 g.Moskva,V-334,GSP-1, Leninskij pr. 38,k.2
Institute:Institute of Energetical Problems of RAS
Moscow **Russia**

Powders =========

ZHUKOV ,G.P.
Institute:Institute of Experimental Meteorology SPA Typhoon
Obninsk **Russia**

Dispersion of pollution in air =========

ZVEREVA ,NELLI STEPANOVNA
Phone: +7-251- 42200
Fax: +7-251- 46932
E-Mail: tim@nogin.obladm.msk.su
Address: 144012 Elektrostal' MO, ul. Tevosyana 12a-25
Institute:Administration of Noginsk region
Noginsk **Russia**

Generation of the aerosol flows =========



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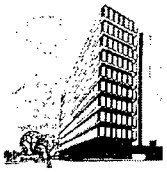


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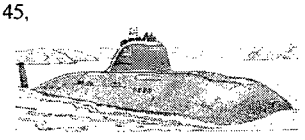
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Karpov Institute of Physical Chemistry **Russia** Moscow 133,
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Russian Ac. Sci **Russia** *Moscow* 100
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Hampton University **USA** Hampton 99,
Novosibirsk State University **Russia** Novosibirsk 152,
Unit mixte CEA-CNRS **France** Gif-Fur-Yvette 102,
University of Illinois at Urbana-Champaign **USA** Urbana 15
BACTERIA & VIRUSES Aerosol Technology LTD **Russia** *Moscow* 1,,4,8
Edgewood Research Development and Engineering Center **USA** Engewood Area 10,
Institute of Novel Energetical Problems **Russia** Moscow 183,
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Ukrainian Scientific Hygienic Center **Ukraine** Kiev 10, 123,
US Army laboratory USA Aber Prv Grd 16



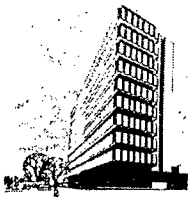




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CLOUD Central Aerological Observatory **Russia** *Dolgoprudnii MR* 147
DEPOSITION Moscow State Aviation Institute (Technical University) **Russia** *Moscow* 186
DISPERSION OF POLLUTION IN AIR Institute of Engineering Cybernetics **Belorus** *Minsk* 161,
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Institute of Atomic Physics **Romania** BUKHAREST 29, 31,
Institute of chemical physics /Chernogolovka/ **Russia** Moscow 80, 81, 113,
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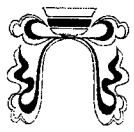
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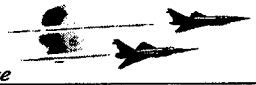


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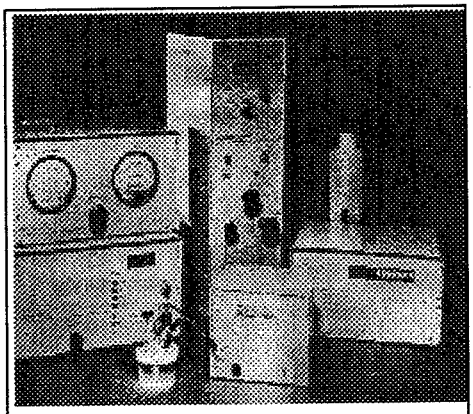
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BIOLOGICAL AEROSOLS GENERATED BY SHOWER BATHING

A. PAUL ADAMS, J. CLIFTON SPENDLOVE

Private consultants in Microbial Aerobiology 4166 Fortuna Way, Salt Lake City, Utah 84124
phone: 801-278-1200 (Formerly Life Science Division U.S. Army, Dugway Proving Ground)

(First received 18 April 1998; accepted for presentation during IAS-4)

A study was made of the number of bacteria aerosolized by communal shower bathing at high school. Aerosol samples were taken in the boys' dressing room and near the shower stalls of boys' gymnastic class. Two types of aerosol samplers were used: Litton high-volume sampler and the Andersen six-stage sampler. As many as 50 bacteria per liter of air were aerosolized during the showering process.

Of those bacteria isolated, 0.74% were found to be S. aureus. as determined by their ability to ferment glucose anaerobically and to produce coagulase. It was postulated that a boy may inhale as many as 74 S. aureus in 10 minutes. Based on infectivity data published in the literature, it was hypothesized that as many as 10% of the bathers may be infected or colonized by a dosage of 74 S. auerus and that some degree of hazard may exist.



1454.
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THE ULTRAVIOLET RADIATION OF BACTERIA UNDER PULSE LASER INFLUENCE

A.M.AGALTSOV, A.N.BORDENIOUK, V.S.GORELIK.

P.N.Lebedev Physical Institute of Russian Academy of Science. 117924, Moscow, Leninskiy pr. 53.

(First received 30 March 1998; accepted for presentation during IAS-4)

The observing of the second ultraviolet radiation of the simplest microorganisms under influence of pulse ultraviolet laser affection is reported. As a source of laser radiation was used copper vapour laser, producing pulse radiation in visible spectrum region (wavelengths 510.5 and 578.2 nm) with average power 4 W and pulses repetition frequency 10000 Hz. The duration of laser pulses generation was 20 ns and their peak power 10000 W. The non-linear optical (ADP) crystal was placed after laser. The crystal was cut out so, that sinhronization conditions were performed for mixed emission compound with wavelength '271.2 nm. So, exciting pulse at laser radiation was at average ultraviolet spectrum region (271.2 nm) and was absorbed by micro-organisms by resonance manner.

For the investigations were chosen bacteria "Bacila Thurin giensis" in 0.9% NaCl aquatic solution, Shtamm War Purstake under T.C. 09.05.096.73-84. The samples were preparated in concentration range from 100 cell/ml to 100000 cell/ml. Besides bacteria, the spectra of the second radiation appearing under affection of ultraviolet exciting radiation in hard GTP hell and in saturated aquatic solution of tryptofane were studied for comparing.

The samples were placed in quartz cuvette with plane-parallel optical windows made from QU-1 glass. The second radiation was observed under 90- degree angle and was registered with small monochromator of MUS-type and rate Photomultiplier PEA-106. Accumulation time of useful signal was defined with computer control program in every fixed location of monochromator lattice. Electronic amplifier with control strob-pulse was used for performing temporary analysis. The strob-pulse duration was 30 ns and his location on temporary scale has

been changed with delay line in range 0-200 ns.

As a result of performed analysis of bacteria in aquatic media, we founded that in second radiation spectrum, side by side with sharp peak (271.2 nm) of exciting radiation was present intensive maximum with wavelength 301.2 nm, corresponding to Raman scattering in water and also there was the wide band in more longwavelength region. Location and shape of this band changed in dependence from bacteria concentration and also from delay time of strob-pulse in relation to exciting pulse radiation.

When the delay was absent the range of the second radiation spectrum (resonance fluorescence-RF) for the sample of low concentration (100 cell/ml) was 310-410 nm. Simultaneously, in observed spectra side by side with wide band were present sharp splashes. Their intensity was higher than that of noise signal. The RF spectrum moved to longwave region with increasing of bacteria concentration. Particualy, for the bacteria sample solution (under condition of high bacteria concentration, the short wavelength ultraviolet radiation should be re-radiated by aromatic amino-acids, for example as tryptofane. As a result of this, the second radiation maximum should be moved to violet region. This effect we have really observed in our experiments.

The investigated ultraviolet radiation of microorganisms may be close to mitogenetic radiation, predicted by A.G.Gurvich and stipulated by exciting of DNA as s result of metabolic processes (look [1,2]).

So, performed experiments showed, that method of resonance pulse laser influence per aquatic samples of microorganisms allows us to fulfil its diagnostics and concentrational analysis.

This work was supported by RFFI-project N 97-02-16404

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1174.

MICRODROPLET METHOD FOR DIAGNOSTICS OF BIOLOGICAL ACTIVE SUBSTANCES IN AEROSOL SAMPLE

BELOV N.N. [1], BELOVA N.G. [1], GALKIN A.S. [2]

[1] *Aerosol Technology Ltd, Phone/Fax: 7-(095)-1474361, E.Mail: belov@tehno.mmtel.msk.su*

[2] *Moscow State University, Biological Faculty, Biochemistry Department, Phone: 7-(095)-9391376*

(First received 28 January 1998; accepted for presentation during IAS-4)

Concentration of biological active substances in aerosol samples is low and sample itself is very complex. Two particles from the same sample can have completely different properties, structure and history. The investigation of such a complex mixture is non trivial task.

Let's imagine that sample contain few small (about 1 micrometer) particles with biological active substances, for example, proteins. All other components of collected sample and instrument surfaces are source of noise. It would be great to establish some kind of preliminary selection for the next step of analysis. Such methods were developed for chemical analysis of aerosol particles. Usually, particle is evaporated and then analyzed on mass-spectrograph [1].

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There are instruments that can measure fluorescence of single particles during sampling process. However particle velocity is too high for detailed (for example biochemical) analysis.

In present work it is suggested to use virtual impactor with transparent bottom and special optics for diagnostics biological substances in aerosol sample. As shown, there is an opportunity to use single particle precise mechanism for sensitive and rapid bioaerosol analysis of single particles. Some of used methods were developed for microelectronics [2-3].

There are elements of Virtual impactor architecture that useful for installation of an additional optic devices. Source of ultraviolet radiation can be positioned in the horizontal air-output slot of the impactor. So there is an opportunity of detection of fluorescent signal from biological particle. To determine location of the fluorescent particle position-sensitive photo pipe can be used. All this data gives complete information about location of impactor bottom particles (at least the big ones) and their quantity.

Fig.1. Virtual impactor with simple optics installed enabled to determine the moment and position at what biological substance appears.

The another way to monitor biological particles is to use fluorescent microscope. Such microscope with great sharpness length and low resolution.

Impactor bottom (3) is quartz window. Light divider (5) leads UV light of lamp (4) on particles at bottom and flying ones (2).

Position-sensitive indicator (6), can be video camera or Position Charged Links matrix. It measures number of fluorescent particles in impactor. Such data is important to monitor dynamics of biologic debris concentration in air. However for complete information about bioaerosol an additional analysis have to be performed on the sediment.

According to the experiments [4] bacteria get into the sampler rarely. It is necessary to pump tens and hundreds of liters of air to capture a single particles. When quantity of captured particles is big enough air flow is redirected to another virtual impactor. This enables to continue collecting the sample for more detailed biochemical analysis.

Transparent bottom of virtual impactor provides optical measurement of colour changes after analytical biochemical reactions. Single particle technology with precise placing of each droplet used for input of biochemical reagents on surface of each bioaerosol particle. The Precise single particle technology uses for droplet printers widely.

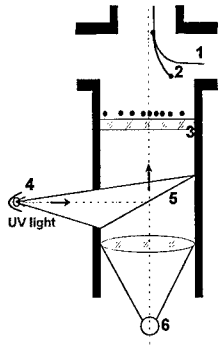


Fig. 1.

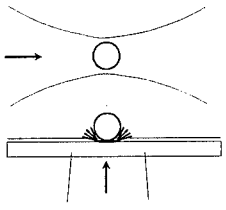


Fig.2.

Our investigation devoted to application of common analytical biochemical reactions [5-9] with single particle technology for investigations of bioaerosols. The offered methods have general character and are used by the scientists for realisation of the quantitative analysis at determination of the contents of biologic active substances, such as proteins, nucleic acid (NA),

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carbohydrate.

The physical-chemical properties of proteins are determined qualitative and quantitative structures of amino acid included. Methods of quantitative determination of NA are based on determination of the contents of making their components: of the nitrogen basis, leptos and phosphorus NA.

The Mainbaum method of determination of the RNA with orcine contents is based on reaction of orcine with ribose, from RNA. As a result RNA hydrolyse in presence of HCl acid, furfurole derivative will be formed. It gives a product of green colour at heating with orcine. The reaction is not high specifics - painted products will form deoxyriboses, polysaccharides and some other chemicals. However sensitivity of the reaction of orcine with rebose is high [7].

Derivatives of hydrocarbon (furfurole type), formed at heating with concentrated H_2SO_4 and artron, give colour chemicals. The developed colouring is proportional to quantity of taken glucose [8].

Proteins of microscopic particle from aerosol sample may be coloured by single droplet (50 mkm) of Fomins reagent with bi-ureton reagent for detection of the peptide links. This reaction proceeds coloured products of aromatic NA. This products may be detect by microscopy easy.

For more thin determination of protein concentration in a preparation it is possible to use coomassie brilliant blue. The method is based on linkage with proteins of one of acid colour - coomassie brilliant blue. At linkage with proteins, the absorption spectrum of colour is varies.

These investigations of selected micro pieces of aerosols sample provides important information about biological active components of bioaerosol sample.

Present investigation uses laser technology for take-off single particle from sampler surface [2-3] for additional analysis. Particles selected from air places with random order on transparent surface of aerosol sampler. Some of them may be microorganisms. These particles must be investigated more careful. Such distribution is received at fall of particles on the bottom of virtual impactor.

Figure 2 presents the scheme of removing of single particle from sampler surface by laser beam of sharp focusing (indicated by arrow) [2], [3].

In this scheme the particles fly away from a plate owing to evaporation of thin sorbing layer on a surface of a glass. Intensive laser radiation forms local gas explosion that pushes a particle from a glass surface. The evaporation of a sorbing liquid requires an appreciable intensity of radiation. The process can be initiated by cowering the plate with a thin film which has high absorption on a wave length of used laser.

This thin film evaporation provides taking off microorganisms from sampler surface without damage of their membrane.

Investigations of optical fields inside of bacteria shows that their membrane may be opened without stressing it's main organs. This effect can be reached by focusing the laser beam inside of bacterium. For this operation Nd or ruby compact laser may be used. Chosen particle can be measured alone after it was took off the plate and passed into the laser beam area for analysis. This technology leads to increasing of sensitivity of bioaeosol investigations.

Authors appreciate Aerosol Technology Ltd firm for financial support of researches. This material is based upon work partially supported by the European Research Office of the US Army under Contract No. 68171-97-M-5652

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1177.

DIAGNOSTICS OF POLYNUCLEOTIDES IN SAMPLES OF AEROSOL

Belov N.N. [1], Belova N.G. [1], Morosov S.Yu. [2]

[1] *Aerosol Technology Ltd, Phone/Fax: 7-(095)-1474361, EMail: belov@tehno.mmtel.msk.su*

[2] *Moscow State University, Biological Faculty, Virusology Department, Phone: 7-(095)-9395534*

(First received 28 January 1998; accepted for presentation during IAS-4)

Sample of bioaerosols is a collection of great number of microscopic organic and inorganic particles. The analysis of this complicated mixture is an important problem that has no solution yet. Usually analysis consists of indentification and detemrmination of type of microorganisms at random position. Present investigations are devoted to using of PCR-method for analysis of sample that consists of aerosol particles collected from monitored air.

DNA contains the main information about microorganism. Multiplication of DNA by PCR method creates area with equivalent DNA molecules (like colony). All this DNA molecules are equal to source DNA. These source DNA molecules are extracted from bacteria sampled from air. (Please note, that concentration of bacteria in air so small that probability of close neighbourhood of two or more microorganisms is negligable small).

Method of Polymerase Chain Reaction (PCR) initially was described in 1985 by Saiki et al. (Science: 230, 1350-1354). Now many variants of PCR are widely used in different fields of molecular biology, genes engineering and biotechnology. The basics of this method is amplification of DNA fragments while having surplus of DNA-replica and ferment DNA-polymerase. Usually thermostable DNA-polymerase, such as Taq-polymerase from thermoohilic bacterium Termus aquaticus, are used. At the beginning of Polymerase Chain Reaction highmolecular two-chain DNA (or single-chain DNA for example cDNA-copy RNA) after melting and annealing of source becomes a primer for ferment-polymerase [1]. Ferment-polymerase produces two-chain DNA fragments that vary in size from few tens up to thousands of nucleotic pairs. Size of fragments depends on position of link areas of source DNA on polynucleotid. Reaction continues with duplication of first step products, i.e. DNA-fragments of fixed size. When quantity of DNA sources, polymerase and deoxynucleotidtriphosphates is enough, any part of polynucleotid (DNA or RNA) can be amplified. So even in situation when the only one polynucleotid molecule is available, it is possible to amplify it or it's part up to quantity that is easy to detected by standart methods. For example brome atidia in agar or

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polycrealamid geles. Test procedure can be greatly reduced in case of use of radioactive deoxynucleotidtriphosphates or their fluorescent analogous. According to this PCR is the most sensitive detection method for biological objects that contain polynucleotides (including viruses, bacteria, primitives, fungi et others). Certainly PCR can be used for detection of single nucleotides in any medium. PCR is widely used in agriculture for diagnostics of animal and plant pathogens. It's high precision and cheapness (comparing to other methods) made PCR the main method for diagnostics of infectional and inherited human diseases.

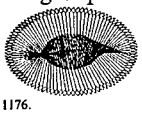
Last years PCR is used widely as the method for monitoring of biologic debris (including single nuclear acids) of the environment, food, medicines etc. Monitoring of pathogen microorganisms at their low concentration in soil, water and air become available only because of PCR. Moreover, PCR method significantly simplifies micro biological control. Now can be reduced such great work as laboratory incubation of microorganisms for following identification. There is an opportunity to extract stamm from specific DNA sources, not only to detect that there is precise type of microorganisms. An additional advance is that PCR method enables to test any type of microorganisms even in spore. But it is impossible to detect viability of detected microorganisms. Nevertheless PCR can be used as initial procedure of monitoring of polynucleotides and microorganisms in environment. Indeed PCR is outstanding method for this purposes.

This multiplication of DNA helps to receive large area around microorganism placed on surface of biosampler, filled with equal DNA molecules. This "colony" of DNA may be selected and measured by phase microscope. This device has an excellent resolution - 50 nm and best. Phase microscope investigations are safety for alive microorganisms. So this technology provides new directions for investigations - dynamical correlation spectroscopy. Time-space correlation vibrations and moving provides good information about source microorganisms. PCR method helps to enlarge area with important information. So phase microscope will find it more simple and with great speed. This method helps to go away from demand on careful collection of microorganisms from air. This direction of bioaerosol sampling is very perspective.

Authors appreciate Aerosol Technology Ltd firm for financial support of researches. This material is based upon work partially supported by the European Research Office of the US Army under Contract No. 68171-97-M-5652

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1176.

PHASE MICROSCOPE FOR BIOAEROSOL DIAGNOSTICS

Belov N.N. (1), Belova N.G.(1), Tychinsky V.P.(2)

(1) - Aerosol Technology Ltd,
Phone/Fax: 7-(095)-1474361, E-Mail: belov@tehno.mmtel.msk.su

(2) - Moscow State University of Radioengineering, Electronics and Automatics
Phone: 7-(095)-4346792

Concentration measurement and identification of microorganisms, collected from monitored air, is important problem. At present for these purposes a following technique is used. Aerosol particles from monitored air are collected and placed on a surface of nutrient medium. Each alive

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bacterium produces colony by self duplication. Colony border is nearly a circle. The differences of refraction parameters of biomass, that forms colony, enables determine colony position and their quantity.

The opportunities to determine a bacterium kind are rather limited. For this purpose the test sowing on various nutrient mediums are used.

This investigations introduces the phase microscopy technology for the diagnostics of microorganisms in sample of bioaerosols. This method provides super resolution with using of optical laser radiation with small intensity. Phase microscope [1] gives the distribution of a phase in the interference image of object. It enables to reach the resolution up to tens nanometers, which is characteristically for electronic microscope. At the same time Phase Microscope does not distort a test and does not kill microorganizms. Moreover investigations by this microscope of the functioning of live bioorganizms can be used for identification of their class and type.

Phase microscope gives a possibility of direct determination of the form and sizes of viruses. Phase microscope used for measurements of height profile of viruses Influenza A. This viruses is about 200 nm in diameter. Results of measurements selects its dense nucleocapcid and protein membrane. Phase microscope technology provides topogrammes of phase image of vaccine of pox-viruses, Riccetsia provazecii[1].

Phase microscope may be applied for investigation of virus structure (nuclea, metahondrii and analysis of cell-virsuses interaction [1]. This technology used for decoding of the structure of the petide-lipide membrane with thickness 50 and 80 nm of cell of Cjriolus fungus [1]. This microscope used for investigation of This microscope has given a opportunity to study in a real time disease of a cell by Influenza A virus [1].

These measurements do not require hard influence on biological structures. It need not in vacuuming of sample. It uses small intensity laser beam in visual spectrum. (Vacuum and electron ray destroy microorganizms). There is no influence on biological processes during experiment.

Membrane fluctuation is a common process of living cells. Another common process is ATP-reaction. Both of this effects were investigated using dynamic phase microscopy. These processes shows micro fluctuation of optical path on membrane surface with measured square near 0.01 micron^2. Position of fluctuation area correlates with local variations of height profile near ATP-cluster.

Spectral analysis of space and temporal fluctuations during ATP-reaction shows that there are contrast components with range of frequency 2-8 Hertz. Intensity of such fluctuation indicates changes on distances near 30 nm. Such spectrums helped to discover basic space-temporal shifted components and correlated areas (50-200 nm) for several active points.

The study of a microorganism structure with the resolution up to hundreds nanometers provides wide opportunities for their identification. However the most wide opportunities become available by method of dynamic microscopy - second step of Phase microscopy application. Changes of correlation characteristics under displacement of different points can be measured. The resolution that is fine enough to detect a single liposome or molecule of ATP lead to new methods of microorganizms identification. Direct measurement of frequency ATP simulation in microorganism, the displacement of optical active parts of microorganism gives contribution to a dynamic correlation picture, given by phase microscope. Urgent problem of certification of such spectra and connection them to particular kinds of microorganisms becomes very important. Interesting that such measurements can be conducted all time of development of microorganism colony in medium.

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ge No 8



Fig.1.

The method of active spectroscopy of bacteria colonies is carried out of the method of dynamically spectroscopy. First step is periodical measurement of phase portrait of precise surface part until area of regularly changed structure detected. This mechanism provides early diagnostics of colonies.

At study of dynamics of movement of microobjects the kind of microorganism can be established by use of the super resolution. After this it is advisable to stop a growth of microorganisms in this colony. The local lighting of this microcolony by UV-radiation through objective of phase microscope can be used for this purpose. For this purpose the UV-radiation by a additional mirror cut from the measuring circuit and is directed on nutrient medium through objective of phase microscope, for example, from small-sized spark gap. Such suppression of identified microorganism colony permits to lower masking of one colony by another.

Use of optical microscope with the super resolution allows to observe alive microorganisms during their living. The resolution of phase microscope is sufficient to show their internal structure. Thus a wide spectrum of the additional information, necessary for identification of microorganism occurs. This information on the sizes of separate microorganism particles and character (speed, frequency, availability of pulsation,...) their mutual displacement. Such approach permits to increase aerosol concentration of aerosol sample on nutrient medium.

The sight field of phase microscope (5 x 5 micron) can be essentially reduced by electronic zooming. As a result the given equipment permits essentially to increase the accuracy of the bacterium analysis for case of slow changing bacteria. For the modern measuring techniques it is the principal restriction.

On the other hand the detecting ability of a equipment permits essentially to increase bacterium concentration on unit of a surface of nutrient medium..

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1175.

DIAGNOSTICS OF VITAL MICROORGANISMS IN AEROSOL SAMPLES

BELOV N.N. (1), BELOVA N.G. (1), UGAROVA N.N. (2)

(1) - Aerosol Technology Ltd, Phone/Fax: 7-(095)-1474361, EMail: belov@tehno.mmtel.msk.su

(2) - Moscow State University, Chemistry Faculty, Chemical Enzymology Department,
Phone: +7-(095)-9395417, Fax: 9393589, EMail:UNN@enzyme.chem.msu.su

Bioaerosol sampler has two conflicting demands. From one side biosampler needs in great air volume of sample with great efficiency of separation of aerosol particles from measured air. From another side all selected particles needs in great care. This demand carried out from method of

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measurement of bacteria in sample by counting of colonies that grew from bacteria on nutrient media after incubation time. It is a problem to prevent bacterial flora from death during collecting aerosol sample.

From the one side, sampler should provide collecting enough aerosol particles to contain no less than 3-10 bacteria. Bacteria concentration in air is about one in tens or even hundreds of liters [1]. Accordingly, sample should contain particles collected out of few hundreds of liters of air. Moreover sample have to be collected each 1-2 hours. This leads to implementation of high efficient air filtration when throughput is about ten liters per minute. Debris particles that collected from a huge volume of air should be transferred into a much more less volume of sorption liquid or be immediately placed into the nutrient medium.

There are methods of detection of bacteria in aerosol sample, based upon calculation of colonies, produced by bacteria. This is the reason why sample for such methods should be made very gentle from aerosol sample volume. There should not be any collisions of bacteria with dry surface. Nearly all ways of increasing filtration efficiency - charging particles, collision of particle on a high velocity with an obstacle, acoustic or ultraviolet fields - lead to the death of bacteria or make bacteria unable to multiplicate.

From the other side when sample is ready it takes colony a lot of time to grow enough to become detectable. So information about dangerous concentration of bioaesorol comes late enough to become not the in-time warning but the explanation of happened disaster.

In this study it is suggested to use bioluminescence for detection of vital cells.

Bioluminescence is the light emission upon oxidation of the organic substance, luciferin, catalyzed by enzyme, luciferase. For firefly luciferase-luciferin system, a necessary and compulsory component of the reaction is adenosine-5'-triphosphate (ATP). It is only at the presence of ATP that the yellow-green light is appeared in this system. Bioluminescence intensity is directly proportional to ATP concentration. Owing to a high quantum yield of bioluminescence in firefly luciferase-luciferin reaction, fairly simple instruments can be used to detect so small ATP quantities as femtomoles by bioluminescence. Bioluminescent ATP assay is the most specific, sensitive, rapid and convenient method to detect ATP micro quantities.

ATP is present in all living cells - plants and animals, microorganisms and man. When the cell dead, the intracellular ATP disappears very rapidly (during minutes) under the action of specific biocatalysts, ATP-ases. The synthesis of new ATP portions is stopped much more quickly. Bioluminescent ATPmetry is a rapid, simple and highly sensitive method for detection of living matter. ATP amount is directly proportional to the number of cells in the sample. The sensitivity of detection is less than a thousand cells per ml of the sample. Analysis takes only several minutes.

During the last years ATPmetry has become a basis for so termed "rapid microbiology". Compared to conventional microbiological tests, the "rapid microbiology" method decreases ten-folds the analysis time, gives quantitative parameters, markedly simplifies the analysis procedure and makes automation feasible. Basic field of "rapid microbiology" applications is detection and control of microbial contamination in biological samples, food products, environment (air, water, etc.). Special methods are used to destroy all cells except bacterial ones and eliminate the nonbacterial ATP from the sample to be analysed. At the same time bacterial cells and its intracellular ATP are not changed. So, it is possible to detect microbial contamination even in the sample that contains both bacterial and somatic cells, for example, the animal or human cells.

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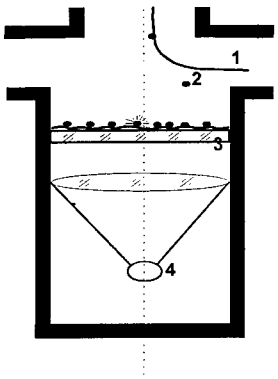


Fig.1.

Best results for measurement of alive bacteria shows virtual impactor with transparent bottom (3). This bottom covered by thin film of reagents for opening of membrane of microorganisms and for activation of ATP-reaction. Each cell gives series of visual quantums. Measurements of bioluminescence pulses sequence by high sencitivity photopipe (4) provides real-time information about bacteria concentration in air.

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Authors appreciate Aerosol Technology Ltd firm for financial support of researches.

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1056.
УДК 541.18

MULTIPARAMETRIC OPTICAL STUDY OF BIOLOGICAL AND OTHERS DISPERSE SYSTEMS

BEZRUKOVA A.G.

St. Petersburg State Technical University, St. Petersburg, 195251 RUSSIA bezr@psb.usr.pu.ru

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Multiparametric optical assay (MOA) can provide further progress in studies of complex disperse systems such as our water and air.

MOA includes the nondistructive analysis of dispersions by different optical methods such as refractometry , absorbance, fluorescence, light scattering (integral and differential, static and dynamic, unpolarised and polarised). Taking into account optical theory and results of study can help to elaborate methods for on-line optical control of complex systems.

Our research has investigated different disperse systems : proteins, nucleoproteins, liposomes, lipoproteids, viruses, lipid emulsions, bloodsubstitutes, latexes, liquid crystals, cells with various form and size, metal powders, barytes, kaolin, kimberlite clay, zeolites and mixtures - liquid crystals with surfactants, liposomes and viruses, mixtures of clay with cells and others, samples of different waters and air sediments, etc., by various optical methods.

One of the most vital problems is development of MOA for on-line environmental control for

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dangerous impurities - metals, oil, viruses, bacteria.

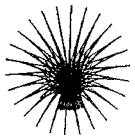
1496.
УДК 541.18

BIOTEST, AN INSTRUMENT FOR MEASURING METABOLIC ACTIVITY OF MICROORGANISMES

B.N.BOYKO, I.I.MATIASHOV,

Institute for Biological Instrumentation of the Russian Academy of Sciences
PERMYAKOV@IBP.SERPUKHOV.SU

(First received 31 March 1998; accepted for presentation during IAS-4)



Abstract

A wide range of problems related to the evaluation of microorganisms concentration or their activity level in various objects while evaluating the effects of different preparations on the microorganisms can be solved by thermodynamical means and methods through measuring the energy generated by the culture in the metabolism process.

The modern level of technology provides for building, with the use of rather simple means, a microcalorimeter permitting to register heat flows of the order of several tenths of microwatt for 1 cubic centimeter. The problem resides not in the measuring system itself but in such a structure of the measuring cells and such measuring technology which could provide for a maximum in reproducibility of results and their comparability.

It was this problem that we aimed to solve when building the BIO-TEST instrument. A method of cultivation in static culture had been chosen for the instrument where the microcalorimetric cell represents a closed system with an initial reserve of nutrient and gaseous medium without removing the products of metabolism.

The cultivation process in such a medium has a characteristic thermogramme, a curve of heat generation vs. time. 4 characteristic phases can be highlighted on a typical thermogramme:

- Initial (lag) phase. It is the time between inoculation and obtaining maximum culture growth rate;
- Exponential (log) phase. It is the time of the maximum growth rate;
- Stationary phase when the growth rate is limited due to substrate amount limitation, to excess population density and accumulation of toxic metabolitic products;
- Dying off phase characterised by growth rate getting down.

Value information, kept in the concrete phase, depends on purposes of study.

The reproducibility and comparability of results are provided by the reproducibility of conditions at the start and during the cultivation process and by the presence of reference thermogrammes obtai-ned under the same conditions for collection strains with given starting concentration.

The main advantage of the thermodynamical method compared with the common methods is the shorting vs. time of analysis. If the time of traditional methods is of several days, for the present technique it is of several hours. In many cases the prompt obtaining of results represents a decisive factor.

The BIOTEST instrument is built according to a differential layout, the heat effect being measured by the method of differential divergence in temperature between the reference and the sample cells. Measurings are carried out at fixed given temperature. The cells of the instrument have useful volume of 10 cubic centimeters and their design allows to place inside preparations under investigation in standard test-tubes. The cells can be sterilized.

The problems solved with the instrument could be devided into 2 groups: poblems of metabolic activity measuring and detection problems. The extreme performance is applied when solving

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the detection problems, e.g. for sterility evaluation. The instrument permits to detect pollution of an about 10 cells per ml for 4 hours of analysis time.
As an example of the instrument application we could mention the investigation carried out by V.E.Ostroumov and N.V.Ostroumova and related to the activity of microorganisms taken in sediments of Pleistocene aged of up to 2 million years from the Kolyma lowland and of yeast from Antarctic samples and its comparison with collection strains. The paper was published in the «Kriosfera Zemli» journal, No 2, vol.1, ed. of SO RAN, Novosibirsk, 1997.



1470
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CORRELATION OF E.COLI LIPID PARAMETERS WITH CELL SURVIVAL IN AEROSOL.

GLUSHCHENKO N.N., BOGOSLOVSKAYA O.A., OLKHOVSKAYA I.P.

Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences Leninskii prosp. 38, b.2, Moscow, Russia. Fax.: (095) 1378258, E mail: nnglu@chph.ras.ru

(First received 01 April 1998; accepted for presentation during IAS-4)

Viability of airborne and lyofilized microorganisms bears on the search of methods for men, animals and plants airborne infections control and, on the other hand, deals with stability, survival and storing of bacterial cells being used for lyofilized vaccines for men, animals and plants immunisation. Lipids are known as a most labile cell structure. Taking into account the role of lipids in the activity of eucariotic and procaryotic cells, we assumed that composition and physicochemical parameters of cell lipids could play an important role in bacterial capacity for survival in the air .

We have found that cell viability in aerosol correlate with cyclopropane acids contents increase, with palmitic acid via palmitolic acid ratio, and might be described with the following equations: lnB = -6,31+2,25ln((17:0+(19:0) - for cyclopropane acids with correlation coefficient 0,81; and lnB = -3,95+3,37ln(16:0)/(16:1(7) - for palmitic acid via palmitolic acid ratio with correlation coefficient 0,86, where B is cell viability in aerosol.

Lipid composition to a large extent is conditioned with lipid physicochemical characteristics,i.e., antioxidant properties, lipid viscosity, oxidizing capacity of lipids.

We have disclosed that cell lipids exhibit antioxidant activity (AOA) and AOA of lipids got from various E.Coli strains vary in the limits differing in 1,5-2 times. Chemiluminescence method enabling to detect antioxidant (AO) contents and antiradical activity (ARA) in cell lipids was used to confirm antioxidants' presence in E.Coli lipids. Antioxidants of E.Coli lipids appeared to vary in contents and ARA.

ARA of E.Coli cell lipids was (3.9-4.6)(105 l/mol(s and in the order of magnitude appeared to be close to ARA value of the wellknown natural antioxidant- (-tocopherol. Acting quotient of antioxidants in E.Coli cell lipids was 0.10-0.16%, lipids from aerosolresistant bacterial straines having higher AO contents, ARA and AOA values than lipids from other strains.

We have revealed that cell lipids of various E.Coli strains differed in lipid peroxidation (LPO) products concentration, minimum LPO products being detected in aerosol resistant strains.

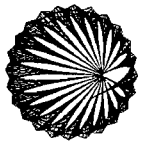
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We determined oxidizing capacity of lipids and calculated the ratio of easy- and hardly-oxidizable lipid fractions (cardiolipin:phosphatidylcholine).

Lipid oxidizability was estimated from the data about fatty acids composition, chemiluminescent curves and double bonds number per one carbon atom in fatty acid chain. Lipids from tested bacterial strains appeared to differ in double bonds numbers and the minimum values were found in aerosolresistant E.Coli strains.

The existence of the LPO regulating system enables to change physicochemical parameters of cell lipids in a specified mode and to affect E.Coli cells survival. Synthetic antioxidants are the agents modifying lipid AOA. Introduction of antioxidants (Fenozans and Ionol) in the E.Coli incubating medium increased cell survival. Fenozan-1 increased cell survival 1.5times, Fenozan-22 - 1.8 times, Ionol - 2.1 times that of untreated samples.

Thus we have proved that physicochemical parametres of lipids of various E.Coli strains correlated with their capacity for survival in the air, i.e.,viability of the airborne bacteria in each group of strains was proportional to lipids AOA and inversely proportional to oxidation products contents. Inverse correlation between viability and double bonds number in E.Coli cell lipids was common for all strains tested. Introduction of antioxidants in the grows medium changed the viability of airborne E.Coli cells. Our data demonstrate the opportunity to modify the viability of airborne bacteria with control on physicochemical parametres of cell lipids.



1196.
УДК 541.18

MATHEMATICAL MODEL OF AEROSOL ASPIRATION IN CALM AIR

KISELEV O.M., ZARIPOV SH.KH., ZIGANGAREEVA L.M.

Kazan State University Chebotarev Institute of Mathematics and Mechanics, Universitetskaya St., 17, Kazan, Republic of Tatarstan, Russia 420008 e-mail:shamil.zaripov@ksu.ru

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It is known that an accurate measurement of the concentration of the airborne dust in the atmosphere is often complicated by nonideality of the aspiration process. Aspiration efficiency is defined as the ratio of a measured concentration to the true one. Determination of the aspiration coefficient for a given kind of aerosol sampler is the problem of great practical interest. The review of theoretical and experimental studies on determination of the aspiration coefficient is done in [1]. The problem of aerosol aspiration by thin-walled tubular inlet in calm air is theoretically solved. For small concentrations of dispersed phase a mathematical modeling of aerosol flows reduces to the solution of two problems: determining the gas flow velocity field and then calculating the trajectories of the aerosol particles in the velocity field obtained. A case is investigated when the gas flow is steady potential axially simmetric flow of an incompressible fluid. For determining velocity distribution of the gas in the vicinity of the sampling inlet the effective numerical method is used. It is based on the boundary value problem for the streamline function in the hodograph plane. The streamline function is represented as the sum of the singular and regular components. For determining the singular component the method of small parameter is used. It allows to reduce the problem to the solution of ordinary differential equations. The regular component is found from the sequence of linear boundary value problems. The equations of a motion of particles are also integrated in the hodograph plane. The limiting trajectory was found by the iterations method. This trajectory divides the particles that enter into the tube from those that do not and allows to calculate the aspiration efficiency. The dependencies of aspiration

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coefficient on Stokes number and settling velocity are constructed. The comparison of calculated data with the experimental formula from [2] is given. This work was supported by Russian Basic Research Foundation, Grant number: 96-01-00111.

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1498.
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TITRATION CALORIMETER IN DIAGNOSIS OF MICROORGANISMS

G.V.KOTELNIKOV, A.N.SHKIDCHENKO, E.A.PERMYAKOV

Institute for Biological Instrumentation of the Russian Academy of Sciences PERMYAKOV@IBP.SERPUKHOV.SU

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Microbial heat production is an integral index for physiological activity of microorganisms which depends on the degree of providing them with carbon and oxygen sources, on cultivation temperature, culture age and other factors.

Information on heat production intensity of a microbial population is of particular interest when cultivating in the area of critical oxygen oncentration where it is possible to pass from aerobic metabolism of substrate utilization to anaerobic one, the readings of the other measuring systems being uncertain.

The variation in intensity of microbial heat production can represent the main criterion of evaluating the effect of various pharmacological and biologically active substances on a microbial population.

It is interesting to solve the problem of measuring heat production in samples of liquid culture with the help of a titration calorimeter. Amongst the most known foreign titration calorimeters we can list the following: OMEGA, an ultrasensitive titration calorimeter of Microcal Corp., USA, 1991; ITC-2, an isothermal titration calorimeter of the Johns Hopkins University Biocalorimetry Center, USA, 1990; a twin titration calorimeter, Colorado University, USA. The first titration calorimeter (KTD-101) in Russia was designed in 1998. This instrument has calorimetric cells as long gold tubes. An additive introduced into the cells can be distributed evenly throughout the volume of the sample placed into the cell. Additives can be introduced repeatedly. Dispensing of additives is carried out with an automated syringe driven from a stepped motor computer-controlled. The time of setting the system of heat production measuring does not exceed 20 s which makes this instrument practically inertia-free for measuring heat production.

Experimental data (1,2) on heat production measuring allowed to provide for necessary ranges of heat production measuring in the KTD-101.

The heat flow value released in fermentation processes under control is of about 4.5 W per 1.5 l of liquid culture.

Calculated for a calorimetric cell of 01.1 cub. cm in volume, the value of registered power is of 3 mW.

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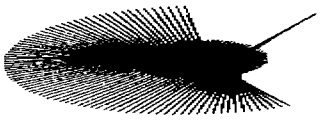
The titration calorimeter KTD-101 permits a reliable measuring of heat production in a sample under investigation its threshold sensitivity being of 0.05 microwatt.

Brief specifications of the calorimeter

Calorimetric cell volume 0.1 cub.cm
Titrant dose range 0 to 10 microliters
Power sensitivity not more than 5.10^{-8} W
Reaction heat sensitivity not more than 10^{-6} cal
PC software operates in WINDOWS-95
Power supply:
- power consumption, V.A not more than 300
- voltage, V 220±22
-frequency, Hz 50±1.

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1295
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CONTRIBUTION OF SOIL BACTERIA IN AIR-PLANKTON OF URBAN ENVIRONMENT

L.V. LYSAK, N.N. SIDORENKO

Moscow State University, Department of Soil Science

Vorobyevy Gory, 119899, Moscow, Russia tel./fax +7 095 / 939 0989 E-mail: klofo@glasnet.ru

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Thanks of its heterogenesis soil provides the existence of different microorganisms, some of them is absorbed on soil particles and other are in water film, capillaries and soil solution. In this connection it should be noted as "the bank of microorganisms or a gene pool of microworld" (Zvyagintsev *et al.*, 1992). This property is a principal biospherical function of soil. Soil bacteria get to the atmosphere and transfer by air to great distances. This is a principal way of its moving all over the earth.

The aim of our work was the investigation of bacterial complex (BC) of soil and connected substrates (litter, leaf fall and phillosphere) contribution in formation of air-plankton of urban environment (Pushchino, Moscow region). The samples were analyzed by sedimentation on the surface of special nutrient medium which allows to count more than 40 genera of soil bacteria. The studies were carried out on three areas with different human impact: in the centre of town (CT), inside an urban public bus and in a suburban forest plot in 1994-96 in different seasons. The quantity and diversity of BC of soil and connected substrates were investigated simultaneously.

Obtained results were processed by modern approaches of synecology. The following regularities were revealed:

— more than 20 genera of soil bacteria were detected in air-plankton composition; the strains of genus Streptomyces, Bacillus, Arthrobacter, Rhodococcus, Cellulomonas, Micrococcus,

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Pseudomonas, Xanthomonas and family Enterobacteriaceae and the gliding bacteria are predominated;
— the maximum quantity and diversity of BC of air-plankton were revealed in the samples of CT and urban public bus; the minimum quantity were in the samples of forest plot;
— considerable changes of quantity of air-plankton by seasons were observed; the maximum index was registrated during spring and summer and the minimum one was in winter;
— the high degree of connection between frequency of some genera from upper lay of soil, litter and leaf fall and genera from the lowest lay of air was emerged;
— the maximum frequency of dominance in BC of air-plankton were determined for such genera of bacteria: Bacillus, Arthrobacter, Rhodococcus, the gliding bacteria (the center of the town); Rhodococcus, family Enterobacteriaceae (the urban public bus); Streptomyces, Arthrobacter, the gilding bacteria (the forest plot)
— fast-growing species of bacteria with short lag-phase were dominated in CT and urban public bus.

The increasing of quantity of genus Rhodococcus and family Enterobacteriaceae in the samples of air from CT and urban public transport are worthy of notice because of their pathogenic, toxigenic and allergenic properties.

Obtained results suggest that contribution of soil bacteria and litter in formation of air-plankton is considerable. The bacteria connected with man are important for composition of air-plankton of anthropogenic habitats.



1044.
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THE METHODICAL APPROACHES TO BIOLOGICAL INDICATIONS OF AIR WASTES OF THE ENTERPRISES OD A MICROBIOLOGICAL INDUSTRY

OMELJANETS T.G., ARTYUKH V.P., GANEVA S.L.

Ukrainian Scientific centre of hygiene, 50, Popudrenko str., Kiev-94, Ukraine, 253660

(First received 23 September 1997; accepted for presentation during IAS-4)

When manufacturing the products with the help of microbial synthesis the pollution of industrial and environment by both viable microorganisms-producents and various protein substances (intermediate products of metabolism of microorganisms - ferments, antibiotics, vitamins and dead microorganisms, their conglomeratesy and dust ready products) is observed.; by impractical microorganisms and their conglomerates; by a dust of a ready product is observed. These biological pollutants can extremely adversely influence on the health of workers, and on the population, who is living in region of accommodation of such enterprises (diseases of a leather, respiratory ways, allergenic disease etc.).

In this connection a major moment at an estimation of biological action of either pollutants the careful its identification and effective method of determination its ingredients is necessary. Especially it has the important meaning at development of the hygienic rules of the allowable contents biological pollutants in industrial and environment objects.

From all methods of the control of biological pollution in air the most full methods of determination microorganisms-producents with use the various apparatus for the samples are developed. At an estimation of microbial pollution of the air in a working zone we used a number of devices - Krotov device, multicascade impactor MB-2, device PAB-1, device MD8 of firm "Sartorius". The device MD8 with the soluble gelatinous filters is the most convenient.

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At determination of protein products, which formed in process of microbial synthesis a method of the immunochemical analysis is the most perspective, it characterised by a high sensitivity, selectivity, expressiveness, allowing determine specific individual albumins.

We used a method of the immunofermental analysis at determination polypeptid-proteins wastes in the air of a working zone and in atmospheric air. Thus we used immunity serum, which was received by immunisation of by a final product (fodder additive of a concentrate of lysine) with using Freund's adjuvant, for increase immunogenity of an antigen the methylated albumin was introduced into the animal.

The selection of samples of the air in a working zone and in zone of air wastes of the enterprises of a microbiological industry was made by aspirator "Krasnogvardeez" on the filter type FPP. Elution of the samples was made with the help of a buffer solution Tries-HCl 0,01M pH7,8. The lysine concentrate contained about 12 % albumin. The chromatographic analysis of a concentrate has revealed presence polypeptides and the protein fragments.

The quantitative determination of an antigen was carried out by a method ELIZA with application of fluorescent or ferment label (peroxidaze). In a case of ferment label the determination, besides, was made according to the intensity of the luminescence in a luminometer.

The results of researches testify, that a method allows to differentiate specific substances of a protein nature from the common protein pollution and to allocate them, even if their amount makes 0,5 -1,5 % from total protein.

The determination of the specific proteins is especially urgent for large microbiological manufactures, which make tens and more preparations using thus many producents and causing the rather complex - structured factors of pollution. Pollutants of a protein nature are rather diverse through the biological properties, and consequently, through the consequences of their influence on health of the persons, from complete tolerance up to provocation of rather heavy diseases. And, the quantitatively insignificant fractions can appear stronger allergens in comparison with other fractions. Therefore it is important to determine just this (the most important by influence on organism) part of protein pollution, as the determination of total protein can mask presence of the specific protein pollutants, to provoke arthefacts and to result to wrong conclusions.

1311
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MICROBIAL BIOMASS AS FACTOR OF STABILITY OF EARTH ATMOSPHERE COMPOSITION

POLYANSKAYA L.

Moscow State University, Departament of Soil Science, Tel+fax +7(095)9390989
Vorobyevy Gory, 119899, Moscow, Russia; E-mail: pol@soil.msu.ru

(First received 06 March 1998; accepted for presentation during IAS-4)

Soil and atmosphere gas change plays a part in the determining atmosphere composition along with volcanic activity, photosynthesis and human impact. Conservation of reduced carbon in soil carries contribution in oxygen component stability of atmosphere. Activity of soil microorganisms has influence on contents combinations N, P, S in atmosphere. Living and dead microorganisms get constantly in atmosphere as result of wind erosion from the upper layer of soil. The number of microorganisms is the important factor of microbiological activity of soil.

Model and field studies of microbial communities allowed to describe seasonal dynamic of number and biomass of soil microorganisms as a whole and different systematic groups and populations. The vertical distribution of microorganisms along the whole profile in the main soil types is studied for the first time. It is shown by the method of epiluminiscent microscopy that the soil microorganisms are widely distributed over the soil profile. The observed results are contradictory to the previous concept about sharp decrease of microbial number at the depth of

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the profiles. The maximum microbe number and biodiversity in all soil types are proper to forest litters. The total amount of microbial biomass by luminescent microscopy studing are considerably above in soil horizons and measured by tens of tons per ha.

The method for account of the microbial biomass in soils was devised. According to this method was conducted the assessment of microbial boimass in the profile of the main soil types. The biomass of soil microorganisms was found to be very sizable. Microbial biomass composes from some units (grey forest soil) to several tens of tons per ha (soddy podsolic soil, chernozem, chestnut soil).

The biomass of mycelium and spores of fungi predominates in the investigated soils and reaches of 88-99 per cent of total microbial biomass. The proportion of procaryotic microorganisms ranges from 1 to 12 per cent depending on the soil type. The predominance of fungi biomass over the bacterial biomass leads to conclusion that the fungi play a main role in destruction of plant debris. The scarce of binding nitrogen commonly occuring in soils becomes clear in spite of sufficient quantity of nitrogen-fixing bacteria. The fungi perform the destruction of main part of plant debris, but they cannot fix nitrogen.

The soils are distinguished by number of microbial biomass and the character of its distribution along the soil profile and in time. The seasonal and interyears dynamic of number of procaryotic and eucaryotic microorganisms in soils was demonstrated. The moisture of soil is one of the main factor which is responsable for these changes. The proportion of microbial biomass carbon is very significant in reserves of organic matter carbon in soil as a whole. The most part of fungi biomass in all soil horizons is viable. Is was revealed that the viable cells of fungi are more in forest litters.

Every soil is characterized by a specific indices of microbial number and quality. The reserves of organic matter connects with favourable conditions for microbial activity and are not determined by deficiency of microorganisms in soil. The indices of microbial biomass and diversity may be used as a criteria for evaluation of ecosystem capability to support the resistance. The large values of these indices are indicative of the stability of the soil-microorganisms-phithocenosis system and is one of the factors of stability of earth atmosphere.



1580.
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BIOSENSORIC APPROACH FOR DETECTION OF MICROORGANISMS

RESHETILOV A.N., ILIASOV P.V.

Institute of Biochemistry & Physiology of Microorganisms RAS 142292, Pushchino, Moscow region, Nauki av., 5 Biosensor research group Phone 007 (095) 9257448 Fax 007 (095) 9233602

(First received 06/05/98; accepted for presentation during IAS-4)

The detection of microorganisms in various media is acute for a number of human activity areas, for instance food industry, environmental monitoring, clinical diagnostics and so on. The existing set of the methods includes direct techniques based on cell count (cytofluorimetry, cultivation on agarized media followed by the clone count, microscopy methods) as well as the indirect ones based on the determination of enzyme activities. In clinical practice and at evaluation of food quality the ELISA-based methods and DNA assays (including PCR) have also been used. The most of these techniques are characterized as time and labor consuming and require high-qualified personnel.

The biosensor assay is characterized by speed, simplicity and precision and in the same time,

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as a rule, doesn't require use of the expensive equipment and highly-qualified personnel. The biosensoric methods of microorganisms detection is intensively developing nowadays; thus, the use of immunosensors for bacterial and yeast cells detection have been described [1,2]. An integration of DNA-biosensoric techniques with PCR opens new possibilities for microbial detection. Such approach allows the assay of DNA sequences specific for the microbial species or taxonomic group.

A promising way is the development of biosensoric methods of cell detection based on registration of their oxide-reductase activities (including dehydrogenase). The analysis of cell dehydrogenase activities can be realized by means of the standard electrochemical transducers used in biosensors - oxygen, ion-selective or mediator electrodes. The receptor of the biosensor in this case will be represented by a membrane containing microbial cells received from the sample. The biosensor based analyzer will register the activities of the microbial enzymatic systems; for a number of cases, if the certain species (strain) will dominate in the sample, it will be possible to identify it using the specific portrait of substrate specificity that represents the ratio of cell catalytic system activities for the set of test substrates.

We used the registration of oxide reductase activity of microbial cells for creation the model biosensor system containing Gluconobacter and Pseudomonas bacteria immobilized on Clark type electrode. The cell membranes of Gluconobacter genus contain dehydrogenases capable to oxidize a broad spectrum of organic substances - sugars, alcohols, and polyols. The oxidation process is accompanied by oxygen consumption and during oxidation of a number of sugars also by appearance of the acidic intermediates. This allows apply the Clark electrodes as well as ion-selective FETs in biosensors for microbial cell detection. The experiments showed that under using of oxygen electrode the lower limit of cell detection made up 0.15 mg of cells/mm^2 (wet weight) in the receptor element, or 10^6 cells in the sample. The value of the same order was obtained for the biosensor based on pH-sensitive FET.

It has been shown that a number of Pseudomonas strains harbor plasmids encoding the enzymes of xenobiotics catabolic pathways that usually belong to oxigenases. Thus, the main steps of degradation are accompanied by oxygen consumption that makes possible the use of such microorganisms for the respective compound detection. Early we reported about the creation of the sensor for naphthalene detection based on P. putida BS238 (pBS2) strain [3]. The transducer of the sensor was represented by oxygen electrode. The technique developed allowed the evaluation of sensor signal dependency on immobilized biomass concentration. The minimal cell concentration in the biosensor receptor made possible the obtaining of signals different from the noise made up approximately 10^6 cells/cm^2 that is ca 10^4 cells in sample.

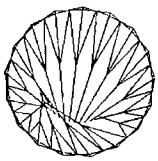
The application of each of the mentioned transducers has restrictions; thus, the use of an oxygen electrode is impossible at anaerobic microorganism detection while the use of pH-sensitive transducer - in the case of absence of pH changes at test compound transformation. These approaches are also not suitable for detection of endospores or other resting/being in anabiosis condition microorganisms as well as viruses. In such cases seems perspective the use of immunosensors or DNA sensors based on coupling the ELISA or DNA assay with biosensoric approach (ion-selective transducer or surface plasmon resonance device). Nevertheless, we think that the approaches described above and based on amperometric and potentiometric assay are able to ensure the sensitive detection of the presence and quantification of microorganisms.

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1061.
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SAMPLING, SEPARATION AND ACCOUNT OF BIOLOGICAL PARTICLES

TOPORKOV V.S., BAKIROV T.S., GENERALOV V.M. , MEDVEDEV A.A.

Research Institute of Aerobiology State Research Center of Virology and Biotechnology Vector Koltsovo, Novosibirsk region, Russia

(First receive 31 December 1997, accepted for presentation during IAS-4)

This paper involves theoretical and experimental researches on the bioaerosol sampling from arbitrary aerosols, transferring them into life- supporting solution as well as separation of the bioaerosols by their polarizability in the inhomogeneous alternating electric field.

A design choosing of the aerosol selective sampler and theoretical calculations of its efficiency have been made. To select optimum parameters of the setup, to improve its scheme and for better understanding of its operation the numerical researches involving the mathematical modeling of air and particle motions have been performed. The air flow field was calculated by Navier-Stokes equations for the viscous incompressible flow. Then particle motion equations were numerically integrated by Runge-Kutta method. The efficiency of particle separation have been determined from the calculated particle trajectories.

A design of the setup for the aerosol particle deposition to liquid has been developed. The design provides the absence of the impact shock in time of contact of particles with liquid, preservation of their viability and high efficiency of transferring of bioaerosol particles to liquid.

The problems of the interaction of bioparticles with the inhomogeneous alternating electric field over a wide range of frequencies and in various life-supporting solutions are discussed. The block-scheme of the program for the determination of the particle polarizability and dipole moment on the basis of the experimental data for measuring chamber geometry, electric potentials at the electrodes and nature of the particle motion is presented.

The coefficients of polarizability and dipole moment for cells of Vero, erythrocytes of goose and monkey have been experimentally determined. The cell deformability in the alternating electric field at different frequencies and under variations in alternating voltage at the electrodes of the measuring chamber have been measured.

The instrumentation and procedures of measurement are described.



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1590.
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AEROPALYNOLOGY IN RUSSIA: RECENT STATE AND PROSPECTS

VALENTINA V.UKRAINTSEVA.

Komarov Botanical Institute of the Russian Academy of Sciences,

Popov Steet , 2 , St.-Petersburg , 197376, Russia

(First received 01 June 1998; accepted for presentation during IAS-4)

Pollen and spores of plants as a component of atmosphere aerosol are a source of great value of information. Investigation of airborne pollen and spores has wide range of application in medicine, plant pathology, ecology, agriculture, foresty etc. (Grana, 1992.Vol.30.No. 1, 2) and in an environmental expertises (Ruffin e.a.,1983; Nilsson, 1991 and so on). Some airborne pollen and spores types are as known of cause of allergy, asthma and alviolity problems when they come in contact with human and animal micosa. That is because very important to know if that pollen/spores family is estimated to be presented or not in air and level of its presence: Absence, Low, Medium, or High. If the pollenotic patients are informed on this subject, they are able to better organize their own life, as concern work and holidays, in order to avoid running risks of diseases or take preventive therapeutic measures. Sampling is also essential for the preparation of adequate extracts.

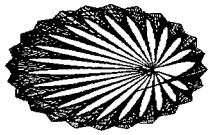
A study of content and concentration of airborne pollen and spores has been carried out at St.-Petersburg by author using first both gravimetric (in 1992-1993) and volumetric (in 1993-1994) methods of sampling. Obtained data allow us to make some conclusions of principle: (1) at first steps of airbiological investigations needed to use both gravimetric and volumetric methods of sampling; (2) in large towns like Moscow, St.- Petersburg, Novosibirsk, Tomsk etc. it is necessary to use for a sampling 2 - 4 Burkard Volumetric Spore Traps because the content of aeroallergens and its concentration differs on principle in different sites ; (3) it is necessary a long standing monitoring of airborne allergenic pollen and spores to use obtained data for preventive medicine. Thanks to these studies first the Data Bank of Allergenic Airborne Pollen has been created at St.-Petersburg.

Over the years more then 20 European countries have contributed data for allergen service information to the International Association of Aerobiologist (IAA), working group <European Allergen Network> (EAN). In the ten past years the number of airborne pollen and spores monitoring stations in Europe and North America has increased considerably, namely due to a growing awareness of the importance of having knowledge of atmospheric content and concentration of pollen and spores for the etiology of pollinosis (Aerobiologia ,1992. Vol. 8. N. 2/1; Traveller's Allergy Service Guide, 1992; Allergy Service Guide in Europe, 1994). In spite of rather good success at the field of aeropalynology in 1960-1970 in my country we have at the moment a few aeropalynological monitoring sits only, e.g. in Moscow, at St.-Petersburg and at Novosibirsk. Russia and neighbour countries (Belorus, Ukraine, Georgia, Kazakhstan, Tadjikistan) are a vest and complex territories, where almost all types of climate and vegetation known to man are represented. It is therefore very important to study the same precision of analysis of air samples. This is because the greatest goals for aeropalynologists of my country and for aeropalynologists of above neighbour countries (former the USSR) at the moment are: 1) distribution pollen and spores monitoring stations and regional nodes over Russia ; 2) to reach the target of constitution of National Airborne Pollen And Spores Data Bank; 3) installation of Russian Aeroallergen Network Server and collaboration both with aerobiologists of European Aeroallergen Network and with aerobiologists of America; 4) creation of <an Atlas Of Airborne Pollen And Spores Of Russia>. The <an Atlas Of Airborne Pollen And Spores Of Russia> will contain descriptions and illustrations of most important allergenic pollen grains and spores taxa

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from different districts of Russia and neighbouring territories. It will be serve as an aid to people engaged in aeropalynology, allergology, agriculture, environmental expertises, criminology , etc.

Sum up all above one can see we have a lot of greatest goals at the moment at the field of aeropalynology. It is hardly too much to say that realization of these goals has very important scientific and applied interests. That is because I believe it is worth to pool our efforts for its realisation.



1568.
УДК 541.18

THE PRINCIPLES AND METHODS OF BIOLOGICAL AEROSOL INVESTIGATION

V.V.VLODAVETS, S.U.LYSENKO

(First received 25 May 1998; accepted for presentation during IAS-4)

Bioaerosols in the indoor air and atmospheric air containing bacteria, viruses, mould spores, yeast, algae and protozoa, obey the physical laws like any aerosol particle of a certain size. At the same time they are the biological objects, and their viability and biological properties depend on many environmental factors. That is why the apparatus for bioaerosol catching must combine high efficiency of catching and maximum favourable conditions of preserving viability and biological activity of microorganisms.

The latter is especially important for detecting low-viable species of bacteria and a number of viruses in the air.

These are the principal requirements for the devices and methods of bioaerosol study.

1. High efficiency of bioaerosol catching.
2. The preserving of viability of the maximum amount of microorganisms caught.
3. Simplicity of apparatus preparing, of sampling and possibility of subsequent sterilizing of instruments.

All methods of bioaerosol investigations may be divided into 3 main groups.

I. Qualitative methods which don't make it possible to detect the content of microorganisms in a certain volume of air.

II. A large group of devices for the calculation of microorganisms in a unit of air volume. This large group of devices should be subdivided into the methods where microorganisms are caught onto the surface of solid nutritive media, and into the methods where bioaerosols are caught into the liquid media.

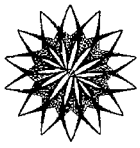
III. Macroscopical research methods that are intended mainly for the studies of the bigger objects of air plankton (mould spores, yeast and yeast-like fungi), as well as for growing microcolonies on the surface of filtration stuffs. And besides, in such cases the use of special investigation methods is possible.

There are some specific features and difficulties while sampling bioaerosol from the moving means of transport (automobiles, planes).These difficulties are especially great when studying viable microorganisms in stratosphere.

All methods of bioaerosol investigations, except microscopical ones, provide for catching microorganisms followed by the use of bacteriological, virological and micological methods of sample analysis.

While analysing the content of certain species of microorganisms in the air, especially low-viable ones in aerosol, the priority should be given to microbiological methods of detection and identification of microorganisms.

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1419.
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METHODOLOGICAL ASPECTS OF ESTIMATING THE MICROBIAL AEROSOL PARAMETERS INDOORS

VOROBEYCHIKOV E.V., GRANSTREM K.O., IVANOV V.P., KURTZER G.M.

St.-Petersburg I.I.Mechnikov State Medical Academy,
Fax: (812)-5431571, paa@infopro.spb.su

(First received 02 April 1998; accepted for presentation during IAS-4)

In practically unventilated enclosed spaces, the estimation of the concentration of a microbial aerosol and its space-and time distribution, as well as the prediction of the pulse of the concentration (dose) of microbial bodies getting into human body or on various surfaces is a complicated methodological task.

The current experimental contact methods of estimating the concentration of the microbial aerosol based on impacting of particles, as a rule, introduce additional turbulence into the studied medium and have a great error of measurements of the order 50%. Application of non-contact methods of study (i.e. optical, laser, electric induction etc.) are based on the dependence of the parameters of the utilized physical field energy on the concentration of particles requires the development of a special procedure that will provide the estimation of non-stationary quantitative characteristics of the microbial aerosol in space and time coordinates with high precision and confidence.

Theoretical investigations of the estimation of aerosol concentration, concentration pulse, and particles sedimentation density include deterministic and stochastic mathematical models which have a good correlation with the experimental data of the distribution of aerosol in an open half-space. In this case, during calculations, a model of a point pulse source of aerosol is used, and the equation of turbulent diffusion is solved with the help of the given conditions at the beginning and end. The probabilistic method is based on spatial distribution of particles which is generally assumed to be Gaussian by three spatial coordinates.

As applied to unventilated enclosed spaces, the deterministic approach has a number of drawbacks because no exact solution of the equation of turbulent diffusion has been found, while possible corresponding estimates of the parameters by means of a simplified approach, for example, substitution of the room boundaries for aerosol sources or run-off are highly approximate which leads to great errors. Besides, it is practically impossible to interpret the obtained estimates because the quantitative parameters of the internal sources and their spatial and time characteristics alter inadvertently which is not considered in this approach. The impact of casual values of the quantitative parameters of the sources requires additional procedures of averaging the estimates with the corresponding laws of distribution.

When estimating the parameters of aerosol, the application of the probabilistic approach is determined by a possibility of justified adoption of the laws of spatial and time distribution of particles in the room. From physical point of view, under such conditions probabilistic and statistical description of the distribution of aerosol is more justified. It should be assumed that in the absence of regulated air flows in unventilated space of the room, the probability of finding aerosol particles in any region depends only on the volume of this region, but not on its form and position in space, whereas the number of particles present in non-overlapping areas is an

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independent random value. In this case, the distribution of aerosol particles present in a particular area can be described by the law of Poisson.

Application of the law of Poisson to estimate the concentration, concentration pulse, and microbial bodies sedimentation density requires the knowledge of the mean concentration of microbial aerosol in this room. Low precision of the experimental estimates of this parameter actuates the development of probabilistic mathematical models to relate the mean concentration of aerosol to the main factors in the room (the number of sources and their capacity, room volume and age, viability of microorganisms, etc.) which affect a given value. For this purpose, the application of the methods of multivariate statistical analysis, i.e. regression analysis and the analysis of variance, the method of main components, etc. is suggested.

Along with the prediction of the concentration pulse on the basis of the distribution of Poisson the actual problem of visualizing the spatial distribution of aerosol in real time is pressing. This necessitates the study of spatial and time interval of the correlation of aerosol concentration with subsequent application of these data for the development of the system of microbiological monitoring the air in the rooms of various designation.

Experimental studies of the concentrations of microbial aerosols have been performed, real ranges of concentrations and dispersion composition of particular species of microorganisms most often encountered in practically unventilated enclosed spaces have been shown. Data on concentrations at various values of factors affecting the variability of quantitative characteristics of microbial aerosols have been obtained. On the basis of experimental data, the estimates of concentration pulse, of the density of sedimentation of microorganisms onto surface have been presented, as well as predictive probabilistic models to evaluate the value of the aerogemic mechanism of dissemination of opportunistic microbes under specific conditions have been designed.



1045

PULSED LIGHT DEVICE FOR DEACTIVATION OF BIOAEROSOLS

WICK C.

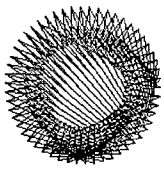
ERDEC

(First received 22 December 1997; accepted for presentation during IAS-4)

The health care community has sought to reduce the hazardous bioaersol levels in hospitals, and operating theaters for many years. Historically, filters and other such devices have been used to some effect, but the problem persists frequently resulting in patients contacting serious infections as a result of the environment. A new device which utilizes high energy pulsed light to completely deactivate bioaerosols is presented. The Pulsed Light Device (PLD) uses high intensity, broad-band pulsed light as the mechanism for killing micro-organisms. Experimental results demonstrated high effectiveness for air streams having flow rates of 20-200 cfm containing Bacillus spores.

Other experiments demonstrated that the PLD could maintain a clean environment in a closed room for more than eight hours, during which high concentrations of Bacillus spores were continuously inoculated into the inlet air stream. Further, the PLD could rapidly decontaminate the air in a room after spores were dispersed inside it. Experiments indicate that the PLD is fully capable of both modes of operation.

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1046.

A PORTABLE HIGH-THROUGHPUT LIQUID-ABSORPTION AIR SAMPLER [PHTLAAS]

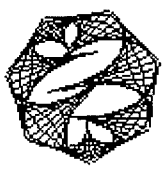
Dr. S. Zaromb, Dr. A. Birenzvige, R.W. Doherty

(First received 13 January 1998; accepted for presentation during IAS-4)

The portable high-throughput liquid-absorption air sampler [PHTLAAS] is an outgrowth of a high-volume vapour collector that was first developed at the Argonne National Laboratory [ANL] for the ultra-sensitive detection of trace concentrations of hazardous or illegal compounds whether in vapour or aerosol form. The sampler is characterized by its light weight (about 1 Kg) and low power consumption (less than 20 watts DC).

The PHTLAAS was evaluated as a sampler for aerosol particles in the size range of 2 - 10 micrometers (aerodynamic diameter) in a wind tunnel. The sampling efficiency was found to be between 20% - 85% (depending on aerosol particle size) at sampling rate of 230 - 250 litter / minute. The sampling efficiency was invariant to the orientation of the intake slit in respect to the wind direction, or the vertical inclination of the sampler up to 75 degrees off the vertical for aerosols of 3 microns diameters and wind speed below about 2.2 m/min (5 MPH). More recently an improved version of the sampler yielded a collection efficiency of about 20% at a sampling rate of 380 litter / minute.

The paper will describe the sampler and its characteristics in details. Also discussed will be test results using fluorescent particles as well as biological particles of Bacillus Subtilis (BG). performed in a wind tunnel and a static aerosol chamber. Potential uses for the sampler will be discussed as well.



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List of participants of IAS-4 with presentations during 6 July 98

Bakirov Talgat Salmanovich *(1946-01-25)*
Russian State Scientific Biological Center VECTOR
Phone: (7)-3832-630055
fax (7)-3832-328831
email: root@churc.nsk.su
Novosibirsk Russia

Balahanov Mihail Valentinovich *(1947-03-08)*
SE VNIIFTRI
Phone: (7)-095-5359359
fax (7)-095-5359349
email: balah@ftri.extech.msk.su
Moscow Russia

Belov Nikolay Nikolaevich *(1947-05-04)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Belova Nina Georgievna *(1944-02-25)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia



Bezrukova Aleksandra Gennadievna
St. Petersburg State Technical University
Phone: (7)-812-5557413
fax (7)-812-5557413
email: bezr@psb.usr.pu.ru
St.-Petersburg Russia

Bordenyuk Andreyi Nikolaevich *(1974-07-27)*
Moscow State Technological University
Phone: (7)-095-1352408
email: zlobina@sci.lebed.ru
Moscow Russia

Bozhevolnov Viktor Evgenevich *(1947-01-01)*
Moscow State University
Phone: (7)-095-9393207
fax (7)-095-9328846
email: gorba@radio.chem.msu.ru
Moscow Russia

Castillo Jose Luis *(1955-02-21)*
Universidad Nacional de Educacion a Distancia
Phone: (34)-1-3987122
fax (34)-1-3986697
email: castillo@apphys.uned.es
MADRID Spain

Chechik Oskar Samuilovich *(1936-05-21)* VNF VAPA
Phone: (7)-812-2514332
fax (7)-812-1643274
Chechik@Chech.USR.PU.Ru
St.-Petersburg
Russia



Chernyak Vladimir Grigorevich *(1946-03-10)*
Ural State University
Phone: (7)-3432-616775
fax (7)-3432-615978
Vladimir.Chernyak@usu.ru
Ekateinburg Russia

Dirksen Veronika Gennadevna
St.-Petersburg Russia

Evsikova Lyubov Georgievna *(1938-08-28)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2188063
fax (7)-812-2183720
St.-Petersburg Russia

Gavrilov Aleksandr Sergeevich *(1948-02-10)*Russian Hydrometeorological Institute
Phone: (7)-812-2243039
fax (7)-812-3251281
email: gavr@mcep.rshmi.spb.ru
St.-Petersburg Russia

Gentry James W. *(1939-11-27)*
University of Maryland
Phone: (1)-301-4051915
fax (1)-301-3149126
email: Gentry@eng.umd.edu
College Park USA

Germogenova Tatyana Anatolevna *(1930-04-10)*
M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Phone: (7)-095-2507861
fax (7)-095-9720737
email: germ@kiam.ru
Moscow Russia

Gluschenko Natalya Nikolaevna *(1946-03-24)*
Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences
Phone: (7)-095-9397937
fax (7)-095-1378258
email: nnglu@chph.ras.ru
Moscow Russia

Granstrem Konstantin Olegovich
St.Petersburg I.I.Mechnikov State Medical Academy
Phone: (7)-812-5431920
fax (7)-812-5431571
email: paa@infopro.spb.su
St.-Petersburg Russia

Grigorev Aleksandr Ivanovich *(1946-01-13)*
Yaroslavl State University
Phone: (7)-0852-3339268
fax (7)-0852-354777
email: grig@univ.uniyar.ac.ru
Yaroslavl Russia

Grushko Yuliyi Sergeevich
email: grushko@LNPI.SPB.su
Gatchina Russia



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Kameshkov Gennadiyi Borisovich *(1943-02-09)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189946
fax (7)-812-2188179
email: Irina@tks-opt.spb.ru
St.-Petersburg Russia

Katkov Vladislav Leonidovich *(1936-05-11)*
Institute of Engineering Cybernetics
Phone: (375)-0172-685296
fax (375)-0172-318403
katkov@newman.basnet.minsk.by
Minsk Belorus

Konovalov Nikolayi Vasilevich *(1947-08-28)*
M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Phone: (7)-095-2507861
fax (7)-095-9720737
email: knv@kiam.ru
Moscow Russia

Koromuslov Vyacheslav Aleksandrovich
Yaroslavl State University
Phone: (7)-0852-222325
fax (7)-0852-354777
email: polya@univ.uniyar.ac.ru
Yaroslavl Russia

Kucherov Arkadiyi Nikolaevich *(1951-02-09)*
Central Aerohydrodynamic Institute named after N.E. Zhukovsky
Phone: (7)-095-5564807
fax (7)-095-5564337
ank@dept.aerocentr.msk.su
Moscow Russia

Kudryavtsev Ilya Aleksandrovich *(1968-12-07)*
Aerospace University of Samara
Samara Russia



Letfullin Rinat Rifgatovich *(1962-03-01)*
Samara Branch of P.N.Lebedev Physical Institute
Phone: (7)-8462-340536
fax (7)-8462-355600
email: theor@fian.samara.ru
Samara Russia

Logvinov Leonid Mitrofanovich *(1944-09-01)*
Aerospace University of Samara *Phone*: (7)-8462-357356
fax (7)-8462-357356
email: onil16@lib1.ssau.ru
Samara Russia

Makovtsov Gennadiyi Anatolevich
Russian Scientific Optical Center named by Vavilov
St.-Petersburg Russia

Mihayilov Oleg Mihayilovich *(1938-12-19)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189952
fax (7)-812-2183720
St.-Petersburg Russia



Omelyanets Taisiya Grigorevna *(1938-01-25)*
Ukrainian Scientific Hygienic Center *Phone*: (7)-044-5593433
fax (7)-044-5599090
email: omelyans@usch.kiev.ua
Kiev Ukraine

Pinaev Viktoor Alekseevich
State University of Kemerovo
Kemerovo Russia

Pominov Evgeniyi Ivanovich *(1946-09-21)*
Aerospace University of Samara
Samara Russia

Redkoboroduyi Yuriyi Nikolaevich *(1940-03-10)*
Astronomical Observatory of Kiev University
Phone: (7)-044-2160906
REDCO@AOKU.FREENET.KIEV.UA
Kiev Ukraine

Terentev Vladislav Evgenevich
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2180082
fax (7)-812-2183720
email: Leader@soi.spb.su
St.-Petersburg Russia

Tkachev Vladimir Vasilevich *(1926-01-20)* Institute of Occupational Health RAMS
Phone: (7)-095-3653130
fax (7)-095-3660583
email: tkachiov@iog.nifhi.ac.ru
Moscow Russia



Ukraintseva Valentina Viktorovna
Komarov Botanical Institute of the Russian Academy of Sciences
email: ukr@nk1834.spb.edu
St.-Petersburg Russia

Uvarova Lyudmila Aleksandrovna *(1951-04-21)* Moscow State University STANKIN *Phone*: (7)-08222-9729520
email: uvarova@stanmat.mian.su
Tver Russia

Vlodavets Viktor Vladimirovich
Moscow Hygiene Institute named Erikhman S.S. Moscow Russia

Vorobeyichikov
St.Petersburg I.I.Mechnikov State Medical Academy
fax (7)-812-5431571
email: paa@infopro.spb.su
St.-Petersburg Russia

Korobeyinikova Aleksandra Vasilevna Institute of Labour Safety *Phone*: (7)-812-2790863
fax (7)-812-2352632
St.-Petersburg Russia



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Сотрудничающий центр ВОЗ по медицине труда
105275 Москва, проспект Буденного, 31 Факс 366 05 83 Тел. 365 02 09

The W.H.O. Collaborating Centre In Occupational Health
31, Prospekt Budennogo. 105275, Moskow, Russian Federation
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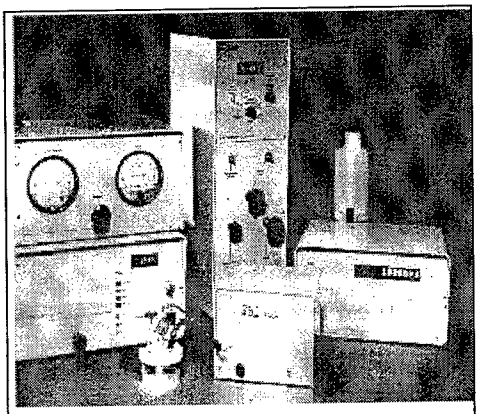
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Dr. BALAKGHANOV M.V.

Moscow -1998

Printed in Russia

address Belov N 21-117
2-Mosfil 119285
tel/fax (095)1474361
BELOV@TEHNO.MMTEL.MSK.SU

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AEROSOL RESEARCH ISSUES RELATED TO HEALTH AND DEFENSE POLICY

Geernaert G.

National Environmental Research Institute, Denmark

(First received 13 January 1998; accepted for presentation during IAS-4)

Aerosols have been identified as one of the key atmospheric constituents which govern health policy, tactical defence operations, and climate. Aerosols originate from a number of natural and anthropogenic sources. Wind blown dust and sea spray are among the natural emission types, which are not easily governed by emissions controls. While also classified as a natural source, forest fires are, on the other hand, in most part controlled by human intervention.

The anthropogenic emissions are governed in most part by the industrial and traffic sectors. These sectors may be characterized with "controllable" emissions, where policies may be formulated to reduce or optimize emissions based on their impact across a variety of economic. In order to optimize labour output, health, tourism, defence, and other sectors, policymakers are obliged to select the appropriate environmental and economic instruments which satisfy a cost-benefit analysis. Such analyses are based on scenarios, options, and forecasts. This presentation summarizes the aerosol research issues which are necessary to carry out, in order to identify the type and extent of emissions control policies. The focus of the presentation will be on the health sector, and a secondary focus will be on defence. The discussion will highlight the experimental needs, quality of parameterizations and models, and the needs of the customers and stakeholders. The points will be illustrated with case studies from Europe, the USA, and southeast Asia.



1267
УДК 541.18

BERILLIUM AEROSOL: HIGH DANGER YET POSSIBLE PREVENTION OF HARMFUL EFFECTS

N. KHELKOVSKIY - SERGEEV

RAMS Institute of Occupational Health, Moscow, Russia

(First received 20 February 1998; accepted for presentation during IAS-4)

Beryllium (Be), its oxides and alloys are applied in power and space technologies, aviation, and other branches of industry In Russia more then 300 plants were primary consumers of Be during the most favourable period of economic development.

Be aerosols are inflammable and explosive, they are extremely toxic (1 class of danger, 0.001 mg/m is the MAC value for the air of working zone, 0.0001 mg/m is the MAC value for the ambient air, they are allergenic and carcinogenic). Acute and chronic respiratory pathologies may develop when Be aerosol penetrate to the body. The most severe and difficult to be cured is berylliosis that may progress long after the ceise of the contact.

Toxicity of Be was found in the middle of the 30 - s in Russia, Germany and Italy. The peak morbidity level fell on the 50 - s and the 60 s when production sharply increased, safety measures were not developed at that moment. About 1500 cases of the disease were registered in Russia and the USA, however, the figure should be considered as a diminished one because the register impairments due to berylliosis was developed in Russia only in the 80 - s, besides, actually no cases of non - occupational berylliosis were found in Russia (while in the USA up to 11% of cases were registered in the highest levels of morbidity). At present acute cases were eliminated though

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single chronic cases can be revealed, however, potential danger still exists.

Be human effects were most thoroughly studied in the RAINS Institute of Occupational Health. Cytotoxicity and allergenic manifestations that cause immune impairment lay the basis of Be human effects. When in the organism, Be may cause local macrophage - neutrophyl response, it impairs cell membranes, penetrates to the cells, leads to hydrolyst and hematoxic factors. It also breaks in cell nucleus the synthesis of protein and provokes the synthesis of autoantigens. As a strong chemical allergen, Be may cause specific reaction. Cytotoxic, allergic and immune processes develop simultaneously, prevalence of any of them depends on the level of exposure and the type of compounds. Of particular importance is the genetic predisposition, or increased sensitivity to Be, as an allergen, on a genetic level, acquired pre disposition developed due to severe endocrine shifts because of chronic pathologies, injuries, surgery, deliveries, etc., is also important.

According to the classification of the IARC Be is referred to 2 A carcinogens.

Safety measures have been well developed. In Russia the greatest number of maximum adminittable levels and concentrations have been established for Be: they are for the air of working zone, ambient air, water basins, for skin surface of hands, equipment, tools, and production, for individual protective clothing, etc. Engineering, construction ventilation measures on work hygiene and environmental protection have been developed including specific fine diagnosis methods. The main criterion of safety is strict observance of hygienic requirements.

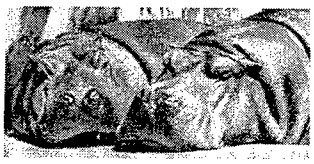
Big Be processing enterprises have been built with regard to helpful consultations of experts of the Institute, long-term follow - up periods of working conditions, environmental protection showed that Be in the concentration in the air could be lower then the standard values. No diagnosis of berylliosis have been put during two decades of follow - up periods using immunological, physiological, roentgenological and clinical methods.

Along with all the mentioned facts, many problems concerning Be are still unsolved:

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1. Long - term follow - up periods with regard to the health are to be continued concerning long - term Be effects, both of active contingents, and those whose contacts have been ceized, at MAC level and lower which will complete the work on hygienic MAC approbation;
2. Necessary is the research of Be carcinogenic effects in cohorts exposed to it at MAC level and lower;
3. Regarding individual sensitivity in the development of berylliosis, adequate seems improvement of tests for medical examinations, pre work identification of risk groups, development of recommendations on ceisure of Be contacts;
4. System of Be monitoring in industry is necessary including the wastes; development of hygienic requirements is necessary to eliminate Be branches;
5. As more then 93% of Be goes to the atmosphere with coal burning at thermal power stations, advisable with be health study of workers, environment, and nearby residents if coal with high Be content is used,.

This question has not been studied so far in full.



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EXOGENOUS SUPEROXIDE IS A VITAL NECESSARY COMPONENT OF THE ENVIRONMENT

GOLDSTEIN N.

Stahnsdorf, Germany Email: 100345.205@compuserve.com Fax:+49(0) 3329-660200

(First received 19 February 1998; accepted for presentation during IAS-4 Published by recommendation of Professor Korkina L.G.)

During the last nearly thirty years, a large body of experimental evidence has accumulated that suggests an important role for reactive oxygen species in numerous pathophysiological processes. The discovery by McCord and Fridovich in 1969 that an enzyme exists that has superoxide dismutase activity, suggesting the continuous formation of superoxide in mammalian cells in vivo as well as involvement of the superoxide in the inflammation and post-ischemic reperfusion syndrome consolidate the opinion about the "good" superoxide dismutase and the "bad" superoxide that they scavenge (1). However, the superoxide is not all bad effects how. Moreover, we have reported that gaseous superoxide (GS) is an inalienable part of the atmosphere, and is also essential for the terrestrial organisms (2). Uninterrupted deprivation of the atmospheric superoxide lead to the degeneration of the hypothalamic and pituitary nervous and secretory cells leading to numerous movement and autonomic disturbances and death of animals. Hypothalamus by means of the "periscope" from the diencephalon, vomeronasal system may monitor exogenous GS and is probably the first brain structure sensitive towards the GS changes in the ambient air. In this connection it is not unlikely that the partial lack of the GS could be the cause for the so called sick building syndrome and other complex vegetative disturbances, in human-beings.

Inhaled artificial GS provokes cascade of dramatic biochemical and physiological reactions. Thus, inhaled GS suppresses monoamine oxidase activity in the regions of hypothalamus and basal ganglia activating brain dopaminergic and serotoninergic mechanisms (3) as well as enhancing brain tissues superoxide dismutase activity. Catalase, glutathione peroxidase, glutathione reductase and glutathione are also involved in these reactions. In addition, inhaled GS suppress cytochrome P-450 activity in the liver causing changes in the metabolism of xenobiotics including various drugs. In the fore-part of pituitary, inhaled artificial GS activates both adrenocorticotropin and thyroid hormone producing adenocytes stimulating the cortisol production by the adrenal glands and activating the cell respiration, in vivo.

The biochemical changes observed underlie the numerous physiological and therapeutic effects caused by inhaled artificial GS. We have reported that the GS potentiates pain-relieving action of the opioid and non-opioid analgesics in animals and human-beings (4 - 6), weaken action of the narcotic and sedative drugs, improves disordered movement and autonomic functions in parkinsonian patients (3), and the respiratory function in asthmatics (7, 8). Exogenous GS abolishes toxic effects caused by the hyperbaric and normobaric oxygen, and enhances efficiency in the various experimental conditions, in animals. In addition, inhaled artificial GS modifies spontaneous activity in animals, and decreases temporal and spatial threshold of the smell (9) and gustatory, in human-beings.

Thus, all our data suggest that the gaseous superoxide found in nature a constructive use and is a vital necessary component of the environment.

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1530.
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EXTREME AEROSOL EVENTS AND HEALTH IMPLICATIONS

G.L. GEERNAERT, P. WAHLIN

Ny Toftegaardsvej 22, DK-3650 Olstykke, Denmark E-MAIL: GLG@dmu.dk

(First received 15 April 1998; accepted for presentation during IAS-4)

Of all the atmospheric pollutants, aerosols provide the most severe impacts on human health. Aerosols affect airways diseases, which lead to respiratory infections, sensitization to indoor allergens, and acute and/or chronic changes in pulmonary function. These health effects are near-term responses, and can be indirectly measured in terms of health various endpoints. Examples include lost days of work, visits to the hospital, and lower job productivity. Given that particulates below 2.5 micron are the most serious for health considerations, the sources of these particulates must be identified in order to construct effective emissions control strategies. Health damages are measured in terms of economic loss, and the damages are distributed into the indoor and outdoor components. Heating systems, industrial production, traffic, and urban construction all contribute as the most important sources. Using examples from Europe and also case studies in southeast Asia, extremes of aerosol concentrations will be discussed in terms of their health and economic impacts. The talk will summarize with uncertainties in existing estimates, with a list of research topics which are necessary to increase the performance of next generation health impact assessments due to extreme aerosol concentrations.



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HYGIENIC CONTROL OF INDUSTRIAL AEROSOLS: PROBLEMS OF INTERNATIONAL UNIFICATION

V.V. TKACHIOV,[2] V.V. SUBBOTIN [1], B.F. KIRIN[2], V.I. DREMOV[2]

[1] *RAMS Institute of Occupational Health, Moscow, Russia*

[2] *State University of Mining Moscow, Russia*

(First received 05 march 1998; accepted for presentation during IAS-4)

Long time exposure to industrial aerosols with elevated concentration of firm particles leads to the development of severe respiratory pathologies in the form of pneumoconiosis and dust bronchitis. Also silicosis (the most severe pathology) may develop due to the exposure to silica dioxide, anthrasiolicosis due to coal and dusts, anthracosis due to coal dusts, etc. 40% of all newly identified occupational pathologies relate to industrial aerosols in Russia. Economic losses due to one severe case make up almost one million of denominated Russian roubles.

The basis of occupational prevention is hygienic rating and control of dust in the air. In Russia gravimetric indices in mg/m3 are used to show the mass of inhaled dust. No legal health standards exist in Russia on the number of particles in a certain volume of air. Numerous instruments of foreign origin designed to control the number of particles, or respirable, fine, fraction can not be applied for Russia.

Duration of gravimetric measurements in Russia is equal to one-time maximal dust concentration and lasts for 30 min. of work at which dust is produced .

Both continuous and intermittent one-time sampling is possible. To compare the results with the MAC values mean concentration of all summated one-time samples taken within the period of 30 min. should be considered with regard to each one-time sample. In other countries mean shift gravimetric values (time-weighted average values) compose a standard. Other safety values have recently been introduced in some countries which are closer to those adopted in Russia.

2.2.3.570-96 Document on Health Safety abbreviated to SanPinп in Russia contains the data on methodology of individual dust exposure with the aim to regulate occupational health risks (principle of protection by time) including 2.2.013-94 document entitled Russian Guide on Hygienic Criteria of Assessment of Working Conditions on Hazardous Indices of Industrial Factors, Severity and Intensity of Work.

Principle of protection by time and reliability of occupational prevention are not possible without improvements of dust control measurements. This control should provide validity of such measurements that would help observe hygienic requirements and would not be costy. The most advantageous in this respect is regular monitoring of dust content in the air of a working zone using stationary sensors with further electronic accumulation, distribution and storage of information.

Approaches to measurements of respirable fraction abroad are different. For instance, in Germany sites of measurement are selected to achieve, if possible, in one and the same zone of gradation the same mean dust concentration. In France and Great Britain the best number of points of measurement is considered the minimal one, In the USA mines individual dust loads with extra measurements in specified sites are of particular attention.

One of the leading German specialists Dr L.Armbruster thinks the present level of dust elimination as well as measurements and assessment of dust concentration in coal mines of the EEC and the USA reflects national specific features as well as specificity of each mine which impedes the assessment of the most essential problem, the efficiency of measures on prevention of occupational pathologies. Gravimetric approach to the measurement of respirable fraction is recognized everywhere in the above- mentioned countries though the term of *fine dust* as well as the design of dust measuring equipment may differ. Unification of measurements is expected

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some years later when CEN standards, or ISO standards are ready in part of dust measuring equipment.

Doubtless, to increase the level of occupational health prevention, international unification of requirements to aerosols is needed including the ones for the assessment of monitoring efficiency for which appropriate certificates are to be issued. Establishment of permissible concentrations is a sovereign right of any nation; it depends on the level of her well-being, law, science, etc. Nevertheless, methods of measurement and values by which the measurement is produced are to be unified. Economic integration, trade relations, exchange of technologies and *know how* require health protection of any sovereign state. Unification of methods for the measurement of fibrogenic aerosols including mining dust should be developed with regard to national specificities to provide low cost alternatives for the improvement of control service and comparability of results.



1440.
УДК 541.18

THE RESULTS OF EXPERIMENTAL RESEARCH OF THE FOREST FIRES INFLUENCE ON THE RADIOACTIVE CONTAMINATION OF ENVIRONMENT AND THE ASSESSMENT OF DOSES TO FIRE FIGHTERS

KADYGRIB A.M.*, KASHPAROV V.A.*, LUNDIN S.M.*, PRISTER B.S.*, PROTSAK V.P.*, LEVCHUK S.E.*, YOSCHENKO V.I.*, GARGER E.K., KASHPUR V.A.**, TALERKO N.N.****

** Ukrainian Institute of Agricultural Radiology, Kiev, Ukraine*

*** Institute of Radioecology of UAAS, Kiev, Ukraine*

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The experimental researches of the resuspension and the transfer of radioactive substances during the dry grass and forest fires were carried out in Polessje district of Kiev region at the experimental sites 50x150 m and 100x200 m respectively. The concentration of radionuclides in the elements of meadow and forest biocaenosis as well as the total contents of radionuclides were measured for both sites. The density of contamination with Cs-137 of the meadow biocaenosis was 4.8 MBq/m^2 with the part of radioactivity localised in plants 0.01%. The density of contamination with Cs-137 of forest biocaenosis was 0.9MBq/m^2 with the part of radioactivity localised at the ground surface about 96%. The values of airborne concentration, dispersal composition and deposition intensity of radioactive aerosol (RA) at the different distances had been obtained at the different phases of fire. The main meteorological parameters had been measured.

The experiments in laboratory were carried out in order to assess the parameters of wind resuspension. The dependence of resuspension intensity on the wind velocity was investigated using the aerodynamic pipe. The ash of samples collected in 30-km zone and burned at the temperature 600 C was used to model the fire products. The dispersal composition of RA and the release of radionuclides during the burning of the samples of forest biocaenosis in a chamber were measured. It was shown that after the burning of pine-needles (the most important flammable material in pine forest) the main part of Cs-137 activity in aerosol is associated with the particles of aerodynamic diameter less than 1.8 mm which are much less than the ash particles (>5 mm).

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Visual analysis of impactor cascades shown that this activity is associated with the tar particles evaporated as a result of pineneedles burning.

Such parameters of RA transfer in atmosphere as the resuspension coefficient, resuspension and deposition velocity at the different distances (15-270 m) from the source had been calculated using the data obtained in experiments on dry grass and pine forest fires.

Using the obtained data a mathematical model of RA transfer in atmosphere was verified. The calculations for the different scenario of fire were performed. It was shown that the wind transfer of radionuclides is not significant even for the hardest scenario of fire - it produces the contribution to the density of contamination of surrounding areas about 10^{-6} of its background values.

The spatial distribution of average RA concentration during the fire shown that the RA transfer in atmosphere was caused both by the convective and the unconvective transfers. The superposition of these transfers results the formation of an ununiform aerosol concentration field with a sharp minimum of concentration at the distance about 100 m from the source and with two maximums of concentration - in close vicinity of the source and at the distance several kilometres.

Both the dynamics of RA concentration and the dispersal composition depend on the distance from the source and the phase of fire. For instance, at the distances 10-300 m and the wind velocity 1-2 m/s the concentration of Cs-137 at the phase of active fire is two orders of magnitude higher than its background value, one order of magnitude higher at the smoulder phase and several times higher at the post-fire phase.

Human respiratory tract dosimetric model recommended by ICRP (Publication 66) was used for the assessments of doses caused by the inhalation intake of RA by fire-fighters. Using the data on RA dispersal composition it was shown that its variability during the fire does not cause the significant changes of 137Cs dose coefficient. Its median value calculated for the 1-year effective equivalent dose (EED) caused by acute intake is $1.53*10^{-8}$ Sv/(Bq*hour/m^3). Due the estimated high solubility of RA the 1-year EED from acute intake reaches up to 90% of 50-years EED. For the wide range of scenario of the forest fires outside the 30-km zone the estimated contribution of inhalation dose into total dose does not exceed several percents. The presence of radionuclides of transuranium elements in the forest fire radioactive release (which is possible for the fires inside the exclusion zone) can result an increasing of the inhalation dose up to the values higher than an external irradiation dose.



1000.
УДК 541.18

APPLICATION OF MICROCOMPUTERS IN SYSTEMS OF RECOGNITION OF COMPLEX PULSES FROM PARTICLES ON THE OUTPUT OF PHOTOELECTRIC GAUGES.

KUDRIAVTCEV I.A., FADEEV V.V.

Samara State Aerospace University named by. Acad. S.P. Korolev (SSAU)

(First received 26 December 1997; accepted for presentation during IAS-4)

The photoelectric analyzers of disperse phase (DP) parameters use a principle of registration of a light flow, scattered by the particle in sensitive volume of the gauge. /1/ As a result of simultaneous presence more than one particle in sensitive volume of the photoelectric gauge imposing of electrical pulses on its output occurs. Thus the multichannel peak analyzer,

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processing target signal of gauge, can not correctly interpete a pulse, being the result of imposing of two and more separate pulses. So the concentration measured is distorted. Concentration determination error value depends on a duration of target pulses and concentration of DP. In /2/ there is the formulation of the numerical approach to the calculation of value of this error.

The employees of research laboratory of SSAU ONIL-16 have developed the technique of processing of target pulses of a gauge, enabling to increase number of pulses, correctly registered by multichannel peak analyzer owing to analysis of pulse form.

The principle of work of the system offered leans on the allocation of local maxima and minima in the form of complex target pulses, produced as a result of concurrence of particles in sensitive volume.

The processing of a signal is conducted with the help of a system of comparators, separating such pulses into different ones the amplitude of which is determined by separate particles, participating in concurrence.

Necessary condition of correct division of pulses is exception of consideration local extremal values, stipulated by noise. It is made with the help of comparison of size of local minima with a level of a voltage, a little exceeding noise level.

The modern element base permits to organize high-speed digital processing of a target signal of a gauge and to make the analysis, proceeding from a duration local maxima and minima. Modeling of complex pulses with the help of a computer has shown, that local maxima and minima in complex pulses have a duration, essentially exceeding average duration of noise peaks, which can be accepted for separate pulses. Thus, using the sampling of a target signal of the gauge and carrying out the analysis of sample as values in a real time scale, it is possible to distinguish noise peaks and peaks, produced as a result of concurrences of pulses. The efficiency of such time recognition is more significant owing to the reduction of threshold value necessary for correct minima determination and, accordingly, increase of quantity of separated complex pulses.

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993.
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BUILT - IN SENSORS (BIS) FOR DIAGNOSTICS OF LIQUID SYSTEMS ON PARAMETERS OF PARTICLES OF WEAR.

LOGVINOV L.M.

Samara state aerospace university named by acad. S.P. Korolev

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In a structure of any liquid system of a product of an air engineering, machines and process equipment there are plenty of tribomechanical units (valves, plungers, bearings and etc.), the reliability of which significantly depends on a level of contamination and other parameters of a liquid /1,2,3,4/. It is known, that the imperfect control of a technical condition of tribomechanical units, included in structures of liquid systems, frequently causes failures and emergencies with products. Taking into account the fact, that the information on a history of development of wear process can be received from parameters of particles of wear, generated, it is possible to consider,

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that quantity and the size of particles, produced by the contacting pair, present the valuable information on a technical condition of whole unit of friction /2,3,4/. The travel of a liquid together with particles of wear in remote sites of a system permits to find out these particles in any place of hydraulic system, provided that built - in sensors (BiS) of technical condition of liquid systems of machines /3/, offered in 1984/5/ by the employees of ONIL-16 SSAU, will be used for this purpose.

Existing till now way of the control of a level of contamination of a liquid, based on the analysis (including automatic) of samples taken, does not permit to receive the information on a level of it's contamination in a real time scale /2,3/. Besides, for this method are inherent significant errors, stipulated by difficulties of maintenance and control of degree of cleanliness of sample containers and presence of "filter effect" of a small backlash in the sample valve, especially at sampling from highways of high pressure (up to 30 MPa). BiS of parameters of disperse phase (DP) offered /3,5/ do not require conventional sampling of a liquid and permit to increase objectivity and efficiency of the control.

In the report generalized functional and physical models, as well as principles of construction and feature of designs and characteristics of BiS of parameters of DP are considered in detail. In the report mathematical model of internal flowing part of photoelectric BiS and basis of their metrological maintenance are adduced.

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994.
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HARDWARE METHOD OF INCREASE CONCENTRATION LIMIT OF PHOTOELECTRIC ANALYZERS OF CONTAMINATION OF A LIQUID

KUDRIAVTCEV I.A.

Samara state aerospace university named by acad. S.P. Korolev

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The concentration limit determines maximum accounting concentration of particles in a researched liquid, when the readout number of particles differs from valid not more, than on 10-15 %. This error is stipulated by coincidences of particles in sensitive volume of an analyzer, i.e. simultaneous presence in it more than one particle, that results in imposing of target electrical pulses of a photoelectric analyzer.

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The existing photoelectric analyzers of contamination of a liquid register pulses only in case when the interval between them exceeds size of a duration of a pulse /3/. Thus the concentration limit is determined by the parameters of sensitive volume of a sensor.

The form and parameters of target pulses of a photoelectric analyzer are determined by distribution of light exposure in sensitive volume of a sensor, form of a particle and its speed, as well as passband of a electronic amplifier. Imposing of pulses results in formation of a signal of the complex form with local maxima and minima. The analysis of the form of such signals permits to recognize в¤Г«м-лГ pulses and, thus, to increase concentration limit /2/.

It can be executed by fixing of size of local maxima, even if the pulse was not finished. Necessary condition is suppression of false maxima, produced by noise, otherwise the concentration measured will be overestimated.

In photoelectric analyzers of a type AZJ-915 and POTOK-945 /3/ the analysis of amplitude of pulses from a output of a sensor is performed with the help of a row of comparators, the outputs of which are connected with the inputs of digital counters /2/. The thresholds of operation of comparators are chosen in order to execute the analysis of the sizes of particles pursuant to GOST 17216-71 (St.Standart). The amplitude of a target pulse of a sensor, determined by the size of a particle, is fixed in a moment when the comparator with a maximum threshold resets. Thus the analysis of a following pulse is made after reset of a comparator with a minimum threshold.

Change of logic of work of a analyzer in order to fix all local maxima of pulses, will allow to decrease "dead" time of a analyzer. For this purpose it is enough to register amplitude of a pulse in case of sequential set and reset of one of comparators, if between these events does not occur setting of any other comparators. The size of a hysteresis of comparators should not exceed level of noise /2/.

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999.
УДК 541.18

INDICATOR OF QUALITY CONTROL OF JET FUELS OF A TYPE POTOK-RT

LOGVINOV L.M., MALYGIN N.A., SMAGIN W.À., COURDIN G.À.

Samara state aerospace university named by acad. S.P. Korolyov, Samara research institute "ECRAN"

(First received 26 December 1997; accepted for presentation during IAS-4)

It is known, that the reliability of fuel systems of products of a air engineering is significantly determined by a degree of their contamination (mechanical impurity and emulgated water) /1,2/. The developed indicator of the control of a degree of jet fuel's cleanliness permits to determine excess allowable and limiting levels of the contents of mechanical impurity and emulgated water during refuel of flying vehicles and executes switching of external executive devices (slide-valves) if a limiting level is exceeded.

The block diagram of an indicator of a type "POTOK-RT" consists of photoelectric built - in sensor (BiS), performed in explosion-proof variant and included in gap of fuel main with diameter of 100 mm, as well as electronics unit /2/. Photoelectric BiS works on a principle of

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measurement of light flows, scattered by particles (droplets) of insoluble water /2,3/. For use of a photoelectric sensor for the control of parameters of mechanical impurity and emulgated (insoluble) water in jet fuel were conducted experimental researches on valuation of a spectral structure of mechanical impurity and emulgated water, passed through the filter-separator if fuel flow changed /2,3/. Results of experimental researches have allowed to establish, that the particles of insoluble water have the sizes, more than two times exceeding average size of filter pores(~ 5 mm) in a wide range of the flows, and overwhelming number of particles of mechanical impurity have sizes in a range 5 ...10 mcm (i.e. less than 10 mcm) /2,3/. Thus, with the help of photoelectric BiS, if a filter with performance of 5 mcm is available in a hydraulic path, one can separately register the parameters of mechanical impurity and water, emulgated in jet fuel.

Main constructive and metrological characteristic of a developed indicator of a type "POTOK-RT" are informed in the report. Particularly, "POTOK-RT" can supervise a degree of cleanliness of fuels of a type TC-1, T-1, T-2, PT, T6 and other, when fuel flow is within the limits of 50...2500 (l/min) and pressure in a highway - 0.1 ..1.6 MPa.

Operation of a device in a range of temperature of a environment from -50 up to + 50| C is permitted. The range of particles size registered is 5...50 mcm, range of indication (in % of mass concentration): for mechanical impurity - 5.10^{-4}; for emulgated water - 5.10^{-3}. Mass of a sensor is not exceed 10 kg, and electronics unit - not more than 40 kg. Feed of an indicator is performed from a alternating current circuit 220 V / 50Hz and direct current source - 27 V. Consumed capacity: on an alternating current - 150 VA; on a direct current - 70 VA.

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995.
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PIEZOELECTRICAL CONVERTERS IN MONITORING SYSTEMS OF PARAMETERS OF METAL PARTICLES

POMINOV E.I.

(Samara state aerospace university)

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The principle of action of piezoelectrical converters (PEP) for the control of size distribution of metal particles in liquid or gaseous dispersion fluids is based on the transformation of energy of impact of particles onto a sensitive surface of a piezoelectrical crystal to electrical signal. Signal of PEP is an radio-wave pulse with initial amplitude, which is proportional to mass and speed of particle at the moment of impact. The pulses from separate particles are being amplified, detected and sorted in dependence from magnitude for various channels of registration, according to certain sizes of particles.

Obviously, the sensitivity of a device is completely determined by the ratio of amplitude of a

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useful signal to peak value of a noise voltage on the output of an amplifier (SNR). A technique and results of calculation of the SNR for PEP and amplifiers with various parameters are discussed in the report . The analysis of the results obtained shows, that the sensitivity of PEP is limited by the noise of amplifier. Maximum of the SNR is attained at some optimum active resistance of a piezoelement's load and grows weakly with the reduction of capacity of a load. The amplifiers with various types of active elements do not permit to obtain significant gain. However, the application of the amplifiers, using bipolar transistors or OA is more preferable; for them the best accordance with output resistance of piezocrystal is provided, which is determined as by small resistance of piezocrystal near the antiresonant frequency, as by relatively small value of resistance of dielectic loss. The maximum of SNR is attained at Q-quality of a resonant contour of an amplifier 1.5 ...3 times smaller, than Q-quality of a piezocrystal; it corresponds to a threshold of sensitivity of PEP about 6.4 mm (at SNR equal 3) for bronze particles at speed of 15 m/sec. at the moment of impact (experimental value is equal 7 mm).

The process of the transformation in PEP is executed in some stages. On the first stage the initial distribution of particles in space in the PEP input is being transformed to a casual sequence of pulses; the intensity of pulse flow is proportional to the concentration of particles, and the amplitude distribution of pulses is correlated to initial size distribution of particles. On the second stage the reverse transformation to experimentally observed size distribution is being made. The discrepancy of the function restored of a distribution of particle size from the initial one is determined by the errors of the control of parameters of dispersion phase. The differences between speed and density of particles, conditions of impact of particles during the analysis, and values, used during experimental graduation of PEP, will result in occurrences of systematic errors, and their fluctuations during the analysis will cause casual errors. However, even during the control of particles of the same size and parameters in the same flow, deviation of signal's magnitudes is observed. It is caused by unevenness of the characteristics of a sensitive surface of the piezocrystal, speed of a flow in the cross-section of a channel and speed of particles driven on various trajectories.

In the report a technique and expressions obtained for density of probability of restored size distribution for monodispersed particles at various modes of flow of dispersion fluids in a channel of PEP are discussed.

Estimations of mean value and standard deviation for densities of probability have given values, correspondingly 1.08 and 0.124 for laminar mode and 1.006 and 0.051 for turbulent mode of the flow.



1297.
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A COMPLEX OF INSTRUMENTS FOR REALIZING THE BASIC TECHNOLOGIES OF ENVIRONMENTAL-STATE EXPRESS-ANALYSIS

PHILIPPOV V.L., MAKAROV A.S., IVANOV V.P., KOZLOV S.D.

The Federal Research & Production Centre -The State Institute of Applied Optics Kazan, TR 420075 RU

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Keywords: Ecological-monitoring system, express-analysis, spectrometers, spectrofluorimeters, laser-locators

In the interests of practical usage of instrumental equipment for a regional ecological-monitoring system, the FNPTS "GIPO" has developed and is sequentially implementing a programme of creating the basic technologies of express-analysis of an air medium, a water

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quality, industrial wastewater, different elements of underlying surfaces on the basis of the available experience of optoelectronic instrument development and conversion production facilities. The manufactured pilot models of instruments (aerosol spectrometers, gas analyzers, spectrofluorimeters, laser-locator complexes) meet the requirements of State Standard (GOST) for use of a photometric method of monitoring and measuring the different environmental-ingredient content.

In the paper, the fulfilled arrangements including the substantiation of requirements for sensors, the interaction organization in the interests of their introduction as soon as possible, the creation of standard-methodical base are described in detail.

The scientific bases of instrument developments are the results of long-term investigations of environmental spectral and space-time characteristic variations in an optical spectral region [1,2].

Depending on an use procedure, the instruments are divided into local-monitoring sensors and remote ones. The remote sensors can be mounted on different carriers, their choice is determined by a task to be achieved as well as by economic considerations [3,4].

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1226
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AEROSOL CEMENT PARTICLES NUMBER CONCENTRATION LIDAR STUDIES

LAKTYUSHKIN G.V., PRIVALOV V.E., SHEMANIN V.G.

Kuban State Technological University, Novorossiysk Department, Novorossiysk, Russia

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Cement particles back scattered Mie radiation intensity dependence on particles number concentration in range of 10 - 1000 cm^{-3} at YAG-Nd second harmonic laser wavelength of 532 nm has been experimentally studied on laboratory bistatical aerosol lidar type [1]. Back scattered radiation was collected by 0.12 m diameter mirror receiving telescope and recorded through 532 nm interferential filter with peak transmission of 64 % and halfwidth of 2.4 nm on PMT FEU - 79. PMT signal was inputed by special controller to IBM PC Pentium 100 RS-232 port. The cement particle air flow was created by particles generator [1] and its concentration and velocity continuously controlled by laser Doppler anemometer [2]. It is getting that back scattered Mie radiation intensity has linear growth with particles number concentration. Measured results treatment allowed to determine by known lidar constant [1] back scattered cross section for concentration unit is equal to $(3.2 + 0.5)\ 10^{-6}\ m^{-4}$. For these results testing lidar equation as in [3] computer simulation has been fulfilled with our experimental conditions. This lidar equation parameters for our case had the next values: h, R = 7.5 m for recording time duration of t_d = 50 nc, A_2= 0.008 m, K_2 = 0.495 at 532 nm wavelength (measurement result), laser pulse energy E_0 = 10 mJ, laser pulse duration t_L = 10 ns, ranging distances R = 7.5 - 15 m, PMT type FEU-79 photocathode spectral sensitivity values at wavelength of 532 nm have been

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radiation power computer simulation have been made with above described data for the ranging distances from 7.5 to 15 m as aerosol particles back scattering coefficient function. The determined power values P(7.5) have been used for particles back scattering coefficient concentration dependence calculation with FEU-79 sensitivity experimental data. All the results both measured and calculated are exhibited in Table 1.

N, cm^{-3}	E(7.5), mJ	$(\frac{\partial\sigma}{\partial N})\,10^6$ m^{-4} sr. C	P(7.5), W C	σ, m^{-1} C	$(\frac{\partial\sigma}{\partial N})\,10^6$ m^{-4} C	$(\frac{\partial\sigma}{\partial N})10^6$, m^{-4} sr.
100	15.5			296	2.96	
150	21. 7			415	2.77	
270	24.8	3.7 +-0.5	0.523	474	1.76	2.1 +-0.6
350	31.0			593	1.69	
500	37.2			711	1.42	

Calculated results were pointed by C in this Table 1, all the other were experimental results. These calculation results confirm the cement aerosol particles number concentration vesus back scattering coefficient linear dependence. Therefore, the such a type aerosol lidar can serve as an instrument for cement aerosol particles number concentration ranging measurement.

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978.
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MEASUREMENT CHARACTERISTICS OF RECEIVERS AND SOURCES OF RADIATION

MIKHAILOV O.M.

ARRC "S.I. Vavilov State Optical Institute (GOI)"

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The paper considers the problems of measurement of the active radiation and its conversion when having a contact with objects of the environment. A large number of receivers of optical radiation with different methods of performance are known, from selenium photo-element and thermo-element to photoelectronic multipliers and avalanche photo diodes. Their main purpose is to indicate the radiation or its modified state. The purpose of any measurements, however, is to obtain true, reproducible and stable results with preset error of measurements and selected confident probability. Such properties belong only to measuring photo receiving devices developed in cooperation with the State Optical Institute.

The paper shows the investigation results of boundary, specific and spectral power characteristics of the photoreceivers being widely used in industrial developments and in optophysical research and providing the unity of the radiation measurements. The measurement receivers of optical radiation, i.e. vacuum photo elements (F21, F28, F35, etc.) vacuum photo multipliers (FEU-142, FEU-154, FEU-100, FEU-84), phosphide-gallium, silicon and germanium photodiodes (FD-Fg, KFD-105A, FD288k, FD-9g, etc.), thermoelements and bolometers (e.g.

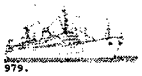
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RTN-30, PP-1). The latter are used as non-selective wavelength receivers in the wide spectral range with linearly-limited voltage and current characteristics and stability. Spectral operation range of measuring receivers is from 0.1 mkm to 11.0 mkm, the linearity of the power-current or light characteristic maintains with variation of radiation on their sensitive elements to 10^8 times (with photomultipliers to 1000 times), long-term reproducibility of power units storage within 10 years is ±5%, the non-stability error of measurement results does not exceed ±1%. the variation range of the incident measured flux is 10-100000 W.

The techniques of spectral correction of absolute and relative spectral sensitivity of receivers have been shown for solving the given photometric problem of measuring the efficient values. The above mentioned involves the use of measuring photoreceivers as standard means of measurements for carrying out equally spectral and light measurements. The property of self-calibration of silicon and germanium photo diodes eliminating the use of the expensive standards of power spectral measurements has been especially emphasized. Transfer and storage of the radiation power unit in different parts of spectrum in 450.....800 nm wavelength is done by the measured current value in Ampers with total error of power determination to 0.1%.

The measurement radiation sources in the traditional spectral region are well known, these are "light measuring" lamps and black body models. The paper emphasizes the broadening of operational possibilities of instruments and the universal character of research due to the development of new fields of science and an increase of dynamic and spectral ranges. The ordinary radiation sources are not able to operate as measuring devices. New standard grid-power sources have been created. Their operation takes into account the broadening of the spectral region into the UV part (gas discharge lamps DNK-90 and VMF-25), the possibility of measuring pulse radiation with up to 1 ms duration (pulsed standard lamps IShO, IPO, ISK, etc) and the necessity of modelling small size objects (stars imitators) and solar radiation. The common range of the confident radiation wavelengths is 0.1... 2.5 mkm, stability and reproducibility of radiation is, type of radiation is a linear or solid spectrum.

The paper briefly considers the problems of spectral and integral attenuation, absorption and diffusion of the measured and active radiation. To conclude, it is noted that the developed methods and means of radiation measurement make it possible to create optoelectronic devices of high accuracy concerning the parameters of power variations of the coherent and non-coherent radiation.



979.

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METROLOGICAL PROVISION OF AEROSOL MEASUREMENTS

MIKHAILOV O.M. , KANATENKO M.A.

ARRC "S.I. Vavilov's State Optical Institute (GOI)"

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Strictly speaking, the total complex of aerosol research, the corresponding temperature tests (including terrestrial ones), and technological processes of aerodispersion systems are not possible to be based on the developed national scheme of transfer and storage of physical units, i.e. calibration scheme, standards, test pieces and working means of measurement. The main reason is the lack of a single or a few physical values that would describe the state of aerosol measurements with a sufficient completeness. Therefore, the latter are of indirect or total character. However, basic research, physical (optical) experiments and the equipment for scientific and applied research can not do without measurements with the results expressed in legal units and the measurement value has a present probability.

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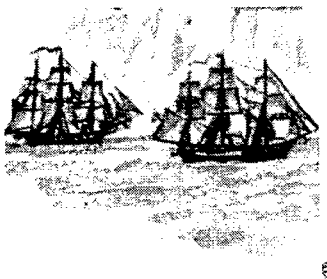
Metrological provision of any kind of research and developments is a special kind of activity which is finally aimed at the achievement of the unity of measurements being carried out. The development of optical aerosol devices, their units and elements, the unique measurement and test methods require experimental research to determine the degree of their correspondence to the established regulations and standards of metrology.

Carrying out optophysical research and tests is generally of a unique pre-informative character with regard to standard and even precision measurements. In such case metrological provision of aerosol research can be based on three techniques described in the paper and conditioned by the content, the method and the final aim of comprehensive tests of measuring aerosol devices, simulation of the external conditions effects and the performance of aerodispersion systems and optophysical aerosol research. The first provides a metrological certification of the set-up and is based on the direct measurements. The second involves the measurement of a few physical values and a by-element certification of the test complex. The third includes the research where new physical quantitative and qualitative relationships are established. In this case the metrological provision is based on certification of the procedures of carrying out the measurements and can also involve a partial metrological certification of separate elements of the scheme. This is the most inexpensive, reliable and universal technique. The three techniques require a deep analysis of the error of measurement results and an establishment of confident limits of their effect.

The paper shows that the basic measure of reliability of aerosol measurement results is the comparison of the measurement results and their mutual recognition on the inter-laboratory and international level. At the Vavilov's State Optical Institute there is a branched network of standard samples and specimens and a developed information automated system of optical measurement means. An operative data search of the instruments can be done both by name (or type) and by present measurement parameters in correspondence with the measurement problem being solved. Standard samples and means of measurement can be placed prior to the local test schemes and provide the unity of measurements of such fields as dispersion media research, colorimetry, polarimetry, spectrophotometry, scattered radiation measurement, etc.

Standard samples of the Vavilov's GOI are used for measuring spectral coefficients of absorption, radiation, transmission and reflection (direct and diffuse), refractive index, gas mixtures, content, normalized characteristics of glass properties, colorimetric relationships. Standard optical measurement means include, in particular, models of black bodies, photoreceiving devices and radiation sources for 100...11000 nm spectral region.

The developed methods, standard means and measures for measuring coherent and non-coherent radiation and its modifications coefficients and the certified methods of carrying out optical, optotechnological, holograghy, fluorescent and spectrophotometrical measurements are aimed at providing reliability and unity of measurements in the research and and building of optoelectronic instruments including those for aerosol measurements.



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1412.
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PORTABLE CORRELATED OPTICAL DETECTOR FOR EXPRESS REMOTE ANALYSIS OF POLLUTING SUBSTANCES IN ATMOSPHERE

V.V.NEKRASOV*, D.R.GASANOV*, A.T.PORTYAN*, N.V.RYJAKOVA*, N.M.SURIN**

** Karpov's Physical-Chemistry Research Institute, 103064, Russia, Moscow, Vorontcovo pole, 10*

nekrasov@cc.nifhi.ac.ru

*** Institute of Oceanology, Russian Academy of Sciences, 117218, Russia, Moscow, Nachimovskiy prospect, 36*

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One of the global problems of environment protection is anthropodenic polluting of atmosphere. Effect of polluting of atmosphere is a destruction of ozone layer of the Earth that leads to change of climate and to worsenning of an ambience of dwelling.

Practically in polluting of atmosphere two formind components participate - aerosol and gas. These components base in the dynamic balance. In the different layers of atmosphere chemical and photochemical reactions with their participation constantly run. For getting complete information on occurring in atmosphere processes, it is necessary to be able to measure chemical composition of gas and aerosol components.

In this reporting prospects of using portable correlated optical detectors for express remote analysis of gas composition of different layers of atmosphere are discussed. Correlated optical detectors are capable to find in atmosphere vapours of different chemical compounds - ozone, oxide of nitrogen, sulphur, carbon and others. These instruments ensure a finding of polluting on distances before several tens of kilometers. Correlated optical detectors possess high selectivity to analyse components, as far as they exclude an influence of any admixture on results of measurements, spectra of which weakly correlate on the structure with the analysed component. As sources of sounding radiating it is possible to use both artificials sources of the light, and natural sunshine, diffused by the celestial sphere or reflected from the surface. This is particularly important for problems of ecological monitoring. Correlated detectors are perspective for using in the composition of apparatus complexes unceasing monitoring of atmosphere in real-time and express making of the large-scale distribution cards and vertical stratifications of analysed components.

Perspective of using of correlated optical detectors is demonstrated on the example of measurements of distribution of dioxide of nitrogen in atmosphere. In the course of studying of distribution of oxides of nitrogen in different regions it is installed that alongside with industrial objects and motor transport, sources of arrivals of nitrogen oxides in atmosphere are agricultural regions. This effect is stipulated by the decomposition nitratecontained fertilizers, not adopted by plants [1]. Contribution of this source is weakly taken account into evaluations of general background p olluting of atmosphere. The situations, when such sources can contribute an essential contribution to polluting of atmosphere and destruction of ozone layers of the planet, are presented wholly real [2].

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1238
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THE NONLINEAR LIDAR-EQUATION - AN INVERSE ILL-POSED PROBLEM

BOCKMANN C., BERNUTAT C., FISCHER S.

Universitqt Potsdam Institut for Mathematik Am Neuen Palais 10 Postfach 60 15 53 144 15 Potsdam
Phone: (0331) 9771743/1500 Fax: (0331) 9771578 bockmann@rz.uni-potsdam.de

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Multispectral lidar measurements, tropospheric aerosol, multimodal aerosol size distribution, inverse ill-posed problem, regularization method, mollifier-method

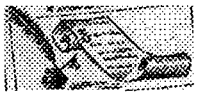
The knowledge of the size distribution of atmospheric particles is of interest in many areas of aerosol research, e.g. for understanding the radiation budget of the atmosphere and for the explanation of heterogeneous chemical processes that occur in the atmosphere. The problem of determining the aerosol size distribution function n(r), by multispectral lidar measurements, belongs to the class of problems in mathematics called nonlinear inverse ill-posed problems. The best and tricky techniques of nonlinear optimization do not work there. Consequently, we have to look for a suitable regularization method to obtain reasonable approximations to n(r).

We consider two linear ill-posed subproblems, i.e. two linear first kind Fredholm integral equations, $\beta^{Aer} = K_{\pi} \cdot n$ and $\alpha^{Aer} = K_{ext} \cdot n$.
Small changes in the data function can produce very large changes in the solution, i.e. the solution n, if a solution exists, does not depend continuously on the right-hand side data functions β^{Aer} and α^{Aer} , respectively.
Since the tropospheric aerosol contains a large number of species, the model process is much more complicated as in the stratosphere. There occur aerosols with different particles, i.e. with different refractive index m. The aerosol size distribution is a multimodal one. In general the number of different particles and their refractive indices are unknown. Now we choose a suitable method to solve the two-dimensional ill-posed problem of integral equations. We propose a mollifier method. We start form the fact that in practice only a finite number of observations are possible. We choose among all n solving the equation the one with minimal norm. We select a smoothing operator $E_\gamma : X \to X$ with $w - \lim_{\gamma \to 0} E_\gamma n = n$ and determine $n_\gamma = E_\gamma n$. If X is a function space, e.g. L^2 or Sobolev spaces $H^{-s}, s > \frac{1}{2}$, we represent E_γ by

$E_\gamma n(r) = \langle e_\gamma(r,\cdot), n \rangle_X$ with a suitable mollifier e_γ, e.g. wavelet functions. The value s depends on the degree of ill-posedness, i.e. on the smoothness of the kernels.
The algorithm for reconstruction n at a specified point r from the given data proceeds in two steps:
1) solve the normal equation
2) calculate n, by parallel processing for different β^{Aer} and α^{Aer} , respectively
The ill-posed part of the algorithm, step 1, is independent of the data. Moreover the matrix of the linear system is independent of r and γ . The regularization parameter γ appears only on the right-hand side. The right-hand side can be compute exactly, avoiding in that way any influence of the noise in the data.
No additional or artificial discretization of the solution n is needed.We may freely select the points r where n_γ is evaluated.



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TOOLS OF MEASURING VISIBILITY OF OBJECTS THROUGH AEROSOL MEDIA

YEVSIKOVA L.G., PUISHA A.E.

ARRC "S.I. Vavilov State Optical Institute (GOI)"

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Observation through aerosol media (fog, rain, smoke, etc.) involves the problem of estimating the visibility of real (voluminous, relieved) objects against real backgrounds, since for such objects luminosity both over the surface of the object and over the surface of the background varies among different sections of the area, thus eliminating the possibility of using the concept of contrast.

At the Vavilov's GOI the method of estimating the visibility of real objects in full-scale conditions with observation through aerosol media has been developed basing on measuring the value of the degree of the object visibility [1]. For this purpose, the notions of conventional contrast, conventional threshold contrasts of visual perception of real objects and their limiting range of visibility have been introduced [2].

Test samples of non-adaptive visibility meters IF-173, IF-173M [3] have been created, with improved optotechnological, accuracy and ergonomical characteristics with the following technical parameters:

Magnification, x	1.5... 10
Field of view angle, deg	40... 5.7
Size of the exit pupil, mm	2 x 2
Dioptry focusing, dptr.	4
Angle of turn of the line of sight, deg.:	
by the horizon	360
by the vertical	10
Overall dimensions, mm	870x290x160

The serviceability of the developed methods has been confirmed by full-scale and laboratory tests [4]. It has been shown that the use of IF-173 and IF-173M equipment makes it possible to measure true, visible threshold contrasts of any objects and their limiting visibility ranges to an accuracy of 8-12% against any backgrounds, in any conditions of observation with no long distant tracing being required.

For estimating the visibility of real objects in the near IR spectral range, the structural and principal circuits of the IR visibility meter in 0.7...0.9 mkm spectral range have been for the first time developed at the Vavilov's, the calculations of the overall dimensions and aberrations of the optical system have been carried out and a laboratory model has been made with the following technical parameters:

Visible magnification, x	4
Field of view angle, deg	11
Focal distance of the lens, mm	120
Exit pupil diameter, mm	5.7
Diameter of photocatode of EOC, mm	25
Electronic-optical magnification, x	1
Dioptry focusing of the eye-piece, dptr.	4
Focusing adjustment of the lens, with	15 and

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A software product of the calibration of the model and experimental data processing has been developed.

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УДК 541.18

UV, VISIBLE AND IR HIGH-QUALITY SMALL-SIZED OBJECTIVES FOR RESEARCH OF ATMOSPHERE OPTICAL PARAMETERS

KAMESHKOV G.B., MIRZOEVA L.A., GRAMMATIN A.P., LUSTBERG E.A., MAKOVTSOV G.A.

All-Russian scientific center "S.I. Vavilov State Optical Institute"

Russia, St.Petersburg, 199034, Birzhevaya line, 12.

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Standard small-sized and light-weight high-quality objectives operating at wide spectral range from UV (0.3 μm) to middle IR (6.0 μm) for aerospace purposes have been produced and tested in All-Russian research center "S.I. Vavilov State Optical Institute" in 1996.

UV objective, 130 g mass, holds high image quality in wide temperature range. Petzval's scheme is used as base element of the objective. Galilee's system with angle magnification less than one is placed before it. Concave- plane Smith's lens is put behind Petzval's objective near image plane in order to correct image curvature. It allowed to reduce general length of the objective to 35 mm. Objective includes 7 lenses, three of them are of lithium fluoride and other four of silica glass. Focal length of the objective is 21 mm, diaphragm ratio is 3.5, angle field of view is 30°. Total transmission in operating range 0.3-0.4 μm is 75%, energy concentration in circle dia 27 mm is 80%, relative radial distortion at edges of filed of view does not exceed 4%. When heating up to +50°C image plane is shifted by minus 0.016 mm, when cooling to -20°C by 0.019 mm correspondingly.

Lens IR objective, 210 g mass, is meant to operate at temperature 90°K. Objective includes 4 lenses, two of them are of silica, two other of fluorite. Four-layer AR-coating on silica lenses provides high transmission (more than 70%) at spectral range 2.6 - 5.0 μ. Focal length of the objective is 18 mm, diaphragm ratio is 1.6, angle field of view is 28.4° at temperature +20°C as well as at -170°C, energy concentration is more than 80% both in the circle dia 20 μ (at the spectral range 2.6 - 3.0 μ) and in the circle 35 mm (at the range 2.6-5.0 μ).

Five-lens objective, 240 g mass, is meant to be used in optical assembly of spacecraft astro-measuring system. When being developed, we paid special attention to provision for following requirements: - small chromatic aberrations at spectral range 0.5 μ wide (operation spectral range is both at visible and near IR ranges); - high-stable image scale within the temperature range 20°C 30°C; - efficient attenuation of side illumination from Sun radiation coming to the objective from

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blind, lighted by the Sun; - low level of light scattering from intensive point sources of radiation (bright stars) within field of view; - decrease of light size of front optical component by matching its first surface with aperture diaphragm, in order to have minimum length and mass of anti-sun blind.

Focal length of the objective is 60 mm, diaphragm ratio is 3.8, angle field of view - 8^0. Total transmission is 90% at spectral range 0,5 - 1.0 μ. Perfect combination of optical materials used for the lenses allowed to achieve high level of achromatization at the working spectral range. Level of scattering was decreased not only by reduce of number of working surfaces bordered on air (three middle lenses were combined into unit by cementing) but the use of five-layer achromatic AR-coatings.

All samples of above described objectives were manufactured and executed tests confirmed that specified characteristics were obtained and they are in agreement with computation.



1189.
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AIRBORNE DEVICES FOR STUDY OF SUPERFINE ATMOSPHERIC AEROSOLS

SMIRNOV V.V., SAVCHENKO A.V., PRONIN A.A.

Institute of Experimental Meteorology, 82 Lenin str, Obninsk, 249020, Russia

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Set of portable instruments for functioning in the car and aircraft laboratories for complex and operative studying the characteristics of superfine aerosols of natural and manmade origins is considered. The electrical aerosol analyser DAES-3, thermodiffusion spectrometer of nuclei condensation Omega-3 and portable sampler PAS-3 allows to get information on concentration and dispersity, as well as on hygroscopic, electrical and chemical characteristics of aerosol particles by diameter from 0,003 to 10 μ. Total weight of set is 15 kg, power consumption is 100 w from network 220/110 V or +27 V. Commercial analogues of instruments unknown.

Separate instruments and set itself were used in the aerosol car - laboratory for control of toxic dust emissions from the Owens Lake dry bed (USA, East California, Owens Valley, springtime 1993, international project LODE [1-3]), stationary polar station for study of background aerosols (Zigler Island, Franz-Joseph Archipelago, springtime 1994, russian-austrian project Polar Spring [4]), airborne laboratory for studying a long-distant transportation of dust from the Kalmykia deserts (summer 1996 and 1997) and others [5].

The portable electric aerosol analyser DAES-3.

Principle of action: the functional unipolar charging the aerosol particles by small aeroions, charged particle selection and ion current measurement. Recommended for the concentration and size spectrum measurement of finely divided aerosols, as well as for control of weakly dusty atmosphere and clear rooms of purity classes 100 and 1 000.

Measured interval by the diameter D = 0,003 - 1 μ in 11 dimensioned gradations. High level of the measured concentration of particles with sizes less D = 0,1 μ is consist $N = 7.10^7$ 1/cm^3. Resulting measurement error of concentration and size in interval D = 0,01-0,5 (m does not exceed 40 and 30%, respectively. Volume sampling flow is 100 - 250 cm^3/s, linear sampling speed is 10 m/s. Weight of the remote gauge up to 7 kg. Power consumption + 27 V, 0.7 A. Removing of sensor not less than 25 m.

In contrast with the famous electrical analyser model 3030 (Thermo - Systems Inc., USA) given

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instrument has the tenfold lower mass and power consumption, as well as more high sensitivity.

2. Portable aerosol sampler PAS-3.

Is kept a rotary high pressure pump, controller and electric power supply 220/110/+12 V, anemometer, barbell by the length 1 m, removable fiber and nucleapore filters, two cascade impactor for large particles (d>2 micrometer). Recommended for continuos sampling of aerosols by sizes from 0,01 to 20 (m for an evaluation of mass concentration and dispersity as well as microelement, radionuclide and PAH - analysis.

Volume sampling flow is 1000 cm^3/s. Efficiency of precipitating of particles by sizes $D_{\leq}$ = 0,01 - 10 (m upon substrates more then 90 %. Total sampling error does not exceed 15%. Power consumption 220/110/+12 V, 1.7 A. Removing of sensor not less than 25 m. Total weight of sampler up to 6 kg.

Condensation activity aerosol spectrometer OMEGA-3.

Principles of action is the flow condensation rising of nuclei within the thermo-diffusion chamber and automatic sizing of water droplets by photoelectric counter. Supersaturation interval over a water 0.01-1%. An interval of measurement from of droplet sizes D = 3 - 200 μm on 8 size gradation. The concentration and size measurement error does not exceed 30 and 40%, accordingly. Optical accounting volume is equal 1 mm^3. Linear speed of sampling is 6 m/s. Lighter is laser diode, wave length 0,85 (m. Weight of the remote sensor 5 kg. Power consumption + 27 V, 0,5 A.

All remote sensors runnable at the air temperature 0-40 °C, pressure 70 -100 kPa, relative humidity up 90%, as well as under the linear vibration and shock 10 g and 15 g, jolting (bumpiness) 4g during one hour.

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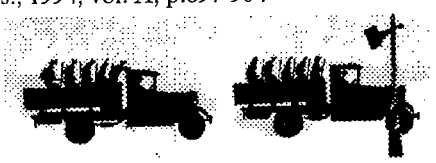
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APPARENT CHARGE METHOD FOR INVERSION OF CHARGE DISTRIBUTIONS

E. CURTO, J.-C. LIN, J.W. GENTRY

University of Maryland, College Park, Md. USA

(First received 01 June 1998; accepted for presentation during IAS-4)

Principal Ideas:

The objective of experiments were to determine the charge distribution on iron and carbon fibers from measurement of the location of deposition of the fibers in a rod-cylinder electrostatic precipitator. A silvered mylar strip was placed on the central rod. After the experiment this was peeled off and the fibers counted. They were sized according to their lengths (L_P) and diameters (D_P) . Since the electrical field was sufficient that all the fibers were collected before the end of the precipitator, a collection efficiency Ef could be determined as a function of precipitator length (L_E). The essential experiments were carried out by Cheng, who then interpreted her experiments assuming that all fibers of the same mobility had the same charge. The scope of this investigation is the development of a method for estimating the charge distribution from these experiments. What we present is an efficient correlation which can be modified to apply to other types of classification. The only restriction is that the collection efficiency must increase monotonically with an increasing number of charges.

Essential Integrals:

The algorithm requires that there exists a theoretical or experimental correlation of the efficiency which relates the location of deposition to the number of elementary charge for a particle of specified size and shape. That is when the number of charges J is specified for fibers of a given length and diameter, one can determine unambiguously the fraction of particles which will deposit at a distance L from the entrance to the precipitator. This fraction we designate as Ef (the collection efficiency). This implies that for a specified field strength, fiber diameter and fiber length, the effective charge (J_E) can be calculated directly from the Ef. The core of the algorithm depends on two integrals designated as **I1** and **I2**. These are defined by

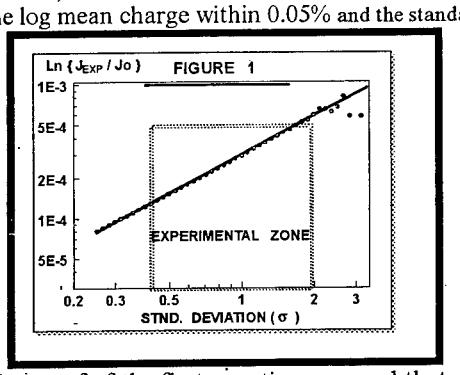
$$I_1 = \int_0^1 \mathrm{Ln}[J_E]\,dEf = \int_0^\infty \mathrm{Ln}[J]\,F_D[J]\,dJ = \mathrm{Ln}[J_0]$$

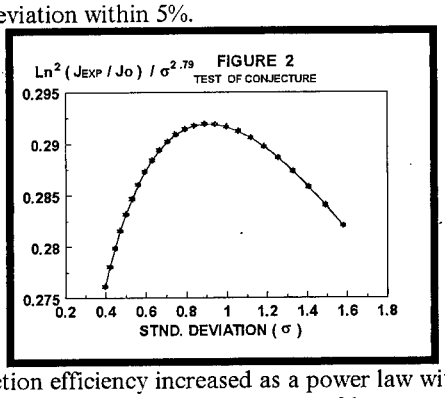
$$I_2 = \int_0^1 \mathrm{Ln}\left(\frac{J_E}{J_0}\right) dEf = C_1 \qquad \sigma^n = C_1\left(\int_0^\infty \mathrm{Ln}\left(\frac{J_E}{J_0}\right) F_D[J]\,dJ\right)^{n/2}$$

The first equation is quite remarkable for the first integral which is the value of the apparent charge averaged over the efficiency depends only on experiment while the second integral in this equation is a mathematical moment independent of experiment and depending on the charge distribution function. The value of the integral is the log mean charge. Previous we showed that if the distribution function F_D can be approximated by an arbitrary sum of log normal distributions and the efficiency is a power law expression, then the relation is exact. The second equation I2 treats the variance. Again the first integral depends only on experiment. Instead of an exact relation, one has an empirical approximation which fits the data over a wide range. The testing of the integrals with a data simulated using a log normal distribution function are shown in Figures 1 and 2 below. The first figure tests the deviation between J_E and J_0. One notes that the error is less than 0.05%. As indicated above we believe that this relation is exact, so that the error in this case is attributed to the numerical integration used to obtain J_E from the simulated data. A value of $\sigma = 1.5$ is a very broad distribution. The second integral tends toward 0 as the

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standard deviation → 0, increasing as the variance in the distribution increases. The test procedure was to assume a value of σ, then to simulate the experimental measurements. The parameters of precipitator length and particle mobility were chosen so that the efficiency ranged from 0 to 1. The integral Int-2 was calculated and then divided by σ^n giving the constant C1. The value of the parameter n was adjusted so that C1 shows the minimum variance. This value was found to be 2.79. In subsequent work with other classifiers, different values of n were found. It appears that n is peculiar to the type of classifier and does not correspond to an integer power of σ. This value (2.79) was then used to determine a particular C1 for each σ. One notes that the variation over the range of σ values normally encountered (0.4-1.6) is less than 5%. This suggests that the method outlined here could be used to obtain the log mean charge within 0.05% and the standard deviation within 5%.





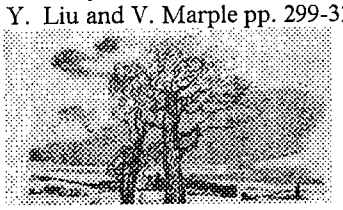
The proof of the first equation assumed that collection efficiency increased as a power law with charge number, and secondly that the distribution consisted of an arbitrary sum of log normal distributions. The power law assumption allowed one to obtain the inverse, expressing the apparent diameter as a function of efficiency. Numerical simulations with a number of relations for efficiency (or penetration) strongly suggest that so long as the efficiency is monotonic between 0 and 1 with charge, it is not further restricted. Although one can not express an arbitrary function with a countable number of log normal distributions, this restriction is more theoretical than practical as we were able to approximate an arbitrary step input with a series of identical lognormal functions with fewer than 2% outliers. Subsequent refinements reduced the error to any arbitrary value. Since an arbitrary distribution function can be approximated by a sequence of step inputs, it follows that the function can be represented by a series of log normal distributions. We believe that this is adequate for the demonstration of equation 1.

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1405.
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APPLICATION OF TIKHONOV REGULARIZATION METHOD TO OBTAIN SIZE DISTRIBUTIONS

ALVAREZ, M. L.[1], CANALS, A., MORA, J., TODOLÍ, J.L.

Department of Analytical Chemistry, Alicante University Box 99, 03080, Alicante, Spain
(1) On leave from Institute of Materials and Reactive for Electronics, Department of Research on Electronics for Solid State (DIEES-IMRE). Havana University, Cuba.

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Keywords: Particle/aerosol size distributions, laser diffraction particle sizing, aerosol characterisation, ill-posed problems, inversion.

Laser Diffraction Spectrometry is a powerful non-intrusive technique for size analysis of aerosols and suspensions. This optical technique do not require single particles to be measured successively and the interaction between light and the ensemble of all illuminated particles is analyzed. This technique is useful for studying dispersion phenomena, aerosol characterization, powders, etc.

The determination of size distribution by light scattering involves a inverse scattering problem, that is associated with the obtention of the size distribution from energy data. The inversion by numerical quadrature is one method to solve this problem. We have applied the Tikhonov Regularization Method (TRM) with the L-curve criterion[1] in order to obtain the regularization parameter. Liquid aerosol and powder of paint are the samples characterized in this work. For theses samples, deviations of particle size measurement for statistical parameters are more important than in the case of the representative parameters. The TRM has been proved to be suitable for certified distributions and has provided successful results.[2]

Pneumatically generated aerosols have been widely studied in Atomic Spectrometry techniques, since their drop size distribution influences the analytical signal.[3] In the present work, the nebulizer employed was the Single Bore High Pressure Pneumatic Nebulizer (SBHPPN). The liquid aerosol was generated from lubricating oil diluted with MIBK (60% in oil). The powder sample was POLIPOX 6 FR gray PR-7004 SMMT and the solvent used to stabilize the slurry was sodium hexametaphosphate in water (HMP, 1.8 g/l). Such a particles are used in paint manufacture.

The scattered energy was measured by means of a Commercial Instrument (CI) (Malvern, mod. 2600c). Figure 1 shows the volume undersize distributions for the samples tested. Two plots appear in this figure: (a) volume undersize (%) measured by the CI and calculated from the same light scattering data using TRM, for liquid aerosols; and, (b) volume undersize (%) measured by the CI and calculated from the same light scattering data using TRM, for slurry.

The matrix used to solve the inverse scattering problem by TRM for the aerosol and the slurry was obtained applying the Fraunhofer diffraction theory and the Mie scattering theory, respectively. In both cases (aerosols and slurries) the inversion method TRM offers always 0 % of volume for minimum limit of measurement with this instrument. For the remaining diameter ranges the results obtained with TRM (L-curve criterion) are close to CI.

Parameter characteristics obtained for drop/particle distributions are shown in Table I. In this table the representative diameters (i.e., median volume, $D_{50\%}$) as well as some statistical parameters (i.e., Sauter mean diameter, $D_{3,2}$, volume mean diameter, $D_{4,3}$ and relative spread, span) are compared for the algorithms used.

The Tikhonov regularization method gives both, representative and statistical, diameters within 5% of those obtained for Commercial Instrument. The distribution spans are virtually the same for the two algorithms, however, in all the cases, the representative diameters are slightly

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lower when TRM is used. This is due to the fact that TRM generates volume fractions for smaller diameters. As a result, the averages variables ($D_{3,2}$ and $D_{4,3}$) are shifted to lower diameters.

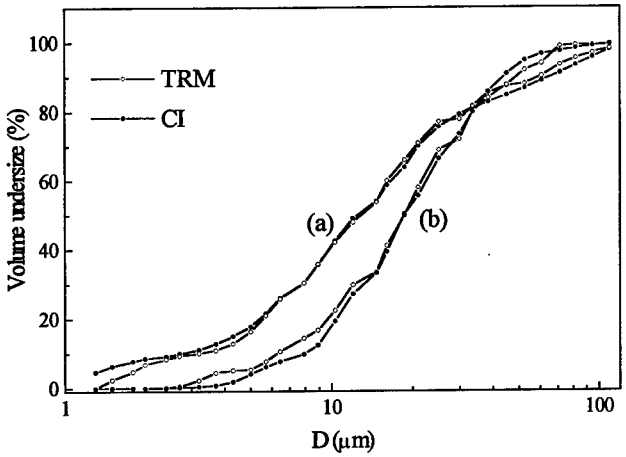


Fig. 1. Cumulative volume fraction vs. diameter for: (a) liquid aerosol and (b) slurry.

Table I. Results obtained with TRM application.

	Aerosol*		Slurry**	
parameter	TRM	CI	TRM	CI
$D_{50\%}$ (μm)	11.4	11.6	18.2	18.5
$D_{3,2}$ (μm)	4.9	5.1	12.4	13.7
$D_{4,3}$ (μm)	20.6	21.4	21.1	22.1
Span	4.9	5.1	2.2	1.8

* the matrix used is obtained applying the Fraunhofer diffraction theory.
** the matrix used is obtained applying the Mie scattering theory.

Acknowledgements

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1377.
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DEVELOPMENT AND METROLOGICAL QUALIFICATION OF THE RADIOACTIVE ISOTOPE DUST-METER IKAR

BALAKHANOV M.V., BOLSHAKOV V.A., KUDRJASHOV V.V., PETROV A.A., SEVASTJANOV V.D., SOLNYKOV V.V.

GP "VNIIFTRI", IPKON RAS, SKB IRE RAS, Moscow

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An operative and exact checking of the air dustiness level are necessary for the raising of air disdusting efficiency on factories, where technological processes are accompanied to the generation of dust. Herewith follow to use such concentration's measurement method, which is less subjected to influence of material and dispersity dust's composition, since stuff and technology of its processing on the concrete factory are not known beforehand and can change over a wide range. Only a radioactive isotope measurement method possesses specified characteristics from known indirect methods of a dust concentration's evaluation in midair. It is based on the measurement of the beta-particle attenuation in a layer of dust, precipitated on the filter from the given volume of dusted air. This circumstance does the radioactive isotope dust-meter preferred not only at the measurement of dust concentrations in midair of a working area, as well as at an environmental ecological monitoring on dust factor.

One of the important conditions of undertaking the responsible measurements is a possibility to metrological qualifications (type approval tests) and to checks of instruments, realizing chosen method. Herewith two approaches are used. In first, master samples of material are used for the check and qualifications. In the event of the measurement of dust concentrations it is practically impossible to create a sample of the standard polluting air because of instability of an aerodispersive air-dust system. In the second approach, simulators or so named equivalent measures are used, which are objects that are distinguish from a measure, but have alike or equivalent influence on measuring instrument elements. However under such approach it is necessary strictly to prove those attenuation laws using in the beta particle's radioisotope method are the same or are like at the accuracy to the constant factor in the layer of dust particles and in the equivalent measure.

A radioactive isotope method of measurement of a dust concentration in midair is based on the filtration of known volume of polluting air and the following determination of sediment on the filter mass of dust on beta radiation attenuation in it.

A theoretical analysis of the a beta radiation which is absorbing in such nonevent dust layer has show that attenuation in it is always less, than in equal on the mass even film, but law of absorbing is distinguish by presence of transfer factor in the power of the exponent. In this case it is important so named uniformity of the sensitivity of the measuring system, defined by the form of a radiation intensity sharing and by an efficiency of registrations on the area of a spot. Developed by authors constructive decisions have ensure the uniformity of this sensitivity and have reduce inaccuracy of measurement.

The experimental check was made with using dust with different disperse and material compositions, it has show fairness of developing theoretical positions, has confirm a coincidence of theoretical and experimental transfer factors (a transition from dust to the film from such material), when ensuring uniformity of the sensitivity on the area of a dust preparation.

The studies have show the equivalence of a light beta radiating absorption in a dust layer on the filter and in nylon films, imitating such layer, that allows to use last as equivalent measures at qualifications and check of radioactive isotope dust-meters.

The carried studies have allow to develop and design a dust-meter, in which the radioactive isotope method of measurement is realized to concentrations of midair dust. At the measurement

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of concentrations a dust-meter executes subsequently a measurement of volume of air, pumped through the filter by the built-in in the instrument pump, and then a measurement of the precipitated on the filter dust mass herewith. Volume of air is defined on the number of swings of pump, but mass of a dust setting-on the attenuation of light beta radiation in the getting dust spot (on the correlation of number of pulses, registered by the detector of radiation before and after pumping of polluting air through the filter). A filtering tape NEL-3-25 is used as a filter, a source, containing the carbon-14 isotope-as a source of beta particles.
In measuring block of the dust-meter occurs a processing of the received information and its calculation to mass concentrations.

Calculation is executed automatically and on the indicator panel of the dust-meter is flashed a numeric value of a dustiness in the sampled air.

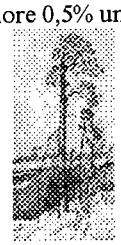
A value of a transformation factor is individually for each instrument (for different copies of instruments this difference is not great), The factor is defined in the process of its adjustment and written in the dust-meter's passport.

A dust-meter adjustment and check are realized by using the equivalent measures that were made from a nylon film. Measures present disks from a nylon film at the thickness 3, 10 and 20 micrometers, bolt in special holders, which locate in the process of adjustment or checks on the imitating dust spot filtering tape. The equivalent measures pass a qualification under their fabrication. The qualification of the measure is concluded in specifically exact measurement of their mass (balances are used with inaccuracy of measurement 1 - 3 mkg) and in determination of their area (on disk's diameter measurement's results with inaccuracy 2 - 3 mkm).

The dust-meter defines automatically in the process of measurement a necessary time for drawing of polluting air through the filtering tape. This is reached by comprising of the composition of instrument of micromanometer, defining swing of pressure on filtering tape in the air selection process. At the achievement of definite value of a pressure difference, corresponding to a dust spot shallow density of 2 - 3 mg/cm2, micromanometer gives a signal, which stops a working pump. This technical decision has allow us automatically to prevent an overflow of a filter by dust, under which possible garbling an exponential law of absorbing a beta radiating and to avoid a significant inaccuracy in the dust concentration measurement's results. A technical feature of the developed express-dust-meter IKAR is given below:

Limits of measurement, (mg/m3) -- 05 - 500.	Mass, not more, kg -- 2,2.
Inaccuracy of measurement, %, not more -- 25.	Performance-industrial.
Times of measurements, not more, minutes -- 15.	

A showing of an instrument do not depend on the change of disperse and material compositions of dust. Metrological qualification of instrument was carried out by VNIIFTRI on the special stand, that allow us to define the main forming inaccuracy of measurements. Master equivalent measures of shallow density of nylon films' type PET-KE were independently qualified on the mass shallow density on the VNIIFTRI's radiometric complex of the State special standard of the neutron fluency and flow density units. At the thickness of films 5, 10 and 20 mkm the shallow densities were measured, accordingly, equal to 0,517-0,519; 1,75-1,80 and 2,94-2,95 mkg/cm2. The measurement inaccuracy of the films shallow density of master equivalent measures formed a value not more 0,5% under confidential probability 0,95.



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DUST GENERATOR QUARTZ

ZVEREVA N.S.

Russia, Noginsk, tim@noginobladm.msk.su. tel.+7-(09651)42200

(First received 02 March 1998; accepted for presentation during IAS-4)

Dust generator "Quartz" is used for highly accurate dozing the particles of different mono- and polidisperse powdered materials (quartz, corundum, metal oxides, carbon black, metals, minerals, silica, pigments, abrasives, catalysts, adsorbents, cement, starch, etc.) into the gas flow.

Generated aerosol helps to control protective and explorative properties of filters and dust removal devices.

Dozing small-size particles is a technically difficult task. Main deficiencies of known generators are irregularity powder dozing and narrow concentration range of generated dust.

Aim of generator developing is achievement of high proportionality powder dozing in wide dust concentration range , including fine-dispercional disposed to aggregation powders.

Dust generator "Quartz" was successfully researched in laboratories and industrial conditions.

Specification

Feed of powder into gas flow, mg/min	3-1000
Reproducibility ,%	3-5
Range of particle size powder to be dispersed, mcm	0,5-1000
Pressure of gas flow, kg/sm2	1,1+0,1
Carrier Gas Flowrate Range ,liters/min	40-100
Period of continuous operation	unlimited
Power Requirements	220,240 VAC; 50-60 Hz; less than 250W
Concentration of generated dust mg/m3	20-1000
Overall dimensions, mm	370x270x280
Weight ,kg	8,0

No support for device installation. It is maintained by one operator.

Dust generator "Quartz" may be used for:

– research of dust capacity and effectiveness of filtration dust removal devices;
– monitoring environmental pollution of air;
– dozing of fine-dispersion powders in chemical industries, powder metallurgy, biology, pharmacology;
– calibration of pollution control equipment.
– inhalation toxicology studies in medicine, agriculture and other fields.

Main structural elements: bunker with powder and special stirrer; disk conveyer of particles; device for powder feed decrease; nozzle of high gas flow; control panel with feed blocks.

Any anticorrosive explosion-proof desiccated gas (pressure 1-5 MPa) is used as gas-carrier.

Generator is the unique device in Russia. It provides high precision and reproducibility at low feed (about few mg/min) of particles of different powders with both wide and narrow range of particles sizes (0,5-5000mcm) and it is one of the most powerful tools for successful aerosol research.

The device is distinguished from similar ones by high reliability under long service life and by easy of operation.



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1376.
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EQUIPMENT FOR MEASUREMENTS AND TESTING OF AIR CONTAMINATION AND CERTIFICATION OF CLEAN ROOMS

BALAKHANOV M. V., GRITSENKO A. P., KOCHERGA V. G., TROTSENKO N.P.

GP "VNIIFTRI"-State Enterprise "All Russian Research Institute of Physical-Technical Radiotechnical Measurements" by Gosstandart of Russia

(First received 30 March 1998; accepted for presentation during IAS-4)

Clean rooms (CR) are required for realisation of the high-tech. in which parameters of all technological environments are testing. Air environment is tested on one of the main parameter. a particle aerosol contamination. As an effect, the amount of a processing, a sending and a recording information about parameters of controlled environments has increased sharply. This has led to the creation and the introduction into practice a new generation of the checking-measuring equipment- computer systems for air environment monitoring in clean rooms. On these reasons a need of association into the computer network a number of autonomous instruments becomes a main condition to fulfil requirements of standards on the testing and the certification of clean rooms. These instruments, which are used for measurements and qualifications, are analysers of the contamination of air, sensors of temperature, pressures, moisture and etc.

A short description of instruments developed in VNIIFTRI is given below: an autonomous counter of aerosol particles "Monitor A-33". having channel for the association in the computer network, and a computer system "Monitor - C" for monitoring and testing the air contamination in CR's. Instrument "Monitor A-33" is a photoelectric particle counter, which principle of action is based on the analysis of light radiation, scattered by aerosol particles when a sampling air is pumped through the illuminated measuring volume.

This instrument consists of an optical block, a pneumatic block and a block of electronics. A halogen tube was used as the radiating source in the optical block. The design of the optical block ensures a reliable checking of aerosol particles with sizes equal and more than 0.3 pm. The pneumatic block ensures a pumping of air through the aerosol chamber and a regulation of its consumption within range from 1 to 3 litre per a minute. The microprocessor block of electronics executes a collection, a processing and a displaying of a measuring information.

The base model of the counter "Monitor A-33" has the following features:

* a number of channels for the simultaneously registering of the aerosol particles - 4;
* sizes of particles in the channels: >=0,3μm, >=0.5μm, >=1μm, >=5μm;
* a volumetric consumption of air sampling for the analysis - 1 litre per a minute;
* an indication of measurement results is numerical, on a built-in 7-sign indicator pa dimensionality of results is a number of particles per a cubic meter of air;
* time of one measurement (sampling) - from 1 minute to 9 hours (will be assign by an operator from the keyboard of the instrument);
* an additional information that is given on the numerical indicator panel in the process of measurement: current time of measurements, a number of particles in each channel for a current time, a checking information on states of working instrument:
* an RS-232C interface for the relationship with external PC;
* the instrument has a built-in block of the optical channel calibration;
* a power supply of an instrument is from industrial network 220 V 50 Hz,
* gabarit sizes - 360x300x120 mm.

Built-in RS-232C interface allows remote control (up to 100 m) by the regime of working instrument and to interchange by the measurement information with an external PC. A special software enables to unite in the computer network up to 256 instruments of given type just

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through COM1 port by using the standard computer analysis facilities, a performing and an archiving of a measurement information.

Parameters of the base instrument models (a threshold value of sizes of particles in channels and volumetric consumption of air) can be changed at the request of the customer.

Base model has a number of modifications and in particular model "Monitor A-33/MAC" is intended for undertaking the measurements in areas with a microbiological contamination control and is adapted to requirements of GMP rules. There are developments with autonomous (storage) by power supply and in the safety explosive performance.

A specified computerising measuring system Monitor-C consists from following elements: an IBM PC/AT computer, a network adapter. a multiplexor and aerosol measuring sensors. As sensors two-channel photoelectric particle counters are used, each counter has a built-in power supply unit and a pneumatic block. All sensors have built-in blocks of remote calibration of optical channels, operated by PC.

Measuring sensors are united with the multiplexor by means of wire communication links at the length to 100 m. A specially designed controller on 64 measuring channels (32 two-channel sensors) serves as a multiplexor. The multiplexor allows to send on the PC up to three independent commands per each sensor and to take from them up to three signals about their functional condition together with the transmission of a measuring information.

The PC interchanges by signals with the multiplexor through the network adapter-a standard 32 ranks parallel interface. It is installed on PC charge in any free slot and is united with PC through ISA bus. The application of a parallel interface has allow to avoid the using of the microprocessors in sensors and in the multiplexor at the pre-processing of a measuring information and switching of testing and control signals and to entrust these functions on PC software. These enable greatly to simplify a hardware part of the measuring system and greatly to reduce its cost. A questioning of the measuring sensors, a checking and a mode control of their work, a collection, an analysis, a keeping and a presentation of all accumulated signals is realised by means of special software with a using of the standard PC facilities in a suitable for the user type.



1582.
УДК 541.18

EXPERIMENTAL MEASUREMENTS WITH THE ORIFICE-ORIFICE CLASSIFIER

Y. MARUI, J-C. LIN, Y.C. CHANG, J.W. GENTRY

University of Maryland, College Park, Md., USA

(First received 01 June 1998; accepted for presentation during IAS-4)

The object of these studies was to develop an inertial classifier utilizing a modification of a Mercer inertial impactor. In the inertial impactor the flow is perpendicular to two discs, the flow is through a central orifice in the top disc and around the second plate. The configuration is very similar to that shown in Figure 1. The modifications made for these instruments were to (1) make the bottom plate from porous metal with independent flows, (2) to consider the bypass stream as the product, and (3) to consider two configurations with independent flow rates. The smaller particles are entrained in the orifice-disc configuration as the larger particles are collected on the porous disc. By varying the flow rate and the separation space the size of particles collected can be varied. Both the simulations and the experiments confirmed this behavior. In this abstract we discuss the orifice-orifice configuration.

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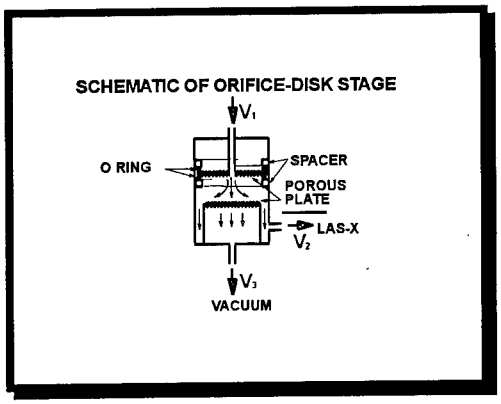


Figure 1

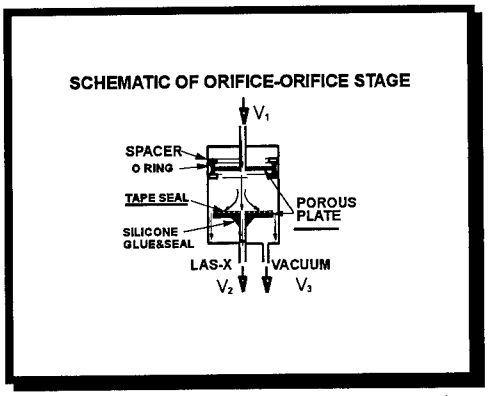


Figure 2

Discussion

The goal in the orifice-orifice configuration was to preferentially collect the larger particles. The smaller particles and the bulk of the gas flow would be vented through the porous plate. This configuration is close to that used in particle concentrators, where the particle stream passes through nozzles into a second stage while 90% of the flow is diverted. From the beginning of our experiments, this configuration did not work so effectively as the orifice-disc classifier. However, the results below show the feasibility of the approach which we adopted and suggested how the design could be improved. In all cases reported in this work the aerosol steam consisted of a 7.5% sugar (a surrogate for surfactant-protein) solution. After generation of droplets in the range 3-10 μm from the aqueous solutions with a Collison nebulizer the particles were passed into a drying chamber. Sufficient flow was diverted so that
the flow entering the inertial classifier was the LAS-X sampling rate + the secondary flow around the plate. It is simple that this simple configuration was adequate to give a sharp parcel concentration for the larger particles.

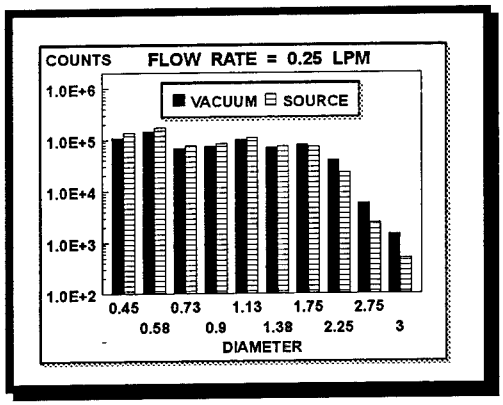


Figure 3a

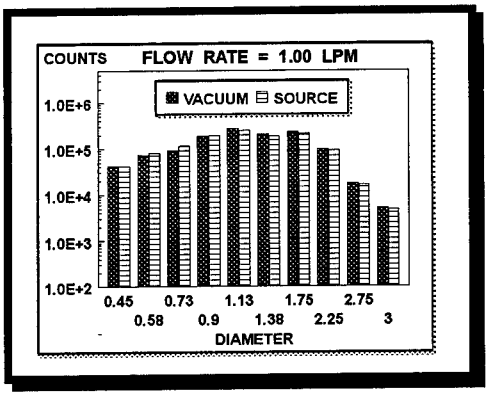


Figure 3b

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Figure 3 presents the particle size distributions as measured for two different flow rates through the exterior. Flow rates of particles through the opening in the central orifice were at rate 0.06 LPM , the sampling rate of the LAS-X . The flow rate in the anterior region was 0.25 LPM (3a) and 1.00 LPM (3b). The plate separation distance was 2.54 cm. The flow with out diversion is designated as source, while the flow which is diverted is indicated a vacuum. The particle sizes counted were 0.45-3.0 μm. Until the particles were larger than 1.8 μm there was little difference in the distributions. For larger particles there was significant deviation.

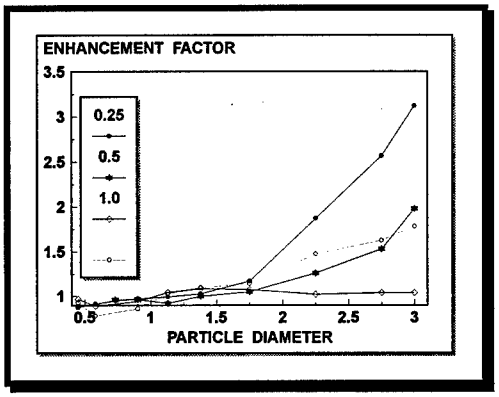


Figure 4

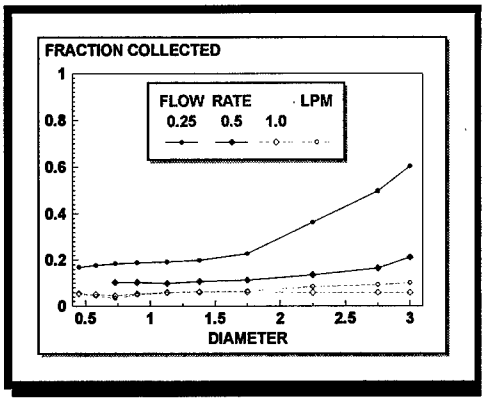


Figure 5

This effect is shown more clearly in figure 4 where the enhancement rate is plotted as a function of the diversion flow 0.25, 0.5, or 1.0 LPM. This ratio indicates how much greater the concentration of particles of a specified size for the case where there is diversion. If there were no concentration this ratio is 1.0. No significant enhancement occurs for particles below 1.8 μm. For our design purposes this is too large, so that the dimensions of this configuration must be changed. The data are replotted in Figure 5, so that the fraction of particles available for collection are expressed as a function of size. The maximum value of 1.0 would mean that all particles larger than a selected size are collected. The data clearly show that the yields for larger particles are satisfactory when the flow rate is 0.25, but drops substantially at lower flow rates. The explanation for this behavior is the onset of turbulence, so the particle stream is mixed rather than remaining laminar until it passes into the next chamber.

1057.
УДК 541.18

MONODISPERSE LATEXES. MAKING, USING, CHARACTERISTICS.

CHECHIK O.S.

Scientific and production firm "VAPA", S-Petersburg, Russia.

(Received 16 December 1997; accepted for presentation during IAS-4)

Monodisperse polystyrene latexes is especial group of latexes. Their main distinction is a narrow latexes particles distribution on size. It permit to employ these latexes for calibrating and checking of distinguish devices (electronic microscpes, particles counters and other), for checking of filters and filtering devices, for creation of modelling colloid systems with giving characteristics. Other specific region of their employing is a protein sorbtion on latex particles surface for making of medical diagnosticums.

We can make these latexes in laboratory scale by means emulsion polymerisation of styrene in presence of little strictly measuring amount of emulgator (sodium laurate or myristate as

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usually). We can receive by this way latexes with particles diameter in diapasone 0,05 microne. For making of latexes with larger particles we use usually seemed polymerisation.

An essential difficulty of these latexes receiving is their reliable attestation (determination of middle particle diameter and of degree their polydispersity. For their describing we use the average-number (S d/n) value of diameter and average-square deviation from average diameter. We use for measuring these characteristics two methods: electronic microscopy (miroscope Tesla BS-242E) and laser spectroscopy (Coultronix N4).

The characteristics of latexes we received are next:

Latex concentratio 10% (mass)

Particles dimensions diapason 0,05 - 4,0 microne

Particles dimensions measuring error 1-3%

Polydispersion extent 5% (for latexes with particles diameter 0,05-0,1 microne and 3,0-4,0 microne 10%).

It should be emphased, here are showed the guaranteed values of characteristics. Real values can be higher. Real measured polydispersity extent can be in diapason 2-3% and less.

Other characteristics of these latexes are next:

Dissoluble in water touch concentration less as 0,1%, it can be decreased, particularly with particles diameter more as 0,3 micrine, by dializing. Latexes particles material is polystyrene, its densityis 1,05 g/ml, refraction index is 1,59.

Depending on supplied latex volume we can sell it at a price 1000-3000 USD per litre. Analogous latexes supplied abroad at a price 6000-30000 USD per litre. Of course, these products are expensive, but a particles number in 1 ml of latex is 10^8 - 10^{13}. It is enough for reliable measuring to treat signals from 10^4 - 10^5 particles, so a value of one measuring is not so high. There are other methods of minimising of measuring value, now we work on one of them together with B.M.Zelicson ("Optica", SPb).

On inquiry of customer we can make modified latexes: painted, nonsedimented, carrying on particles surface carboxylic group, metal ions, metal atoms, including copper, silver e.o.

Other region of monodisperse latexes consuming is making on their basic of distinguish diagnosticums by sorbtion on their particles surface of distinguish proteins. The most interesting latexes are here on their particles surface are fixed functional groups: carboxylic, amino- et other, they allow strong to bind proteins macromolecules, excluding their desorbtion from particles surface. We can supply these latexes too.

Monodisperse latexes application here before "perestroika" became broadening, so it can expect to groww consuming of these latexes with renewal of home industry, especially based on high technologies.



1662 УДК 541.18

NEW TECHNIQUE FOR MONITORING OF AEROSOL CONCENTRATION

DR IGOR AGRANOVSKI

School of Environmental Engineering, Griffith University,

Brisbane, 4111, Australia Griffith University, 4111, QLD. Ph.: +61 7 3875 7923 Fax: +61 7 3875 7459, Mobile: 0411562786. EMail: I.Agranovski@ens.gu.edu.au http://www.ens.gu.edu.au/Agora/

(First received 17 June 1998; accepted for presentation during IAS-4)

At the present time a variety of techniques is available for the measurement of aerosol concentration in exhaust air streams. All of them have disadvantages. Some of them are too slow and could not be used for continuous and frequent monitoring. The others are either not precise

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enough or have significant limitations on the concentration of particles in gas streams. A new instrument has been developed for an accurate measurement of aerosol concentration in air streams. This instrument is based on the dew-point principle. Sample of an analysed air stream is sucked isokinetically through the sampling probe and initial vapour content of measured substance is determined by the measurement of the dew-point temperature of the substance. Another part of the sample is made to pass through the heated pipe to provide a complete evaporation of aerosols. After the evaporation, the new vapour content is measured by the same procedure as the initial one. The difference in vapour contents before and after evaporation of aerosol is equal to the total aerosol concentration in the air stream.

The advantages of the instrument are:

1. Fast measurement (about 2-5 seconds for one measurement).
2. High accuracy.
3. Could be used for wide range of substances including acids, oils, etc.
4. No other measurements (sampling time, weighing of a sample, etc.) required.
5. Compactness. Can be used in laboratories and in industry.



1078
УДК 541.18

OPTICAL DISTANCE PROBING OF EXTRACTIVE PULPS

TERENTIEV V.E.

All - Russian Scientific Centre "State Optical Institute name after S.I.Vavilov", Russia, 199034, St.-Petersburg, Birgevaya line, 12 Tel: (812)218-00-82, fax:(812)218-37-20, E-mail: Leader@soi.spb.su

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The problem determination of small concentration of elements and combinations in the form of admixture with a mass portion ~ 0.1% and less in the extractive pulps (the dispersion systems of a fine - fragments solid substance with water) is solving at present by means of a laboratory method titration of samples, selected from the extractor with periodicity defined of the duration of analytic measuring (more 40 minutes). It's suggested the new probe of principle - optic-electronic analyser of admixtures, allowed to measure a concentrations of admixtures in extractive pulps continuous in process of production [1,2]. In given work the theoretical and methodical principles of optical distance probing of extractive pulps were examined, the results of the industrial probations of the analyser were presented.

It's supposed in theory, that pulps is describing by the strong stretched forward diagram of the light scattering, and theory, were developed in work [3], is spreading on pulps. Side by side with calculation of the scattering, determination of concentration SO_{3free}, P_2O_5 and other admixtures in pulps is founding on differences of optical spectrums between molecular interaction for different admixtures in the same condensed medium [4]. Influence of a pulp boundary on optical bunch is defining by refraction of radiation in the perturbed by boundary layer. Liner depending is supposed between indices absorption, scattering and correspond concentrations of admixture and of suspended substance.

With calculation the named assumption the formulae, established a communication of concentration of admixture as well as suspended substance in pulp with reading of the analyser, were defined. Methodic principles of foundation, colibration of analyser of admixtures in pulps

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were elaborated. Some results of measurements were presented.

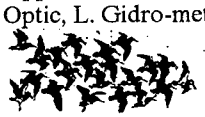
At time the industrial probations of analyser the effect "Vanish of boundary division of pulp - air", consist in stabilization of the analyser reading by disturbance of stratification of pulp sample account for intensive mixing by the rest of the same conditions, were discovered. It's possible that effect is conditioned by optical pulp characteristics, namely, by great value of average quadratic scattering angle in one scattering act $<\vartheta^2>$ in comparison with diffraction angles Θ of radiation bunch in result refraction in perturbed by boundary layer.

In regime of continuous probing of extractive pulps the mistake of measurements of concentrations SO_{3free} isn't exceed $\pm$ 0,1÷0,15% mass for concentrations 1,0÷3,5% by a correlative coefficient no less 0,9 with data of control analytic measurements [2].

Author thanks to Mrs. M.N.Batova for participation in industrial probations and treatment of results, metrological certificate of optic-electronic analyser of admixture.

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1225.
УДК 541.18

SOLID PARTICLES CONCENTRATION OPTICAL MEASURING INSTRUMENTS ON THE BASIS OF INTEGRATED LIGHT SCATTERING METHOD APPLICATION FEATURES

PAVEL V.CHARTY, VALERY G. SHEMANIN

SPA "Stromecology", Novorossisk, Russia

(First received 15 February 1998; accepted for presentation during IAS-4)

Integrated light scattering on particles method is one of optimum methods due to a number of the characteristics sold in solid particles concentration in technological gases automatic measuring instruments. IVA-3M concentration automatic measuring instrument realizing this method [1] was developed and is made at SPA "Stromecology" in Novorossiysk. Actual task is the place for control choice at gaspipe because the particles concentration measurement by this device is carried out practically in one point (measuring volume is about 30 cm^3), instead of the whole gaspipe cross section. In cases, when it is possible to suggest distribution of particles concentration is more or lesser constantly, satisfactory recalculation of the whole section concentration have to make by results of one-point measurement [2].Ideal for the particles control are the vertical lines gaspipe, which lengths as the minimum on the order exceed their cross sizes [2].

In real operation conditions it frequently fails to choose close to an ideal condition for this instrument installation. Therefore the experimental work on influences of the various factors on IVA-3M instrument calibration characteristics is necessary for adequate results of measurement getting with this automatic device.

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Comparative measurements results of concentration of solid particles in technological gases in the industrial enterprise conditions in a wide range variation of the basic technological parameters are given in the present work. IVA-3M instrument calibration characteristics have been received for various installation sites and the recommendations for concentration of firm particles in technological gases optical measuring instruments constructed on the basis of integrated light scattering method practical application have been formulated.

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1107.
УДК 541.18

USING OF POLYDISPERSE AEROSOLS AND SPECIAL AEROSOL SOURCES FOR CALIBRATION OF AEROSOL RADIOMETERS

FERTMAN D., RIZIN A.

Scientific & Engineering Centre "SNIIP", Moscow, Russia.

(First received 20 January 1998; accepted 29.04.98 for presentation during IAS-4)

The national radioactive aerosols standard exists in Russia since 1973 [1]. It reproduces and keeps the unit volume activity of the most toxic Pu-239 and Sr-90 radionuclides model aerosols and transfers its value with best accuracy to the operating measurement means (OMM) with the help of standardized methods and reference means. Polydisperse media of model radioactive aerosols in standard has a range of the sizes of particles of an inhaled faction, recommended ICRP [2]. The keeper of the standard is National scientific metrological centre "VNIIFTRI" of State committee on standards of Russia.

Direct usage of national standard for metrological provision of measuring operating means is too expensive. At each stage of developing and using measuring equipment the choosing of technical means for realizing main tasks of metrological provision shall be performed with optimal cost-effectiveness ratio. Such offers were formulated in work [3].

The national standard design was practically reproduced at participation of the authors as metrological complex in aerosol laboratory of metrological centre of Ministry of Atomic Energy in SEC "SNIIP". It is used for the calibration, certification and verification of the radiometers and other practical metrological provision. Main parameters of a metrological complex are resulted. In addition the important problems arised in radio-active aerosols metrology in last decades were resolved:

- it was extended radionuclide structure of aerosols - was added generation of natural uranium aerosols;
- questions of calibration and type samples of radiometers and measuring channels of the radiation control systems directly on consumer's place were resolved by using of priority designed model aerosol sources (Special Aerosol Sources - SAS) [3].

SAS with radionuclides Pu-239 and Sr-90 + Y-90, specially made for reference radiometer and certificated on equipment of the national radioactive aerosols standard with accuracy 10 %, have allowed at next certification of radiometer to lower meaning of its main error to 20 % (on

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uranium natural up to 30 %). The original technology of manufacturing of a source permits to take into account peculiarities of the sampling communications of a concrete type of radiometer, but also geometry and conditions of registration of radiation of sample radionuclides.

Structure of model radioactive aerosol particle sizes was estimated by six-cascade impactor and radiometer MS-01P.

Radionuclides and characteristics of model aerosols are close to similar parameters of the national radioactive aerosols standard. It is a necessary condition for maintenance of unity and correctness of measurements when the calibration, certification and verification of OMM are made by reference radiometer. Such procedure corresponds to a procedure of dynamic tests of aerosol monitors , accepted, for example, in standard IEC - 761- 6 and other similar documents. The meanings of sensitivity of several types OMM were defined by metrological complex equipment. Then the similar procedure with the purpose of specification of their sensitivity was lead on national radioactive aerosols standard. The experiments demonstrate good convergence of comparative measurements results.

Experience of long-term operation of the national radioactive aerosol standard in Russia, and efficiency of the used metrological provision have appeared are rather high, that on this way there were the experts of other countries. The French experts from IPSN-CEA have the most advanced in last years , having created aerosol standard ICARE [4]. In result of cooperation between SEC "SNIIP" (Russia) and IPSN-CEA (France) [5] was made a number aerosol samples with certain radionuclide ingredients. Independent mutual measurements of activity of these samples were carried out. Received data have allowed to increase accuracy of measurements up to level of the international requirements (error of measurements does not overtop 20 %)

The joint work of the experts of laboratories from Russia and France is step to creation of international system of the radioactive aerosols standards. This system, in opinion of authors should be based on activity of nominated autorized national laboratories, make speciality of practical radioactive aerosols metrology.

The authors of the report have expressed representation about level and functions of such national laboratory and have demonstrated it on example of aerosol laboratory SEC "SNIIP" of Russian Federation Atomic Energy Ministry. And experience of cooperation of the Russian and French experts SEC "SNIIP" (Russia) and IPSN-CEA (France) has planned main contours of system of international trust in this area and possible ways of achievement of such trust.

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List of participants of IAS-4 with presentations during 6 July 98

Bakirov Talgat Salmanovich *(1946-01-25)*
Russian State Scientific Biological Center VECTOR
Phone: (7)-3832-630055
fax (7)-3832-328831
email: root@churc.nsk.su
Novosibirsk Russia

Balahanov Mihail Valentinovich *(1947-03-08)*
SE VNIIFTRI
Phone: (7)-095-5359359
fax (7)-095-5359349
email: balah@ftri.extech.msk.su
Moscow Russia

Belov Nikolay Nikolaevich *(1947-05-04)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Belova Nina Georgievna *(1944-02-25)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia



Bezrukova Aleksandra Gennadievna
St. Petersburg State Technical University
Phone: (7)-812-5557413
fax (7)-812-5557413
email: bezr@psb.usr.pu.ru
St.-Petersburg Russia

Bordenyuk Andreyi Nikolaevich *(1974-07-27)*
Moscow State Technological University
Phone: (7)-095-1352408
email: zlobina@sci.lebed.ru
Moscow Russia

Bozhevolnov Viktor Evgenevich *(1947-01-01)*
Moscow State University
Phone: (7)-095-9393207
fax (7)-095-9328846
email: gorba@radio.chem.msu.ru
Moscow Russia

Castillo Jose Luis *(1955-02-21)*
Universidad Nacional de Educacion a Distancia
Phone: (34)-1-3987122
fax (34)-1-3986697
email: castillo@apphys.uned.es
MADRID Spain

Chechik Oskar Samuilovich *(1936-05-21)* VNF VAPA
Phone: (7)-812-2514332
fax (7)-812-1643274
Chechik@Chech.USR.PU.Ru
St.-Petersburg
Russia



Chernyak Vladimir Grigorevich *(1946-03-10)*
Ural State University
Phone: (7)-3432-616775
fax (7)-3432-615978
Vladimir.Chernyak@usu.ru
Ekateinburg Russia

Dirksen Veronika Gennadevna
St.-Petersburg Russia

Evsikova Lyubov Georgievna *(1938-08-28)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2188063
fax (7)-812-2183720
St.-Petersburg Russia

Gavrilov Aleksandr Sergeevich *(1948-02-10)*Russian Hydrometeorological Institute
Phone: (7)-812-2243039
fax (7)-812-3251281
email: gavr@mcep.rshmi.spb.ru
St.-Petersburg Russia

Gentry James W. *(1939-11-27)*
University of Maryland
Phone: (1)-301-4051915
fax (1)-301-3149126
email: Gentry@eng.umd.edu
College Park USA

Germogenova Tatyana Anatolevna *(1930-04-10)*
M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Phone: (7)-095-2507861
fax (7)-095-9720737
email: germ@kiam.ru
Moscow Russia

Gluschenko Natalya Nikolaevna *(1946-03-24)*
Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences
Phone: (7)-095-9397937
fax (7)-095-1378258
email: nnglu@chph.ras.ru
Moscow Russia

Granstrem Konstantin Olegovich
St.Petersburg I.I.Mechnikov State Medical Academy
Phone: (7)-812-5431920
fax (7)-812-5431571
email: paa@infopro.spb.su
St.-Petersburg Russia

Grigorev Aleksandr Ivanovich *(1946-01-13)*
Yaroslavl State University
Phone: (7)-0852-3339268
fax (7)-0852-354777
email: grig@univ.uniyar.ac.ru
Yaroslavl Russia

Grushko Yuliyi Sergeevich
email: grushko@LNPI.SPB.su
Gatchina Russia



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Kameshkov Gennadiyi Borisovich *(1943-02-09)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189946
fax (7)-812-2188179
email: Irina@tks-opt.spb.ru
St.-Petersburg Russia

Katkov Vladislav Leonidovich *(1936-05-11)*
Institute of Engineering Cybernetics
Phone: (375)-0172-685296
fax (375)-0172-318403
katkov@newman.basnet.minsk.by
Minsk Belorus

Konovalov Nikolayi Vasilevich *(1947-08-28)*
M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Phone: (7)-095-2507861
fax (7)-095-9720737
email: knv@kiam.ru
Moscow Russia

Koromuslov Vyacheslav Aleksandrovich
Yaroslavl State University
Phone: (7)-0852-222325
fax (7)-0852-354777
email: polya@univ.uniyar.ac.ru
Yaroslavl Russia

Kucherov Arkadiyi Nikolaevich *(1951-02-09)*
Central Aerohydrodynamic Institute named after N.E. Zhukovsky
Phone: (7)-095-5564807
fax (7)-095-5564337
ank@dept.aerocentr.msk.su
Moscow Russia

Kudryavtsev Ilya Aleksandrovich *(1968-12-07)*
Aerospace University of Samara
Samara Russia



Letfullin Rinat Rifgatovich *(1962-03-01)*
Samara Branch of P.N.Lebedev Physical Institute
Phone: (7)-8462-340536
fax (7)-8462-355600
email: theor@fian.samara.ru
Samara Russia

Logvinov Leonid Mitrofanovich *(1944-09-01)*
Aerospace University of Samara *Phone*: (7)-8462-357356
fax (7)-8462-357356
email: onil16@lib1.ssau.ru
Samara Russia

Makovtsov Gennadiyi Anatolevich
Russian Scientific Optical Center named by Vavilov
St.-Petersburg Russia

Mihayilov Oleg Mihayilovich *(1938-12-19)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189952
fax (7)-812-2183720
St.-Petersburg Russia



Omelyanets Taisiya Grigorevna *(1938-01-25)*
Ukrainian Scientific Hygienic Center *Phone*: (7)-044-5593433
fax (7)-044-5599090
email: omelyans@usch.kiev.ua
Kiev Ukraine

Pinaev Viktoor Alekseevich
State University of Kemerovo
Kemerovo Russia

Pominov Evgeniyi Ivanovich *(1946-09-21)*
Aerospace University of Samara
Samara Russia

Redkoboroduyi Yuriyi Nikolaevich *(1940-03-10)*
Astronomical Observatory of Kiev University
Phone: (7)-044-2160906
REDCO@AOKU.FREENET.KIEV.UA
Kiev Ukraine

Terentev Vladislav Evgenevich
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2180082
fax (7)-812-2183720
email: Leader@soi.spb.su
St.-Petersburg Russia

Tkachev Vladimir Vasilevich *(1926-01-20)* Institute of Occupational Health RAMS
Phone: (7)-095-3653130
fax (7)-095-3660583
email: tkachiov@iog.nifhi.ac.ru
Moscow Russia



Ukraintseva Valentina Viktorovna
Komarov Botanical Institute of the Russian Academy of Sciences
email: ukr@nk1834.spb.edu
St.-Petersburg Russia

Uvarova Lyudmila Aleksandrovna *(1951-04-21)* Moscow State University STANKIN *Phone*: (7)-08222-9729520
email: uvarova@stanmat.mian.su
Tver Russia

Vlodavets Viktor Vladimirovich
Moscow Hygiene Institute named Erikhman S.S. Moscow Russia

Vorobeyichikov
St.Petersburg I.I.Mechnikov State Medical Academy
fax (7)-812-5431571
email: paa@infopro.spb.su
St.-Petersburg Russia

Korobeyinikova Aleksandra Vasilevna Institute of Labour Safety *Phone*: (7)-812-2790863
fax (7)-812-2352632
St.-Petersburg Russia



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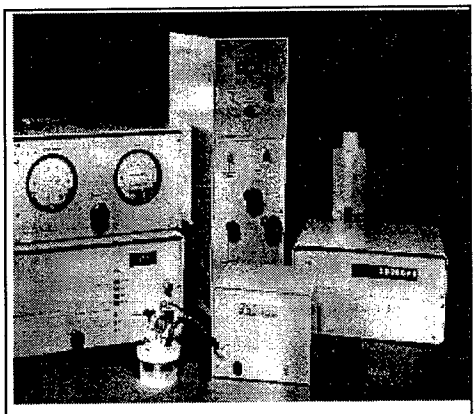


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AEROSOL THEORY

Prof. **CASTILLO J.L.**

Prof. **UVAROVA L.A.**

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address Belov N 21-117
2-Mosfil 119285
tel./fax (095)**1474361**
BELOV@TEHNO.MMTEL.MSK.SU

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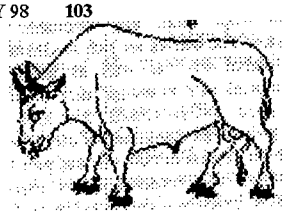
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NUMERICAL MODELING OF GAS-AEROSOL INTERACTION IN WET ATMOSPHERE

A.E.ALOYAN, V.O. ARUTYUNYAN, P.I. LOUZAN

Institute for Numerical Mathematics, RAS, 8, Gubkin str., 117333, Moscow, Russia hohov@inm.ras.ru

(First received 20 April 1998; accepted for presentation during IAS-4)

KEYWORDS: turbulence, air pollution, photochemistry, numerical modeling

MODEL DESCRIPTION

For numerical simulation of minor gaseous constituents in the lower troposphere and their interaction with aerosol, a complex of mathematical models is necessary to be developed allowing one to consider a series of interconnected physical, chemical and dynamical processes. In particular, gas- and aqueous-phase photochemical processes are closely connected and have to be modeled jointly. This stems from the fact that the increase of acidity depends (inversely) essentially from concentrations of active radicals, ions, and ozone in a surrounding space of aerosol particles. From the other hand, the increase of ambient air temperature can lead to formation of new particles and the widening of drop size spectra is related to turbulent pulsations. Evidently, these mechanisms can be described in full measure using hydrodynamical models. Our mesoscale wet convection model is based on 3-dim non-hydrostatic atmospheric thermo-hydrodynamics equations, heat, specific humidity, and water content influx equations, as well as terms accounting on phase-transitions of humidity and long-wave radiation heat influx (Aloyan et al., 1992, 1993, 1995, Penenko and Aloyan, 1985).

In the background of flow formed, the transport and diffusion of multicomponent gaseous pollutants and aerosols is considered having regard to gas- and aqueous-phase photochemistry and aerosol formation due to convection and coagulation (Aloyan et al., 1992, Mattijsen et al., 1995, Seinfeld, 1986, Schwartz, 1986). Mathematically this can be written down as:

$$\frac{\partial \varphi_i}{\partial t} + \nabla U\varphi_i = \nabla K\varphi_i + B_{ij}(x,\varphi_i,\varphi_j) + C_{ij}(x,\varphi_i,\varphi_j) + P_{ij}(\varphi_i,\varphi_j) + M_{ij}(\varphi_i,\varphi_j) + I(\varphi_i,t)$$

where φ_i is the concentration of gaseous pollutants or aerosol particles ($I = 1, 2, \cdots, n$); K is the turbulent diffusion coefficient; x is the radius-vector; U is the wind velocity vector; B is a nonlinear operator describing the gas-phase photochemical processes; M describes aqueous-phase chemical processes; P describes condensation and evaporation; C describes coagulation.

In the photochemical block, two oxidation mechanisms of S(IV) to S(VI) were considered: (1) gas-phase oxidation of SO_2 and dissolution of H_2SO_4 in cloud drops, (2) dissolution of SO_2 in cloud drops and oxidation of sulfat-ions in solution under interaction with O_2, O_3, H_2O_2, and dissolved metals. Besides, condensation processes for the gas-particle system was studied by the example of H_2SO_4 vapors.

NUMERICAL EXPERIMENTS

The above mentioned complex of models has been used to perform numerical experiments for simulating the following processes: (1) aerosol formation processes and atmospheric circulation; (2) new particle formation and further growth in saturated vapor bringing to disperse phase development (here a coagulation-induced formation of the atmospheric sulfuric acid aerosol particles is considered both for polluted and non-polluted atmospheric conditions); (3) formation of acid drops having regard to the dependence of dissolved SO_2 on pH, Fe and Mn, pollution



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level of the atmosphere as well as to fluxes of atmospheric radicals OH and HO_2 into drop (in so doing the influence of dissolved Fe and Mn on drop acidity is assessed); (4) interaction of ozone with cloud drops depending on fluxes of radicals OH and HO_2, and dissolved metals Fe and Cu in drop.

This work was supported in part by the Russian Foundation for Basic Research under Contract 96-05-64733 and by the International Science.

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1,3-PROPANDIOL - SULFUR HEXAFLUORIDE VAPOR NUCLEATION IN THE VICINITY OF CRITICAL TEMPERATURE

ANISIMOV M.P., NASIBULIN A.G., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

(First received 10 January 1998; accepted for presentation during IAS-4)

The history of the nucleation theory began about a hundred years ago. As a result of its rapid development, the classical theory of nucleation was created [1,2] in 1940's. However, it may hardly be considered as universal theory, because of it's coincidence with experimental results only within a narrow range of temperatures and supersaturations for definite classes of substances. The theory of phase transitions includes a number of unjustified assumptions, which do not make allow to describe of such small clusters. Although researchers tries to describe properties of embryos by using the microscopic approach the development of the new phase formation knowledge necessitated rejection of the use of the different thermodynamic corrections within the framework of the classical model. When the size dependencies of the surface tension and density of nuclei was taken into account [3,4] and the inherent degrees of freedom were considered in the statistical sum for a nascent cluster [5], agreement between theoretical predictions and experimental results became even worse.

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In order to make the theory consistent, we must revise all its foundations. The role of the gas-carrier during nucleation should be analyzed, too. From the standpoint of the existing theory, this gas does not participate in the formation of critical embryos but only serves as a medium that maintains isothermicity of the nucleation processes. To create a more accurate theory and gain a better understanding of the processes that take part during aerosol formation, qualitatively new experimental results are required.

The present work is devoted to investigation of the critical temperature influence on nucleation phenomena. It is known, a chemical potential of a condensed phase has some peculiarities at a temperature of second-order phase transitions. The Gibbs's free energy of a critical embryo of a condensed phase and therefore vapor nucleation rate must feel temperature behavior of the chemical potential near the phase transition.

For this purpose, we selected experimental conditions in the vicinity of critical temperature, because they are suitable for exerting an inactive influence on the nucleating system at the level of intermolecular interaction and for studying the results of this influence.

As the object of our study, we selected 1,3-propandiol and as the carrier gas, we used sulfur hexafluoride (T_{cr} = 318.7 K, P_{cr}= 3.76 MPa).

The particle formation by homogeneous nucleation has been experimentally studied using a laminar flow diffusion chamber technique [6].

During our studies the following results were received:

1. Experimental dependencies of the nucleation rate on the activity of the investigated substance vapors under different pressures of the gas-carrier are measured;
2. Influence of critical parameters on the nucleation rate, size and composition of critical nucleus are found;
3. Dependency of critical system temperature and nucleation rate on the pressure of gas-carrier are detected.

The received experimental results point that the formation of new phase from vapors of the substance under investigation in the atmosphere of gas-carrier should be interpreted as binary nucleation.

Authors would like to acknowledge the Russian Fundamental Research Foundation for the Grant No 97-03-33586.

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NUCLEATION IN THE VICINITY OF CRITICAL PARAMETERS OF THE 1,3-PROPANDIOL - CO2 BINARY SYSTEM

ANISIMOV M.P., NASIBULIN A.G., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

(First received 25 February 1998; accepted for presentation during IAS-4)

Studies of a vapor nucleation have a significant interest. The reason of such interest is a fundamentally important problem of the kinetics description of the first-order phase formation. The next reason is the necessity to create the engineering computational methods for processes during homogeneous formation of a new phase takes place. The current level of research techniques for study an aerosol formation is fairly high, but there is no theory that would be suitable for the quantitative prediction of experimental results.

For the theory development it is necessary to have additional experimental facts which could be received under conditions differ from traditional nucleation studies. One of the possible direction of kinetic studies of new phase embryos formation is an experimental determination of isothermal nucleation rate in the vicinity of critical parameters of system under investigation.

The present work is devoted to investigation of 1,3-propandiol vapor nucleation in CO2 atmosphere in a vicinity of critical temperature of the system. The particle formation by homogeneous nucleation has been experimentally studied using a laminar flow diffusion chamber technique [1].

Nucleation of this system has been investigated under the pressure range from 0.10 MPa to 0.30 MPa and in the broad interval of temperatures. The nucleation rate was measured in the range of 6 orders.

During our studies it was established the influences of critical temperature of gas-carrier (critical parameters of CO2: T_{cr} = 304.2 K, P_{cr} = 7.39 MPa) on the vapor nucleation rate. The analysis of critical activities, a, at the constant vapor nucleation rate, J, on nucleation temperatures showed that the CO2 mole fraction increase (CO2 partial pressure) entails the drop of the critical temperature. The mole fraction increase of CO2 skews of the critical temperature of the system to the critical temperature of the pure carbon dioxide. These experimental results do not have the explanation from the standpoint nor one of existing nucleation theories. The same behavior in the vicinities of critical point of nucleated system it was earlier found by us in other systems [2,3].

Using experimental nucleation rates versus 1,3-propandiol vapor activities, the number of molecules in embryos was evaluated [4]. It was established the influence of critical parameters on a size of critical embryos.

The influence of gas-carrier pressure on the nucleation rate was detected.

The experimental results were compared with the classical nucleation theory [5] and self-consistent theory [6]. It was found essential deflection from the theoretical models of description of nucleation process.

Thus, the formation of a new phase in the 1,3-propanol - CO2 system under investigation should be interpreted as binary vapor nucleation.

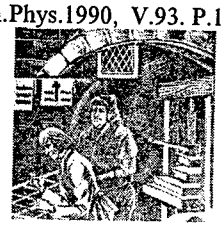
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MICROPARTICLE CONCENTRATION MEASURING IN THE NON-SELF-SUSTAINED GAS DISCHARGE DUSTY PLASMA

G.I. APONIN, A.A. BESSHAPOSHNIKOV, D.M. KULAKOV, A.F. PAL', A.O.SEROV*, N.V.SUETIN"

**Moscow State University, Nuclear Physics Institute, 1 J 9899 Moscow. Russia.*

Troitsk Institute for Innovation and Fusion Research, 142092. Troitsk, Moscow reg., Russia.

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The thorough monitoring dusty particle concentration is required when the investigations of the microparticles influence on the rates of the elementary processes in low temperature plasma are carried out. The reasons to use the non-self-sustained gas discharge (it means the discharge controlled by the external ionisation source) for examination of the recombination processes on the dusty particle surface are described in [1].

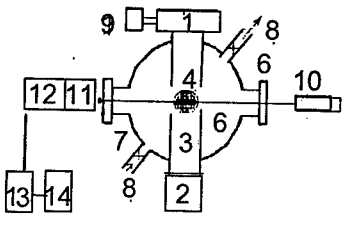


Figure1.

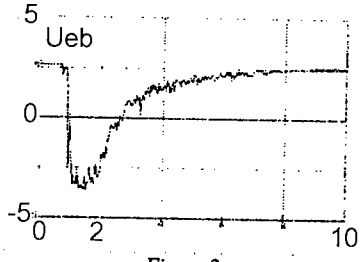


Figure2.

The experimental setup is shown schematically in Fig.1. The pulsed electron beam was injected into the discharge gap from electron accelerator through the beryllium foil. The electron energy was 125 keV, electron beam current density was up to 100 $\mu A/cm^2$ and duration was 1 ms.

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The discharge gap 0.9 cm long was limited by the electrode of mesh structure for electron beam injection and the solid circle electrode of 1 cm^2 square. The voltage pulse with variable amplitude, duration. and delay was applied to the electrodes. The most of experiments were carried out with discharge in helium at the atmospheric pressure. For discharge gap dusting the powder of glassy carbon balls of 20 - 30 μm diameter vas used.

The powder was placed into the container 1 (see Fig. 1) with the mesh bottom arranged above the discharge gap. It was possible to shake the container with the powder either in pulse manner. or with 100 Hz frequency. The container 2 was arranged under the discharge gap for powder collection.

These containers were connected by the vertical tube 3. The discharge electrodes were arranged in the middle part of the tube. Two opposite holes 5 of 2 mm diameter are in the walls at the perpendicular direction to discharge axis for probing laser radiation input and output. The discharge chamber external shell 6 was constructed in such a way that the optic windows were placed far away from the dusty volume. The working gas inside the chamber was renewed permanently between the discharge pulses. The gas flow was stopped just before the container with powder is shaken. The dusty particle concentration was defined by measuring the laser radiation absorption in the dusty cloud. The measuring scheme is given in the Fig. 1. The He-Ne laser 10 radiation {0.63 μm, 1 mW) passed through the discharge chamber 3 containing the dusty gas. The passing radiation was intercepted by the detector 11 (photodiode FD-24k) through the filter 11 and registered by the electronics 13 and 14. The filter was chosen so that the detector current was not saturated. The passing light intensity is ruled by the Lambert-Bouguer - Beer law:

$I = I_o \exp\{-\sigma N l\}$,(1)

here I_o is the initial radiation intensity. I is the intensity of the radiation passed through dusty plasma, s is the effective cross-section of the light extinction at the dusty particle, N is the dusty particle concentration, 1 is radiation path length in the dusty cloud. The effective cross-section of the radiation extinction is obtained by solving the radiation- particle interference wave task (Mie theory [2]). The result of the interference depend on the particle structure and shape, the refraction index of the particle matter and on the diffraction parameter $\rho = 2\pi a/\lambda$, here a is the characteristic particle size (radius r for the balls), λ is the incident radiation wave length. Our experimental conditions correspond to the "big balls' case ($\rho >> 1$). The light extinction by "big balls" is described correctly by Mie theory, however it is convenient to use in practice the approximation where the interference between light radiation and particle is divided into two parts [3,4]:

1. the diffraction pattern identical to one by disk with radius equal to r take place irrespective on the particle optic properties. The scattering cross-section is $\sigma_d = -\pi r^2$ in this case, and scattering indicatrix is: $I(\vartheta, r) = J_1^2(\rho \sin\vartheta)/ \sin^2\vartheta$. here ϑ- scattering angle, J, - Bessell function of the 1 kind, 1 order. The proposing relation $\sin\vartheta = \vartheta$ is just under our conditions. The larger part of light energy scattered by diffraction, is limited to the angle defined by directions to the first diffraction minimum: $\sin \vartheta_m = 3.83/\rho$,

2. the scattering and absorption defined by the particle refraction index take place as the result of light reflection on and penetration through the particle (irrespective to the particle size).

The absorption prevail under our conditions (carbon particles), so it is possible to consider σ_a, $= \pi r^2$. The total effective cross-section is $\sigma = \sigma_d + \sigma_a = 2\pi r^2$. Choosing the registration angle ϑ_{reg} $= D/2L > \vartheta_m$, where D is the detector diameter, L is the distance from the examined region to detector, one intersepts the diffracted radiation by detector and the convenient for calculation relation obtained from (1) is:

$$N = 0.75 \lg(I_o/I)\, r^2\, 1 \qquad (2)$$

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The visual observing (without discharge) show that the dust fill the discharge chamber internal volume homogeneously and is absent practically out of it. So the distance along the laser beam between the discharge chamber walls define the value L = 1 cm.

The photodiode operating check has been executed with the help of the specimen neutral absorbers taking into account the Fresnel losses.

The detector signal oscillogram after the container with the powder has been shaken is shown in Fig. 2. The falling dust cloud filled the discharge gap during some seconds. So it is possible to carry out the experiments with wide dust density range varying the discharge switching on time delay (the particle concentration during the discharge pulse (1ms) did not change). Considering the oscillograph error in indication as the main error source, one obtains the measuring range N_{min}= 5 10^3 cm^{-3}, N_{max} = 10^6 cm^{-3} for the particles of 25 μm diameter. In reality the particle size dispersion exists and the indefinite particle size contribute the main input to the error of the 4 measuring which equals 5%.

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1317

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DIFFUSIOPHORESIS OF AEROSOL PARTICLES AT ARBITRARY KNUDSEN NUMBERS: APPLICATION OF THE SHERMAN'S METHOD

S.A.BERESNEV, A.S.PASECHNICK

Department of Molecular Physics, Ural State University, Ekaterinburg, 620083, Russia

(First received 02 March 1998; accepted for presentation during IAS-4)

Concentration gradients of the chemical species in a gas mixture are known to cause movement of aerosol particles. The particle motion is commonly termed "diffusiophoresis", and the force producing this motion is known as "diffusion force" [1], This phenomenon, which cannot be described within the ordinary continuum theory, may find various technological applications, one of which will be the separation and collection of small particles (micron- and submicron-sized).

The theory of diffusiophoresis has been developed previously only for particles whose radius was either much smaller or much larger than the mean-free path of gas molecules. The analysis covering the regime of an intermediate Knudsen number, i.e. transition regime, is an important but difficult problem in aerosol microphysics. A few studies have been made in the transition regime based on kinetic theory treatment (one of these theories is the method of giant molecules [2]).

The strict and consequent approach to the problem should be based on the decision of the Boltzmann equation (or appropriate model kinetic equation of rather high order) with adequate boundary conditions for the distribution function on a particle surface. The first stage of the problem decision at such level is presented in the report of V.Chernyak, S.Beresnev and S.Starikov "Kinetic theory of diffusiophoresis of aerosol particles in a binary gas mixture" (where the results for the small concentration of one species are obtained). The solution of the problem

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for arbitrary concentration of species encounters a number of serious difficulties of computing character (one of them necessity for accounts every time to set parameters of a specific binary mixture).

The aim of this report is the attempt of reception of estimated results (with an error no more than 10 %) for the friction force, diffusion force and difFusiophoretic velocity for the arbitrary concentration of species in a binary gas mixture in the whole range of Knudsen numbers on the basis of a so-called Sherman's method [3] (interpolation method allowing on the known decisions in free-molecular and hydrodynamical limits to receive results in the intermediate regime).

Note, that the Sherman's method for phoretic problems in case of gas mixtures is used, apparently, for the first time.

The received results are compared with known theoretical and experimental data. The high efficiency of the developed technique is shown. The received expressions can be useful for the practical estimations of diffusiophoretic behaviour of aerosols in binary gas mixtures.

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1319
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AEROSOLS ELECTRODYNAMIC PARAMETERS INVESTIGATION: IMPORTANCE FOR A NUMBER PHENOMENON

SERGEY BERESNEV AND ALEXANDER STARINOV

Department of General and Molecular Physics, Uhral State University,
Ekaterinburg, 620083, Russia E-mail: sergey.beresnev@usu.ru, alexander.starinov@usu.ru

(First received 02 March 1998; accepted for presentation during IAS-4)

The rapt of attention is now given to questions connected with dynamics of heating, evaporation, destruction and movement of aerosol particles under the influence of directed electromagnetic radiation, both solar radiation and powerful laser radiation. The theory of the droplet evaporation in the field of directed radiation is now known to solve three interconnected essential problems. First, it is necessary to determine heat sources distribution of the electromagnetic origin within a particle. Second, the solution of the heat-conduction equation (considering conditions of heat exchange with environmental gas of course) allows finding out temperature distribution within the drop volume. And third, it is necessary to analyze processes a heat- and mass-transfer in gas environment using the kinetic theory. The problem of aerosol particle movement under photophoretic force action seems to partition similarly. Thus complex character of aerosol problems does not allow ignoring either electrodynamical or kinetic part of

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the solution.

The droplet evaporation time in a radiation field is well-known to depend on absorption factor J0 which can be obtained as a function of the particle parameters, such as complex refraction index, size and form.

Following two approximations restrict most of all recently published theoretical investigations of droplet evaporation (their review is given in the monograph [1]). According to the first one the heat sources distribution within particle is considered to be homogeneous. One of the other restrictions is the usage of hydrodynamic approximation at the description of process heat- and mass-transfer in a gaseous phase. Such theories are applicable only for small Knudsen numbers, where it is enough to consider the steam diffusion and thermal conductivity of gaseous mixture processes only. So it is clear, to avoid the first restriction in numerical solution we ought to give a main attention to the precision of the electrodynamical parameters. That is not trivial task, due the complexities of theory even for spherical homogeneous particles. Recently, certain progress has been achieved in kinetic part of evaporation problem solution [2,3] also. These newly appeared theories allow to use them to analyze kinetics of evaporation aerosol particles in the whole range of Kn, taking into account optical, heat and kinetic properties of a particle and a gaseous phase.

The electrodynamical part of problem can be solved on the basis of the Lorenz-Mie theory [4] for scattering and absorption of electromagnetic radiation by a spherical or elliptical particle (one or some layers). Though problem of scattering and absorption is known to be solved for a long ago, numerical results and therefore possibilities for analyzing have been received recently because of development of computer facilities [5,6,7]. Calculation complexities make it difficult to achieve exact numerical results thus the represented results are the most often incorrect or reflect qualitative view only. The main results of an electromagnetic part of aerosol problems are following: the factor of absorption Jo, asymmetry factor of the temperature distribution on a surface of a particle J1 (it is for the first time appeared in [8]), in general, J-L factors, and a source function of radiation B. So the precise values of J0 are very important in problems of droplet evaporation because quantitatively determine evaporation time of a drop as shown above. Value J1 specifies the angular non-uniformity of the heat sources at particle surface and appears in a photophoretic problem [8] and determines both a direction and magnitude of photophoretic force and the particle movement velocity. Thereby it is necessary to calculate J1 as exactly as possible, but its precision limits with evaluation time. Our algorithm allows to get 18 decimal signs and guaranteed correct values for the whole range of diffraction parameter and complex refractive index. It is known, the main difficulty of such calculation is getting so-called Mie coefficients which define magnitudes of J1. Because of Mie series for these electrodynamic parameters converge too slowly so the maximal precision of Mie coefficients is necessary. Precision of our method is approached by combination of the best sides of Lenz and Bohren-Huffman algorithms taking ito account possibilities to evaluate some types of non-spherical particles. Logarithmic derivation and basic mathematical functions was calculated with continued fractions method, besides the criterion of the number items in series was modified too. In detail this theory of photophoresis for the whole range Kn is written in [9].

The analysis of mentioned electrodynamic parameters have been already carried out [7], but the most of the investigations concern the abstract dependence of B on dimensionless radius R and non-existing refraction index n and the absorption index k. Probably these dependencies are not related to reality, at least because values n and k for really substances are interconnected with Kramers-Kronig equation. We've carried out the systematic analysis of values J0 for aerosols of various substances types [10] taking into account the aerosol classification given at [11]. Rather simple half-empirical formula describing average (the factor of absorption for small particles is known to have a so-called ripple structure at its dependence on R) behavior of values J0 offered for various types of substances. For the first time the similar formula was offered by Shifrin [12].

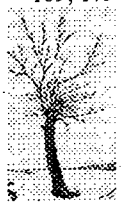
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But, due to the method of its construction it is suitable only for water-containing aerosols and describes only bottom bound of true values J0 [10]. The Shifrin's formula upgraded by us is now suitable for solid aerosol particles also. The systematic analysis of factors of next orders J2 , J3 (which apparently make more exact of values mentioned above J0 and J1) is now being conducted.

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1420.
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INFLUENCE OF DIFFUSIVE LEAKAGE IN METHODS OF PARTICLE REJECTION FROM SURFACES

CASTILLO J.L.*, GARCIA-YBARRA P.L.**

**Dept. Fisica, UNED, Apdo. 60141, 28080 Madrid, Spain;*
***CIEMAT, Avda. Complutense 22, 28040 Madrid, Spain*

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Keywords: Brownian Diffusion, Thermophoresis, Blowing, Aerosol Deposition, Aerosol Physics

In some industrial applications and material processing techniques, one tries to avoid the problems associated with the arrival and deposition of small particles on specific locations. For instance, in coal combustion processes, the deposition of soot particles and flying ashes on combustor walls and heat exchange tubes leads to slagging and fouling and provokes a reduction in the efficiency of the process. Also, in CVD growth techniques care should be taken to reduce the deposition of particles on the surface of the growing solid, to avoid the pollution of the resulting materials.

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particle laden gases: such as thermophoresis, blowing, buoyancy effects, etc. The efficiency of these methods lies on the generation of a particle repulsion field near the wall. However, due to the unavoidable presence of Brownian diffusion some particles will diffuse against the repulsive force and reach the solid surface. This work deals with the analysis of the deposition flux due to Brownian diffusion under these constraints. The asymptotic limit of very large Schmidt numbers will be studied.

Heating the surface and imposing a thermal difference between the wall and the mainstream can reduce particle deposition rates. Then, thermophoresis (drift of particles down a temperature gradient, Rosner et al. 1992) pushes the particles away from the heated surface and a dust free region generates around the surface due to this thermally induced repulsion. Anyway, there exists a particle leakage towards the surface due to Brownian diffusion. Previous theoretical works, Gokoglu and Rosner, 1986, Friedlander et al. (1988), Garcia-Ybarra and Castillo (1996&1997), as well as recent experimental measurements, Wirzberger, et al. (1997), show the persistence of particle deposition rates which decrease exponentially with increasing wall-to-gas temperature differences.

Blowing is another mechanism commonly used to keep the particles away from walls. Here, the convective flow near the solid body opposes the transport of the aerosol particles to the wall. Also, buoyancy effects may be used to achieve this goal by locating the worthiest walls on the top. In any case, due to Brownian diffusion some particles are able to leakage against the flow field or buoyancy forces and deposit on the surface. The deposition rates of large particles will be analyzed in the limit of high Schmidt numbers.

As a model problem, the laminar (and self-similar) boundary layer around a wedge shaped solid will be considered. In the differential equation governing the particle mass fraction, the highest derivative (of the mass fraction with respect to the spatial similarity variable) is the term accounting for Brownian diffusion which is multiplied by the inverse of the particle Schmidt number.

In the limit of very large Schmidt numbers, the solution of this equation becomes singular. An approach in the same way as the analysis presented by Garcia-Ybarra and Castillo (1997) is always feasible.

Numerical evaluation of the asymptotic expression for the deposition rates will be presented and compared with the complete numerical solution.

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1243.
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LIGHT-INDUCED EVAPORATION AND GROWTH OF AEROSOL PARTICLES

CHERNYAK V., KLITENIK O.

Department of Physics, Ural State University, Ekaterinburg 620083, Russia

(First received 18 February 1998; accepted for presentation during IAS-4)

The purpose of this work is the elaboration of a kinetic theory for the evaporation and condensational growth of the particle under the effect of resonant optical radiation.

Consider a spherical nonabsorbing and non-heating particle suspended in a mixture of its own vapour and a non-condensed gas.

Could the evaporation or especially the condensational growth of the nonabsorbing particle be possible? The microscopic analysis answers in the affirmative on this question.

Let the frequency of the travelling light wave is close to the absorption line of the electronic or vibrational-rotational transition of vapour molecules. Due to the Doppler effect, only the vapour molecules whose velocity projection on the radiation direction lies within a certain velocity range can be excited. The excited molecules change their transport properties - in particular, the collision cross section. If excited and nonexcited vapour molecules interact with molecules of the buffer gas differently, the distribution function for the vapour molecules becomes nonequilibrium.

As a result the temperatures of the vapour and the vapour-gas mixture are different (resonant heating or cooling of the vapour). When the vapour temperature is higher than the equilibrium temperature of the system, the droplet is evaporated. In the opposite case the condensational growth of the particle takes place.

The next reason for a perturbation of phase equilibrium is a dependence of the collision frequency of vapour molecules on quantum state. The absorbing molecules change their collision frequency. In this case the number of vapour molecules sticking the surface of the particle per time unit is changed. As a result the dynamic equilibrium between evaporation and condensation is upset. The difference in the condensation coefficients for excited and nonexcited vapour molecules is the reason of evaporation or growth of the particle too. If the condensation coefficient of excited molecules increases then the condensation process is predominant, i.e. the growth of the particle takes place.

It has been assumed:

* The particle is exposed to the monochromatic optical radiation. A travelling light wave is absorbed by the vapour molecules in the electronic or vibrational-rotational transition from the ground state to an excited state. The radiation frequency is slightly detained from the centre of absorption line.
* The distribution functions of the excited and nonexcited vapour molecules and the distribution of the buffer gas molecules satisfy the Boltzmann kinetic equations.
* The evaporation coefficients for excited and nonexcited molecules are different and the effective cross sections are different too.
* Let the particle size is much smaller then the mean free path of molecules in a gaseous phase, i.e. free-molecule regime.
* The particle does not absorb the radiation; it does not change its temperature during evaporation or condensational growth.

It has been obtained:

* The expressions for kinetic coefficients, which characterise the surface and bulk mechanisms of evaporation (condensation) rate.
* The dependence of kinetic coefficients on the detuning between the radiation frequency and the

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centre of the absorbing line has been studied. The evaporation (condensation) rate has a maximum at exact resonance.

* The direction of the process, i.e. evaporation or growth of the aerosol particle takes place, is determined by the differences in the effective diameters of the excited and unexcited vapour molecules, in the evaporation coefficients of the excited and unexcited molecules and by the detuning magnitude.



1315
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KINETIC THEORY OF DIFFUSIOPHORESIS OF AEROSOL PARTICLES IN A BINARY GAS MIXTURE

V.G.CHERNYAK, S.A.SERESNEV, S.A.STARIKOV

Department of Molecular Physics, Ural State University, Ekaterinburg, 620083, Russia

(First received 02 March 1998; accepted for presentation during IAS-4)

Concentration gradients of the chemical species in a gas mixture are known to cause movement of aerosol particles. The particle motion is commonly termed "diffusiophoresis", and the force producing this motion is known as "diffusion force" [1]. This phenomenon, which cannot be described within the ordinary continuum theory, may find various technological applications, one of which will be the separation and collection of small particles (micron- and submicron-sized).

The theory of diffusiophoresis has been developed previously' only for particles whose radius was either much smaller or much larger than the mean-free path of the gas molecules. The analysis covering the regime of an intermediate Knudsen number, i.e. the transition regime, is an important but difficult problem in aerosol microphysics. A few studies have been made in the transition regime based on kinetic theory treatments (one of these theories is the method of giant molecules [2]). The aim of this work is the elaboration of a consistent gas-kinetic theory for the diffusion force, friction force, diffusiophoretic velocity and the study of their dependencies on the properties of an aerosol particle and binary gas mixture. Consider a spherical particle placed in an infinite expanse of binary gas mixture with a low concentration gradients along OZ axis. As the concentration gradients are very low, the velocity distribution functions for the binary gas mixture can be linearized. This allows to split the problem (the diffusion force problem and the friction force problem). The particle surface temperature and the temperature of a gas mixture are the same (and constant). Let us use the Lorentz's and the Rayleigh's vapour-gas mixture approximations when the vapour concentration is small, and the molecular mass of the vapour is much less or much larger than the molecular mass of background gas.

The problem is solved in a steady-state formulation on the basis of the linearized McCormack model kinetic equation [3] under the boundary conditions of Maxwell's type (diffuse reflection type). The integral-moment method of solution for arbitrary values of Knudsen number is employed. The set of integral moment equations for macroparameters was solved by the Bubnov-Galerkin method. Numerical calculations of the diffusion force, friction force and diffusiophoretic velocity for the extensive range of Knudsen numbers are carried out. The results obtained are compared to the known theoretical [2,3] and experimental [4,5] data.

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1362.
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MODE ANALYSIS OF OSCILLATORY NUCLEATION IN VAPORS

FISENKO S.P.

A.V. Luikov Heat & Mass Transfer Institute , National Academy of Sciences 15 P. Brovka St.,220072, Minsk, Belarus E-mail: fsp@hmti.ac.by

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The simulations of heat and mass transfer processes related with kinetics of the phase transitions received new impact from applied research related with novel material production based on a nanoparticles [1]. The homogeneous nucleation is the first stage of nanoparticles creation at vapors mixture.

High rates of a nucleation and nanoparticles growth lead to a depletion effect of vapor density at nucleation zone. In some cases this effect brings to stop of the nucleation process which is extremely sensitive to the supersaturation value. The diffusion mechanism restores the vapor density at nucleation zone in some time if new phase particles have been removed from nucleation zone. Finally, nucleation and particles growth is repeated. Such process is called oscillatory nucleation. It's clear that oscillatory nucleation impacts greatly on the productivity of a devices for nanoparticle production.

The physical and mathematical model of oscillatory nucleation is developed to simulate some parameters of an this process . The mathematical model includes integro-differential equation of the mass transfer processes with source related with growth and motion of a nanoparticles. It have been shown that heat processes have small influence on oscillatory nucleation if pressure carrier gas is much larger the partial vapor pressure. The evolution of the moving source are described by the systems of ODE.

$$\partial_t n(x,t) = \partial_x (D(x)\partial_x n(x,t) - I(R(z(t)), < n(z(t)) >, t) \qquad (1)$$

where n(x,t) is the vapor density, <n(x,t)> is the average vapor density in a spatial domain occupied by nanoparticles, D(x) is a vapor diffusion coefficient, I is general form of moving source, z is the position of the center of mass of a nanoparticles clouds, R(z(t)) is the average radius of nanoparticles. The value of I is directly proportional the number density of nanoparticles.

$$\frac{dz}{dt} = v(R, < n(z(t)) >) \qquad (2)$$

where v is the velocity of nanoparticles. The drag force, gravitational force and thermophoretic force influent on the velocity value.

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$$\frac{dR(t)}{dt} = L(R)[< n(z(t)) > - n_e(z(t)) >] \qquad (3)$$

where $n_e(z(t)$ is the saturated vapor density, L is the known function of Knudsen number.

The theory is illustrated by an example of oscillatory nucleation in diffusion cloud chamber. The spectral variant of Galerkin's method is used for investigation this mathematical model. Results of numerical simulation of oscillatory nucleation are presented. The mass transfer processes are calculated in one-dimensional approximation. In particularly, for oscillatory nucleation at microgravity environment are considered. The comparison of experimental results (Fourier spectra of nanoparticles production rate) and theoretical calculation of the frequencies of oscillatory nucleation are discussed.

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1010.
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SOME REGULARITIES OF A PRECIPITATION OF STOKE AEROSOL AND ITS ACCUMULATION ON A SOIL AND A VEGETATION

GRIGOR'EV A.I., SIDOROVA T.I.

Yaroslavl State University, 150040, Yaroslavl, av. October, house 17 "D", sq. 28, Ph. (0852) 22 - 23 - 25 Grigor'ev A.I.

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Smoke aerosols are known to be among the main sources of heavy-element soil pollution in urban areas. In connection with scheduled environmental studies, we measured the concentrations of various chemical elements Pb, Ni, Cu, Zn, Ba,and Co in the soil around a petroleum refinery. It is apparent that the positions of maximum concentration of different elements do not coincide. This result is in general quite unexpected, since indirectly through the relation describing the precipitation of smoke onto the soil it indicates that smoke particles of the same origin have different physicochemical properties.

It is not surprising that particles with different physicochemical properties appear in the smoke aerosol formed in the burning of combustible substances of complex chemical composition, since the chemical composition of a certain particle is determined by its entire history: the place at which it is nucleated in the flame and the chemical composition and temperature of the surrounding vapors and the products of combustion. Let us assume as an initial idealization that a smoke particle is formed as a result of condensation of vapors on a nucleus in accordance with the Maxwell equation, according to which the flux of condensing vapor of a substance onto a particle is

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proportional to the difference between the partial vapor pressure of this substance in the surrounding medium and that at the surface of the droplet, where the vapors can be assumed to be saturated. Since the pressure of the saturated vapor varies exponentially with temperature, it is easy to see that the temperature of the gaseous combustion products surrounding a smoke particle at the center of the flame and that of a smoke particle at the periphery of the flame will differ by hundreds of degrees. In this situation the mass fluxes of condensates onto the particles in the two situations will differ both in intensity and in chemical composition. As a result, the spread in the physicochemical properties of the material of different smoke particles can be extremely wide.

1658.
УДК 541.18

DISCRETE MODEL OF NONEQUILIBRIUM VAPOR - CRYSTAL TRANSITION AND THE PROPERTIES OF SMALL CONDENSED PARTICLES

S.I.IGOLKIN, V.N.USKOV

Baltic State Technical University, St.-Petersburg

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Theory of condensation /1/ is based on the term "liquid nuclei". The arising and growing of a nuclei is described by the mathematics formulas operated with the surface tension of a liquid. A lot of materials, particular at reduced pressures, do not have a liquid phase, nevertheless, they condense and form the complex fractal structures or, for example, fullerenes, which by no means consistent with the nucleation theory. Very small condensed particles and clusters formed at nonequilibrium, fast and deep supercooling of vapor bypassing the liquid state possess a new important properties, determined by specific internal and surface structure. The abilities of some substances to change the physic-chemistry characteristics in a cluster phase motivate us to search the unity way of such transitions description to bring all kinds of condensation according to the properties of particles. New approach is the base of analysis and computation of condensation kinetics for any initial and final state, and the classic nucleation theory is an important particular case. Method of description is borrowed from low temperature plasma kinetic theory /2/ and based on a deep analogy of plasma phase transitions and all other ones. The evaporation process can be reflected in the same terms as the ionisation. The recombination is full analogue of the condensation and interlevel relaxation of exited electrons in plasma is close to the structure transformations in condensed matter.

Every atom in a crystal grid has its own position replied to discrete energy potential. The sum of joined potential amount to the full bind energy of cluster. Every level can be filled by some ways and at the different rate, depending on an external parameters and the prehistory of the process. In a perfect crystal all the lowest energy levels are filled and upper ones are empty. The defects of a crystal grid accord to the partly filling of any upper energy levels. The existence of some crystal modifications means the different schemes of population permitted for this substance. It is close analogue of the metastable states of the exited atoms and molecules, known from the spectroscopy measurements.

In such terms we got a convenient system of the description of the crystal grid filling throughout the discrete states or energy levels /3/ attached to the well developed in /2/ mathematics apparatus of interlevel transitions. Small solid particles has some different discrete places to join other molecules and clusters. Depending on the necessary computation accuracy and on a kind of a matter been studying it's possible to take into account all permitted positions inside a grid, or any of them, the states inside a volume, on the surfaces and on the summits of a crystal. The growing of cluster means the filling of corresponding levels. For the two-levels

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scheme (surface and inside a volume state only) we have the classic nucleation model which is, as early, incorrect for any size solid aerosols and for all liquid particles containing no more, approximately, than 102 molecules. The further growing of the aerosols is differ for every model. The classic case of liquid drop condensation replies to the immediately relaxation to the base, the most energy profit state. All the rest ways allow the filling and freezing of other permitted positions related to higher energy levels. At a deep supercooling the filling of high exited levels is preferable. That's why the process of vapor-crystal condensation in a fast expanding vapor jet, for example, at the low temperatures and pressures can not lead to the dense perfect crystal grid formation.

All phase transitions, size and structural changes can be formalised in the terms of the populations of corresponding states of a matter. Porous, fractal and thread-like aerosol particles reply to the partly filling of the most profitable energy levels. Discovered in the experimental investigations of condensation specific thin and long metal threads, the plate nets and the volume clouds of fractal-cluster particles reply to the occasional or regular filling of corresponding states. In a case of fast carbon condensation we got the fulleren balls. Here every atom joins three other ones and, hence, fills three potential holes only.

The row of unusual features of high dispersed matter incline us to speak about a separate phase of a substance. The most important among it's properties are the significant store of internal energy of new crystal structures and ability to release it in a relaxation process. Such phase state and transitions, for example, are the most probably reason of anomaly optic phenomena in atmosphere. The majority of ones are connected with the long living aerosol cluster clouds. This conclusion is the only to explain the high energy, low-rate relaxation and self-heating of the fractal-cluster aerosols. The shifts of the melting temperature and saturated vapor pressure under the external forces with the diminishing of particles sizes are among the other facts hardly explained in the common terms. All of them are proper to the suggested here model of cluster phase.

The physics constants of the substances, as the temperatures and enthalpies of the phase transitions, dissociation energy and so on, contain enough information to build the approximate schemes of the energy levels and to analyse the condensation process parameters. The exact computations and measurements continue to be the subject for the further elaboration.

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1013.
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INSTABILITY OF A CHARGED DROP FREELY FALLING IN THE ATMOSPHERE

KOROMYSLOV V.A., SHIRYAEVA S.O.

Yaroslavl State University, Physical Faculty,

Sovetskaya 14, Yaroslavl, 150000, Russian, Ph. (0852) 22 - 23 - 25 Shiryaeva S.O.

(First received 21 October 1997; accepted for presentation during IAS-4)

The problem of dispersion of a charged drop which is freely falling in surrounding media presents significant interest in connection with the numerous applications in various sections of physics of aerosol systems. The instability of a large charged drop freely falling in media resulting

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from joint action of a sheer flow on the drop - media interface and its own charge results in deformation of aerosols distribution function of the sizes and charges of drops. In this connection the problem of finding the critical conditions of instability of a charged liquid drop, moving with constant speed in a dielectric media presents interest.

Solving the system of the electrohydrodynamic equations we received, that the charged drop is capable to undergo instability in a flow of a liquid or gas. It is accompanied by emission of heavily charged daughter micro droplets. The parents drop have a subcritical charge due to instability to self own charge. It is possible due to a superposition of two above listed instabilities. The drop can undergo instabilities of two types: aperiodic and oscillatory, depending on the relation of a drop and media density, the quantity of charge and velocity of a media flow. The aperiodic instability can be realized by deformation to extended spheroid, then a drop break up on two parts of the comparable sizes (at small velocity of a flow) or deforms to the parachute form which break up on set of fine and a several large drops (at high velocity of a flow).



1242.
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CHEMOJET MOTION OF SOLID PARTICLES IN AEROSOLS

MELIKHOV I.V., VEDERNIKOV A.A., SIMONOV E.F., BERDONOSOV S.S., BOZHEVOL`NOV V.E.

Chemistry Department of Moscow State University, Russia

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Aerosols fill up the interstellar space (1) and Earth atmosphere (2). Therefore it's important to investigate the nature of the motion of aerosol particles in the surrounding gas. For aerosols in which particles mass and gas composition don't vary the motion of aerosol particles have been studied in detail [3]. However, in most natural and technogenic aerosols particles tend to evaporate or coarsen,[absorb or give off gases [4-6]. Thus a question arises of how the velocity of aerosol particles will change as a result of some physicochemical process initiated in it.

Experimental data we have obtained(7-9) show that the particle motion speeds up if the particle takes part in a physicochemical process (sorption, oxidation, catalysis) causing a change of its mass or gas composition. This phenomenon which we called chemojet motion is due to space-time heterogeneity of the interaction between the particle and the gas, more specifically to the differential of the process intensity on different faces of the particle and to process rate fluctuations on each face.

For the purpose of quantitative description of the motion caused by a physicochemical process we introduce chemojet intensity of gas (vapour) impact on the particle $\vec{F}_R$ and corresponding velocity of its motion $\vec{V}_R$:

$$\vec{F}_R = \int_S \left(\vec{J} - \vec{J}_0\right) dS; V_{Rj} = \sum_{l=3}^{3} \lambda_{jl} \left(\vec{F}_R \vec{e}_l\right)$$

where $\vec{J}$ and $\vec{J}_0$ are impulse flows transferred by gas molecules through the particle surface S under or without the process, respectively; V_{Rj} is component of the chemojet motion velocity; γ_{jl}

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are components of the particle mobility tensor; $\vec{e}_i$ is the unit vector of the co-ordinate system.

Velocity $\vec{V}_R$ was defined in special cylindrical reactor in which it was possibly to look on trajectory of particles falling down in gas. The chemojet motion of particles in the size range a=1-50 μm was investigated. The particles were in fact the agglomerates of smaller particles thus having not only surface but also volumetric heterogeneity. The experiment was set up as follows. Reactor was filled up by gas-reagent and termostated. Through a small hole in the reactor lid we injected particles which were then falling down and in 0,1-5 s reaching the bottom of the reactor, where the exact point of landing was marked. After several hundred particles had been injected we determined the co-ordinates and size of each particle on the reactor's bottom.

The distance L between the particle's mass center and the injection point projection of the reactor's bottom was considered horizontal shift of the particle in time t_k, hence $V_j=L/t_k$ represented the radial component of particle's velocity. The time t_k was calculated from the equation for a vertically moving particle adjusted for the vertical chemojet shift. In each experiment the gas composition and its temperature were approved to remain constant during the trial.

The particles were first injected in the reactor filled by non-reacting (background) gas with density and viscosity characteristics close to those of the gas-reagent.. Under these conditions we determined the average velocity $<V_{Bj}>$ of particles in the absence of any interaction with the gas. Then we estimated the average rate $<V_j>$ in the gas-reagent as well as the average radial component of the chemojet motion velocity $<V_{Rj}>=<V_j>-<V_{Bj}>$. The values $<V_{Bj}>$ were found to be close to the results calculated for the non-reacting particles. However, $<V_{Rj}>$ values were found to be sufficiently high to conclude that the presence of the chemojet motion of solid particles in the laboratory reactor was fully confirmed by the experimental data. It was discovered that trajectory of each particle twisted at large t_k but particles group motion became chaotic. It allows us to suggest that if we moved from the laboratory reactor in our model to an unrestricted aerosol we could still detect a chaotic chemojet motion characterized by diffusion coefficient

$$D=\frac{1}{3}\sum_{j=1}^{3}\left[\gamma_{jj}^2\int_0^\infty A_{jj}(\tau)d\tau+<V_{Rj}^2>\tau_\pi\right]$$

where $A_{jj}(\tau)$ are terms of the fluctuations correlation matrix Z_k for time shift τ. D calculation for crystals in the size range 1-10 μm which are growing in supersaturated vapour in accordance with most widely accepted current theory of growth led to value 3-4 orders higher than in the case of the Brownian diffusion. It was shown that observation for motion opens new possibilities in the important field of in situ process studies on an individual solid particle.

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1644. УДК 541.18



SOOT PARTICLES RESTRUCTURING IN FLOW CONDENSATION CHAMBER

E. F. MIKHAILOV, S. S. VLASENKO, A. A. KISELEV

St. Petersburg State University, Institute of Physics, Department of Atmospheric Physics
198904 Petrodvoretz, Ulianovskaya 1, Russia Phone: [+7] 812-4287240; FAX: 4287240
vlas@phys.niif.spb.su

(First received 30 April 1998; accepted for presentation during IAS-4)

In most cases, carbon black particles resulting from burning of hydrocarbon raw materials are structures of complex organization composed of a large number of primary nuclei (monomers) of nanometer size. The internal structure of such aggregates complies with the known fractal scaling relationship between the number of monomers and aggregate size, that is why such particles are often referred to as fractal clusters. The main distinction of these aerosols particles is their physics properties dependence on their internal geometric structure.

The specifity of soot particles in relation to other similar objects is determined by a relatively low bond energy of the interparticle contacts in the aggregates that account for the strong structural changeability of the aggregates under the effect of external factors. From the viewpoint of the applied studies, especially those concerning the effect of soot aerosols on atmospheric processes, investigation of the restructuring processes of carbon black aggregates in an environment of condensing water vapor is of particular importance. Under conditions of higher humidity, carbon black particles become compact, thus increasing their fractal dimension and simultaneously decreasing their sizes [1]. Despite the importance of this mechanism of aerosols transformation, the process of interaction between soot particle and water vapor was studied rather unsufficiently. The study is complicated by the fact that condensing ability of soot agglomerates varies with their hygroscopicity and surface structure which in turn strongly depends upon conditions of clusters formation. So while exploring aggregates restructuring under the effect of condensation it is necessary to monitor humidity of water vapor condensing on the soot particles surface. That is why we applied the special modification of flow diffusion nucleation chamber [2] designed for measuring of condensation activity of large aggregates.

To study the structural changes of soot aggregates resulting from water vapor condensation the soot aerosol mixed with water vapor in certain proportion and passed first through the preheater and then through tube cooler where condensation took place. Water vapor was produced by clean air bubbling through water maintained at certain temperature. Varying the water temperature one was able to regulate the vapor concentration. On entering the condensation chamber after preheater, the relatively warm vapor diffused to the cooler walls of chamber where it condensed. Energy was transported to the walls too thus cooling the flowing aerosol stream and resulting in supersaturation of vapor (up to 200%) in a region downstream from the entrance to chamber. When passing through the region soot particles appeared to be centers of vapor condensation that accompanied by restructuring of aggregates.



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The result of condensation effect was estimated by means of electronmicroscopic analysis of the particles sampled on formvar film using the thermoprecipitator. The structural and disperse parameters (cluster size distribution, average size of monomers, fractal dimension) were determined using specific image processing technique.

The soot particles size distribution was found to change significantly upon vapor condensation, which is indicated primarily by a decrease in characteristic size of clusters. The changes observed in particle size distribution appeared to be accounted for by the compaction of large aggregates. Note that nearly spherical globules of closely packed primary particles were formed on the clusters. These globules can cover the cluster either partially or completely and form compact aggregates. The formation of these structures can be accounted for by the effect of surface tension of condensed water on particles in aggregates.

It is of interest to note that the structural change of soot aggregates took place even in slightly undersaturated vapor (more than 95%). In the case restructuring increased the fractal dimension of aggregates but they retained their branched character (there were no compact globules on aggregates). This effect appeared to be bound up with capillary condensation on the interparticle contacts in aggregates. This process gave rise to association of adjacent branches of cluster and formation of multiply-connected chains of primary particles. As a result, the cluster structure retained its rarefied character only at large scales (comparable with the cluster size), while the branches themselves are no longer the chains of monomers, but formations of closely packed particles. When the partial vapor pressure increased, the deformation involves larger and larger cluster branches that yield more and more compact aggregates.

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1544
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EXTINCTION OF LIGHT BY AEROSOL SOOT PARTICLES WITH DIFFERENT MORPHOLOGY

E. F. MIKHAILOV, S. S. VLASENKO, A. A. KISELEV AND J. F. SAPHRONOVA

St. Petersburg State University, Institute of Physics, Department of Atmospheric Physics
198904 Petrodvoretz, Ulianovskaya 1, Russia tel: [+7] 812-428-7240; FAX:+7 812-428-7240
vlas@phys.niif.spb.su

(First received 30 April 1998; accepted for presentation during IAS-4)

The particles of soot fraction of atmospheric aerosol effectively interact with solar radiation, while absorbing and scattering light in the wide range of spectrum [1]. On the other hand, soot particles interact with the atmosphere itself, because being an active centers of heterogeneous nucleation they take part in the condensation and vaporization processes of the water vapour [2]. The cause of such "efficient" behaviour is in the specific structure of soot

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Specified processes of soot "ageing" in atmosphere result in aggregates structure parameters altering "restructuring", that in its turn produces the alteration of optical characteristics of soot aerosol. In this sense the processes of soot interaction with radiation and environment become inseparable, thus constituting how much important is to establish the correlation between soot aggregates morphology and its optical properties. To solve the task we undertook the set of experiments aimed to find the relation between the extinction of visible light by aerosol soot particles and its structural parameters - mean gyration radius, size distribution, anisotropy coefficient, fractal dimension and primary particles diameter. Extinction and angular scattering diagram were measured in the polar nefelometer directly in the aerosol flow. To study the structure effect while keeping chemical composition and therefore refractive indexes unchanged, the soot aerosol flow was subjected to heating up to 1000 degrees C in the flow furnace, thus modifying the whole set of controllable structure parameters. Simultaneously with optical measurements the particles were sampled for transmission electron microscope viewing with the consequent digitized image processing, providing the averaging over the few hundreds particles in each temperature case. It was found that structural parameters practically doesn't exhibit alteration if heating doesn't exceed 600 degrees, but with the gaining temperature the mean aggregates size gradually reduces from 0,6 mcm to 0,3 mcm; projection fractal dimension retrieved from the well-known statistical relation between the mean size of fractal aggregates and the mean number of monomers in it abruptly falls from 1,7 to 1,1. Synchronous measurement of light extinction in the laminar aerosol flow demonstrated the steep rise of reduced extinction from 7 sq. meters per gram up to 15 sq. meters per gram. Such structure characteristics behaviour witnesses the process of disintegration of clusters, which are falling apart into smaller ones, probably keeping its fractal nature up to some temperature limit, when the primary particles themselves start to burn out. Apparently soot clusters disintegration clears the way for incident wave to irradiate the previously inaccessible internal parts of the cluster, so that more of primary particles become involved in the absorption - scattering processes. With the further heating the soot aerosol evolves into system of small chain-like aggregates and the scattering diagram approaches the form of Mie scattering diagram for the composition of small (but still non-Raleigh) polydisperse spheres. This is demonstrated by relative increasing of forward scattered light for the clusters subjected to the strong (T >700 deg.) heating.

The obvious strong correlation between measured extinction of light and the structure parameters of atmospheric soot aerosol allows a new point of view on the known in literature variety of extinction values for carbon smokes: probably it could be explained by variability of optical characteristics due to environmental conditions and the different ways of origination.

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1406. УДК 541.18

NUCLEATION PROCESSES IN ANALYTICAL HOT LIQUID AEROSOLS

MORA J., TODOLÍ J.L., CANALS A.

Departamento de Quimica Analitica. Facultad de Ciencias. Universidad de Alicante. P.O. Box, 99. E-03080 Alicante, Spain.

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Keywords: Thermospray Nebulizer, Nucleation, Aerosol Characterization, Lase Fraunhofer Difraction, Solvent Nature

Studies on heterogeneous nucleation are of crucial importance in techniques such as Atomic Spectrometry since samples are usually introduced as liquid aerosols. In these techniques, the aerosol should be as fine and monodisperse as possible. Nucleation processes should be avoided

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in order to prevent the deterioration of the analytical results. The present survey deals with the nucleation processes taking place when the hot aerosol generated by a thermospray nebulizer1,2 passes through a cold environment. To this end the effect of surrounding temperatures and liquid nature on the aerosol characteristics have been studied.

Two different devices coupled to a thermospray nebulizer have been employed. In the first system (A), the hot aerosol was directly introduced into a cooled environment (i.e., a cooled Scott-type spray chamber3). In the second system (B), once the aerosol was generated, it was heated and further cooled (i.e., two step desolvation system4). Drop size distributions were measured by means of a model 2600c laser Fraunhofer diffraction system (Malvern Instruments, Worcestershire, UK) as stated elsewhere.4,5

System A

Figure 1 shows the median of the volume-based drop size distribution (D50) and the volume concentration (VC) of the aerosol as a function of the temperature of the spray chamber (Tsc) for the solvents studied. From Figure 1 it can be seen that Tsc hardly affects D50 values. Nevertheless, an increase in Tsc causes the VC to decrease. These behaviours can be explained in terms of droplets growth by nucleation.6 In a simplistic way, nucleation makes the total liquid volume of the aerosol to increase and the drop size distribution curves to shift to larger diameters. Nevertheless, nucleation will not change D50 values since the largest droplets are always removed. This is the behaviour observed in Figure 1. On the other hand, when Tsc is decreased a fraction of the solvent condensed on the nuclei (i.e., droplets or dry particles) could be carried by the gas exiting to the spray chamber and giving rise to VC values greater than the expected.

As regards the solvent nature, Figure 1 shows that water gives rise to the finest aerosols followed by ethanol and butan-1-ol. On the other hand, butan-1-ol is the solvent with the highest VC all along the Tsc range. This fact can be accounted for by its higher vapour pressure (Pv) that causes an increase in saturation ratio (rs) and, hence, in the intensity of the nucleation process.6

System B



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Figure 2 shows the effect of the heating unit temperature (Th) on D50 and VC for water at several temperatures of the condensation unit (Tc). For a given Th value, D50 and VC values decrease when Tc is increased. This effect is more important as higher Th is. These results can be explained as follows: firstly, increasing Th causes the evaporation of the solvent and the amount of vapour to increase, and hence, D50 to decrease. Therefore, rs raises, making the nucleation processes more severe. In second place, the lower Tc and the higher Th (i.e., higher the solvent vapour amount), the higher rs is and, hence, the greater the extent of the nucleation process.6 Thus, for instance, at Tc < 0 eC, increasing Th hardly modifies D50 values, since the increase in droplet evaporation is counterbalanced by the concomitant increase in the nucleation process. At Tc > 0 eC evaporation is more intense than nucleation, with the result of a reduction in D50 when This increased.

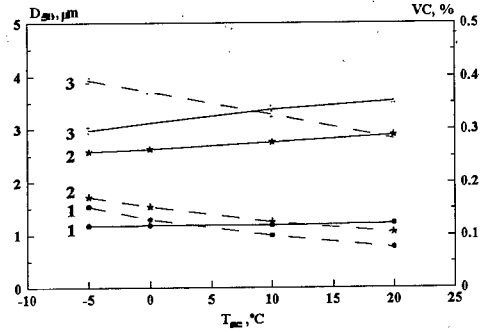


Figure1. Effect of the temperature of the spray chamber on D50 (solid lines) and VC (dotted lines), for all the solvents studied: (1) water, (2) ethanol; (3) butan-1-ol.

As regards the solvent nature, Figure 3 shows that butan-1-ol affords the highest values of D50 and VC. These results can be explained by considering that butan-1-ol generates the coarsest aerosols5 and shows the lowest Pv values (i.e., high rs values and, so, strong nucleation process). Figure 3 also reveals that aqueous aerosol are coarser than those obtained with ethanol. This unexpected behaviour can be assigned to the higher volatility of the latter.

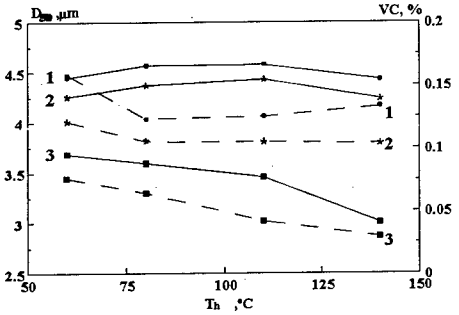


Figure 2. Effect of Th on D50 (solid line) and VC (dotted line) for different Tc: (1) -5 eC; (2) 0 eC; (3) 20 eC. Solvent: water.

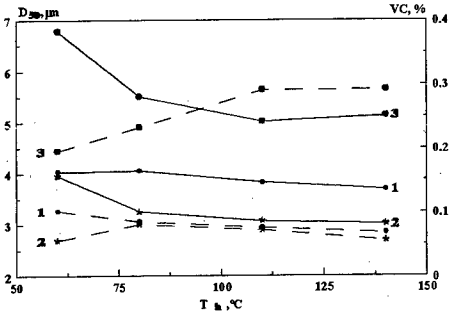


Figure 3. Effect of Th on D50 (solid line) and on VC (dotted line) for the different solvents tested: (1) water; (2) ethanol; (3) butan-1-ol. Tc = 10 eC.

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1289 УДК 541.18

DETERMINATION OF SURFACE ENERGY OF CRITICAL EMBRYOS

NASIBULIN A.G., SHANDAKOV S.D., ANISIMOV M.P., TIMOSHINA L.V.

Kemerovo State University, General Physics Department, Krasnaya Str.6, 650043 Kemerovo, RUSSIA.

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New experimental results on the vapor nucleation such as an influence of total pressure (background gas) on the nucleation processes [1-5], oscillatory nucleation [6-7], etc. has been presented recently. These results need to revision of main positions of the nucleation theory. One of the theory problem is a surface energy estimation uncertainty. The energy of new phase formation of critical embryo in the classical theory is a third part of the total surface energy of critical embryos. However, application of microscopic surface tension for critical embryo is doubtful, because of too small associates which have significant fluctuation even in thermodynamic equilibrium. Moreover, the sense of surface energy is impossible to understand. We can say only about excess of embryo's energy in comparison with the same number of molecules of a bulk condensed phase.

The present work shows that excess of embryo's energy Θ (or surface energy) may be received from experimental dependencies of critical vapor activity a (or supersaturation) on temperature T, when nucleation rate J. It could be shown that

$$\Theta = -n\,kT^2 \left(\frac{\partial \ln a}{\partial T}\right)_J , \qquad (1)$$

where n is the number of molecules in critical embryo, k is Boltzmann constant.

This result may be obtained using first and second nucleation theorems [8] and the criterion of the right description of nucleation rate experiments, following from the partial derivative theory for function of two variables such as:

$$-\left(\frac{\partial \ln a}{\partial \ln J}\right)_T \cdot \left(\frac{\partial \ln J}{\partial T}\right)_a \cdot \left(\frac{\partial T}{\partial \ln a}\right)_J = 1 \qquad (2)$$

On base of Eqs.(1-2) the values of surface energy of critical embryos was experimentally determined. We used experimental results of glycerin vapor nucleation rates in atmosphere of helium and argon in the vicinity of glycerin melting temperature and experimental results for binary system of glicerin-SF6 nucleation near the critical temperature of this system. Obtained experimental results were compared with Fisher's drop model, where surface energy is $\Theta_{drop} = 4\pi\sigma r^2$ ..

The influence of gas-carrier pressure, melting point of condensate and critical temperature of binary system on the values of surface energy was established.

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The reasons of the droplet model and the experimental surface energy deflection are discussed.

Acknoledgment

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1331.
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MICROMECHANICS OF DROPS INTERACTION IN AEROSOL FLOWS

PODVYSOTSKY A.M.

Institute of Energy Saving Problems. National Academy of Sciences.

11, Pokrovskaya str., Kiev, 252070, Kuev, Ukraine

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1. Flows of polydisperse multiphase media consisting of drops and/or solid particles suspended in a gas are widely spread in nature and modern engineering. Multiphase polydisperse flows represent a sufficiently complicated hydrodynamic system and are characterized by variety of physical phenomena accompanying them. The most important of them are the following:

a) particle of the disperse phase interactions with the carrying gas flow, and, as the result, deformation and destruction of drops by aerodynamic forces;

b) interfractional collisions of particles in the stream which lead to coalescence and breakup, exchange both of momentum and energy between the fractions;

c) interactions of the multiphase flow with the wall of apparatus, coagulation of particles on its surfaces, liquid film flow along the surfaces, etc.

The regularities of proceeding of each phenomena mentioned above can have essential influence on local and integral characteristics of the multiphase flow. That is why for description of the regularities of transfer processes in polydisperse multiphase flows, the information about proceeding of these phenomena is necessary. Nowadays, at development of mathematical models of multiphase flows, a semi-empirical approach is sufficiently effective - here, in addition to analytical description of the flow, empirical information about the regularities of proceeding of the most important physical phenomena is used.

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This paper is devoted to experimental study of drop interactions with solid particles and between themselves in a gas suspension flow, and also to investigations of mass transfer at drop interactions with a solid surface.

2. mass transfer at drop collisions is one of classic problems of physical hydrodynamics. Depending on the kinetic energy of the interaction and its geometry, collision of two drops can result in: mutual bouncing, full coagulation, coalescence with formation of some fragments, breakup, etc. Substantial part of known works is devoted to determination of the boundary between the regions of hydrodynamic conditions under which various types of interaction take place. However such an approach does not give any information on the intensity of the drop breakup and on initial parameters of the fragments, but just these data are necessary for practical calculations of multiphase flows. This demerit can be removed if, instead of establishing the boundaries between the regions above mentioned, the efforts will be directed to investigation of the interaction material balance. For quantitative estimation of the mass transfer at drop collisions, dimensionless parameter Φ_{ji} has been used, which is the ratio between the target (large drop) mass change caused by j - i ($\delta_i > \delta_j$) interactions and the total mass of small drops (projectiles) colliding with the targets.

The experimental apparatus allowed to arrange interaction between two monodisperse streams of projectiles, moving with high velocities, and freely falling targets under strictly controlled conditions. For drop interactions in quiescent gaseous medium, the following empirical formula for the parameter Φ_{ji} value averaged by the midship section of the target was obtained

$$\Phi_{ji} = 1 - 0{,}246\,\mathrm{Re}_{ji}^{0.407}\,\mathrm{Lp}_i^{-0.096}\,(\delta_i/\delta_j)^{-0.278}, \qquad (1)$$

valid in the range $30<\mathrm{Re}_{ji}<6000$; $5<\mathrm{Lp}_i<3\cdot10^5$; $1.9<\delta_i/\delta_j<12$ ($\mathrm{Re}_{ji} = |V_j - V_i|\delta_j\rho/\eta$; $\mathrm{Lp}_i = \delta_j\rho\sigma/\eta^2$; V is the velocity; ρ, η, σ are the density, viscosity and surface tension of the liquid, respectively).

Under the action of the gas flow, the value of coalescence and breakup parameter decreases:

$$\Phi_{ji}^{o} = \Phi_{ji} - \varphi_{ji};\ \varphi_{ji} = \begin{cases} 0.00446A_{ji}, & A_{ji} \le 40.6 \\ 11.85(0.01A_{ji}), & 40.6 < A_{ji} < 120, \end{cases} \qquad (2)$$

where $A_{ji} = \mathrm{Re}_{ji}^{0.285}\,\mathrm{Lp}_i^{0.2}\,\mathrm{We}_i^{0.442}\,(\delta_i/\delta_j)^{0.4}$ and $\mathrm{We}_i = (V_g - V_i)^2\rho_g\delta_i/\sigma$ (subscript g pertains to gas).

3. Interaction of small solid particles with large drops. To study this interaction, small spherical particles were "fired" with high velocities by a rotor-type thrower under the action of centrifugal forces and bombarded large freely falling drops. As a result of observations, it was stated that four characteristic collision modes existed:

a) solid particles capture by drops without fragments formations(complete coagulation);
b) drops "shooting through" by projectiles; some fragments are formed;
c) formation of an air bubble inside the target;
d) target destruction into several large fragments with loosing its individuality.

Capture was observed mainly at central impacts and small relative velocities, when projectiles with small or mean density collided with viscous drops. Destruction took place within a sufficiently narrow range of interaction conditions (dense projectiles and drops of mean viscosities). Hydrodynamic boundaries between four modes, mentioned above were found in dimensionless coordinates. For cases (a - c), the coalescence and breakup parameter can be represented as $\Psi_{ji} = \Psi'_{ji}\,\rho/\rho_p + \Psi''_{ji}$, where the first term allows for the liquid mass variation

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the target, and the second one - for the solid particles capture by it ($\Psi'_{ji} \le 0$, $\Psi''_{ji} \ge 0$). The following empirical dependence was obtained:

$$\Psi'_{ji} = 1 - 0.23(\mathrm{Re}_{ji})^{0.04}(\mathrm{We}^{o}_{ji})^{0.26}(\rho_p/\rho)^{-0.1}(\delta_i/\Delta_j)^{0.31} \quad (3)$$

and $$\Psi''_{ji} = \begin{cases} 1 - 0.191 S_{ji}, & S_{ji} < 5.24; \\ 0, & S_{ji} \ge 5.24 \end{cases}$$

$$S_{ji} = (\mathrm{Re}_{ji})^{0.19}(\mathrm{We}^{o}_{ji})^{0.17}(\rho_p/\rho)^{-0.12}(\delta_i/\Delta_j)^{-0.25} \quad (4)$$

at $6<\mathrm{Re}_{ji}<1.4\cdot10^4$; $240<\mathrm{We}^{o}_{ji}<13.3\cdot10^3$; $2.1<\rho_p/\rho<15.2$; $3<\delta_i/\Delta_j<5.6$ ($\mathrm{We}^{o}_{ji} = (\mathrm{Re}^2_{ji}/\mathrm{Lp}_i)\rho_p/\rho$; ρ_p, Δ are the density and diameter of solid particles). In the case (d), fragmentation of the target into several (from 2 to 6) fragments, approximately of equal sizes, was observed.

Measurements of the coalescence and breakup parameter at collisions of solid particles with large drops containing solid inclusions were carried out as well. The effect of solid inclusions on the parameter Ψ was evaluated by the difference $\Delta\Psi_{ji} = \tilde{\Psi}_{ji} - \Psi_{ji}$. In this case, the total volume of fragments was greater than that during collisions with pure drops, all other condition being equal. The experimental data are described by the formula

$$\Delta\Psi_{ji} = -6V \quad (5)$$

at $26<\mathrm{Re}_{ji}<2000$; $1900<\mathrm{We}^{0}_{ji}<2600$; $6<\rho_p/\rho<14$; $3.7<\delta_i/\Delta_j<5$; $0<V<0.22$. Here V is the volume concentration of solid inclusions in the drops.

4. Collisions of drops with a wall. These investigations can be divided into two different problems: study of drop collisions with a dry solid surface, and with a liquid film on it.

4.1 At investigations of the mass transfer regularities at drop collisions with dry surfaces, the drops-projectiles moving with high velocities bombarded disks (the model walls), rotating slowly in horizontal plane. Due to disk revolution, every successive drop collided with dry, unwetted part of its surface. Smooth and rough plates made of different materials were used, and this made it possible to carry out investigations in a wide range of contact angles. To determine the coalescence parameter Φ_w (it is similar by sense to the parameters Φ_{ji} и Ψ_{ji} described above), a weight methods was used: the model wall was weighed on an analytic balance before and after the experiment. Essentially nonmonotonous character of the dependence of the Φ_w parameter against drops viscosity was discovered. The influence of the drops velocity, physical properties of the liquid, collision angle, wetting conditions of the surface, and its roughness on the value of the Φ_w parameter was studied. The wetting conditions of the surface have small influence on the value of the parameter Φ_w. A dimensionless relationship allowing to calculate the value of the parameter Φ_w in a wide range of determining parameters change was obtained.

4.2. At study of drop collisions with a wetted surfaces a flat tray which was filled by a thin layer of the liquid was used as a model wall. The thickness of the liquid film varied. The wetted surface was bombarded, like previous experiments, by monodisperse fast moving drops at various angles. The range of coalescence angles φ in these experiments was essentially expanded practically up to normal impacts. The experiments have shown, that at first, with grow of the interaction angle φ, the coalescence parameter increases up to values which are typical for intensive coagulation; then it decreases and passes through a minimum at φ~20-30deg.(depending on other conditions of the interaction), and further it increases again up to values corresponding to practically complete coagulation. An empirical formula for the parameter Φ_w was obtained.

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1431.
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EXPERIMENTAL INVESTIGATION OF DRIFT MOTION IN AEROSOLS AND HYDROSOLS UNDER PROPAGATING ACOUSTIC WAVE

YU.REDCOBORODY, S.GRINSHPUN, V.ZADOROZHNII

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Experimental setup has been developed and mounted for obtaining of one-dimensional propagating acoustic wave in a glass waveguides filled with highdispersed water suspension (polystyrene latex (PSL) particles) or with aerosol (cigarette smoke) . It has been shown that small foreign particles (PSL particles 0.17 mcm in size), which are suspended in water, because of unidirectional drift phenomenon move at a constant rate in the wake of the acoustic wave. Laboratory experiments with water suspensions under propagating acoustic wave were executed which made it possible to calculate the foreign particles drift rate in relation to wave intensity. The experimental results are in good agreement with analytical relations for small particles entraintment effect under propagating acoustic wave at the expense of viscous forces that has been predicted and calculated by one of the authors in 1995.

It has been shown that, if wave intensity in aerosol is the same as one in the case of water hydrosol , the drift rate in aerosol is several orders greater than in hydrosol. Drift effect investigated provides the basis of vibrational method for purification of any liquids and gases from foreign inclusions of any nature with size more than 0.01 mcm (including viruses, bacteria etc.). For wave intensity of 20 W/cm2 the drift rate in water suspension is of the order of 0.01 cm/s (it is far beyond that the gravity precipitation rate, which is markedly less than 10-4 cm/s for such particles).

Since any individual microparticle follows the unidirectional drift laws, such a method is applicable for initial impurity concentrations that can be made as small as one likes. Besides, this method is comparatively energysaved (energy consumption does not exceed (0.01-0.1) kWh per litre of purificated liquid and 1 kWh per cub. m of purificated gas) and allows, conceptually, to achieve absolute purification of medium. Results obtained may be of interest for purification of air and other gases , for motor car industry (petroleum and diesel fuel purification, refining of oil in engines, etc.), and for medical and pharmaceutical industry (settling of blood red cells, purification of water etc.). The drift method may be used in order to design acoustic levitators (devices for prevention of particle sedimentation), and acoustic separators (by size), and acoustic concentrators for very small particles. It should be noted that these devices will be able to operate at high temperatures, under hostile conditions as well.



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1012.
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ON A STABILITY OF CAPILLARY OSCILATIONS OF HEAVILY CHARGED ELLIPSOIDAL DROP

SCHUKIN S.I., GRIGOR'EV A.I., BELONOJKO D.F.

Yaroslavl State University, 150040, Yaroslavl, av. October, house 17 "D", sq. 28, Ph. (0852) 222325

(First received 21 October 1997; accepted for presentation during IAS-4)

The study of the equilibrium forms and stability of charged drops presents significant interest for physics of a liquid-droplets aerodispersion systems. The research of charged drop stability at a big deformations to oblate and prolate spheroids is one of scantily explored of questions. In this research both these questions are incorporated at study of stability of triaxial heavily charged ellipsoidal drop, which is carried out on the basis of a principle of the minimum potential energy of closed system. The purpose of the given work is research of charged ellipsoidal drop stability and laws of realization their instability to there own charge. The numerical analysis of expression for potential energy of a heavily charged drop, which has the form of triaxial ellipsoid, shown, that the charged spherical drop is stable in relation to indefinitely small distortion of the form at $W < 4$. A Rayleigh parameter is determined by the relation of a square of the drop charge to the volume of the drop and the interface tension coefficient. The dependence $U = U(x)$ in a range of meanings of the Rayleigh parameter $3.546 < W < 4$ has two minimum: at $x = 1$ and at $x > 3$. Thus the rather big influence can results in a bifurcation of the drop form. The spherical drop is unstable when the Rayleigh parameter meanings $W > 4$.

The condition of a drop as fattened spheroids of rotation is unstable at any meanings of Rayleigh parameter: the energy of such drop at $W < 4$ is more, than spherical drop and it have spontaneous evolution. The drop, which has the form of fattened spheroids of rotation at $W > 4$, is extended on one of directions, which are perpendicular of symmetry axis. Thus it passes to the form triaxial ellipsoid, and then extends to ellipsoids of rotation, which energy is minimum.



1011.
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THE DISPERSION OF A BUBBLE IN A UNIFORM ELECTROSTATIC FIELD IN DIELECTRIC LIQUID

SHIRYAEVA S.O., JAROV A.N., KOROMYSLOV V.A.

Yaroslavl State University, Physical Faculty,

Sovetskaya 14, Yaroslavl,150000, Russian, Ph. (0852) 22 - 23 - 25 Shiryaeva S.O.

(First received 21 October 1997; accepted for presentation during IAS-4)

The problem about instability of neutral bubbles in a liquid is of interest for the theory of an atmospheric electricity. From experiments it is known, that free from charge bubbles in result of instability in an external electrostatic field can break up on a little bit fine bubbles. The instability of bubbles can play the important role at transport charge from a surface of oceans during a thunder-storm.

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The instability of a bubble in liquid dielectric in an external electrostatic field begins with that it is extended in a direction of an external field in a figure close to prolate spheroid. Then on the ends of a bubble is forming emission ledges, with top of which issue of daughter bubbles, forming two congestions at both tops of a parental bubble, begins.

The dimensionless radio and charge of daughter bubbles are designed on the basis of a Onsager's principle of minimum energy dissipation rate. Was found out, that the quantity of daughter bubbles strongly depends on intensity of an external field, increase of which on three tenth results in increase of quantity of daughter bubbles at the order.



1537.
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THE GRAIN ORIENTATION IN GASEOUS-DUST MEDIUM

V.I.SIKLITSKY

A.F. Joffe Physico-Technical Institute, 194021 St. Petersburg, Russia e-mail: siklitsky@pop.ioffe.rssi.ru

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In gaseous-dust oblate dust particles (grains) rotate and have different orientation in space (Le Borgne & Mauron 1989; Le Borgne, Mauron & Leroy 1986; Mauron & Le Borgne 1986). Thus we can determine the function of orientation of dust particles in gaseous-dust medium. Based on Barnett effect the orientation function is obtained in this paper.

In interstellar and circumstellar media the grains rotate with high angular velocities. The rotation is due to such processes as collisions with ambient gas atoms, hydrogen molecule formation on the grain surface, photoeffects, non-uniformity of the accommodation ability on the surface area etc. (Hunter & Watson 1978; Purcell 1979). The equilibrium angular velocity may reach $\Omega \approx 10^6$-10^9 rad s^{-1}

Any rotating grain acquires a magnetic moment $\mu = \chi\Omega \cdot V\,(m_e c/eg)$ because of the Barnett effect. One can say that any rotating object is magnetized as strongly as it would be if at rest in an external field $B_o \approx (2Vm_e c\Omega / eg)$. Here m_e is the mass and e the charge of electron, V is the grain volume, χ is the magnetic susceptibility of the grain substance, and g=1-2 is the gyromagnetic ratio. The field B_0 for a grain with $\Omega \approx = 10^5$ - 10^6 rad s^{-1} is about 0.05-0.5 G, i.e., it is much larger than the typical interstellar field value of $\approx 3\ 10^6$ G. For pure silicate, ice or carbon dust grains with $V = 10^{-14}$ cm^3 and $\Omega = 10^6$ rad s^{-1} one gets $\mu = 10^{-20}$ - 10^{-21} erg G^{-1}, and for a similar dust grain with paramagnetic inclusions $\mu = 10^{-18}$ erg G^{-1}. These estimates show that the magnetic moment of a cosmic grain is mainly caused by the Barnett effect (see Dolginov & Mytrophanov 1978).

In the process of the grain rotation the angular velocity vector Ω precesses relative to the grain body. This leads to a continuous reorientation of the electron spans in the body. The reorientation takes some time and leads to the energy dissipation. In turn this leads to some lag in the orientation of p with the Ω direction. The energy dissipation leads to orientation of the Ω with respect to the direction of angular momentum J and to orientation of the angular momentum with respect to the grain body axes. If the grain is axisymmetric, with the symmetry axis a, then the process results in $a \parallel J$ for an oblate and $a \perp J$ for a prolate grain. This process for

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a grain $V = 10^{-14}$ cm^3 and $\Omega = 10^{-6}$ rad s^{-1} needs a time less than a year. So we can assume that $\boldsymbol{J}$ possesses the orientation with respect to the axis a from the very beginning.

If there is an external field B_{ext}, then the magnetic moment of the grain also takes part in the processional motion around the field lines. The characteristic time-scale of precession is $t_{pr} = 2\pi J / \mu B_{ext}$. A dust grain's precession in the interstellar medium tends to be upset many times during t_{pr}, since the time interval between collision t_{sc} with the surrounding atoms is typically less than t_{pr}. Although $t_{sc} < t_{pr}$ a sum of fragmentary precessions is sufficient to smear out any alignment of $\boldsymbol{J}$ except that which is parallel to the magnetic field $\boldsymbol{B}$.

This will lead to a random distribution of turning angles of the vector $\boldsymbol{J}$ about the direction of $\boldsymbol{B}$ for grains in the dust medium. Averaging of the directions $\boldsymbol{J}$ about the field direction leads to the field being likely to become the orientation axis of the grain ensemble even though the orientation mechanism is not dynamically caused by the field (Dolginov & Mytrophanov 1978).

The mechanism of Davis & Greenstein when applied to standards interstellar conditions (diffuse HI clouds) requires a magnetic field to achieve alignment which is about one order of magnitude too high compared with other determination. The suprathermal rotation of grams which may occur because of the molecular H_2 formation on the gram surface (Purcell 1979) increases the effective rotational temperature of the grain and provides a better alignment. However, the time necessary to reach a sufficient alignment is too long.

The time of alignment in gaseous fluxes is much shorter in many cases. They are an effective mechanism of alignments especially in stellar vicinities where the stellar wind provides a stationary, well directed flux. Various gaseous fluxes and streams are common in interstellar and circumstellar media. The alignment in a gaseous flux takes place only until the grain velocity differs from the flux velocity. The time t_{car} necessary for the grain to get the flux velocity is longer than the alignment time in many cases. It is the time necessary to transmit the momentum $m_{gr}/V_{flux} = m_{at}n_{at}S_{gr}\, V_{flux}^2\, t_{car}$, i.e. $t_{car} = m_{gr}/m_{at}n_{at}S_{gr}V_{flux}$. The time t_{at} of alignment in the gaseous flux can be estimated as follows (Dolginov, Gnedin & Silantev 1979).

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1087.
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COLLECTIVE ELECTROMAGNETIC AND HEAT EFFECTS IN AEROSOL SYSTEMS TWO AEROSOL INTERACTED PARTICLES–CONTINUOUS MEDIUM

UVAROVA L.A.*, KRIVENKO I.V., SMIRNOVA M.A.****

** Moscow State Technological University "Stankin", 101104, Moscow, Vadkovsky str., 3a,*
*** Tver State Technical University, 170026, Tver, Af. Nikitin emb., 22*

(First received 10.10.97; accepted for presentation during IAS-4)

In this paper we investigated collective effects, conditioned by the electromagnetic and heat interaction in placed in continuous medium two aerosol particles system. There were solved the system of stationary Maxwell equations for two spherical absorptive particles and heat equation with heat source, initiated by electromagnetic radiation:

$$\nabla^2\mathbf{E}_j + k^2\varepsilon_j\,\mathbf{E}_j = 0, \quad \nabla^2\mathbf{H} + k^2\,\varepsilon_j\mathbf{H}_j = 0,$$

$$\nabla\mathbf{D}_j = 0, \quad \nabla\mathbf{B}_j = 0,$$

$$\nabla(\chi_j\,T_j) + q_j = 0,$$

$$q_j = 4\pi n_j\,m_j|\mathbf{E}|^2 I/(n_3\lambda), \quad j = 1, 2.$$

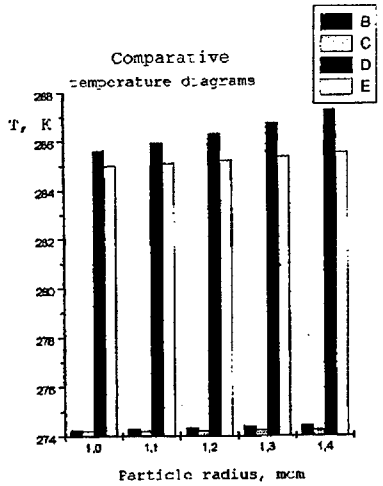
Here are: $k = 2\pi/\lambda$, λ - electromagnetic wavelength, $\varepsilon = \varepsilon^{*} + i\varepsilon^{**}$ - complex dielectric permittivity, T - temperature, χ - coefficient of the heat conductivity, χ = (T), q - the density of the heat source, n - refractive parameter, m - adsorption coefficient, I - intensity of the initiative radiation, the indexes j = 1, 2 are related to the first and the second particles accordingly, the index j = 3 - to the surrounding medium, $\varepsilon_3^{**} = 0$, $q_3 = 0$. Using the received analytic solutions for the electric and magnetic vectors in the form of the infinite system of linear algebraic equations [1] there were received a program for the calculation of the densities q_j in the each particle and the temperatures T_j. By means of carrying out computations there were varied the radii of the particles r_j, the interparticle distance, the intensity of radiation I, wavelength, optical and heat characteristics. In the picture there are presented as a primer the diagrams, received on the basis of the carrying out computations for water drops. There were assumed, that =10.6 mcm, r_1=1 mcm, r_2=1 — 1.4 mcm, the temperature of the undistorted by the presence of the particles atmosphere T_0 =273 °K, the intensity of initiative radiation I_1, I_2 , $I_1=10^6$ W/m², $I_2=10^7$ W/m².

The rectangles are shaded at the pattern and accords the following cases: 1) B, C for $I=I_1$ и $I=I_2$, accordingly, there were there were taken into consideration the electromagnetic and heat interactions; 2) D и E, $I= I_1$ и $I= I_2$ accordingly, there were taken into consideration only electromagnetic interactions of the particles (the computation of the temperature was carrying out for single particles on the basis of the found from the electrodynamics problem heat sources densities) was hold haw for the single particles. At the ordinate axis there are put the values of the temperature at the surface of the first particle. Since, in general, the surface temperature of the particles T_{sj} depends on the surface point $M^{(1)}$, then there was computed T_{s1} in the point $M_o^{(1)}$ with the coordinates $\xi = r_1$, $\eta = \pi$ in bispherical coordinate system for the clarity. The valueT_{s1} was determined with the consideration of Knudsen layer influence.



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The represented diagrams are illustrated the increase of the heat interaction caused contribution with the rise of the second particle radius (it goes to 13% for r_2=1.4 mcm, if I= I_2, and to 28%, if I=I_1).



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List of participants of IAS-4 with presentations during 6 July 98

Bakirov Talgat Salmanovich *(1946-01-25)*
Russian State Scientific Biological Center VECTOR
Phone: (7)-3832-630055
fax (7)-3832-328831
email: root@churc.nsk.su
Novosibirsk Russia

Balahanov Mihail Valentinovich *(1947-03-08)*
SE VNIIFTRI
Phone: (7)-095-5359359
fax (7)-095-5359349
email: balah@ftri.extech.msk.su
Moscow Russia

Belov Nikolay Nikolaevich *(1947-05-04)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Belova Nina Georgievna *(1944-02-25)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia



Bezrukova Aleksandra Gennadievna
St. Petersburg State Technical University
Phone: (7)-812-5557413
fax (7)-812-5557413
email: bezr@psb.usr.pu.ru
St.-Petersburg Russia

Bordenyuk Andreyi Nikolaevich *(1974-07-27)*
Moscow State Technological University
Phone: (7)-095-1352408
email: zlobina@sci.lebed.ru
Moscow Russia

Bozhevolnov Viktor Evgenevich *(1947-01-01)*
Moscow State University
Phone: (7)-095-9393207
fax (7)-095-9328846
email: gorba@radio.chem.msu.ru
Moscow Russia

Castillo Jose Luis *(1955-02-21)*
Universidad Nacional de Educacion a Distancia
Phone: (34)-1-3987122
fax (34)-1-3986697
email: castillo@apphys.uned.es
MADRID Spain

Chechik Oskar Samuilovich *(1936-05-21)* VNF VAPA
Phone: (7)-812-2514332
fax (7)-812-1643274
Chechik@Chech.USR.PU.Ru
St.-Petersburg
Russia



Chernyak Vladimir Grigorevich *(1946-03-10)*
Ural State University
Phone: (7)-3432-616775
fax (7)-3432-615978
Vladimir.Chernyak@usu.ru
Ekateinburg Russia

Dirksen Veronika Gennadevna
St.-Petersburg Russia

Evsikova Lyubov Georgievna *(1938-08-28)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2188063
fax (7)-812-2183720
St.-Petersburg Russia

Gavrilov Aleksandr Sergeevich *(1948-02-10)*Russian Hydrometeorological Institute
Phone: (7)-812-2243039
fax (7)-812-3251281
email: gavr@mcep.rshmi.spb.ru
St.-Petersburg Russia

Gentry James W. *(1939-11-27)*
University of Maryland
Phone: (1)-301-4051915
fax (1)-301-3149126
email: Gentry@eng.umd.edu
College Park USA

Germogenova Tatyana Anatolevna *(1930-04-10)*
M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Phone: (7)-095-2507861
fax (7)-095-9720737
email: germ@kiam.ru
Moscow Russia

Gluschenko Natalya Nikolaevna *(1946-03-24)*
Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences
Phone: (7)-095-9397937
fax (7)-095-1378258
email: nnglu@chph.ras.ru
Moscow Russia

Granstrem Konstantin Olegovich
St.Petersburg I.I.Mechnikov State Medical Academy
Phone: (7)-812-5431920
fax (7)-812-5431571
email: paa@infopro.spb.su
St.-Petersburg Russia

Grigorev Aleksandr Ivanovich *(1946-01-13)*
Yaroslavl State University
Phone: (7)-0852-3339268
fax (7)-0852-354777
email: grig@univ.uniyar.ac.ru
Yaroslavl Russia

Grushko Yuliyi Sergeevich
email: grushko@LNPI.SPB.su
Gatchina Russia



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Kameshkov Gennadiyi Borisovich *(1943-02-09)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189946
fax (7)-812-2188179
email: Irina@tks-opt.spb.ru
St.-Petersburg Russia

Katkov Vladislav Leonidovich *(1936-05-11)*
Institute of Engineering Cybernetics
Phone: (375)-0172-685296
fax (375)-0172-318403
katkov@newman.basnet.minsk.by
Minsk Belorus

Konovalov Nikolayi Vasilevich *(1947-08-28)*
M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Phone: (7)-095-2507861
fax (7)-095-9720737
email: knv@kiam.ru
Moscow Russia

Koromuslov Vyacheslav Aleksandrovich
Yaroslavl State University
Phone: (7)-0852-222325
fax (7)-0852-354777
email: polya@univ.uniyar.ac.ru
Yaroslavl Russia

Kucherov Arkadiyi Nikolaevich *(1951-02-09)*
Central Aerohydrodynamic Institute named after N.E. Zhukovsky
Phone: (7)-095-5564807
fax (7)-095-5564337
ank@dept.aerocentr.msk.su
Moscow Russia

Kudryavtsev Ilya Aleksandrovich *(1968-12-07)*
Aerospace University of Samara
Samara Russia



Letfullin Rinat Rifgatovich *(1962-03-01)*
Samara Branch of P.N.Lebedev Physical Institute
Phone: (7)-8462-340536
fax (7)-8462-355600
email: theor@fian.samara.ru
Samara Russia

Logvinov Leonid Mitrofanovich *(1944-09-01)*
Aerospace University of Samara *Phone*: (7)-8462-357356
fax (7)-8462-357356
email: onil16@lib1.ssau.ru
Samara Russia

Makovtsov Gennadiyi Anatolevich
Russian Scientific Optical Center named by Vavilov
St.-Petersburg Russia

Mihayilov Oleg Mihayilovich *(1938-12-19)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189952
fax (7)-812-2183720
St.-Petersburg Russia



Omelyanets Taisiya Grigorevna *(1938-01-25)*
Ukrainian Scientific Hygienic Center *Phone*: (7)-044-5593433
fax (7)-044-5599090
email: omelyans@usch.kiev.ua
Kiev Ukraine

Pinaev Viktoor Alekseevich
State University of Kemerovo
Kemerovo Russia

Pominov Evgeniyi Ivanovich *(1946-09-21)*
Aerospace University of Samara
Samara Russia

Redkoboroduyi Yuriyi Nikolaevich *(1940-03-10)*
Astronomical Observatory of Kiev University
Phone: (7)-044-2160906
REDCO@AOKU.FREENET.KIEV.UA
Kiev Ukraine

Terentev Vladislav Evgenevich
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2180082
fax (7)-812-2183720
email: Leader@soi.spb.su
St.-Petersburg Russia

Tkachev Vladimir Vasilevich *(1926-01-20)* Institute of Occupational Health RAMS
Phone: (7)-095-3653130
fax (7)-095-3660583
email: tkachiov@iog.nifhi.ac.ru
Moscow Russia



Ukraintseva Valentina Viktorovna
Komarov Botanical Institute of the Russian Academy of Sciences
email: ukr@nk1834.spb.edu
St.-Petersburg Russia

Uvarova Lyudmila Aleksandrovna *(1951-04-21)* Moscow State University STANKIN *Phone*: (7)-08222-9729520
email: uvarova@stanmat.mian.su
Tver Russia

Vlodavets Viktor Vladimirovich
Moscow Hygiene Institute named Erikhman S.S. Moscow Russia

Vorobeyichikov
St.Petersburg I.I.Mechnikov State Medical Academy
fax (7)-812-5431571
email: paa@infopro.spb.su
St.-Petersburg Russia

Korobeyinikova Aleksandra Vasilevna Institute of Labour Safety *Phone*: (7)-812-2790863
fax (7)-812-2352632
St.-Petersburg Russia



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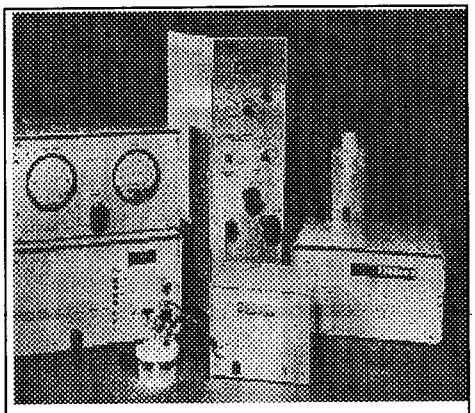
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Prof. GARGER YE.K.

AEROSOL OPTICS

Prof. GERMOGENOVA T.A.

NONLINEAR AEROSOL OPTICS

Dr. LETFULLIN R.R.

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address Belov N 21-117
2-Mosfil 119285
tel/fax (095)1474361
BELOV@TEHNO.MMTEL.MSK.SU

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1052.
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MODELING OF MESOMETEOROLOGICAL PROCESSES AND POLLUTANTS TRANSPORT IN THE BOUNDARY LAYER

ARGUCHINTSEV V.K.

Irkutsk State University, Russia

(First received 11 December 1997; accepted for presentation during IAS-4)

Transport of atmospheric admixtures from their sources depends on meteorological conditions, orography and interaction of admixtures with the earth's surface.

For determination of admixtures motion velocities and coefficients of turbulent diffusion it is necessary to solve the equations of geophysical thermodynamics in combination with equations of admixtures transport.

We consider the statement and the method of solution of non-stationary three-dimensional nonlinear problem for mesoscale processes arising over thermal and orographic nonhomogeneities of the underlying surface on a background of time and space - variable large-scale meteorological fields. The model is constructed without the hypothesis on quasi-static and without the simplifications of the free convection theory.

The model takes into consideration all the components of Coriolis force and atmospheric compressibility. The model will enable to give an account of a broad spectrum of mesoscale phenomena: breeze, mountain and valley circulation with external wind, katabatic winds, dry winds, orographic waves, mesoscale structure of meteorological fronts, convection which is generated by anthropogenic factors etc.

Integration of the equation was realized for Cartesian coordinate system with the aid of the fictitious regions method. To solve the equation we use the methods of constructing of conservative finite difference schemes based on the conservation laws. The time approximation of the problem is constructed with the aid of two-cyclic full splitting. We use the nonmonotone factorisation for the numerical realization of the finite difference equations.

Numerical experiments were realized for study of mesometeorological processes and aerosols transport in the region of Lake Baikal.



1668∞
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FINITE DIFFERENCE SCHEME FOR MODELLING OF AIR FLOWS IN ATMOSPHERE BOUNDARY LAYER

N.N. BELOV, P.N. BELOV

Aerosol Technology Ltd, Russia, +7(095)-1474361, pnbelov@orc.ru

(First received 01 January 1998; accepted for presentation during IAS-4)

Modelling of low velocity gas flows, was made by a little number of scientists because of computational difficulties while solving complex non-linear three dimensional Navies-Stokes gasdynamics equations. Present work is devoted to model of air flows in boundary layer of atmosphere. This model could be used for simulating of aerosol dispersion.

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Three dimensional Navier-Stokes equations were used for construction of finite-differences scheme. Two level iteration process was used. The inner level iterations are used to solve non-linear equations at fixed time moment. Higher level controls time steps during computation. Eight final-differences schemes were made to verify solution computed by eight different styles of net nodes numeration.

Testing of PC codes for three dimensional flows is very difficult because there is not enough detailed experimental data and precise analytical dependencies for slow air flows in boundary atmosphere layer.

Work presents method of construction and verification of finite difference schemes and some simulation results. For stable stratification case thermal processes may be neglected. Convective flows are too slow comparing to the wind velocity. In this case air density can be represented as sum of two parts: an average air density value and much less density perturbation value. So scheme gets more easier and require less memory space.

Athours appreciate firm Aerosol Technology Ltd for it's financial support of investigations. This material is based upon work supported by the European Research Office of the US Army under Contract No. 68171-97-M-5712



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ON A CONTRIBUTION OF WIND SHEARS INTO HORIZONTAL DISPERSION OF POLLUTION PLUME FROM A CONTINUOUS POINT SOURCE

BESCHASTNOV S.P., NAIDENOV A.V.

Scientific Production Association 'Typhoon' Obninsk, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

Pollution dispersion in the vicinity of a point source is governed, as is known, by turbulent diffusion, at average distances it is controlled by diffusion and wind shears. According to this

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empirical formulae for calculating horizontal dispersions depending on an pollution source in its vicinity involve only the terms considering turbulent diffusion, at large distances shear components are added. Empirical formulae [1] can be mentioned for a remote zone as an example. This and other formulae obtained by other authors have not been yet widely verified experimentally. Therefore, the goal of this work is to estimate with a diffusion numerical model an effect of wind shears on the magnitude of horizontal dispersions under different conditions and to validate the parametrization shear components used now practically.

In limited case at long diffusion times one may reduce from the empirical formulae and semiempirical diffusion equation the following relations:

$$\sigma_x^2 \approx a_x \left(\frac{\partial V}{\partial z}\right)^2 \sigma_z^2 t^2 \quad \text{and} \quad \sigma_y^2 \sim a_y V^2 \left(\frac{\partial \varphi}{\partial z}\right)^2 \sigma_z^2 t^2, \tag{1}$$

where V is the velocity module, φ is the wind direction, t is time. In [1], as in most other works, $a_x = a_y = 1/3$. Pasquill [2] propose to use the coefficient by the order of magnitude less: $a_y \sim 0{,}03$. In a limited case of a horizontally homogeneous atmosphere the model equations for dispersions are reduced for large distances from source to: $\frac{\partial \sigma_\alpha^2}{\partial t} \approx 2 K_z \left(\frac{\partial \rho_\alpha}{\partial z}\right)^2$, (2)

where $p_\alpha = \bar{x}, \bar{y}$ are the co-ordinates of the cloud gravity centers; $\sigma_\alpha^2 = \sigma_x^2, \sigma_y^2$ are dispersions. Using the relation $d\,p_\alpha = d(t\,u_\alpha)$ describing a variation of the cloud gravity center with time, one may obtained (1) from (2). An analysis of the numerical results obtained has shown that at large distances from a pollutant source comparable estimates of dispersions can be obtained only when the coefficient a_x and a_y are decreased, as in [2]. The model estimates of dispersion σ_y^2 appeared to be in satisfactory agreement with the Gifford dependence [3] generalising different experimental data. An analysis of the data available and their comparison with the model estimates of dispersions made it possible to refine the range of possible values of a_x, a_y depending on the diffusion conditions with the account of simplifications of (1) in practice.

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THE INVESTIGATIONS OF SPATIAL VARIABILITY FOR WIND FIELD AND ITS EFFECT ON POLLUTION CONCENTRATION NEAR THE GROUND FOR A LOCAL SYSTEM OF RADIATION MONITORING

BESCHASTNOV S.P., NAIDENOV A.V.

Scientific Production Association 'Typhoon' Obninsk, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

The results of field measurements and of numerical simulation of wind field are considered along with the calculations of pollution concentration distribution from an elevated source over a heterogeneous surface in the re-gion of a local system of radiation monitoring for Obninsk, which being designated in conditions typical of middle regions of Russia. The wind spatial distributions was stu-died during simultaneous basic balloon observations and with a mesoscale nonhydrostatic model of the atmospheric boundary layer (ABL) incorporating a microrelief, a penetrable region of obstacles (a forest, bushes, a settlement, a town), albedo and roughness variations. The extent of the wind field spatial heterogeneity effect on the pollution concentration distribution from an elevated source was estimated with a numerical model of pollution diffusion.

It has been found that considerable variations in wind velocity and direction caused mainly by the influence of the obstacles region and albedo variations were observed at weak winds and convective conditions. A comparison performed has demonstrated that there exists a satisfactory agreement in the tendencies of wind velocity and direction spatial variations in field measurements and numerical simulation.

An analysis of numerical results of the lower atmosphere pollution has shown that the wind spatial variability influences strongly the pollution dispersion. But more crucial for the pollution concentration is the choice of a representative site for aerometeorological observations as the wind direction in the ground surface layer in the vicinity of the source may vary by $70\text{-}120^0$.

The investigation results obtained have shown that even under the conditions typical of the middle regions of Russia wind field natural variability is so high that its does not allow one to use unambiguously the data of the national meteorological network in local system of radiation monitoring. For the latter subsystems of meteorological support should be created including at least a meteorological mast near the source term.



1326
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STOCHASTIC MODELING OF AEROSOLS TURBULENT DIFFUSION IN LOWEST TROPOSPHERE

GAVRILOV A.S.

Russian State Hydrometeorological University

(First received 10 March 1998; accepted for presentation during IAS-4)

Methods of the stochastic modeling (Monte-Carlo methods) has a wide application in

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studying of the turbulent diffusion of an pollutant in the atmosphere. These methods are of great interest because of contradictions between results of calculation, based on well known semiempirical diffusion equation, and observation data. Its main advantage in comparison with the other methods consists in the opportunity of the simultaneous description of the diffusion processes from sources of complex spatial and temporary structure over the heterogeneous surface.

The computing of the air pollution from industrial sources with complex configuration or from vehicles in the street canyon is considered here as an example. It is hardly possible to receive the analytical solutions of the semiempirical equation of the turbulent diffusion because of the complexity of the boundary conditions, whereas numerical approach encounters with a problem of singularity around the emission sources.

The method of the stochastic modeling of the aerosol particles dynamics in the turbulent flow is free from these shortcomings, however this approach for solution of the practical problems became possible only during the last years due to the wide application of the high-efficient personal computers in the engineering practice.

Despite of the rather extensive scientific literature devoted to the questions of stochastic modeling with the computer using of the turbulent diffusion in atmosphere, attention given to a problem of reproduction of such pseudo-random wind speed field , whose statistical characteristics are really observed in nature, is not enough discussed. Especially large difficulties appears when it is necessary to solve the problem of the turbulent diffusion above a complex terrain, where the statistical characteristics of the turbulent flow are unique in each point.

The solution of this problem can be found due to additional attraction for the calculations of the necessary turbulent characteristics of the numerical three-dimensional hydrodynamic model of a high level closure. Thus there is an additional requirement of an interconsistency of stochastic model and determinated model, which must be understood as a coincidence of a stochastic random field, with a field received from hydrodynamic model.

The way to solve specified problem can be found in application of randomization procedure to the original hydrodynamics equations which lead to a system of the Lanjeven's stochastic equations for a components of a vector of wind speed, which are used for modeling of dynamics of aerosol particles in the atmosphere.

Besides on the basis of the given equations the Fokker-Planck equation for probability in the space of the lagrangian coordinates and speeds can be received. With use of those equations, actually, all necessary system of the equations for the one-point moments of the second and third orders also is deduced, and is closed with the application of the methods, described in the literature.

The problem of air pollution is solved in two stages. In the first stage the system of the hydrodynamics equations complemented by the equations for the six independent components of the turbulent tensor and some other moments is integrated numerically. Thus depending on meteorological conditions the three-dimensional fields of the components of a vector of speed and turbulent characteristics are reproduced with including of the relief and buildings of district, and also of some additional elements of structure of a surface.

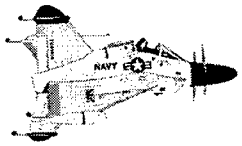
In the second stage the pseudo-random trajectories of particles in the turbulent flow are simulated with the use of method of Monte-Carlo with account of their gravitational sedimentation and interaction with a surface and buildings. The consecutive testing of the offered numerical models is carried out, for this purpose the data of the special experimental programs both for natural conditions, and for wind tunnels were involved.

On the basis of the described above approach program complex «ZONE» now is developed and successfully applied for the solution of practical problems of air pollutions which has been



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produced as special geoinformation system. The program complex allows to solve several types of problems. First of all, these are the problems of the analysis and assimilation of the observation data (meteorological and air pollution).



1483.
УДК 541.18

MODELING OF ATMOSPHERIC TRANSPORT OF AEROSOL

VLADISLAV KATKOV

Institute of Engineering Cybernetics, National Academy of Sciences, Belarus, Minsk

katkov@newman.basnet.minsk.by

(First received 19 March 1998; accepted for presentation during IAS-4)

Despite of sarcophagus, covering damaged reactor on Chernobyl Nuclear Power Plant, the emission of radionuclides in an atmosphere continues, as well as repeated their transport owing to destruction of an underlying surface with realization of agricultural works, wood fires, melioration, construction etc. Besides the growth of cities, development of industrial manufacture, chemical processing of raw material, use of fertilizers in an agriculture and other factors require creation of adequate mathematical models for forecast of pollution transport on territory of Byelorussia and for estimation of consequences of this process.

For this reason several regional models of pollutants transport by wind have been developed in Institute of Enfineering Cybernetics which are taking into account the following factors: presence of turbulent boundary layer of an atmosphere, washing out of pollutants by atmospheric precipitation, polydispersness of radionuclides, various type of an underlying surface and some other. The model, created in USSR in Institute of Experimental Meteorology, was taken for a basis of our approach [1].

The three-dimensional equations of diffussion transport of each fraction were used for the description of volume concentration changes of radionyclides. The wind field is proposed known. On the top boundary the condition of complete absence of particles flow was put, on a underlying surface the partial absorption of radionuclides was taken into account, and on lateral sides the condition of absence of a flow of particles was put.

The wind field can be set in model by any of three manners: (1) in geostrophic approximation through geopotential; (2) as the values measured on an irregular network of meteostations, and (3) as the values of speed or geopotential received after the objective analysis or the weather forecast. The calculation of speed on a regular grid is realized with a special procedure of interpolation, one of variants which is described in [4].

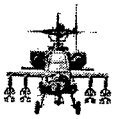
For the numerical decision of the equations one of implicit difference scheme was used [3]. The program has been written in language C++ and works under Windows 95. The program execution on three day forward requires several minutes on the PC Pentium with frequency 100 MHz. The model is easily set up on new regions by change of the appropriate geographical map. There is an opportunity of reception a demonstration movies. The comparison of results of modeling of Chernobyl accident for ten days with the real data shows their satisfactory coincidence [2].

The model can be used for forecast development of various hypothetical situations of extreme character and estimation of their consequences for a nature and economy of Republic.

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1190.

УДК 5418

REGULARITIES OF LONG DISTANT TRANSPORT OF SOIL DUST

SMIRNOV V.V. *, GILLETTE D.A., NOVITSKI M.A.*, GRANBERG I.G.*****

**Institute of Experimental Meteorology, Obninsk, Russia*

***ARL/SUDL, NOOA, Research Triangle Park, N.C., USA*

****Institute of atmospheric physics RAN, Moscow, Russia*

(First received 01 February 1998; accepted for presentation during IAS-4)

Main source of air contamination on terrain, removed from the desert, is wind erosion of loess similar soil. These soil most often folded by sedimentary rocks and so their distinguishes good dispersivity and high contents of different salts. Corresponding dust emission can be initiated by the moderate wind (mean speed 7-12 m/s) within many hours. In total even the moderate flows of dust materials possible to watch a significant contamination an atmosphere after removing from the dust source of the order hundred km [1].

Situation is aggravated, when wind erosion of dry and drying large pools is occurs. Aerosol products of similar emissions are characterized by the high dispersity, condensation activity, electrization and significant contents of toxic substances [2, 3]. In the available literature practically are absent quantitative data about kinetics of aerosol particle concentration and size spectra during a transportation of the dust cloud and stream. Accordingly were unclearly an possibility of theoretical description on evolution and forecasting of similar dust emissions.

In the report are analyzed results of the stationary, car and airplane measurements of dust particle spectrum and concentrations, optical depth and atmospheric electrical field along dust stream on distance to 150 km from the erosion center. Investigations were conducted in the Owens Valley, East California, USA within the framework of the international project LODE-1993, as well as in 1994 -1997 at deserts near Aral Sea, Kasakhstan and Kalmykia, Russia [1]. Areas of an wind erosion at dust source is 60 - 80 km^2. Averaged dust storm at these regions lasted approximately 3 hours, generating into atmosphere from 10000 to 50000 ton finely divided dust [4].

Optical transparency of atmosphere were measured in the wavelengths 0.45 – 0.65 μm by means of the photometer "Sirius-2" with Se - photosensor. Electric aerosol analyzer DAES-2 was used for the concentration and size spectrum measurement of dust particles by the diameter from 0,0032 to 1 μm. Battery -operated rotary fluxmeter was used for the measurement of electrical field tension in atmosphere in vicinity of dust stream. Possible note the following interesting results of experiments.:

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the following interesting results of experiments.:

On removal X = 2 - 3 km from the dust source an atmospheric electrical field E achieves values +400 - 800 V/cm, exceeding the corona threshold for sharpened objects on land surfaces (people, bestial, trees, shrubs, antenna and the like). On removal 8 - 15 km field E decreased before the zero and changed a sign. Negative field value also has a maximum E = 100 - 200 V/cm on X = 30 - 80 km. Hereinafter removals X = 120 - 150 km field falls to background value E = +(0.1 - 0.2) V/cm;

On removals from the dust source X = 30 - 40 km spectrums of dust are powerfully enriched (by factors of 20 - 100) by dust particles of respirable size fractions (D>0,5 μm).

Very high concentration of superfine dust particles (D<0.1 μm) distinguishes the dust from the bottom dry pools from sandy desert. So be basis to suppose that for the appearance at atmosphere the superfine aerosols of the mineral, saline and biological nature can be responsible not extensive sandy deserts, but arid wind - erosion provinces with loess - similar soil (Central and Middle - West Asia, China, Caspian Sea shore, the South - East states of USA and others);

After removals greater X = 30 - 40 km a spectrum of speck sizes is gradually transformed: total dust concentration is reduced but a contribution of middle size fractions D = 0,075 - 0,25 μm grows, i.e. natural monodisperisation of dust spectrum is occurs. Approaching a dust spectrum to the background atmospheric spectrum is observed on removal an order 100 km and more;

Before small removals X = 3-5 km the basic factor of dust stream (or cloud) dissipation is coagulation of superfine particles (D<0,05 μm) and sedimentation coarse particles, over X = 5-10 km is turbulent diffusion.

The proposed mathematical model for contaminant transport is based on the three-dimensional semiempirical equation of turbulent diffusion and the model for mesometeorological atmospheric boundary layer and adequately describes the experiment within 150 km of the seat of the dust storm. Offered asked semiempirical formulas for the estimation of the dusting and electric power of a dust source and for prediction a degrees of atmospheric contamination at region using separate photometric measurements an dust stream [5, 6].

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1019.
УДК 541.18

ON DEFINITION OF ABSORBTION AND REFLECTON COEFFICIENTS OF PARTICLES BY UNDERLAYING SURFACE

VOSZHENNIKOV O.I., NIKONOV S.A.

TAIFUN

(First received 10 January 1998; accepted for presentation during IAS-4)

The scheme for specification of interaction between impurity particles and underlaying surface for stachastic Monte-Carlo models of atmospheric diffusion is proposed. The absorbtion and reflection coefficients in this scheme are defined by means of falling stream and stream of absorbing particles by surface which are stated by the differencial equation generated by the condition of constancy streams within surface layer. The proposed scheme are tested in Monte-Carlo Langevin model for the different types of impurity and underlaying surface. The obtained results cotton with conventional expert assessments.



1273
УДК 541.18

ABOUT DETERMINATION OF COEFFICIENTS OF ABSORPTION AND REFLECTIVITY OF MATERIAL PARTICLES FROM THE UNDERLYING SURFACE

VOZZHENNIKOV O.I., NIKONOV S.A.

Scientific Production Association 'Typhoon' Obninsk, Russia

(First received 12 February 1998; accepted for presentation during IAS-4)

As powerful computation means have become available we see reviving interest to using methods of random wanderings (Monte-Carlo), both for research problems on turbulent diffusion in complex meteorological processes and for applied problems related to calculation of material dispersion in case of regional and long-range transport. This method has been put to use by many research institutions and prognostic centres, among them Livermore National Laboratory (USA), RSMC "Obninsk" and others.

When applying this method, researchers encounter the "chronic" difficulty, namely parametrization of particles interaction with the underlying surface. To our knowledge, there is no solid research on the topic in the literature. Each research team uses its own developments in transport models which, as a rule, have not been discussed by the scientific community.

The present report describes one of possible approaches to determination of coefficients of reflectivity and absorption of material particles by the underlying surface. The approach is based on using traditional characteristics of near-surface and near-ground atmospheric layers.

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The sought values are determined for logarithmic near-ground layer, both for weightless and settling material. The simplest is the expression for the absorption coefficient for weightless material dispersing in the neutral atmosphere:

$$K_{-} = \frac{V_{g0}}{K_L + V_{g0}}, \qquad (1)$$

where V_{g0} is the velocity of dry settlement in the near-surface layer,

$K_L = \frac{\aleph U_*}{\ln h / z_0}$ is the exchange coefficient in the near-surface atmospheric layer, $\aleph \approx 0.4$ is the Karman constant, U_* is the dynamic velocity, z_0 is the roughness parameter, h is height at which the limiting conditions for the vertical flow are set.

The reflectivity coefficient can be simply calculated as:

$$K_{+} = 1 - K_{-} = \frac{K_L}{K_L + V_{g0}} . \qquad (2)$$

In the case of settling material the reflectivity coefficient is found from the balance flow equation at the border with the surface.

For a simple logarithmic vertical wind profile characteristic of neutral stratification the reflectivity coefficient takes the form

$$K_{-} = \frac{W}{W + V_{g0}\left[\left(h/z_0\right)^m - 1\right]}, \qquad (3)$$

where $m = W/(\aleph U_*)$

For verification of the proposed approach we used the Monte-Carlo method of random wanderings in the velocity space. A series of experiments with the logarithmic wind profile were conducted. The report describes the results of comparison of modelled concentration profiles using the above defined absorption and reflectivity coefficients with exact solutions of diffusion equations for the simplest cases. The analysis suggests that this approach holds much promise in specifying the interaction of wandering particles with the underlying surface.



1271.
УДК 541.18

AN EFFECT OF SOURCE TERM IMPURITY CLOUD CENTER RANDOM WALKS ON IMPURITY CONCENTRATION FLUCTUATIONS

VOZZHENNIKOV O.I., ZHUKOV G.P., SVIRKUNOV P.N.

Scientific Production Association "Typhoon", Obninsk

(First received 12 February 1998; accepted for presentation during IAS-4)

It is well known that turbulence has a double effect on impurity cloud dynamics in the atmosphere. The pulsations of the total spectrum typical scales of which do not exceed the cloud sizes result in cloud expansion; the pulsations of larger scales (up to the external scale) induce random walks of the cloud center. The latter must give rise to impurity concentration fluctuations, that may appear to be significant at calculations of exposure doses under

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pollutants emergency releases.

The goal of the paper is in studying probability characteristics of an impurity concentration caused by the impurity cloud center random walks mentioned.

The Gifford model should be used as a theoretical basis in the frames of which the fluctuations of the cloud center are described by the Gaussian distribution:

$$f(y', z') = (2\pi M_y M_z)^{-1} \exp\left(-\frac{y'^2}{2M_y^2}\right)\left(\exp\left(-\frac{(z'-h)^2}{2M_z^2}\right)+\exp\left(-\frac{(z+h)^2}{2M_z^2}\right)\right) \quad (1)$$

where M_z^2, M_y^2 are the cloud center dispersions along the vertical and cross horizontal directions, h is the source height.

For the concentration distribution in the cloud the Gaussian model will be used as well. In particular, the exposure dose (integral over time and concentration) at the surface denoted as q_n is determined by the expression:

$$q_n = \frac{Q}{\pi S_y S_z \overline{U}} \exp\left[-\frac{(y-y')^2}{2S_y^2}-\frac{z'^2}{2S_z^2}\right] \quad (2)$$

where Q-is the amount of the impurity released; S_y^2, S_z^2 are the dispersions of the concentration within the cloud; y', z' are instantaneous random co-ordinates of the cloud center.

In view of (2) and (1) for the distribution probability density of q_n one can obtain an expression:

$$f(q_n) = \frac{S_y S_z}{q_n^* M_y M_z} \cdot \left(\frac{q_n}{q_n^*}\right)^{\beta^2-1} \exp\left(-\frac{y^2}{2M_y^2}-\frac{h^2}{2M_z^2}\right) \cdot \sum_{k=0}^{\infty} I_{2k}(B_1) I_k(B_2) \cos(2k\phi) \quad (3)$$

where

$$q_n^* = \frac{Q}{\pi S_y S_z \overline{U}}, \quad \beta^2 = \frac{1}{2}\left(\beta_y^2+\beta_z^2\right); \quad \beta_y^2 = \frac{S_y^2}{M_y^2}; \quad \beta_z^2 = \frac{S_z^2}{M_z^2};$$

$$B_1 = r\sqrt{y^2\frac{S_y^2}{M_y^4}+h^2\frac{S_z^2}{M_z^4}}; \quad B_2 = \frac{1}{4}\left(\beta_z^2-\beta_y^2\right)r^2; \quad r = \sqrt{2\ln\left(\frac{q_u^*}{q_u}\right)}; \quad \phi = \operatorname{arctg}\frac{hS_z}{yS_y}\frac{M_y^2}{M_z^2},$$

$I_k(x)$- are the modified Bessel's functions.

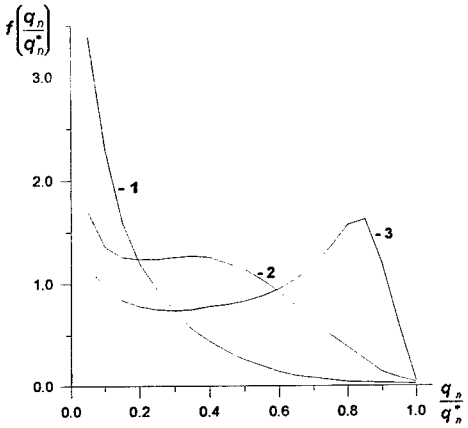
The first moment q_n (mean over the cloud center random positions) has the form of:

$$< q_n >= \frac{2Q}{\pi\sigma_y\sigma_z\overline{U}} \exp\left(-\frac{y^2}{2\sigma_y^2}-\frac{h^2}{2\sigma_z^2}\right) \quad (4)$$

To calculate the distribution function $f(q_n)$ the experimental data on S_z^2 and S_y^2 were involved [1], along with the data for σ_y^2 and σ_z^2. from [2]. The calculation results coincide with the experimental conditions [1] for h=300m, i.e. weakly unstable stratification.



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The figure gives the graph for $f(q_n)$ for different distances from the source term:
1) 5km;
2) 10km;
3) 30km.

As the calculations have shown, at the points of the nearest zone a great uncertainty in the q_n values takes place, and an average value of $< q_n >$ is not at all representative for the assessment of real concentrations. Here for the calculations of the pollutants impact one should use the probability calculations with $f(q_n)$ with the inclusion of more general risk conceptions. This fact should be taken into consideration when calculating exposure dose rates under emergency releases.

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1278.
УДК 541.18

EXPERIMENTAL AND THEORETICAL STUDYING OF LANGEVIN SCHEME OF STOCHASTIC WANDERING.

ZHUKOV G.P., NIKONOV S.A.

Scientific Production Association 'Typhoon' Obninsk, Russia

(First received 12 DFebruary 1998; accepted for presentation during IAS-4)

The Langevin equation, initially derived for describing the Brownian motion in the velocity space, is now successfully used for accounting for random wandering of liquid particles in modelling turbulent dispersion of material. The advantage of this approach is a possibility to adequately represent both relative and absolute diffusion. This is because the process of random wandering of particles in the coordinate space is non-Markovian, which allows going beyond the traditional K-Theory of diffusion.

The proposed work uses the numerical Langevin model of stochastic wandering to analyse results of the experiments on material dispersion from an instantaneous source in the

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atmospheric boundary layer (testing site of the meteorological tower, Obninsk, Russia). In these experiments, a plume was simulated by release of chaff with a low sedimentation rate (<30mm/sec). The chaff cloud was tracked using the meteorological radar, which made possible determination of relative distribution of the concentration in the cloud and calculation of the variance in chaff concentration by three directions. First results of these experiments were published in [1]. The meteorological conditions of these experiments were such that the stratification of the atmospheric boundary layer ranged from almost neutral to moderately unstable. In the experiments, the conditions of cloud expansion were: $S^2 \sim t^3$ (at $t \leq \tau_L$, τ_L is the Lagrangian time scale, L is the effective cloud width with the Gaussian approximation of concentration in it) $S^2 \sim t$ (at $t > \tau_L$). This permitted estimation of τ_L and diffusion coefficients for the meteorological conditions of the experiment. All experiments provided for measurements of main meteorological parameters using instruments located at the meteorological tower.

The used stochastic model was validated against the theoretical dependencies derived in [2]. Then, using the values τ_L and σ_u determined in the experiments the conditions of relative and absolute diffusion were reconstructed. Setting the initial distribution of the velocity of liquid particles to be Gaussian resulted in the absolute diffusion regime equivalent to a continuous source. It was found that the variance in distribution should be equal to the Eulerian dispersion of the medium in the release point. In this case, we get satisfactory agreement between the curves of growth of lateral dispersion of continuous jet in the IAEA methodology [3]. Given the delta-shape distribution, by the initial velocities the model simulates relative diffusion, i.e. increase in the size of the instantaneously released cloud. At large times, as follows from the theory, both regimes coincide.

For determination of the variance in meandering of the cloud in the model and in experiment the following formula was used

$$M_y = \sigma_y - S_y, \qquad (1)$$

where M_y is the variance in cloud meandering, σ_y is the absolute dispersion (which was taken from the IAEA methodology as lateral dispersion of continuous jet for experimental determination of meandering), S_y is the relative diffusion of expansion of an instantaneous cloud. For distances less than 10 km the experimental and model characteristics of meandering showed good agreement. At considerable distances, the meandering obtained by the combination method (experiment + IAEA methodology) shows higher values than the model. For example, at 30 km the variance in meandering is as large as 1 km. In our view, the obtained values are indicative of overestimation of variances in [3].

Based on the experimental data, we estimated a simple scheme to account for the vertical gradient of velocity in the model, namely

$$du/dt = -(u-\bar{u})/\tau_L + f_u(t) + G\cdot\omega\,, \qquad (2)$$

where u is the horizontal velocity, $\bar{u}$ is the mean horizontal velocity, f_u is the random force of the pressure gradient, G_T is the vertical gradient of velocity, ω is the pulsation of vertical velocity. It was concluded that such an account leads to overestimation of the longitudinal diffusion of the cloud. This fact can be interpreted as violation of the turbulence uniformity condition which was one of the main assumptions of the model.



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1023.
УДК 541.18

THEORETICAL AND EXPERIMENTAL STUDYING OF LANGEVIN MONTE-CARLO SCHEME FOR ATMOSPHERIC TURBULENT DIFFUSION

ZHUKOV G.P., NIKONOV S.A.

TAIFUN

(First received 04 December 1997; accepted for presentation during IAS-4)

Monte-Carlo scheme of diffusion based on Langevin equation is considered. The conditions which lead to absolute (Taylor form of diffusion theory) and relative diffusions are deduced. These conditions are checked using simple numerical model compared with both the theoretical pridictions of dispersion's growing of plume diffusing into semi-infinite space and the experimental data on diffusion plume from Obninsk meteorological mast (300 m of height). The results evidence that it is necessary to use Lagrangian velocity variance in model, Eulerian one gives over- stated characteristics of diffusion. Also it is shown that the direct implementation of vertical gradient in Monte-Carlo Lange- vin model causes too fast diffusion of plume.



1535.
УДК 541.18

EFFECT OF FILIFORM-STRUCTURE-BASED, SPACIALLY-DISTRIBUTED AEROSOL FORMATIONS ON ELECTROMAGNETIC WAVE PROPAGATION OVER A SUPER-WIDE RANGE OF FREQUENCIES

V. A. ALEKSASHENKO [1], L. I. STUPNIKOVA [2], A. A. SOLOVYOV [3], L. G. SUKHOVERKHOV [4]

[1] *GosCNIRTI, Moscow ;* [2] *GosCNIRTI, Moscow ;* [3] *OVTiU, Omsk;* [4] *RNTOO oSferan, Moscow*

(First received 28 April 1998; accepted for presentation during IAS-4)

The results of investigation into effect of filiform-structure-based spacial forma tions on electromagnetic radiation over a range of frequencies from radar to optical are summerized.

Considerable recent attention has been focussed on scientific and technological problems

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related to the capability for asserting influence on electromagnetic-wave propagation channels over a super-wide range of frequencies (from radar to optical) [1...2].

This capability, along with conventional use for reducing observability of various objects, can be used for radio channel screening in a desired frequency band, for communication link blocking, in anti-terrorist security arrangements, for assistance in offensive commando operations etc.

One possibility is that spacially-distributed formations (SDF) can be used to significantly to reduce electromagnetic radiation in a desired frequency band.

During the progress of our work a comparative analysis of various techniques for SDF generation has been performed in terms of:

areas of application, operating frequency band, formation time, life time, weight and size, attenuation characteristics, cost.

The following types of spacially-distributed formations were compared:

plasma formations; chaff; SDF based on excited molecules; SDF based on highly-excited atoms and molecules; SDF based on ultradispersible elements; classic aerosol formations, that is, the two-phase systems containing dispersible particles of any form having the representative dimensions much less than the wave length and the density equal to density of the bulky specimen,

SDF based on filiform structures, that is, the elements whose length is considerable greater than thickness (C/d>5), and whose density is one or two orders of magnitude lower than the density of the bulky specimen.

The analysis showed that the spacially-distributed formations based on filiform structures were preferable.

The results obtained can be summarized as follows.

1. A theoretical model for generation of the spacially-distributed filiform formations was developed, on the basis of which we have estimated:

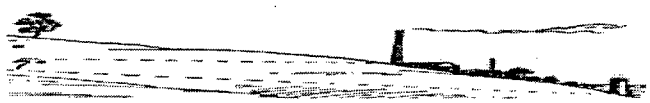
- the critical frequency beginning with which the media containing filiform structures attenuate electromagnetic-radiation notably better than other types of SDF;
- the attenuation of electromagnetic radiation per unit length p/C and the absorbability per unit
- weight G' . The values of these quantities (f18 +100 dB/m, G' =10 ...10 m /kg.) are abnormally large, two or three orders of magnitude larger than that of other types of SDF (in particular, of chaff, the most effective absorption medium);
- weight and consumption of a material whereof the most effective SDF is developed. So, against a radiation source moving at speed of 20 m/sec., it was found that SDF of representative size 10...100 m, providing attenuation by 20 dB (100- fold), require (10 ...10) kilos of material per centimeter (total weight of 0,18...4,3 kg) depending on the type'of material and the repre sentative size, which is considerably less than for other types of SDF.

2. The laboratory and quasi-full-scale experiments have, basically, supported the theoretical results. Several types of materials used for SDF were identified.

3. While predicted results remained unattainable, we were able to obtain the attenuation per unit length p/C =10 dB/m and the absorbability per unit weight G' =10 ...5~10 m /kg, that is, the parameters superior to those of other types of SDF.

Conclusions:

1. The comparative analysis of various methods and means for effecting the electromagnetic wave propagation channels showed that the filiform-structure-based, spacially-distributed aerosol formations are best suited for this purpose since their attenuation characteristics are superior to those of other types of formations.



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2. Futher investigations are needed to solve the problem of determining the optimal composition of the material with the aim to realize the theoretical attenuation characteristics

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1374.

УДК 541.18

EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER IN REGULAR FLOW OF MONODISPERSE DROPS

ANKUDINOV V. B., KLYONOV M. G., MARUHIN U. A., OGORODNIKOV V. P.

Moscow Power Engineering Institute (Technical University).

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The importance of investigation of heat transfer in the flows of monodisperse drops is connected with development of untraditional monogranulation technique. This technique is based on phenomena of forced capillary breakup of liquid jet [1]. One needs to optimize cooling rate of drops in the process of producing of monodisperse spherical granules [2]. It's difficult to solve this problem because of absence of methods of heat transfer coefficient calculation. So , it's necessary to obtain experimental data on heat transfer from the flows of monodisperse drops.

For this purpose experimental unit was designed, which make it possible to investigate heat transfer from regular flow of monodispers drops in a wide range of working parameters.

Vacuum oil is used in it as a working liquid. The unit is provided with two types of generators. This allowes one to produce both the hollow and ordinary drops with diameter range 50 - 3000 mkm.

For keeping temperature of oil in the generator constant the termostabilization system on the base of highly precise temperature regulator was designed. This system provides constant temperature with deviation no more than 0. 1 K.

A thermocouple detector for measurements of drops temperature in the flow was designed. In it the flow of monodisperse drops has transformed in a continues flow and than the oil temperature has measured. The temperatures is measured by copper- constantan thermocouples. The heat transfer coefficient is determined from heat balance equation for drop.

Designed investigation method allowes one to determine heat transfer coefficient with the error no more than 20%. The experimental data obtained allowes one to analyze heat transfer from monodisperse drop flow.

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1373.
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CONCEPT OF POLARIZED LIGHT SCATTERING MATRIX CORRECTNESS

GERMOGENOVA T.A., KONOVALOV N.V., PAVELYEVA E.B.

Keldysh Institute of Applied Mathematics, Russian Academy of Sciences,
Miusskaya Sq. 4, Moscow, Russia, 125047 fax 7-095-9720737

(First received 26 February 1998; accepted for presentation during IAS-4)

The polarization effects play an essential role in the radiative transfer in oceans, in atmospheres of the Earth and of planets, in astrophysical objects. The contemporary experimental facilities are able to fix the polarization value beginning with the thousandth fraction of percent. The polarization effects registration results in the sharp increase contents and size of an accessible information. It permits to interprete and understand more deeply the physical processes in real objects, to obtain qualitative and quantitative characteristics of the scattering substance nature.

In our report some aspects of transfer theory and numerical methods relating to the polarized light transfer in scattering and absorbing media are considered. The conception of the non-negativity of polarized scattering matrices is the base of developed theory.

The key moment of this theory is the Stokes cone introducing. This cone is the set of Stokes vectors satisfying some inequalities in four-dimensional real vector space. Those inequalities imply from a physical analysis of Stokes parameters, characterizing the polarized light. The matrix, transforming linearly the Stokes vectors is named nonnegative, if any Stokes vector is transformed also into Stokes vector.

Almost complete absence of the information on scattering matrices for real physical objects is the obstacle to the successful solution of the polarized transfer problems. The scattering matrices, which are measured experimentally or obtained numerically, are always determined with errors and are not nonnegative. Thus, the main problem of the polarized transfer theory is a problem to develop a physical correctness (non-negativity) criterion for scattering matrices, to check and correct the known scattering matrices.

We formulate in report the necessary and sufficient conditions of the non-negativity of polarized scattering matrices in the form convenient for practical use.

The correction algorithm for polarized scattering matrices which are not non-negative is proposed and discussed. It is based on the combination of the well-known methods for extremal problems: methods of the steepest gradient descent, Gelfand-Cetlin method of "ravines" and local step search. Our correction algorithm has been developed and realized in FORTRAN codes. The experimental matrices of radiative scattering by the natural ocean waters have been studied. We found them to be incorrect at the scattering angles near 0 or 180 degrees, where the measurement accuracy is low. These matrices have been corrected.

Numerical transport methods and Monte-Carlo methods require a very large calculation time in problems for optically thick media. It is naturally to use in those problems the asymptotic approaches developed in traditional (scalar) transfer theory. Our investigations in this direction are based on the analysis of characteristic equation taking into account the polarization effects. In general suppositions we have investigated the structure of the characteristic equation spectrum and establish base properties of the main eigenvalue and corresponding eigenfunction, determining radiative regime far from irradiated boundaries.



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1195.

COLLECTION OF EMISSION FROM OSCILLATING DIPOLES INSIDE AN ILLUMINATED MICROSPHERE: ANALYTICAL INTEGRATION OVER A CIRCULAR APERTURE

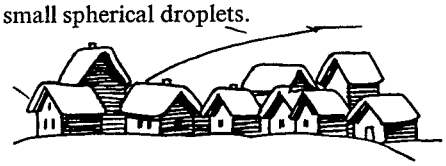
PENDLETON J.D., HILL S.C.

US Army Research Laboratory ATTN: AMSRL-IS-EE

2800 Powder Mill Road, Adelphi, Maryland 20783-1197; dpendlet@arl.mil shill@arl.mil

(First received 29 January 1998; accepted for presentation during IAS-4)

We describe a method for analytically integrating, over a circular aperture, the emission from an illuminated microsphere containing a uniform distribution of molecules. Each molecule is modeled as an oscillating dipole with polarizability proportional to the internal (Mie) electric field at its location. The model is useful for investigating fluorescence, Raman, or other emission from excited molecules inside of small spherical droplets.



1423.
УДК 541.18

OPTICAL PROPERTIES OF NON-SPHERICAL AEROSOL PARTICLES IN RANDOM ORIENTATIONS

SUTHERLAND R.A., KLETT J.D.

US Army Research Laboratory, Atmospheric Effects Branch, White Sands Missile Range, New Mexico, USA

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Several approximate methods for modeling the electromagnetic (em) scattering and extinction properties of non-spherical aerosol particles are presented and applied to the practical problem of modeling the composite properties of ensembles of random orientations. The random orientation distributions are themselves modeled using semi-empirical methods approximating the effects of atmospheric turbulence. Although some of the methods are applicable to arbitrary shapes we confine our attention to homogeneous cylinders, discs, and

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spheres for which there are some exact solutions available for comparison. Methods include the classical approaches such as the Rayleigh-Gans (RG), Anomalous Diffraction (AD), Wentzel-Kramers-Brillouin (WKB) methods (Klett& Sutherland, 1992; Lopatin & Shepelevich, 1995), and various exact and approximate solutions in the "IPHASE" collection of Evans (1996).

Most of the methods include the full vector (polarimetric) propagation and include extinction, absorption, and scattering in all directions denoted as the differential cross-section, the equivalent of the classical phase function used in optics. The particle orientation model is based upon semi-empirical relationships valid for the inertial subrange of turbulence often used to approximate the real atmosphere. Results for thin cylinders show a tendency for particles to orient in the stable fall mode (long axis horizontal) for low levels of turbulence as long as the particle lengths are on the order of the inner scale (ie. a few millimeters), otherwise the more usual uniform random approximation applies. The paper reaffirms our earlier assessment of the WKB method which offers a viable alternative to the more widely used RG and AD approximations and provides a significant improvement in accuracy with only a slight increase in mathematical complexity.

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983.
УДК 541.18

METHODS AND COMPUTATION CODES FOR CALCULATION OF BACKGROUND OBJECT RADIANCES WITH ACCOUNT OF AEROSOL SCATTERING

VESELOV D.P., MIRSOEVA L.A., GRIPOST S.B., SEMENOVA V.I., LOBANOVA G.I., POPOV O.I.

All-Russian scientific center "SOI named after S.I.Vavilov";
Birjevaya linia, 12, St-Petersburg, Russia.

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In SOI during some years the methods and computation codes for calculation of radiative characteristics of the system the Earth-atmosphere were developed in ultra violet, visible and infrared spectral ranges. The code was developed to calculate background radiances with an approach of single scattering of solar radiation for different combination of aerosol models and wide range of illumination and observation conditions in the spectral interval 1...3.0 mcm with spectral resolution 0.025 mcm. The software operates with data base including altitude (up to 100 km with a step 1 km) and spectral profiles of aerosol attenuation and scattering factors for nearground, tropospheric, stratospheric and mesospheric aerosols in different regions. The software uses C-language and operational systems Windows 3.1, Windows 95, Windows NT. The requirements to hardware are following: processor 486-DX2- 66, operative memory >4 Mb, the data base storage of hard disk - 10 Mb.

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1656.
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LOW THRESHOLD OPTICAL BREAKDOWN OF AIR AND FORMATION OF DAMAGES TO ALKALI HALIDE SURFACES

A .M. BONCH-BRUEVICH, V.N. SMIRNOV

S.I.Vavilov State Optical Institute Birzhevaya Liniya 12, St. Petersburg 199034, Russia
Phone: (812) 218-02-31, E-mail: photphys@dost.beam.info.ru

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Key-words: optical breakdown of air, threshold breakdown lowering, alkali halide crystal surface, underthreshold phenomena, formation of damages

It is well known that the presence of small particles in an intense laser beam reduces the threshold for laser air breakdown. It is also well known that laser air breakdown threshold near a solid surface is lower than that far from such a surface. This type of air breakdown is named as low threshold optical breakdon of air (LTOBA). Since seventies much attention is being given to studies of both air breakdown in the presence of aerosol particles and LTOBA. Many investigations have been performed for various materials of aerosol particles and targets, at various laser wavelengths (0.26 - 10.6 μm), spot sizes and pulse durations. In the course of those investigations it has been revealed that the problem of aerosol induced laser breakdown of air and the problem of LTOBA are rather similar [1]. That is why the results of investigations of the former are very interisting for those who are studying the latter and vice versa.

In this report some results of many years studying LTOBA under the action of TEA CO_2 laser pulses on the targets of various materials have been presented. The main attention has been given to LTOBA near surfaces of optically polished plates made of NaCl and KCl. Underthreshold phenomena and macroscopic surface damages formation have been studied.
First of all the presence of spot size dependence of LTOBA threshold should be mentioned. This dependence has been observed by us not only in the case of air-crystal interface irradiating but also in the case of irradiating interface of liquid-crystal. Liquids (H_2O, CCl_4) with various absorption coefficients have been used. Obtained data confirm that LTOBA initiation is a result of temperature growth of absorbing inhomogeneities (AI) of crystal surface layer under the action of laser pulse.

The nature and localization of AI in a crystal surface layer have been studied. It has been believed that AI may be localized both over surface and under it. Theoretical analysis and experimental study of damage threshold dependences on radiation incidence angle, radiation polarization and mentioned type of AI localization have been carried out. It has been shown that LTOBA is initiated with heating of AI localized under a crystal surface. These AI may be a result both crystal growth technology and technology of surface poliching. The nature of AI caused with crystal growth technology has been studied with electron scan microscope and electron X-ray microanalyzer. It has been shown that they are microareas with high

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concentrations of heavili absorbing molecular ions. AI caused with technology of surface polishing are most probably abrasive grains.

Light and charged particles emission pulses as a result of crystal surface irradiation at low laser pulses intensity q (0.1 - 10 MW/cm^2) have been studied. An estimation results of AI temperature growth (100 K at q = 1 MW/cm^2) and peculiarities of observed signals kinetics, light pulses spectra and some other their characteristics cannot be explained on the base of thermal nature. On the contrary, all obtained data do not contradict idea that observed light and charged particles pulses are caused by triboluminescence and fractoemission accordingly. Both of them are a result of cracs and microcraters formation in surface layer under the action of thermal stresses arising near by heated AI. In accord with an estimation (at temperature growth 100 K) stresses may reach a value ~10^4 kg/cm^2, whereas yield stress of crystal is 20 kg/cm^2. This means that crystal area surrounding AI ought to crack even at q ~ 0.1 MW/cm^2.

It has been shown experimentally that arising of charged particle caused by surface cracking under mechanical action on crystal leads to lowering of plasma formation threshold under the action of laser pulse synchronized with surface cracking process. Lowering threshold of LTOBA (from 130 to 70 MW/cm^2) near mechanically damaged surface has been observed.

The possible mechanism of optical breakdown lowering of air near solid surface has been suggested. In accordance with it activization of cracking process of surface layer at laser pulse intensity increase up to breakdown threshold leads to electron concentration growth and electron avalanch development in electrical field of laser radiation. Such being the case breakdown development has to take place if laser pulse fluence Q and laser pulse intensity exceed accordingly Q_a and q_a at a moment of avalanche development. Here Q_a is a value of Q which provides a necessery concentration of initial electron for avalanch development and q_a is a value of q which provides increasing of electron concentration. A truth of this model has been confirmed in experiments carried out in a wide range of q. In the course of them dependence of plasma formation threshold on q has been observed. These data are in agreement with the results of theoretical analysis.

The sequence of processes leading to macroscopic damage to crystal surface under the action of overthreshold pulses has been presented. They are - heating AI of surface layer, formation of microcracks and microcraters on it, fractoemission out of microcracks and microcraters, avalanche development and plasma formation near the surface, heating surface layer under the action of vacuum ultra-violet radiation of plasma and macrocracks formation on the surface under the action of thermal stresses.

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1076.

LASER BEAM EVAPORATION OF ICE PLATE AEROSOL PARTICLE

KUCHEROV A.N.

Central Aerohydrodynamic Institute (TsAGI), Department of Fundamental Research, 140160 Zhukovsky, Moscow region, Russia

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When the investigating the destruction process and describing the mass and heat exchange of ice aerosol particles under laser beam radiation a large number of particles may be treated as plate disk, the thickness of which is less than its radius [1]. The physical evaluations show that energy demand and time necessary to heat an ice aerosol particle up to the melting temperature are significantly lower than those for the melting process. Similarly, energy expense and melting time are significantly lower than evaporation time and evaporation energy of a particle, transformed into a droplet.

Studying the sublimation and evaporation process of a single ice disk is made at temperature T,K and heat release intensity q,W/m^3 averaged over the volume of the aerosol particle. If the beam intensity is moderate, then the melting temperature is not reached. Let's call the maximum heat release intensity q, at which the particle is not melted, threshold of melting $q_{melt.}$ In the first its value depends on ambient air temperature T_∞, pressure $q_{melt.}$ and minimum particle size (half thickness of the disk). In Fig.1 the dependence of $q_{melt.}$ value on the ambient temperature T_∞ is drawn at a pressure p_∞=1 bar and a disk half thickness r=d/2=1mkm. For comparison, the dependencies of q_{melt} value versus T_∞ are also drawn for a sphere and long thin cylinder of r=1mkm.

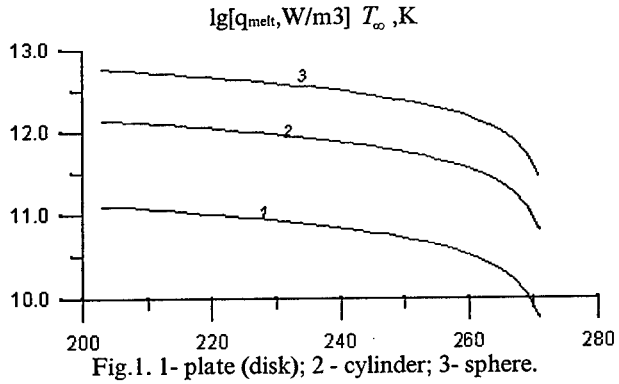


Fig.1. 1- plate (disk); 2 - cylinder; 3- sphere.

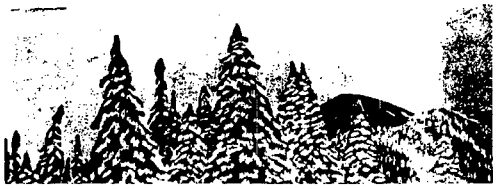
Thermal physical and optical properties of ice and water are insignificantly different ones from another [1-3], except thermal conductivity coefficient and vapour saturation pressure. At the same time the vapour mass flow from the disk surface is significantly less than that from the cylinder surface. The latter is less than vapour mass flow from the sphere surface if the cylinder and sphere radii are equal. Thus, the phase state of an aerosol particle (ice or water) influences heating and evaporation process firstly through the ice aerosol particle form. When $q < q_{melt}$ the particle slowly sublimates losing its mass. The dependencies of the ice particle evaporation efficiency on ambient physical parameters, incident radiation, particle size are investigated. The characteristics of plate (disk) and spherical ice particles sublimation and

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evaporation, as well as the super cooled water droplet evaporation are compared. This work is done under the financial support of the Russian Foundation of Fundamental Investigation (RFFI) and ISTC (Project 200).

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1380.
УДК 541.18

AEROSOL REACTOR FOR CREATION OF BIPHASE ACTIVE MEDIUM OF LASERS

LETFULLIN R.R., IGOSHIN V.I., SANNIKOV S.P.

Lebedev Physics Institute of Russian Academy of Sciences (Samara Branch), Novo-Sadovaya St. 221, Samara 443011, Russia, Tel:+7(846 2)341481, Fax:+7(846 2)355600, E-mail: fian@ssu.samara.ru

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Gas disperse systems, consisting from small disperse particles of a metal or their connections, weighted in gas mix, present significant interest as in fundamental, as applied areas of a science. For example, such disperse system make the basis of an active medium of a lot of lasers on the metal vapours, chemical pulsed oxygen - iodine and HF lasers with the next aerosol parameters: radius of particles ~ 0,1 μm, and their concentration ~ 10^9 cm^{-3}. In this connection, the solution of the problem of reception submicron aerosol of high concentration, homogeneously dispersed in large volume is very important for prepare biphase active medium. Existing mechanical, chemical, electrolitical, condensional and other methods of reception of powders not always satisfy to the requirements, presented to the ultradisperse systems in the attitude of dispersion, the forms, distribution of particles on the sizes and pollution by extraneous impurity. As practice has shown, method of electrical explosion of wire and a levitation method of condensational reception of powders on opportunities are the most suitable for the decision of specified problem. These methods permit to receive ultradisperse powders with particles, possessing small average size, narrow distribution on the size, spherical form and high cleanliness, but in comparison small area of the space ($\approx 10^2$ cm^3), and problem of homogeneous filling of large volumes ($\geq 10^3$ cm^3) by small disperse metal particles with high concentration do not decided. By use ready powders, dispersed by dispergator, it is difficult technically to supply required parameters of dispersion, size and concentration of particles, as well as uniformity of filling whole working volume, because of agglomeration and moulding of disperse particles. Besides, the filling of large aerosol volumes with the help of dispergators proceeds for the reasonably large times ≥ 10 minutes in comparison with a time of submicron aerosol life, which for particles in a range of sizes $r_0 = 0{,}09 \div 0{,}4$ μm makes ~ 200 sc.

In the present work a new way of reception of biphase laser active medium from submicron conducting particles of high concentration, concluded in evaporation previously put on a

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internal wall of a quartz chamber of a thin metal layer in electromagnetic field of a solenoid and subsequent condensation of metal vapours is offered. We this device for reception large aerosol volumes shall name aerosol reactor.

The quartz cylindrical chamber, with temperature melting of walls considerably exceeding in melting temperature of a metal film, is placed in uniform electromagnetic field of a solenoid. Aerosol reactor consists also of a power supply and battery of condensers C. On a internal wall of a quartz chamber on all length, or in a kind of a closed final ring on a centre, a film from a chosen metal and given thickness is previously put plasma powdered or other way. For protection a chamber butt-end walls from hit of a metal and ensuring of homogeneous filling of volume by metal vapours the film evaporation can be conducted at laminar flow of a carrying gas through unions on the ends of a chamber, in conditions of atmospheric or lowered pressure. The linear sizes of aerosol reactor are not limited and determined by the requirements of particular technological process.

Work of aerosol reactor we shall consider for a case, when the metal film is put on all length of a internal cavity of a quartz chamber. A block from n electrical condensers of designed capacity discharge for a small time τ on a solenoid with given parameters: by the length l, number of coils N, section of wires S and resistance of a primary winding R. Inside a closed cavity of a primary winding with the inductance L a uniform magnetic flow Φ sufficient for evaporation for a short interval of a time of a metal film is created. Further, the metal vapours are interacted with a environmental cold gas and undergo a condensational jump, accompanied by formation of submicron metal particles. The necessary average size of formed particles and their concentration are reached by variation of thickness of a initial metal film, as well as electrical parameters of the unit. Evaporation of a metal film and vapour condensation in a flow of a carrying gas gives a additional opportunity of variation the aerosol particle size. Combined use of all parameters, influencing on the aerosol particle size (thickness of a film, electrical parameters of the unit, pressure and sort of a gas, the speed of a gas flow), permits to change the average size of particles over a wide range from tens up to thousands angstrem and to reach homogeneous filling by particles whole aerosol cavity volume. The scheme of aerosol chamber with a limited length of a film has a additional opportunity of variation of aerosol parameters at the expense of change of a length evaporated film. Besides, this scheme is more preferable from the point of view of protection a chamber butt-end walls from hit of a metal, that inadmissiblly, for example, by use of such chamber inside an optical cavity of a laser to reception of biphase active medium. The offered method is universal in relation to various metals and alloys to receive for short times large aerosol volumes from ultradisperse particles with the small average size, high concentration, narrow distribution on the size and spherical form.

1381.

УДК 541.18

DESIGN OF HIGH-POWER PULSED CHEMICAL HF-LASER ON BIPHASE ACTIVE MEDIUM WITH AEROSOL REACTOR

LETFULLIN R.R., IGOSHIN V.I., SANNIKOV S.P.

Lebedev Physics Institute of Russian Academy of Sciences (Samara Branch), Novo-Sadovaya St. 221, Samara 443011, Russia, Tel:+7(846 2)341481, Fax:+7(846 2)355600, E-mail: fian@ssu.samara.ru

(First received 25 December 1997; accepted for presentation during IAS-4)

A perspective direction in the field of creation powerful pulsed chemical HF generators – amplifiers is to use the photon - branching chain (PBC) reaction, which is ignited in biphase active medium, i.e. in the medium, containing by a working gas and at ultrafine passive particles



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of a metal. However, here unsolved remains the problem of reception and homogeneous filling of large working volumes of a laser ($V > 10^3$ cm^3) by the submicron monodisperse aerosol for small times, not exceeding of lifetime of such aerosol with given properties: by the size of particles $r_0 \approx 0{,}09 \div 0{,}4$ μm and their concentration $n \approx 10^9 \div 10^7$ cm^{-3}.

In the present work a new design of high-power pulsed HF laser on PBC reaction, which initiated in the aerosol reactor is offered in essence. In such closed scheme of a laser, for the first time including by the device for reception and homogeneous filling of working volumes by the ultrafine aerosol, is considerably reduced a formation time of biphase active medium and is ensured required parameters of disperse components.

The optical scheme of a laser consists from unstable telescopic cavity, structurally connected with aerosol reactor. On a forward cavity mirror a aperture of connection with a specifying generator is executed. Aerosol reactor represents cylindrical chamber from tempriturefirmed quartz glass, on a internal wall of which a aluminium film of given thickness is previously put plasma dusting or other way. Reactor consists also from a solenoid, power supply and battery of condensers. The linear sizes of aerosol reactor are defined by a design of a optical cavity.

The formation of biphase active laser medium in the aerosol reactor occurs at the expense of evaporated metal film in magnetic field of a solenoid and subsequent condensation metal vapours. For protection of cavity mirrors from metal vapours hit and both for ensuring of homogeneous filling of reactor volume by the aluminium vapours the evaporation of a film is carried out at laminar flow of carrying gas through unions on the ends of a chamber. The small additive of a oxygen in the mixture results in formation oxidised film on a surface of formed aluminium particles. Such oxidised film, thickness 10 — 20 angstrem, prevents spontaneous hydrogen - fluorine ignition of a working laser mix at mixing with disperse component. The necessary average size of formed particles and their concentration are reached by variation of a initial film thickness, as well as electrical parameters of the unit. Combined use of all parameters, influencing on the aerosol size (thickness of a film, electrical parameters of the unit, pressure and speed of a gas flow), permits to change the average size of particles over a wide range from tens up to thousands angstrems and to reach homogeneous filling by particles whole working volume of a chamber. The aerosol chamber scheme with a limited length of a film, dusted manner of a ring on a chamber centre, has more one additional opportunity of aerosol parameters variation at the expense of evaporated film length change. Besides, this scheme is more preferable from the point of view of protection edge of a chamber walls from metal hit, that madnusseble by use of such chamber inside a laser cavity to reception of biphase active medium. The offered method of the biphase active laser medium creation is universal in relation to various metals and alloys and permits to receive for small time large aerosol volumes from ultradisperse particles with the small average size, high concentration, narrow distribution on the size, spherical form.

Pulse from external IR laser source through a central connection aperture on a source cavity mirror initiates reaction in a central zone at evaporation by IR radiation of disperse aluminium particles, previously formed in the aerosol reactor. Again the arising radiation, superior initial on energy, initiates reaction in following cylindrical zone, possessing by greater volume and etc.. Mirrors consistently "ignite" reaction in all volume, changing a direction of photons movement. In essence in this scheme arises autowave process of excitation in active laser medium the self-preservation of photon branching zones.

In particular accounts the following characteristics of a offered design of a laser were accepted. A length of unstable telescopic cavity $l_c = 49{,}5$ cm, diameter of the first mirror $d_1 = 14$ cm, diameter of the second mirror $d_2 = 6$ cm and it focal distance $F = 53$ cm, diameter of source aperture $d_0 = 1$ cm. Accordingly, the linear sizes aerosol reactor were chosen following: l

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= 50 cm, diameter of quartz chamber d = 15 cm with thickness of walls H = 1 cm. On a internal wall of a chamber on all length a aluminium film by thickness h = 350 nm is put, for evaporation of which appropriate parameters of the aerosol reactor electrical circuit were selected. Accounts have shown, that the solenoid with a primary winding from a copper wire by a diameter of 4 mm, number of coils N_1 = 50, as well as condenser with capacity C = 10 mf and voltage U = 30 кV provides reception of aluminium aerosol with radius of particles r_0 = 0,2 μm and concentration $N_{Al} = 1{,}3 \times 10^8$ cm^{-3}. Then, at specified parameters of aerosol, cavity and intensity of initiating IR laser radiation I_0 = 3 MW / cm^2 the output power of HF laser $P = 5 \times 10^{10}$ W and amplifier coefficient on energy ε = 648 is reached.



1379.
УДК 541.18

TIME DYNAMYCS OF THE DISPERSE COMPONENT OF THE BIPHASE LASER ACTIVE MEDIUM

LETFULLIN R.R., MELIKHOV K.G., IGOSHIN V.I.

Lebedev Physics Institute of Russian Academy of Sciences (Samara Branch), Novo-Sadovaya St. 221, Samara 443011, Russia, Tel.:+7(846 2)341481, Fax:+7(846 2)355600, E-mail: fian@ssu.samara.ru

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Heterogenius chemical active systems, consisting from disperse particles of metal or their compounds suspend in gas mixtures, present a significant interest for getting the high concentrations of free atoms (active chemical reaction centres) in the quantum electronics for making the active medium of lasers. So, for instance, disperse phase forms a base of the active medium variety of lasers on metal vapours [1], as well as in under development the pulsed chemical oxygen-iodine [2] and fluorine-hydrogen [3,4] lasers.

Main defect of lasers on the biphase active medium is a quick degradation of the disperse component and, consequently, small lifetime of the active medium with given characteristics. Ever changing with time of the disperse phase properties lead to worsening the output features of laser, or to breakdown of laser generations in general. Regrettably, in the laser studies on disperse medium was not conducted analysis of degradation processes of the biphase active medium, and not determined possible limits of changing the aerosol parameters, for which laser generation on such scheme impossible. In particular, small lifetime existence of given working mixture of a HF-laser with disperse phase insufficient for preparing of master generator and initiating a laser in the experiment, can be one of the possible reasons that hitherto experimentally not received its generation.

This work is devoted to detailed studying the processes of disperse component degradations of the active medium of pulsed chemical oxygen-iodine and HF-lasers, considered with provision for coagulation [5] particles, their gravitation precipitation and electrostatic scattering.

The range at most-possible parameters of the disperse component, under which possible generation of pulsed chemical oxygen-iodine and HF-lasers, is determined from laser-chemical kinetics and the aerosol optics analysis, calculated by diffraction Mie theory [6]. For a HF-laser a radius of aluminium particles must falls within $r_0 = 0.09 \div 0.4$ μm, but their concentration, accordingly, $N_0 = 10^9 \div 10^7$ cm^{-3}. In the case of a pulsed chemical oxygen-iodine laser on biphase active medium must satisfy parameters: radius of iodine particles $r_0 \leq 0.04$ μm at

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concentrations $N_0 \geq 10^6$ cm^{-3}, or radius of iodine particles $r_0 = 1 \div 5$ μm under their concentrations, accordingly, $N_0 = 4 \cdot 10^4 \div 8 \cdot 10^3$ cm^{-3}.

It's shown that main contribution to disperse component degradation of the active medium of lasers contributes a process of Brownian coagulation, changing by precipitation for big particles.

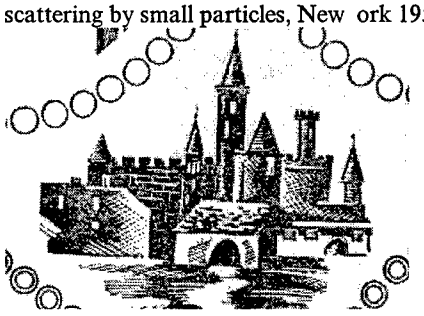
Take as a criterion of active medium optical transparency for laser radiation a condition $I_{sca}/I_0 << 1$, where I_{sca} and I_0 - intensities of scattering and incident radiation, most possible value of time of existence of the biphase active medium of said lasers was evaluated. So, for instance, for a HF-laser the maximum scattering of radiation on $\lambda = 3.3$ μm correspond to the size of the aluminium particles $r = 0.6$ μm, consequently, chosen by us criterion will be executed, if in result distribution on sizes N(r) practically particles of specified radius are absent. Coming from this, and considering all processes, which is leading to the diligence of aluminium aerosol in the active medium of a HF-laser, it was determined that condition $N(r = 0.6\ \mu m)/N_0 << 1$ is good executed only for a time $t \leq 250$ seconds ($r_0 = 0.05$ μm, $N_0 = 2 \cdot 10^9$ cm^{-3}). For pulsed chemical oxygen-iodine laser a time of existence large iodine aerosol within said restrictions is equal $t \approx 180 \div 260$ seconds and defined by high precipitation the particles.

Obtained results in the article allow to give concrete recommendations on a time of preparations and of the biphase active medium of pulsed chemical oxygen-iodine and HF-lasers with given parameters.

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1654

УДК 541.18

CREATING OF MICRON-SIZE AEROSOL IN LASER ABLATION OF THIN METAL FILMS ON THE POLYATHYLENTEREPHTHALAT SUBSTRATE

S.G. POKROVSKY, A.K. FANNIBO

Sci. Researc Inst. Poligraphmacsh, Moscow, E-mail: S.Pokrovsky@g23.relcom.ru

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aser ablation of metal films(0.1-0.3 μm) on polyathylenterephthalat(lavsan) substrate by the 1.06-μm wavelength radiation had studied. Studying had carried both for pulsed millisecond irradiation and for continuos beam with moving target regimes. Ablation thresholds for several

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coating materials were obtained. It was established that for treatment times of 10^{-6}-10^{-3} s the ablation is controlled by the finite rate of the subsurface lavsan layer pyrolysis with activation energy E_a= 175 кJ/mole [1]. Heat transfer from coating, that absorbs laser energy, leads to cracks appearance in lavsan at temperatures t~250-300^{0}C and cracks in metal film that is connected with polymer substrate. Following coating ablation is going independently for each fragment. Fragments from central zones of the focal spot in continuos beam treatment move away in liquid phase but ones from periphery - in solid phase. Specify of thermotensile distribution in lavsan at the periphery of the moving continuos Gauss laser spot defines the quasi-periodic structure of cracks in coating film with 3-5 mcm diameter of square-form fragments. That are the same fragments that forms the micron size solid-state aerosol atmosphere, that affects upon the laser engraving process. Laser treatment velocity dependence of solid aerosol generation was analyzed. It had shown that the aerosol particles diameter decreases as the treatment velocity to the second power.

Mentioned quasi-periodic structures along the laser engraving path were observed for all the types of vacuum deposited coatings: Ni, Ti, TiN, Ti+TiO_2, stainless steel and others that used for experimental offset printing plates laser engraving. The obtained results may be used for calibrated aerosol particles generator designing and for analysis of laser beam transporting in coating-on-polymer laser treatment applications.

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1602.
УДК 541.18

THE LASER WITH INTRACAVITY REACTOR FOR PROCESSING OF DISPERSIBLE PARTICLES

WOLKOV S.A.

St.-Petersburg Institute of Fine Mechanics and Optics 197101 Russia, St.-Petersburg, Sablinskaya st. 14.

(First received 06 May 1998; accepted for presentation during IAS-4)

The efficiency of laser processing of dispersible materials is largely determined by a way of organization of interaction of laser radiation with a dispersible system.

In the present paper the new method of laser processing of dispersible particles is suggested. This method consists of introduction of treated particles in the form of gas-dispersive mixture into the waist of high-power laser beam.

The experiments have been carried out using the Nd-glass laser rod placed inside the resonator which geometry is close to confocal. The reactionary cell was made in the form of the vacuum chamber with the sprayer of a disperse phase. Working volume of cell was combined with the waist of a beam. In experiments the powders of materials with various optical and thermophysical characteristics - C, Zn, Ni, Cu etc. were used. The chamber could be filled in with various gases which pressure may be varied over a wide range.

The experiments yield the following results:

The dynamics of laser generation has nonlinear character. The effect of Q-modulation leading to considerable increase of radiation power in comparison with free-running mode is found out.

The optimum relations between the parameters of laser medium (gain, function of pumping, volume of laser rod), parameters of resonator and parameters of gas-dispersive system (factors

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of efficiency of absorption, scattering, concentration of particles, gas pressure) which are necessary for steady and effective operation of the laser-reactor are found.
In our experiments the use of particles with parameter Mie>5 the value of initial aerosol losses could be as high as 80%, thus the intensity of radiation in resonator and the duration of laser pulse has appeared enough to make quick heating and evaporation of particles.

The use of inert gases in the reactionary cell has allowed to organize the effective vapor condensation and to obtain ultradispersive particles and aggregates of different materials.
In an outcome of the present research the project of the quasiCW laser-reactor with a flowing aerosol cell of the closed cycle.



1604.
УДК 541.18

ABOUT THE LASER WITH ACTIVE AEROSOL MEDIUM

WOLKOV S.À.

St.-Petersburg Institute of Fine Mechanics and Optics 197101 Russia, St.-Petersburg, Sablinskaya st. 14.

(First received 06 June 1998; accepted for presentation during IAS-4)

The idea of creation of the laser with active aerosol medium is discussed in literature for a long time. The difficulties of realization of this idea are related both with the problem of inversion and formation of optically homogeneous medium.

In the report the results of research of quasihomogeneous optical discharge plasma in aerosol media including the chemically . active ones are represented.

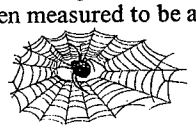
The systems of [He],([Ar]) - [M] ; [He],([Ar]) - [O] - [M], where [O] - gaseous oxidizer, and [M] - dispersed metal have been investigated.
The formation extended quasihomogeneous plasma or plasma-chemical channels has been carried out using two methods:
1) by focussing of high-power laser radiation in gaseous dispersive system by raster optical elements,
2) by radiation of high-power opened electrical discharge on a surface of a dielectric limiting reactionary volume.

The dense quasihomogeneous metal plasma in volume of 20 sm. x1.5 sm^2. with temperature in some eV is obtained. The specific released energy contributions to gaseous dispersive system corresponding to quasiuniform plasma channel are measured. The results of diagnostics of parameters of plasma (concentration of charged particles, temperature, speed of retraction) using spectral and probe methods are represented.

For chemically active gaseous dispersive systems the power thresholds and rate of exchange oxidizing responses initiated by laser radiation or source of a solid spectrum are measured.

The spectra of chemiluminescence of some responses interesting for creation of laser medium are investigated.

The generation of stimulated emission on oscillation - rotation transitions of a TiO molecule with partial inversion is obtained in the range of 12 mkm. The energy of pulse under laser initiation of a chemical response has been measured to be about several millijoules.



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List of participants of IAS-4 with presentations during 6 July 98

Bakirov Talgat Salmanovich *(1946-01-25)*
Russian State Scientific Biological Center VECTOR
Phone: (7)-3832-630055
fax (7)-3832-328831
email: root@churc.nsk.su
Novosibirsk Russia

Balahanov Mihail Valentinovich *(1947-03-08)*
SE VNIIFTRI
Phone: (7)-095-5359359
fax (7)-095-5359349
email: balah@ftri.extech.msk.su
Moscow Russia

Belov Nikolay Nikolaevich *(1947-05-04)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Belova Nina Georgievna *(1944-02-25)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia



Bezrukova Aleksandra Gennadievna
St. Petersburg State Technical University
Phone: (7)-812-5557413
fax (7)-812-5557413
email: bezr@psb.usr.pu.ru
St.-Petersburg Russia

Bordenyuk Andreyi Nikolaevich *(1974-07-27)*
Moscow State Technological University
Phone: (7)-095-1352408
email: zlobina@sci.lebed.ru
Moscow Russia

Kameshkov Gennadiyi Borisovich *(1943-02-09)*
Russian Scientific Optical Center

Bozhevolnov Viktor Evgenevich *(1947-01-01)*
Moscow State University
Phone: (7)-095-9393207
fax (7)-095-9328846
email: gorba@radio.chem.msu.ru
Moscow Russia

Castillo Jose Luis *(1955-02-21)*
Universidad Nacional de Educacion a Distancia
Phone: (34)-1-3987122
fax (34)-1-3986697
email: castillo@apphys.uned.es
MADRID Spain

Chechik Oskar Samuilovich *(1936-05-21)* VNF VAPA
Phone: (7)-812-2514332
fax (7)-812-1643274
Chechik@Chech.USR.PU.Ru
St.-Petersburg
Russia



Chernyak Vladimir Grigorevich *(1946-03-10)*
Ural State University
Phone: (7)-3432-616775
fax (7)-3432-615978
Vladimir.Chernyak@usu.ru
Ekateinburg Russia

Dirksen Veronika Gennadevna
St.-Petersburg Russia

Evsikova Lyubov Georgievna *(1938-08-28)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2188063
fax (7)-812-2183720
St.-Petersburg Russia

Gavrilov Aleksandr Sergeevich *(1948-02-10)*Russian Hydrometeorological Institute
Phone: (7)-812-2243039
fax (7)-812-3251281
email: gavr@mcep.rshmi.spb.ru
St.-Petersburg Russia

Letfullin Rinat Rifgatovich *(1962-03-01)*
Samara Branch of P.N.Lebedev

Gentry James W. *(1939-11-27)*
University of Maryland
Phone: (1)-301-4051915
fax (1)-301-3149126
email: Gentry@eng.umd.edu
College Park USA

Germogenova Tatyana Anatolevna *(1930-04-10)*
M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Phone: (7)-095-2507861
fax (7)-095-9720737
email: germ@kiam.ru
Moscow Russia

Gluschenko Natalya Nikolaevna *(1946-03-24)*
Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences
Phone: (7)-095-9397937
fax (7)-095-1378258
email: nnglu@chph.ras.ru
Moscow Russia

Granstrem Konstantin Olegovich
St.Petersburg I.I.Mechnikov State Medical Academy
Phone: (7)-812-5431920
fax (7)-812-5431571
email: paa@infopro.spb.su
St.-Petersburg Russia

Grigorev Aleksandr Ivanovich *(1946-01-13)*
Yaroslavl State University
Phone: (7)-0852-3339268
fax (7)-0852-354777
email: grig@univ.uniyar.ac.ru
Yaroslavl Russia

Grushko Yuliyi Sergeevich
email: grushko@LNPI.SPB.su
Gatchina Russia



Terentev Vladislav Evgenevich
Russian Scientific Optical Center named by Vavilov

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Kameshkov Gennadiyi Borisovich *(1943-02-09)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189946
fax (7)-812-2188179
email: Irina@tks-opt.spb.ru
St.-Petersburg Russia

Katkov Vladislav Leonidovich *(1936-05-11)*
Institute of Engineering Cybernetics
Phone: (375)-0172-685296
fax (375)-0172-318403
katkov@newman.basnet.minsk.by
Minsk Belorus

Konovalov Nikolayi Vasilevich *(1947-08-28)*
M.Keldysh Institute of Applied Mathematics, Russian Ac. Sci
Phone: (7)-095-2507861
fax (7)-095-9720737
email: knv@kiam.ru
Moscow Russia

Koromuslov Vyacheslav Aleksandrovich
Yaroslavl State University
Phone: (7)-0852-222325
fax (7)-0852-354777
email: polya@univ.uniyar.ac.ru
Yaroslavl Russia

Kucherov Arkadiyi Nikolaevich *(1951-02-09)*
Central Aerohydrodynamic Institute named after N.E. Zhukovsky
Phone: (7)-095-5564807
fax (7)-095-5564337
ank@dept.aerocentr.msk.su
Moscow Russia

Kudryavtsev Ilya Aleksandrovich *(1968-12-07)*
Aerospace University of Samara
Samara Russia



Letfullin Rinat Rifgatovich *(1962-03-01)*
Samara Branch of P.N.Lebedev Physical Institute
Phone: (7)-8462-340536
fax (7)-8462-355600
email: theor@fian.samara.ru
Samara Russia

Logvinov Leonid Mitrofanovich *(1944-09-01)*
Aerospace University of Samara *Phone*: (7)-8462-357356
fax (7)-8462-357356
email: onil16@lib1.ssau.ru
Samara Russia

Makovtsov Gennadiyi Anatolevich
Russian Scientific Optical Center named by Vavilov
St.-Petersburg Russia

Mihayilov Oleg Mihayilovich *(1938-12-19)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189952
fax (7)-812-2183720
St.-Petersburg Russia



Omelyanets Taisiya Grigorevna *(1938-01-25)*
Ukrainian Scientific Hygienic Center *Phone*: (7)-044-5593433
fax (7)-044-5599090
email: omelyans@usch.kiev.ua
Kiev Ukraine

Pinaev Viktoor Alekseevich
State University of Kemerovo
Kemerovo Russia

Pominov Evgeniyi Ivanovich *(1946-09-21)*
Aerospace University of Samara
Samara Russia

Redkoboroduyi Yuriyi Nikolaevich *(1940-03-10)*
Astronomical Observatory of Kiev University
Phone: (7)-044-2160906
REDCO@AOKU.FREENET.KIEV.UA
Kiev Ukraine

Terentev Vladislav Evgenevich
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2180082
fax (7)-812-2183720
email: Leader@soi.spb.su
St.-Petersburg Russia

Tkachev Vladimir Vasilevich *(1926-01-20)* Institute of Occupational Health RAMS
Phone: (7)-095-3653130
fax (7)-095-3660583
email: tkachiov@iog.nifhi.ac.ru
Moscow Russia



Ukraintseva Valentina Viktorovna
Komarov Botanical Institute of the Russian Academy of Sciences
email: ukr@nk1834.spb.edu
St.-Petersburg Russia

Uvarova Lyudmila Aleksandrovna *(1951-04-21)* Moscow State University STANKIN *Phone*: (7)-08222-9729520
email: uvarova@stanmat.mian.su
Tver Russia

Vlodavets Viktor Vladimirovich
Moscow Hygiene Institute named Erikhman S.S. Moscow Russia

Vorobeyichikov St.Petersburg I.I.Mechnikov State Medical Academy
fax (7)-812-5431571
email: paa@infopro.spb.su
St.-Petersburg Russia

Korobeyinikova Aleksandra Vasilevna Institute of Labour Safety *Phone*: (7)-812-2790863
fax (7)-812-2352632
St.-Petersburg Russia



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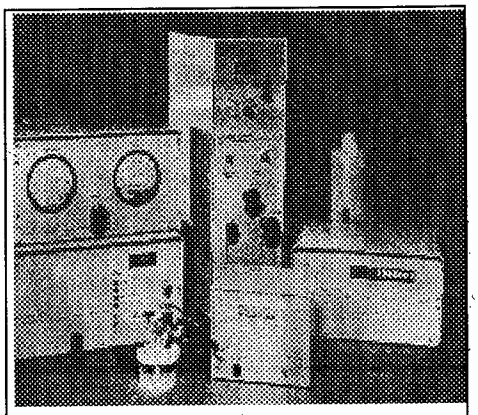
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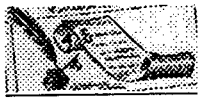
Prof. **SHINOHARA H.**
Prof. **CHERNOZATONSKII L.A.**
Prof. **VINOGRADOV G.A.**

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address Belov N 21-117
2-Mosfil 119285
tel./fax (095)**1474361**
BELOV@TEHNO.MMTEL.MSK.SU

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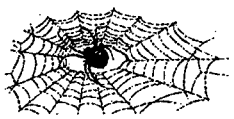
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1183.
УДК 541.18

DETERMINATION OF EFFECTIVE ANNEALING TEMPERATURE RANGE IN THE FULLERENE FORMATION

OSAWA E., SLANINA Z., ZHOU X., MATSUMOTO T.

Computational Chemistry Group, Department of Knowledge-based Information Engineering, Faculty of Engineering, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempakucho, Toyohashi, Aichi 441-8122, Japan.

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Our knowledge on the events occurring in the course of fullerene formation is limited primarily because experimental techniques for high-temperature chemistry have not been well developed. For example, it is not yet clear if the distribution of configurational isomers in higher fullerenes fraction represents thermodynamic equilibrium or a snapshot of kinetic process. An well-known example favoring the kinetic view is the disagreements in the kinds and relative amounts of the isomers of [78] fullerene separated from the extract of soot produced by arc discharge of carbon electrodes: Diederich et al. first separated two isomers, D2v(I) and D3, in a ratio of ca 5:1, then Kikuchi et al. gave three, D2v(II), D2v(I) and D3, in a ratio 5:2:2, then Taylor et al. and we found ratios of 18:52:30 and 595: 1026:386, respectively, for the same three components as found by Kikuchi et al. This and other examples might appear to demonstrate experimental difficulties in controlling high-temperature processes.

However, we doubt the validity of these determinations for two reasons. First, all of the above analyses (HPLC) ignore possible variation of extinction coefficients among the isomers at the UV wavelength with which relative peak height was determined. We noticed considerable differences in the shape of spectra of the above three isomers around 312 nm. Second, structural assignments have been heavily assisted by the computed enthalpies at 0 K (for ab initio methods) or at room temperature (for semiempirical methods). This is doubly wrong because the annealing occurs at much higher temperature, and the effect of vibration must be explicitly taken into account by using free energies. Regarding the second point, recent progress in evaluating free energies of fullerene isomers over a wide range of temperatures (typically 0 to 10000°K) using higher levels of MO theories has provided reliable criteria to determine equilibrium compositions of isomers and straighten the past confusion.

Under this circumstance, if we assume thermodynamic equilibrium and have accurate experimental compositions of isomers, we will be in a position to estimate the temperature of annealing. For this purpose, we need accurate distributions of isomers in higher fullerenes. Fortunately, recently reported method of introducing helium atom into the inside of fullerenes under high pressure of helium (BC provides a convenient determination of isomeric compositions. Although the rate of He incorporation by this method does not exceed a few tenths of percent, highly sensitive 3He NMR allows analysis of the mixture without further purification. Applying the method to a sample of 'highly purified fullerene fraction containing mostly C78' and a similarly designated sample of C84, Saunders and his coworkers found that the purified samples contain five and nine isomers of [78]- and [84]fullerenes, respectively. In contrast, only three isomers of [78]- and two isomers of [84]fullerenes have been described previously.

Thus, temperature range of annealing process in the fullerene formation has been estimated to be 2300°K with standard deviation of a few hundred°K, by fitting the isomers distribution of [78]- and [84]fullerenes obtained by 3He NMR measurements to the computed free energies of isomers vs temperature relation. Stone-Wales rearrangements occur in this temperature range

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about 105 times per second, fast enough to reach complete thermal equilibrium among configurational isomers of IPR fullerenes.



1182.
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POINT IONS APPROXIMATION WITHIN THE MARCH MODEL FOR THE FULLERENE MOLECULE

DESPA F.

Department of Theoretical Physics Institute of Atomic Physics
Magurele - Bucharest, PO Box MG-6 Romania

(First received 26 January 1998; accepted for presentation during IAS-4)

Progress in the investigations of the Buckminsterfullerene has until recently been largely confined to the molecule model within which the positive ions are uniformly smeared over the surface of a sphere and the valence electrons constrained to move on the sphere surface.

The model has successfully been used in describing some electronic and optical properties of C60.[1-4]

Recent interest centers on new approach[5-8] of the continuum positive charge model which employ Thomas-Fermi theory in describing the electron distribution and the stability of the fullerene. The latter molecule model was inspired from the March's one-centre model[9] for heavy, almost spherical molecules. The results were decidedly encouraging, and led them to suggest possible improvements. One of them we attempt to present in this paper.

We shall use a point ions approximation within the March model for the fullerene molecule and, we shall self-consistently derive the electron distribution of a fullerene molecule by a systematic application of the well-known results of the many-body perturbation theory.

Previously,[9] the March's one-centre model was employed to investigate special molecules XY_n, like CH_4 or SF_6, and it has been provided with a sound theoretical basis.[10] Shortly, the positive charges of the Y nuclei are smoothed out uniformly over the surface of a sphere with the X atom at the centre and, then the essential problem being to apply self-consistent field methods for the delocalized electrons.

As a theory in its own right, the method developed by March has not been without its successes, and it seemed a natural step therefore to investigate whether the method could be extended to the fullerene molecule. The March model strictly corresponds to the endofullerene molecule and it has been explored recently by Clougherty.[8]

For the fullerene case, there is no central atom and the boundary conditions imposed in the March model change at the origin.[6]

The molecule model assumes that the valence electrons cover the inner and the outer surfaces of the uniformly charged fullerene cage moving in a common potential generated both by the positive charges and by their distribution. One point need stressing here: Smearing the positive ions into a continuum surface charge distribution, as indicated above, it leads to electrons moving in a less rapidly varying spatial potential than for the point ions in the fullerene molecule. (Note that inside a sphere, the electrostatic potential due to a surface charge distribution is constant.) Mostly, the inside electron distribution seems to be affected by employing the continuum positive charge approximation; only lesser than half of all the valence electrons of the fullerene molecule are inside the shell.[6,7] Therefore, the fullerene molecule

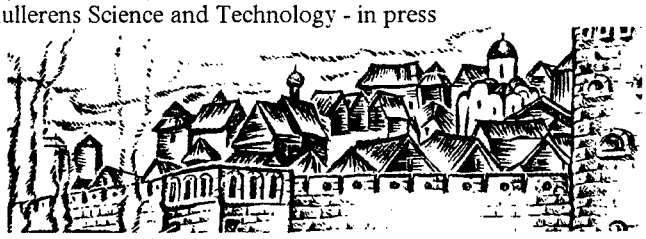
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being too "rarefied" within its natural limits, some objections can be risen on its mechanical stability.[5-7]

This situation can be overcame in a case which we shall present here by employing a point ions approximation. In this case, the valence electrons are found to be confined, in majority, inside the shell as a consequence of the adequate changing of the internal electrostatic potential. Moreover, both the inside and the outside electron distributions show distinctive peaks near the fullerene cage,[11,12] fact which differs from the other results recorded in the field[5-7]

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1508
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ABOUT ENTHALPY OF FORMATION OF FULLERENE C70

V. P. KOLESOV, S. V. MELKHANOVA, S. M. PIMENOVA

Department of Chemistry, Moscow State University, Moscow 119899

tel: (095) 939-5373, fax: (095) 932-8846, E-mail:Kolesov@thermo.chem.msu.su

(First received 20 April 1998; accepted for presentation during IAS-4)

The standard molar enthalpy of formation of fullerene C70 is one of the key values for a thermodynamic study of fullerenes and their derivatives. The results of two works in which the combustion energy of C70 has been measured differ substantially: $\Delta_c u^o$ =-35587+25 J g^{-1} [1] and $\Delta_c u^o$=-35802+31 J g^{-1} [2] (the uncertainties are given for 0.05 significance level). The discrepancy of these two results stimulated a new determination of enthalpies of combustion and formation of fullerene C70 in this work.

Two samples of C70 were obtained, purified and analysed at the Chemistry Department of the Moscow State University. Sample 1 was obtained from fullerene-containing soot extract by column chromatography (separation on graphite, with toluene + n-hexane, 8:2, as eluent). After purification by HPLC C_{70} was annealed at 250°C and 10 Pa for 1 h; no weight loss was detected after annealing. HPLC analysis indicated that the sample contained 2.0% of C_{60}. The contents of the solvent was negligible. Sample 2 was in addition purified by sublimation; it

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contained 1.2% of C_{60} and about 1% of heavy fullerenes (C_{78} and C_{84}), according to the HPLC analysis.

The energy of combustion was measured using a static bomb isoperibolic macrocalorimeter. Weighed amount of C_{70} (40 to 60 mg) was sealed in a terylene-film bag and placed in a small thin-walled quartz crucible-tripod standing in a small platinum cup. Benzoic acid was used as an auxiliary material to produce a proper temperature rise and to ensure a complete combustion of C_{70}. Special attention was paid to the analysis of combustion products. After each run the combustion products were analysed for carbon dioxide. No soot was revealed after combustion experiments. Qualitative tests for CO with indicator tubes were negative within the limits of their sensitivity (0.0001 mol.%).

Five runs were made with the sample 1; the mean value of massic energy of combustion, $\Delta_c u^o$ =-35664+44 J g^{-1}, was based on the mass of the sample of C_{70}. The results for sample 2 (three runs) don't differ significantly from the results given above for sample 1. The standard molar enthalpy of formation of crystalline C70, calculated using this value, is equal to 2439+37 kJmol^{-1} or 34.84 kJ(g'atom C)$^{-1}$. This value lies between the data [1,2].

It is important to notice that the quantity of carbon dioxide recovered in combustion products of both samples of C70 was about 99.8% from theoretical one. The deficiency of 0.2% undoubtly exceeds the error of analyses. To check the accuracy of the method, the combustion energy of graphite was measured. The Acuo value was in agreement with recommended one, and the quantity of CO2 in combustion products was close to theoretical (99.99%). So, obviously, the detected deficiency of CO_2 in combustion products of C70 is not accidental.

A similar problem was displayed at the determination of the combustion energy of fullerene C_{60} [3]. Two samples were studied, and about the same deficiency of CO_2 (=0.2%) was revealed in all runs with sample 1, which was dark brown and powdery. On the contrary, the quantity of CO2 discovered in combustion products of sample 2, which had a developed crystal structure, was in good agreement with theoretical one (99.99+0.02%). The mean value of the energy of combustion Of the Sample 1 Of C_{60} Was =130 J g^{1} lower than the more reliable value, Obtained for the sample 2.

The deficiency of CO_2 in combustion products of both samples of C_{70} and of sample 1 of C_{60} is probably connected with a low degree of crystallinity and a great number of defects in these samples. This could increase the possibility of retaining some occluded impurities. Taking into account the difference between the energies of combustion of two samples of C_{60}, one can suppose that perhaps the energy of combustion of C70 should be a little greater (=100-150 J g^{-1} ') than a value $\Delta_c u^o$=-35664+44 J g^{-1} obtained in this work. Obviously for reliable determination of the enthalpy of formation of C_{70} a pure sample with developed crystalline structure is needed.

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1274
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ALIGNMENT EFFECTS IN NA*(3P) - C60 CHARGE TRANSFER REACTIONS

HEUSLER G., CAMPBELL E.E.B.

Max-Born-Institut fur Nichtlineare Optik und Kurzzeitspektroskopie,
Rudower Chaussee 6, 12489 Berlin, Germany

(First received 03 March 1998; accepted for presentation during IAS-4)

In a crossed beam experiment of neutral C_{60} and neutral Na charge transfer is observed when the sodium atom is excited to its 3p state. To investigate this reaction, we used an effusive sodium source and collimators to get a sodium beam. The fullerene beam was obtained from a small-sized oven. The fullerenes leave the oven through a 15 mm long tube of 1.5 mm inner diameter leading to a non-Maxwellian-Boltzmann velocity distribution.

The sodium in the interaction zone was excited to its first excited state (sodium D_2-line) using a two-mode laser. This laser is a cw dye laser emitting light at two wavelengths at 589 nm [1].

The laser was focussed to approx. 1 mm in the interaction region. The sodium atoms therefore pass through about 50-100 pumping cycles. The fluorescence light emitted by the sodium atoms was detected by a photodiode.

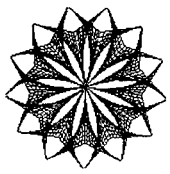
The interaction zone was completely surrounded by a box made from m-metal. This served as a shield to the earth's magnetic field.

The charge transfer was observed by detecting the emerging negatively charged C_{60} ions. They were accelerated from the interaction zone by an electric field. A lens allowed to focus the ions into the entrance hole of a quadrupole. In front of the quadrupole an ionizer is provided which allows electron impact ionization at variable energy. The ionizer could also be used to produce C_{60} - by electron attachment.

To investigate alignment effects, the polarization plane of the laser light was rotated continuously by a polarization rotator driven by a stepper motor. The fluorescence light and the C_{60} anion signal were registered simultaneously. A clear alignment effect could be observed and will be discussed in detail.

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1453.
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DIAMOND NANOCLUSTERS NUCLEATION IN AMORPHOUS CARBON MEDIA

V.I.IVANOV-OMSKII AND S.G.YASTREBOV

A F Joffe Physico-Technical Institute RAS, St Petersburg, 194021, Russia

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Keywords: amorphous carbon, diamond nucleation, copper, phonon spectroscopy

We report on observation of copper-assisted nucleation of diamond nanoclusters in amorphous carbon films. Ultradispersed copper was introduced in the bulk of amorphous

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carbon by plasma co-sputtering of copper and graphite on silicon substrates at 200' C, using a planar DC magnetron in argon-hydrogen (80% Ar and 20"/,' H,) plasma. It was possible to grow films with thickness from O. 1 to 2.0 μm. The copper nanosize clusters (-3 nm) are responsible for the enhancement of copper activity as a catalyst of diamond nucleation. As a. result temperature of diamond nucleation decreases from 800-900" C in conventional HTHP industrial process to 200" C in this work. Diamond nucleation was monitored by the measurement of IR-absorption at the diamond two-phonon frequencies. Anomalously high two-phonon absorption observed in this experiments allowed to increase the sensitivity of the method even in the case of very thin films (See figure). The application of the two-phonon spectroscopy to detection of diamond nucleation on the copper background in thin amorphous carbon films is important, because the close coincidence of the diamond lattice parameters with those of copper hampers application of diffraction methods.

We wi11 demonstrate experimentally that, owing to an anomalous enhancement of two-phonon absorption, it becomes competitive with the traditionally used Raman detection of diamonds in the actual case of tiny diamond crystals immersed in the amorphous carbon matrix. Moreover two-phonon absorption bands may be considered to be real fingerprints of diamonds, owing to the impossibility of any imitation. Mechanisms of the two-phonos absorption arnplification are discussed in the frames of electrodynamics of media containing nanosize inclusions of conductive phases of various shapes (spheres, plates, needles and so on). It is assumed that local field induced in the vicinity of diamond nanocrystal is responsible for observed arnplification of absorption in the actual IR frequency range, Prime novelty: Observation of high activity of ultradispersed copper as a catalyst of diamond nucleation

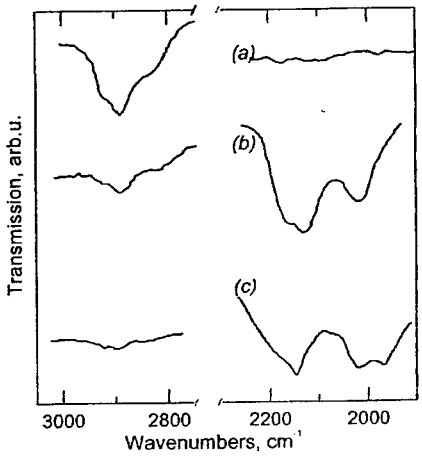


Fig. Fragments of double pass transmission spectra: curve (a) is for an amorphous carbon film (thickness = 0.8 p.m); curve (b) for an a-C:H:9%Cu film (thickness 0.8 pm); and curve (b) for a CVD diamond film (thicknes 320 p,m).

Acknowledgments:

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1587.
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ELECTRON STRUCTURE OF CARBON NANOTUBES MODIFIED BY ALKALI METAL ATOMS

N.G. LEBEDEV, I.V.ZAPOROTSKOVA, A.O.LITINSKII, L.A.CHERNOZATONSKII*

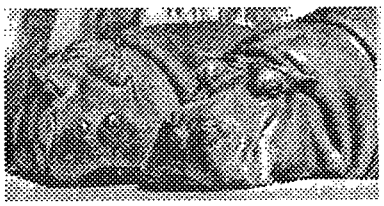
Volgograd State University, 400062 Volgograd, Russia

**Institute of Biochemical Physics, Russian Academy of Sciences, 117334 Moscow, Russia*

(First received 01 June 1998; accepted for presentation during IAS-4)

We have studied electron structure and energy zone structure characteristics of (n,0) zigzag type carbon nanotubes modified by alkali metals Li, Na atoms and intercalied by K atoms. Cycle cluster model and quantum chemical semiempirical MINDO scheme has been used for the calculation. We have obtained density of energy states of modified tubelenes. It has been shown internal and external metal atom modification of carbon nanotubes leads to high metallisation of such carbon structures.

Theoretical computings are compared to the last experimental results.



1479.
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ENDOHEDRAL METALLOFULLERENES: PREPARATION, EPR SPECTROSCOPY & POTENTIAL APPLICATION.

V.K.KOLTOVER, V.P.BUBNOV, YA.I.ESTRIN, E.E.LAUKHINA, E.B.YAGUBSKII.

Institute for Chemical Physics Research, RAS, Chernogolovka, Moscow Region, Russia.

koltover@icp.ac.ru

(First received 26 March 1998; accepted for presentation during IAS-4)

Endometallofullerenes (incarceranes, M@C2n) are endohedral carbon clusters that contain metal atoms (lanthanides, or Sc, Y, U, and Ca) trapped within a fullerene cage. The unique structure and reactivity of M@C2n are of great interest in the context of their chemical reactivity and physical properties. However, physical and chemical properties of M@C2n are as yet poorly investigated owing to poor accessibility of these compounds. Therefore, improvement in methods for the synthesis and isolation of M@C2n is one of the current problems in the area of chemistry and physics of carbon clusters. As far as the M@C2n molecules have essentially asymmetrical electron structures, they should possess large dipole moments in contrast to with empty fullerene molecules. We have developed a novel proficient method of extraction of M@C2n from fullerene-containing soots, the advantage of which lies in usage of two consecutive extraction steps, each relying on a fundamental difference in polarity between endohedral metallofullerenes and empty fullerenes. In the first step, o-xylene was used. This solvent of low polarity expelled empty fullerenes from the fullerene-containing soot but did not significantly reduce the content of M@C2n in the soot. In the second step, polar solvent N,N-dimethylformamide (DMF) was employed for the selective extraction of M@C2n from the residue soot. This method has been applied for isolation of endohedral La- and Yfullerenes from the soots obtained in the electric-arc reactor. The resultant DMF extracts

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reaches 1% of the primary soot mass. We have obtained as much as 100 mg of the endometallofullerene concentrate without empty fullerenes upon extraction of 10 g of the primary soot.

Thus, our method enables production of large amounts of concentrated M@C2n to be used in basic and applied research.

In part, it has been suggested that La@C82 be used for measurement of oxygen in microheterogeneous chemical and biological systems. Under careful deoxygenation, the solutions of La@C82 in o-dichlorbenzene demonstrate octet EPR signals with the individual line-width value 0.14 G at room temperature. This value grows with increase in the air-oxygen pressure. Similarly, the solutions of Y@C82 under careful deoxygenation demonstrate doublet signals with the line-width value 0.12 G that increases with oxygen concentration. The effects of line-width broadening by oxygen are of reversible linear character that makes it possible to use La@C82 and Y@C82 for measurement of oxygen.

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1600.
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FEATURES OF THE SORPTION OF LIGHT ATOMS ON SINGLE WALL CARBON NANOTUBES

I.V.ZAPOROTSKOVA, N.G. LEBEDEV, A.O.LITINSKII, L.A.CHERNOZATONSKII*

Volgograd State University, 400062 Volgograd, Russia

**Institute of Biochemical Physics, Russian Academy of Sciences, 117334 Moscow, Russia*

(First received 04 June 1998; accepted for presentation during IAS-4)

The mechanisms of sorption of F, O, C, and Cl atoms on the surface of a single-wall carbon nanotube are studied, and a comparison is made with the case of sorption of these atoms on graphite surface. Three versions of the position of the adatoms above the surface were studied. A cyclic-cluster model and an appropriately modified MNDO computational scheme are use. The optimal geometry of the sorption complexes and sorption energies are obtained.

The fact that most advantages versio of sorption if the adatoms studied is above a carbon atom of nanotube can be explained by the fact that the sorption bond is stronger because it has a higher s-type fraction.



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FORMATION OF FULLERENES AND THEIR ISOMERS

YU. E. LOZOVIK, A. M. POPOV

Institute of Spectroscopy, Russian Academy of Science, 142092, Troitsk, Moscow region, Russia

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Since the discovery of fullerenes the explanation of their formation mechanism is one of the most interesting and puzzling problems in fullerene science. In our review report we consider various models for fullerene formation: assembling from graphite sheets, assembling of other clusters, models of 'nautilus' and 'fullerene road' and different ways of annealing from clusters with other structure (See also [1]). Two contradictory facts should be explained.

A set of experimental data shows than fullerenes easily form from hot carbon clusters of arbitrary structure and size during their annealing. Nevertheless, only few fullerenes (C60, C60, and several other) are abundant.

It was proposed that in typical conditions of are discharge or during laser ablation for mation of fullerenes takes place through following stages: firstly carbon clusters form in hot unequilibrium plasma and after that these clusters anneal in cooler regions of plasma and transform to fullerenes. However, this model explains only the first of two mentioned above facts and therefore needs in further assumptions to develop corresponding scenario.

The only assumption which is in agreement with the mentioned theory was suggested: the selection of abundant fullerenes takes place after the fullerene formation. Here we carry out the detailed analysis of experimental facts concerning this problem. We propose that abundant fullerenes selection is mainly due to reactions of molecule C2 insertion into fullerene and molecule C2 emission by fullerene [1]. Therefore the relationship of rates of these two channels of fullerenes interconvertion determines a set of abundant fullerenes. Namely, for fullerenes C28, C32, and C84, the constant of reaction of molecule C2 insertion is small; for fullerenes C36, C44, and C76, the constant of reaction of molecule C2 emission is small; and for the most abundant fullerenes C50, C60 and C70 both constants of reactions are small in comparison with that for fullerenes of neighbour size. The experimental conditions where microcluster insertion or emission by fullerenes or both processes take place are discussed.

The constants of reactions of molecule C2 insertion and emission are determined by local structure of fullerene area where the reaction take place. Therefore these constants may be different for fullerene isomers with different local structure. Thus we believe that observation only one isomer of fullerenes C60 and C70 and a few number of isomers of some other abundant fullerenes may be explained by selection with the help of these reactions.

This work was supported by the grants of Russian Foundation of Basic Research, Pro grams "Fullerenes and atomic clusters", "Surface atomic structures" and "Physics of nanos tructures".

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1194.

FULLERENE MOLECULE AND ALKALI FULLERIDES

APOSTOL M.

Department of Theoretical Physics, Institute of Atomic Physics, Magurele-Bucharest MG-6, POBox MG-35, Romania email: apoma@theor1.ifa.ro fax: 40-1-423 17 01

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With the advent of the C60 fullerene molecule we are in the presence of a new microscopic object: a hollow, highly-symmetric, (quasi-) spherical molecule consisting of a large number of carbon atoms. Molecular physics can, therefore, borrow standard methods for treating such an object from solid-state and condensed matter physics.

To the first approximation the fullerene molecule may be viewed as a spherical, elastic shell of atoms; having derived its elastic energy, one may obtain the corresponding vibration spectrum.

The linear elasticity of a spherical thin film has to be established from first principles.

The oscillation modes of this sphere can be classified into four classes, out of which a few particular modes only can be computed anallytically. The vibrations are coupled to rotations, the main effect of this coupling, however, being static deformations beyond the harmonic approximation. If such a molecule is being to blow up during rotation, this would happen for certain polar angles on the sphere; a situation never reached, however, for the fullerene molecule. The dynamical anharmonicities of such an elastic, hollow sphere are, nevertheless, an extremely intriguing subject.

Carbon is a life element (is our life carbonic?). We know it, mainly, as sp2-hybridizations in graphite layers, or sp3-hybridizations in diamond. Is the fullerene molecule a curved, spherically-shaped graphitic layer? The electron affinity of carbon is 1.26 eV, while the electron affinity of the C60 fullerene molecule is much higher, about 2.65 eV.

Any standard theory of chemical bonding would have principled difficulties in accounting for this discrepancy.

How does a fullerene molecule react to an electron moving in the vicinity of its surface? One may think that the molecule gets polarized, and bound states will appear for the moving electron.

The electronic spectrum of such a quantum system is a hydrogen-like spectrum, in agreement with the experimental indications of the single-charged fullerene anion.

Highly-charged anions could also be treated within such a simplified model, at least in principle.

Layered structures of graphite have been doped in the past with alkali cations, which are easily accommodated in-between the layers, with the hope, among others, to fabricate electric charge batteries. Solid-state fullerites accept easily alkali cations, too, and form stoichiometric compounds to various degrees. The best known among these alkali fullerides are A3C60, where A denotes Rb, K, Cs, or even Na and Li. These compounds have a fcc- structure, with two distinct coordination sites for the alkali cations, one tetrahedral, the other octahedral. These two types of sites look like fullerenic cages wherein alkali cations are accommodated. The tetrahedral coordination is rather tight, so that the relatively small-size alkali cations occupy central positions inside. On the contrary, the octahedral coordination is pretty wide, and, while large alkali cations like Cs are central in these coordination, small- and even medium-size alkali cations, like Li, Na, and, respectively, K are placed off centre, along the structural directions of high symmetry. For example, a K cation may ocupy one of the eight corners of a small cube centered on the octahedral coordination. Detailed computations using inter-ionic



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potentials confirmed this picture, leading to the conclusion that ocathedrally coordinated alkali cations in some fcc-alkali fullerides may acquire off-centre sites placed along the (111)-symmetry directions.These off-centre positions of the alkali cations in alkali fullerides give certainly birth to a certain disorder, though not a completely undetermined one, i.e. this disorder is only a partial one, preserving to a certain degree the original ordering of the host lattice. This circumstance is rather singular, in any case not very common in solids, and its effects on the transport phenomena, thermal properties, local electronic structure, etc remain to be investigated. In particular, diffusion of the interstitial impurities on off-centre sites may exhibit new, universal features, still unknown, to a large extent.

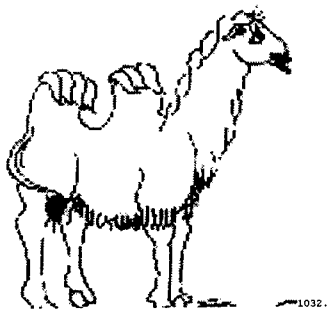
The off-centre sites may degenerate in highly-doped alkali fullerides into clusters of small-size alkali cations built inside the octahedral cages. Tetrahedral-, cubic-shaped and even cubic-centered Na clusters (i.e. Na_4, Na_8 and, respectively, Na9) have been reported in alkali-doped fullerites, and the questions of their stability, the nature of their chemical bonding, the degree of ionicity, the extent of their metallic behaviour, etc, have been rightly raised. These atomic systems are very complex to be approached by any specific theoretical method, even a numerical one. We are left, for the time being, with approximate models, able to give only a qualitative understanding of these micro-objects. Such an approach is the Thomas-Fermi model, where the electronic cloud moves in a self-consistent potential, usually of high symmetry. The Thomas-Fermi model for this situation tells us that the tetrahedral cages are too small to permit clusters building; that the alkali clusters in the octahedral cages are only formed in the presence of the cage walls which give rise to huge, repulsive electronic potentials; in other words, these clusters are actually groups of alkali cations strongly squeezed inside the fullerenic cages; this squeezing generate a high degree of collectivization of the alkali electrons, so that we may view these micro-objects as small metallic drops; whose ionicity is not very high, however: the Na_4 cluster, for instance, has a total charge of about +2.7 electronic charge, the Na9 cluster is almost neutral, while the Na8 cluster seems to be rather unstable. Alkali clusters in highly-doped fullerides may exhibit their own molecular dynamics, which is worth-testing by various spectroscopical methods.

There is no perfect solid, and the alkali fullerides are no exception. Usually, the defect concentration increases with increasing temperature. However, upon certain conditions of preparing the sample, when the preparation involves an equilibrum process, a slight defect concentration may appear, which is independent of temperature, and this seems to be the case for some alkali fullerides. In these compounds there seems to exist a small concentration of alkali vacancies in the tetrahedral coordination, which give rise to an additional line in the NMR spectra of 87Rb and 39K. This phenomenon is known as the T-T□ splitting of the NMR spectra of the alkali cations in Rb_3C_{60} and K_3C_{60}, and the mechanism of alkali vacancies migrating through the lattice seems to explain the occurrence of the additional T□-line, beside the T- and O-lines originating in the two distinct types of coordination (tetrahedral and octahedral) of a perfect compound.

The octahedral off-centre positions of the alkali cations in these compounds may also distort the shape of the alkali NMR lines originating in the tetrahedral cordination. Usually, the off-centre sites generate a quadrupolar coupling whose effect in the NMR spectrum is averaged out by the tunneling of the atoms between the highly-symmetric off-centre sites. However, in the case of K_3C_{60}, the alkali cations in the tetrahedral sites are polarized by the octahedral off-centre cations, in such a way that a net effect is obtained in the form of an assymmetric shape of the tetrahedral NMR line. This seems to be again a rather unique situation, pertaining to the fullerenic compounds.

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FUNCTION OF DISTRIBUTION OF FULLERENE SOOT PARTICLES

BELOV N.N.[1], SIMANCHEV S.K. [2], TOKAREVSKIKH A.V. [2]

[1] *Aerosol Technology LTD, BELOV@TEHNO.MMTEL.MSK.SU tel/fax 7-095-1474361*

[2] *Karpov Institute for Physical Chemistry , e-mail: simanch@cc.nifhi.ac.ru*

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Function of distribution of «fullerene soot» was obtained for interval of diameter of particles from 0.04 to 0.4 mkm. Function was approximated by five theoretical law.

Obtained firstly in the Kratshmer's laboratory new modification of carbon - fullerenes [1] are in the focus of many experimental and theoretical studies throughout the world. Range of using of fullerenes is increased, continuously new interesting properties are found. Also interest in soot are increased. This soot is obtained during vaporization of graphite into inert gas by different ways. It is show that the powder of activated carbon, prepared from waste of fullerenes production (fullerenes was extracted from such soot by organic solvent) favorably compares with commercially accessible activated carbon as adsorbent for removal of organic pollutes from one-component systems [2]. It is very important to know the function of distribution of soot particles in studies of thermophoresis, rate of sedimentation of soot particles and etc. The function of distribution was obtained for soot, generated in argon, under pressure 150 Torr [3]. In this article the function of distribution of soot, generated in helium under pressure 150 Torr is obtained.

The «fullerene soot» was generated by Kratschmer's method with some modification. The process was proceeded in the plasmochemical reactor for fullerene synthesis of «Aerosol Technology» firm. The construction of reactor is follow. The chamber of synthesis was 55 mm X 260 mm vertical cylinder with cooling water jacket. The cylinder may be disconnected in two same parts. The 10 mm hole was in face-end of upper part. The ballast 2100 cm^3 chamber was connected to reactor through this hole. The pressure in reactor was increased not more 10% due to ballast bulk. Anode - graphite 6 mm rod. Its primary length - 210 mm. Cathode - graphite 40 mm ∅ 9 mm cylinder. Electrodes was situated perpendicularly to axis of chamber at 70 mm from lower face-end. The rate of erosion of anode was 3 g/min. (4-5 cm/min.) under pressure of helium 150 Torr. Current was 110 A, voltage - 25 V. The function of distribution is the paramount characteristic of disperse system. There is a need to measure the grate number of particles for better description of function. So it was measured 300 particles (interval of diameters was from 0.04 to 0.4 mkm). The subsequent measurements did not change the functions of distribution noticeably. The photos was made by electronic microscope JSM-35CF of firm GEOL. Then photos was magnified by graphical computer program PhotoFinish. Data were approximated by five functions by program Mathcad PLUS 5.0 of firm MathSoft.

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Results of approximation are shown on fig. 1.

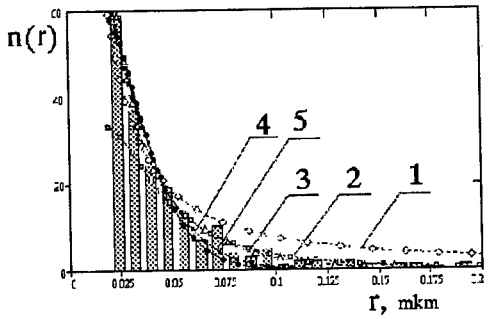


Fig.. 1. Function of distributio soot (diameter of particles from to 0.4 mkm was measured Histogram - empirical data,
1 - Junge's law,
2 - Kolmogorov's law,
3 - Chrgiane-Mazin's law,
4 - Best's law,
5 - Litvinov's law.

Junge's law:

$$n(r) = c\, r^{-k},$$

here c = 0.377, k = 1.3, r - radius of particles. Kolmogorov's law:

$$n(r) = \frac{A}{\sqrt{2\pi}\,\sigma r} \exp\left(\frac{-\ln^2\left(\frac{r}{r_0}\right)}{2\sigma^2}\right),$$

here A = 1.684, = 0.79, r_0 = 0.0349. Best's law:

$$n(r) = \frac{A\,k\,r^{k-4}}{\pi c^k} \exp\left(-\left(\frac{r}{c}\right)^k\right),$$

here A = 9.994Ч10^{-4}, k = 2.41, c = 0.109. Chrgiane-Mazin's law:

$$n(r) = A r^2 \exp(-br)$$

here A = 1.208 106, b = 105.794. Litvinov's law:

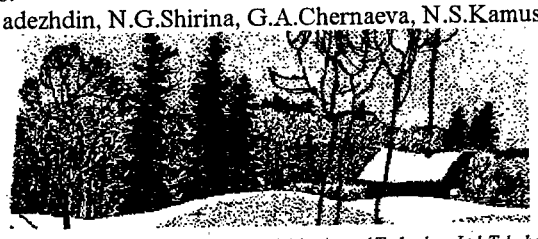
$$n(r) = A \exp\left(-b r^{\frac{3}{2}}\right),$$

here A = 100.809, b = 160.357.

Thus, coefficients of functions of distribution are found for interval of diameter of parti from 0.04 to 0.4 mkm. It is shown, that soot consist of particles less than 0,4 mkm. It is visi that average size of soot, prepared in helium, is roughly in one order more as comparison prepared in argon soot.

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1522
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HYDRIDES OF SINGLE-WALLED CARBON NANOTUBES

L.A. CHERNOZATONSKII, N.G. LEBEDEV*, A.O. LITINSKI*, I.V. ZAPOROTSKOVA *

Institute of Biochemical Physics, Russian Academy of Science, 117334 Moscow, Russia
**Volgograd State University, 400062 Volgograd, Russia chernc@sky.chph.ras.ru*

(First received 22 April 1998 1998; accepted for presentation during IAS-4)

Carbon nanotubes are the richest material for various applications in science and technology. These carbon structures show some unique properties, which allow to use them as interesting physical and chemical systems. Due to their small sizes (the diameter is some nanometers, the length is up to some micrometers) nanotubes represent the quasy-one-dimentional nanosystems, which can widely used in nanoelectronics, medicine, aerosol technology and so on. In particular, it is suggested that nanotubes might be effective as a hydrogen-storage material.

As it is well-known fullerenes C_{60} and C_{70} are effective adsorbents of light atoms (H, O, F, He and so on) because of the curvature of their surface. They connect themselves to these atoms, radicals and functional groups, thus compounds and crystal structures with various physical-chemical properties are obtained. Carbon nanotubes similar to fullerenes to be suggested are effective adsorbents too.

Here we present the results of calculations of adsorbtional properties of small diameter single-walled nanotubes (SWNTs) being compared with C_{60}. We carried out the quantum chemical calculations of (9.0) zigsag-type and (6,6) (10,10) armchear-type SWNT which were interacting with atoms H and compared the results with those for the case of hydrogen adsorbtion on a graphite surface and fullerene C_{60}. For the calculations we used the MM2 molecular mechanic method (for modeling geometry of SWNT hydrides) and MNDO-method, modified within a cyclic cluster model for nanotubes.

We considered the infinite carbon tubes as models of SWNTs. So we applied the ionic-embedded covalent-cyclic cluster model developed for the calculation of electronic structure, energetic cheracters of the band structure of solids and polymers. For determination of the most energetically propable hydrid structure we carried out calculations of two types of hydrogenization of SWNTs: a) atoms H were placed over C atoms of each fourth neighbour layer of hexagons (on six H atoms over each layer) so that rings of the superlattice, containing adatoms, are not displaced relatively to each other; b) even rings of adatoms are displased relatively to odd onee on a C-C bond length.

The analysis of the results has shown that the second variant of hydrogenization is more energetically advantageous. Furthermore the results show a good agreement with those of

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calculation of single atom adsorbtion. Allowing for hydrogen adsorption in the ratio C4/H on the surface of the (10,10) tubes, we obtain reasonable agreement with the experiment of A.C. Dillon group (Nature 386,678 (1997)). Considered hydrogen adsorption in the ratio C2/H proves to the possibility of SWNT's using as a good hydrogen storage.

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1452.
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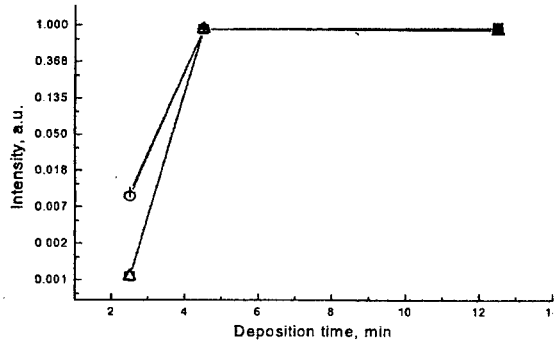
IR-ACTIVE MODES OF FULLERENE GROWN ON SILVER

V.I.IVANOV-OMSKII, E.K.KUZNETSOVA, S.G.YASTREBOV AND G.A.DYUZHEV

A.F.Ioffe Physical-Technical Institute RAS, St.Petersburg, Russia, 194021

(First received 30 March 1998; accepted for presentation during IAS-4)

We report on the charge transfer from metal substrate to the fullerene film produced b vacuum evaporation of pure C60 on metal substrates. Intensity of four main absorption bands in IR spectra attributed to IR-active modes of C60 oscillations was measured as functions of the C60 film thickness. Fullerene films were deposited both onto glas substrates covered with Ag and KBr substrate. Ellipsometrical measurements were don at 632.8 nm wavelength. Optical and IR spectra were performed in 0.25-25 mkm spectrs range. Measurements of absorption intensity for specific optical bands appearing in U' and VIZ spectral wavelength ranges and ellipsometrical studies showed that film thickness varied within the range from hundreds to several thousands of nanometers. Dependence of intensities of four mmn IR absorption bands of C60 deposited on silver as a function of the deposition time is shown in the Figure. It was found that in the case when the film thickness is of 150 nm (2 minutes of deposition) the intensity of four the bands of fullerene deposited on KBr are much more intensive than ones for the film deposited onto silver. Increasing the thickness up to 300 nm (4 min of deposition), the absorption intensity increases correspondingly. A pronounced departure of relative ratio of high and low frequency absorption band intensities for fullerene deposited onto KBr and silver substrates was found. For films thicker than 1000 nm no difference between the bands of fullerene deposited on metallic and dielectric substrates was observed. This effect is discussed in the frames of electron screening mechanism of IR-induced oscillations of the fullerene, which causes the suppression of the IR-absorption bands.



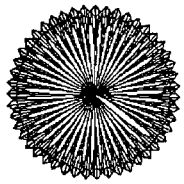
Electronic phenomena appearing at the metal/fullerene interface are considered as a possible reason to arise electron concentration in thin fullerene films, which is necessary for the electromagnetic screening.

Figure. Dependence of intensities of four main IR absorption bands of C60 deposited on silver vs the deposition time. Crosses stand for 527 cm^{-1} mode, squares stand for 577 cm^{-1}, triangles stand for 1429 cm^{-1} mode, circles stand for 1183 cm^{-1} mode.

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1257.
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MECHANISM OF SOOT FORMATION IN PYROLYSIS AND COMBUSTION OF HYDROCARBONS

KRESTININ A.V.

Institute of Chemical Physics, Russian Academy of Sciences, Chernogolovka, Moscow Region, 142432, Russia

(First received 26 February 1998; accepted for presentation during IAS-4)

Two existing approaches to quantitative description of soot formation mechanism through <aromatic> and <polyyne> models are critically reviewed. Aromatic model considers the soot particle inception process as coagulation of polycyclic aromatic hydrocarbons (PAH). Polyyne model assumes that primary soot particles originate from fast polymerization of "supersaturated polyyne vapor". Certain experiments disagree with "aromatic" hypothesis. D'Alessio and co-workers recently discovered 3-6 nm sized transparent in visible particles in the soot zone of a premixed hydrocarbon flame. The concomitant conclusion states that primary soot particles are not giant aggregates of large condensed PAH, and the process of their formation may be faster than predicted by quantitative kinetic schemes of PAH growth and coagulation. Second, Tesner and co-workers in the studies of hydrocarbon pyrolysis discovered that admixture of acetylene to PAH decreases the soot particle number density. The opposite trend could be expected from the viewpoint of aromatic model since acetylene promotes PAH growth.

An essentially improved version of the polyyne model which details the acetylene pathway to soot particles is presented. The model is based on the idea that the fast polymerization process of polyynes C2nH2 , n=2,3,..produces primary soot particles in the form of polymeric globules. Soot nuclei arise in the model as radical centers of the polymerization process. Their irreversible growth is conditioned by the occurrence of supersaturation of a "polyyne vapor" in the reactive atmosphere. The carbonization process of primary soot particles is presented in the model as well. Its duration determines how long soot particles coalesce in the coagulation process. The computer code of the model comprises a detailed description of gas-phase and heterogeneous reactions, soot particle nucleation, surface growth and coalescence of soot particles. The principal quantities of soot formation process in hydrocarbon pyrolysis, namely, induction time, soot particle number density and soot volume fraction are available in the model. Calculations performed earlier for methane, acetylene, ethylene and benzene well agree with experiments [1-3]. The quantitative explanation of both high efficacy of PAH-molecules in soot particle nucleation and the "inhibition" of this effect by admixture of acetylene is presented in the report. Experimental results on those mixtures are crucial for understanding the main kinetic regularities of soot formation in pyrolysis and combustion of hydrocarbons.

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NEW ALGORITHM FOR THE GENERATION OF NANOTUBE CAPS

T.YU.ASTAKHOVA, N.YU.BUZULUKOVA, G.A.VINOGRADOV.

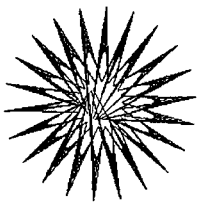
Institute of Biochemical Physics RAS, ul.Kosygina 4, Moscow 117334.

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A new algorithm for the generation of nanotube caps is suggested in the present work. The method for the unfolding of fullerene caps on the honeycomb lattice [1] is utilized. Our approach is based on the representation of pentagons as defects on the regular honeycomb lattice, where pentagons coordinates can be defined by a pairs of integer numbers {m_k, n_k}, k=1,2,..6. The nanotubes are well defined by a tubular vector C_h, and it is well established that the given vector C_h(i,j) gives a finite set of topologically different nanotube caps [2]. The relation between the set of coordinates {m_k, n_k} and the components (i,j) of the tubular vector allows to introduce two Diophantine equations in integers connecting these values. The solution gives an extracompleted list of nanotube caps, and the topological duplicates are discriminated by the eigenvalue spectra of the F-matrices, -- an analog of the adjacency matrix for the dual triangular lattice. Their made few corrections to the numbers of isolated pentagons caps for some nanotubes [2].

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1446

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NEW ISOMERIZATION REARRANGEMENTS FOR FULLERENES.

T.YU.ASTAKHOVA, N.YU.BUZULUKOVA, G.A.VINOGRADOV.

Institute of Biochemical Physics RAS, ul.Kosygina 4, 117334 Moscow.

(First received 31 March 1998; accepted for presentation during IAS-4)

A new approach to the problem of fullerene isomerization mechanisms is developed. The fullerene isomerizations are represented as special operations applied to the graph of the initial isomer. In this approach the isomerization rearrangements are considered as transformations of the patch of a graph preserving its fullerene character. There are proposed two classes of isomerization transformations for fullerene graphs -rotation and mirror reflection of the chosen part of the graph. It is found that the Stone-Wales rearrangements are the particular cases of the suggested transformations.

The developed matrix formalism allows to perform an efficient computer search of all isomerization transformations allowed for the chosen isomer.

The isomerization map of C_{40} fullerene is constructed as an example.

There are found three "simple" rearrangements irreducible to the Stone-Wales transformations. These rearrangements can be represented by rotation of a C-C bond or a "vertex star" and seem to be realizable under experimental conditions. The energetics and reaction paths of these rearrangements are calculated by semiempirical quantum-chemistry methods.

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PHOTOINDUCED GENERATION OF H_2O_2 IN WATER/HYDROCARBON EMULSIONS CONTAINING C_{60}

NADTOCHENKO V.A.*, KIWI J. **

**Institute of Chemical Physics in Chernogolovka, Russian Academy of Sciences*
Chernogolovka, Moscow region, Russia, 142432.
*** Institute of Physical Chemistry II, EPFL. Lausanne II, Switzerland, 1015.*

(First received 01 March 1998; accepted for presentation during IAS-4)

Photoexcitation of natural or artificial pigments in the air saturated water solution could lead to the formation of H_2O_2. This process plays important role in the mechanism of the pigment bleaching under the light and in the redox oxidation of organic compounds in the contaminant or natural waters. The main goal of this study is to test the photoinduced generation of H_2O_2 sensitized by C_{60}. C_{60} is not dissolved in the water therefore the hydrocarbon/ water emulsions were tested. Basic photophysical and photochemical properties of C_{60} are well studied. Triplet excited C_{60} is quenched by air oxygen with the efficient production of the singlet excited oxygen. In the presence of the electron donor molecules the quenching of the triplet excited C_{60} by donor with the formation of the C_{60} anion radical is possible. The following oxidation of C_{60} by air oxygen should produce the O_2 radical. The formation of H_2O_2 should be expected due to the following redox processes involving reactions of singlet oxygen or O_2 radical.

There were studied the water/thoulene and water/hexane emulsions. There was used solutions of hydrocarbon saturated by C_{60}. The Sun-test lamp was used for the excitation. The concentration of H_2O_2 was measured by iodometric titration technique. Aniline, triethanolamine, phenol, oxalate were tested as electron donor quenchers. As control experiments were performed the measurements of H_2O_2 formation in: a) complete emulsion solution containing C_{60}, donor, oxygen in dark; b) emulsion solution containing donor, oxygen without C_{60} under the light; c) emulsion solution containing C_{60}, oxygen without donor under the light; d) emulsion solution containing C_{60}, donor without oxygen under the light.

The results can be summarized as following:

a) there is observed photoinduced generation of H_2O_2 in the complete emulsion solution containing C_{60}, donor, oxygen under the light.

b) there is no or negligible small formation of H_2O_2 in the control experiments;

c) there is observed the growth of H_2O_2 concentration during 4 hours. After that the growth is stopped. Long time excitation during 24 hours leads to the H_2O_2 degradation.

d) there is observed the degradation of C_{60} after 3-5 hours.

e) maximum of H_2O_2 concentration depends on the donor. This value achieves to 10 M.

Qualitatively the properties of C_{60} as a photosensitizer of H_2O_2 is close t the properties such most efficient sensitzer as dye methelene blue. The optimization of the efficiency the H_2O_2 formation relative the absorbed light energy is possible.

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PRODUCTION AND CHARACTERIZATION OF ENDOHEDRAL LI@C_{60}

KRAWEZ N., GROMOV A., HEUSLER G., PRAXEDES A., HERTEL I.V., CAMPBELL E.E.B.

Max-Born-Institut fur Nichtlineare Optik und Kurzzeitspektroskopie, Rudower Chaussee 6, 12489 Berlin, Germany

(First received 03 March 1998; accepted for presentation during IAS-4)

A method to produce Li@C_{60}, which has a much higher efficiency than any other available method for producing endohedral fullerene, will be presented [1]. In this method monolayers of C_{60} are continuously exposed to an intense beam of alkali ions at an energy chosen such that the ions can penetrate the carbon cage but cannot destroy it. In this way it is possible to build up a film of fullerenes of many nanometres thickness which contains a substantial percentage of Li@C_{60}. The ratio of Li^+ to C_{60} during the deposition was estimated to be 6:1 (for which the the best capture rate was found). As determined from laser desorption mass spectroscopy, this capture rate was up to 50% (i.e. equal intensity of the C_{60} and Li@C_{60} mass peak).

However, to purify the endohedral species, it was found that the best solubility was obtained for films produced at the lower Li+ to C60 ratio of 1:1 (and hence a lower content of the endohedral species). Results of the purification process using HPLC will be presented.

To characterize the endohedral species, mass spectrometry, infrared, Raman and X-ray spectroscopy investigations have been performed. Some of the results will be presented.

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1066.

PUTTING METAL ATOMS INTO FULLERENES: ENDOHEDRAL METALLOFULLERENES

SHINOHARA H.

Department of Chemistry, Nagoya University, Nagoya 464-8602, Japan

(First receive 27 December 1997, accepted for presentation during IAS-4)

Endohedral metallofullerenes are novel fullerene-based materials and have attracted much attention in the last four years. In the last couple of years, some important progress have been made in direct structural analyses of metallofullerenes by using synchrotron X-ray diffraction and 13C-NMR studies. Recently, we have succeeded in determining the endohedral nature of the metallofullerene, Y@C82, and obtaining its total electron density via synchrotron X-ray powder diffraction(1). The results reveal that the yttrium atom is displaced from the center of the C82 molecule and is strongly bound to the carbon cage.

In the present study, both the isomer and the endohedral structures of a typical di-metallofullerene, Sc2@C84, have been determined for the first time by high-resolution 13C-NMR (2) and synchrotron X-ray diffraction studies, respectively. The results show that one of the major isomer of Sc2@C84, i.e., Sc2@C84 (III), has a D2d (23) symmetry and that some dynamical averaging of the Sc ions might be taking place around the optimum scandium

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position. This is a striking contrast to the Y@C82 case, where the yttrium atom is attached to the carbon cage even at room temperature.

Some important features of the crystal structures of Y@C82 and Sc2@C84 will also be presented and discussed.

1569.
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SLABS AND FIBERS DEFORMATIONS IN INORGANIC FULLERENE-LIKE STRUCTURES

A. ESPINOSA C.

Instituto Nacional de Investigaciones Nucleares, Carretera Mexico-Toluca, Km.36.5,52045 Salazar Edo. de Mexico, Mexico.

*Retorno 505 No.115 (antes 6) U. Modelo, C.P.09090, Mexico, D.F.Mexico. *e-mail: aesc@nuclear.inin.mx*

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Nanotubes and fullerene structures were first predicted and experimentally observed in carbon particles . Some fullerene-like properties and characteristics have been studied in other compounds.

The concept of fullerenes have been extended beyond carbon chemistry in the study of fullerene-like structures and fibers, specially in layered metal-chalcogenide compounds[1-3], which have been named inorganic fullerene-like structures-IF.

An analysis of the theoretical energy calculations of the deformations of different numbers of packing layers of MOS2 is presented, theoretical energy calculations of layers deformations, layer defects and twist defects of MOS2 have been investigated. The models have been studied theoretically by molecular mechanics calculations, high resolution transmition microscopy (HRTM), and computer simulations which have complemented each other in the microscopic description of MOS2 slabs. The total calculated energies include contributions from the bond stretching and bending, torsions, inversions (improper inversions) and van der Waals energies. The MOS2 slabs force field used for the calculations has been described previously [4]. The energy minimization procedure utilized a conjugate-gradient technique.

The molecular structure and schemes [5-7] for the minimum energy stacking layers deformation for MOS2 are shown in figures 1-4. Four slabs structures were subjected to bendings of 30, 60 and 90 degrees. The minimum energy for each structure were obtained using a molecular mechanics force field from which it can be seen that the energy of one slab remains almost constant during the bending and it grows as the numbers of slabs is increased.

The distance of the S-S bonds presents a significant difference from the natural value (3.16 angstroms) near the boundaries, as it could be expected, and this change can be seen in figure 5, in this figure it is also shown with the number 4, the spread of the atomic distance in the bends.

The theoretical HRTM images are useful to distinguish fibers and slabs in real experimental images (figures 6-7).

Aknowledgments

The author thank J. Fujioka for his enlightening comments and helpful suggestions.

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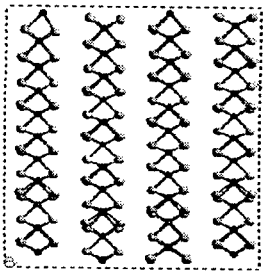


Fig. 1 The crystal structure in [0 0 1] direction of MoS2 for 4 slabs.

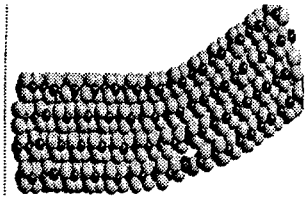


Fig. 2 4 Slabs Of MOS2 bended 30 degrees.

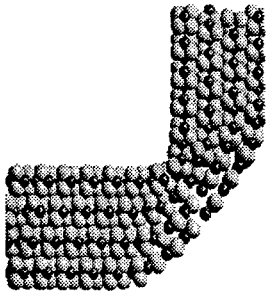


Fig. 3 4 Slabs Of MOS2 bended 90 degree

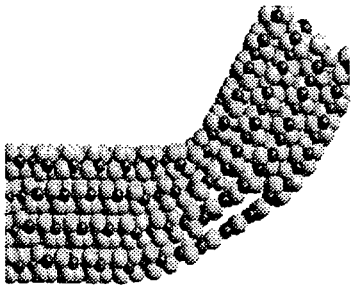


Fig.4 4 Slabs Of MOS2 bended 60 degree

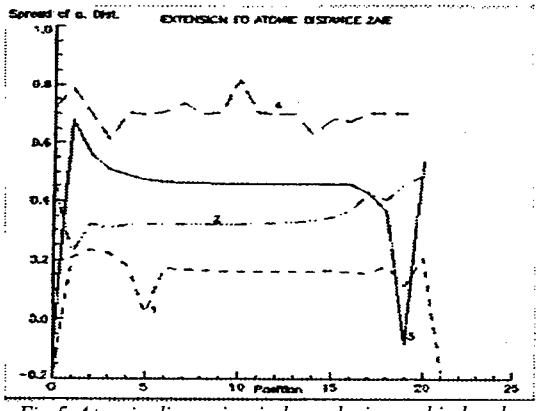


Fig.5 Atomic dispersion in boundaries and in bends.

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1254.
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SOOT AEROSOL AND FULLERENE FORMATION IN CARBON VAPOUR CONDENSATION PROCESS

KRESTININ A.V., MORAVSKY A.P., TESNER P.A., FURSIKOV P.V.

Institute of Chemical Physics, Russian Academy of Sciences,
142432, Chernogolovka, Moscow Region, Russia

(First received 26 February 1998; accepted for presentation during IAS-4)

The very discovery of fullerenes and further studies on their formation process implied that kinetic mechanism of carbon vapour condensation has little in common with studied earlier processes of other simple substances condensation. In fact, the variation of the conditions of fullerene synthesis in an arc reactor leads to obtaining of 0 to 24wt.% of fullerenes C60+C70 in the product of carbon vapour condensation (fullerene soot).

Analysis of carbon vapour condensation process indicates that the following factors determine the kinetics: a) growth and decay reactions of carbon clusters under non-isothermic conditions, b) soot aerosol formation and growth, c) heat and mass transfer processes essentially influencing the temperature and gas phase composition. A kinetic model allowing for these factors is presented in the work. To test the model two sets of experimental data were used. These are kinetic data on fullerenes thermodecay in a shock tube [1] and on fullerenes synthesis in a carbon arc reactor [2].

The numerical analysis of the kinetic model of carbon vapour condensation lead to the following general conclusion. Under close to optimum conditions for the synthesis of fullerenes strict constraints on the kinetic scheme of vapour condensation are imposed by two factors: the high value of fullerene yield and constancy of molar ratio C70/C60 in the products of arc synthesis. In particular, the following is valid:

1) Coagulation of large clusters, for example, coalescence of cycles and polycycles, cannot be the main route to fullerenes C60 and C70. The inevitable high contribution of clusters coagulation to the soot particle nucleation would lead in that event to catastrophic fall in fullerene yield because of prevailing condensation of carbon vapour on readily formed soot particles.

2) The growth of fullerene structures ranged between C60 and C70 should proceed through insertion of C1, C2 or C5 fragments to get the main reaction route passed exactly both through C60 and C70 clusters. There slightly exists an alternative to this condition since it furnishes under mild additional restrictions both the high yield of fullerenes and constancy of the C70/C60 ratio in the products. The model employes the insertion of C2 - fragment as the main reaction route for fullerene structures growth. The decay of fullerene structures is well known to produce mainly the C2 fragment as well.

Two probable routes to perfect fullerene structures are compared in the model.
The first includes original formation of defect C60 and C70 clusters followed by monomolecular Stone-Wales type annealing into perfect molecules. The second one goes through the regular channel of fullerene growth by addition of C2 - fragment. Under some natural assumptions the value of the C70/C60 ratio obtained in calculations is almost constant and pressure dependence of fullerene yield coincides with experimental one for both routes.

The work is supported by Russian Fund for Basic Research, Grant No.96-03-34411.

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1306
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SYSTHESIS OF HIGHLY DISPERSED PRECURSORS FOR C60 PHOTOPOLYMERIZATION

LAVROV V.V., ARKHANGEL'SKII I.V., SKOKAN E.V.

Moscow State University, Department of Chemistry,
Moscow, 119899 Fax: (095) 939-0198, E-mail: skokan@thermo.chem.msu.su

(First received 02 March 1998; accepted for presentation during IAS-4)

Since the polymerization of fullerene molecules was observed, this phenomenon was intensively studied. The most efficient and studied types of polymerization are photochemical and pressure-induced. However, only the quenching technique, applying high-temperature and high- pressure treatment allow to obtain bulk quantities of polymerized fullerenes.

As the polymerization mechanisms are not enough studied, it was proposed that the products of photopolymerization and pressure-induced polymerization are the same. But according to Woodword- Hoffmann theory of 2+2 cycloaddition reactions photochemical process, representing photoexcitation and pressure-induced process at elevated temperature, representing thermal excitation have different mechanisms and should result in different products.

In the current paper some techniques for photochemical polymerization of small C_{60} particles are described. These techniques make possible to produce macroscopic amounts of polyfullerene C_{60} by UV-irradiating of water suspensions, soles and powders. Therefore methods for solid state analysis, i.e. XRD, NMR and DSC can be used to characterize samples. Precursor samples were prepared using several methods: grinding in a ball mill, lyophylisational drying of frozen solution, precipitation from saturated solutions and joint condensation of C_{60} and liquid media vapor. Every type of dispersed precursor consist of small particles, less then 0.5 -7 in diameter and are actually free of oxygen, which photochemically react with C60 molecules. Fullerite, used for preparation of precursors, was carefully purified of solvent admixture. Polymerized samples appear to be insoluble in toluene and after heating revert to pristine C_{60}.

Preliminary experiments were performed to study how oxygen affect polymerization process.

Samples of polyfullerene C_{60} were studied by means of IR, Raman and UV - spectroscopy, X- rays diffraction, ^{13}C NMR, differential scanning calorimetry, HPLC, tunneling electron microscopy and mass-spectrometry. New spectral features consistent with the change in bonding due to polymerization are reported. Thermal behavior of polymerized samples was studied and enthalpies of depolimerization were determined.



1024.
ДК 541.18

SYNTHESIS OF NANOSTRUCTURED MATERIALS FROM AGGREGATES PRODUCED BY A PULSED ARC GAS AGGREGATION CLUSTER SOURCE

MILANI P., PISERI P., BARBORINI E.

INFM-Dipartimento di Fisica, Universita' di Milano, Via Celoria 16, 20133 Milano, Italy

BOTTANI C.E., FERRARI A., BASSI A.LI.

INFM-CESNEF, Politecnico di Milano, 20133 Milano, Italy

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Cluster beams are a versatile tool which is assuming an increasing importance for the synthesis of nanocrystalline materials. The use of clusters as elemental building blocks can open new routes towards the creation of an entire new class of architectures and

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nanostructures.

The ability of structuring materials on a nanometer-size scale depends critically from the control of the precursors and of their interaction to form more complex structures. The use of aerosol techniques is a viable way for the production of macroscopic quantities of precursor clusters.

Molecular beams techniques, coupled to sources based on efficient aggregation phenomena, can unfold the opportunity of controlling parameters such as size, composition and kinetic energy of the aggregates. The availability of well characterized cluster beams will help in the study of cluster coalescence processes and reorganization after the deposition which are still largely unknown.

Here we will present and discuss the synthesis of nanocrystalline thin films by the deposition of a supersonic cluster beams. In order to meet the requisites necessary for thin film deposition we have developed a Pulsed Arc Gas Aggregation Cluster Source (PAGACS) for the production of intense and stable ionized and neutral cluster supersonic beams. Laser photoionization and mass spectrometric techniques have been used to characterize the source, the cluster mass distribution and energy.

The PAGACS has many analogies with arc discharge apparatus for the production of fullerenes and nanotubes, with this source nanocrystalline carbon thin films have been produced have by ballistic consolidation of carbon cluster supersonic beams and characterized in their structural and electronic properties in order to correlate them with the precursors and post-deposition treatments.

Structural properties and the mesoscopic elastic response of the films were measured by Scanning Electron Microscopy, Raman and Brillouin light scattering. SEM and Raman spectroscopy show that the film are a low-density porous network of nanometer-size particles. The nature of the films is essentially graphite-like with a large number of distorted bonds. The values of bulk modulus and shear modulus were estimated from the shifts of both surface and bulk phonon peaks measured by Brillouin spectroscopy. On a mesoscopic scale, the shear modulus is in the range of that of crystalline graphite, whereas the bulk modulus and the Poisson's ratio are significantly different.

The presence of nanotubes and ordered polyhedral particles embedded in a disordered matrix has been detected by Transmission Electron Microscopy.



1218.

POSSIBILITY OF ORIENTATIONAL MELTING OF TWO-SHELL CARBON NANOPARTICLE

LOZOVIK YU. E., POPOV A. M.

Institute of Spectroscopy, Russian Academy of Science 142092, Troitsk, Moscow region, Russia

(First received 05 February 1998; accepted for presentation during IAS-4)

The discovery of fullerenes gives rise the interest to other carbon nanostructures included the nanoparticles with shell structure. It is known that a melting of single cluster essentially differs from phase transitions in macroscopic systems.

The melting of a cluster may manifest itself as an hierarchy of transformation in shells or breaking the order between them. E.g., in 2D microclusters with Coulomb, dipole and logarithmic interaction between particles the rotational melting (i.e. rotation of "solid" shells) preceedes to melting inside the shells [1]. However, the rotational melting had not been discovered in 3D clusters.

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Van der Waals interaction between atoms of neighbor shells in carbon nanoparticles is considerably weaker than valent interaction between atoms inside the shell. Therefore these nanoparticles seems to be possible candidates for rotational melting. To investigate the possibility of this phenomenon we consider the two-shell carbon nanoparticle with fullerene C_{60} as inner shell and fullerene C_{240} with icosahedral symmetry as outer shell (four different shapes of this fullerene are considered). The fullerene C_{60} is the smallest fullerene without adjacent pentagons in its structure, therefore the absence of chemical bonds between shells in this case is very probable. We describe the interaction between atoms of neighbor shells by Lennard-Jones potential. The energies of shell deformation is described in terms of deviations of bond lengths and angles between bonds from their equilibrium values.

The global and local minima of total potential energy of nanoparticle are found by optimization of three angles of relative shell orientation. The high I_h symmetry of shells leads to great number of equivalent global minima. The energies of shell deformation are also calculated. The barriers for relative rotation of shells in the nanoparticles under consideration are calculated for relative orientations corresponding to global minima of total potential energy. It is found that the obtained values of barriers for rotation are surprisingly small and shell deformation during intershell rotation does not considerably influence on the magnitudes of barriers. Moreover, these barriers are only several times greater than barriers dE_a, the differences between minimum and maximum in dependencies on angle of rotation for energy of interaction between one atom of the second shell and the whole first shell.

For example, for the nanoparticle with close to icosahedron shape of second shell C_{240} the barrier for rotation around fifth order axis is dE_r = 159 K. Simultaneously the maximal barrier among the barriers dE_a for individual atoms of the second shell are 22 K, i.e. dE_r \ll 240 \dE_a.

The detailed analysis shows that in the case of relative shell orientations with coincident symmetry axis of shells the second shell have several tens groups of atoms with different orientation relative the first shell. The maxima of dependencies E_a for individual atoms from different group correspond to different angles of rotation and so the dependence of total energy on angle of rotation is essentially smoothed. In the case of relative shell orientations with noncoincident symmetry axis barriers for relative rotation are very small due to incommensurability of atom positions in two shells.

The orientational melting may be considered in a sense as a two stage phenomenon. At low temperatures the relative reorientations of shells are frozen. Initially, the jump-like rotational diffusion begins with increasing of temperature. For greater temperature free rotation of shells take place.

The temperature T_1 of crossover from frozen state of nanoparticle to rotational diffusion of shells is estimated to be several Kelvin degrees. The temperatures T_2 of crossover from jump rotational diffusion to free rotation of shell is identified as the point where the two free energies of these states are equal. These temperatures are about tens Kelvin degrees. Both temperatures T_1 and T_2 are determined by the shape of second shell.

The molecular dynamics simulation of the process of nanoparticle orientational melting is performed.

The obtained very small temperatures T_1 and T_2 in the two-shell nanoparticle allow us to proposed that rotation melting may occur also in many-shell nanoparticles.

This work was supported by the grants of Russian Foundation of Basic Research, the programs "Fullerenes and atomic clusters", "Surface atomic structures" and "Physics of nanostructures".

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1060.
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TO THE HIGHER FULLEREN PROBLEM

VOLKOV I.A.

All-Russia Petroleum Scientific-Research Geological Exploration Institute (VNIGRI)
Liteiny, 39, St.-Petersburg, 191104, Russia Fax: 7-812-2755756 E-mail: ins@vnigri.spb.su

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The problems of the higher and odd-numbered carbon clusters are principal but unresolved [1] ones. Like Balmer empirical spectral formula, the simple integer-valued formula for numberes of atoms in relatively stable carbon clusters Cn have been obtained by author. It specifies the following finite set:

n= 60, 70, 84, 120, 165(330), 280, 819(1638).

The even numbers indicated in the bracets are doubled corresponding odd-numbers. As was to be expected, the series begins with two knownfullerenes,besides, three first members are exactly in line with augents of Fowler's rules (the necessary condition for clousedness of electron shells)

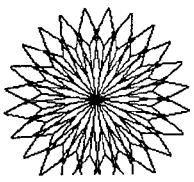
$$n1 = 60 + 6S, n2 = 70 + 30S, n3 = 84 + 36S (S = 0, 1, 2, ...).$$

The displayed formula correlates well with LD-TOF mass-spectrum [2]. If we draw the enveloping line along the most peaks, marked by authors themselves, clusters Cn for n=60, 70, 84, 118, 166 will be on it. A typical FT-ICR mass spectrum [1,3] has a noticeable maximum for odd- numbered clusters in vicinity of the point n=165 in addition to the extremum (n=330) of relatively intensity for even numbered clusters. That previously unnoticed fact has been recorded only owing to the prediction by the formula and equipment with high mass resolution used in American Institute of Physics. The series ends with giant clusters (for n=819, 1638). By similar vertification we have not been possible to detect their between fragmentary published experimental evidence. Nevertheless, cited above resultsgive the assurance that the proposed formula adecuately depicts something actual law. The following task of research is the revealing of the formula physical meaning by analogy with the energy interpretation of Balmer formula. Agreement of our formula for 3-dimentional carbon clasters with Hukkel's formula for 2- dimentional structures of aromatic hydrocarbons by their simultaneously correlation with average quantum-mechanical values in problems having centpal symmetry have been established [4].

The method of the new linear reccurrencerelations developed by the author for classical orthogonal polynomials and for others specials functions used in quantum theory is the mathematical basis of the investigation.

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List of participants of IAS-4 with presentations during 7 July 98

Andreev Nikolayi Alekseevich
Moscow State Aviation Institute
(Technical University)
Phone: (7)-095-1584930
fax (7)-095-1584930
email: alt@tk.mainet.msk.SU.
Moscow Russia

Arsenteva Irina Petrovna
Moscow Evening Metallurgical
Institute
fax (7)-095-3611446
email: andreeva@ipmt-hpm.ac.ru
Moscow Russia

Bazarov Vladimir Georgievich
(1939-05-02)
Moscow State Aviation Institute
(Technical University)
Phone: (7)-095-1584770
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia

Belov Nikolay Nikolaevich
(1947-05-04) Aerosol Technology Ltd.
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Chernozatonskiyi Leonid
Aleksandrovich *(1943-10-01)*
Institute of Chemical Physics of
RAS *Phone*: (7)-095-9397486
fax (7)-095-1370050
email: cherno@sky.chph.ras.ru
Moscow Russia

Choi Joo-Hong *(1955-03-22)*
Gyeongsang National University
Phone: (82)-591-7515387
fax (82)-591-531806
email: jhchoi@nongae.gsnu.ac.kr
Chinju
South Korea



Chung Jin Do *(1960-09-23)*
Gyeongsang National University
Phone: (82)-418-405463
fax (82)-418-405460
jdonchung@dogsuri.hoseo.ac.kr
Asan South Korea

Druzhinina Anna Ivanovna
Moscow State University
Phone: (7)-095-9395396
fax (7)-095-9328846
varushch@thermo.chem.msu.su
Moscow Russia

Fedorov Andreyi Vladimirovich
Moscow institute of fire safety
Phone: (7)-095-2822150
fax (7)-095-3624241
Moscow Russia

Gertsenshteyin Semen Yakovlevich
Moscow State University
Phone: (7)-095-9395136
fax (7)-095-9390165
Moscow Russia

Heusler Gero *(1969-07-09)*
Max-Born-Institut
Phone: (49)-30-63921218
fax (49)-30-63921229
email: heusler@mbi-berlin.de
Berlin Germany

Lavrov Vitaliyi Vladimirovich
Moscow State University
Phone: (7)-095-9395248
fax (7)-095-9391240
email: rftrst@cityline.ru
Moscow Russia

Lebedev Nikolayi Gennadievich
Volgogradskyi State University
Phone: (7)-8442-433556
ivanov@physic.vgu.tsaritsyn.su
Volgograd Russia

Lepeshinskiyi Igor Aleksandrovich
(1937-08-15)
Institute of Low Temperature
Phone: (7)-095-1584063
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia

Lorber Karl E. *(1945-02-03)*
Montanuniversitat Leoben
Phone: (43)-3842-4610350
fax (43)-3842-4610352
enttech@grz08u.unileoben.ac.at
Leoben Austria



Milazzo Mario *(1937-02-23)*
Instituto di Fisica Generale
Applicata
Phone: (39)-2-2665468
fax (39)-2-2665717
email: Mario.Milazzo@mi.infn.it
Milano Italy

Nekrasov Igor Vladimirovich
Institute of Mechanics of Moscow
State University
Phone: (7)-095-9395136
fax (7)-095-9395136
email: Nekrasov@inmech.msu.su
Moscow Russia

Pokropivnuyi Alekseyi
Vladimirovich
Moscow Physical & Technological
University
Dolgoprudnii MR
Russia
Popov Mihail Yurevich
Institute of Spectroscopy of RAN
Phone: (7)-095-3340855
fax (7)-095-3340886
email: popov@ntcstm.msk.ru
Troitsk Russia

Prin Elena Maratovna
Institute of Chemical Engineering
Khimtekhnologiya
Phone: (380)-6452-93829
fax (380)-6452-25367
email: prin@ixt.sed.lg.ua
Ceverodonetsk Ukraine

Puhliyi Vladimir Aleksandrovich
Moscow State Aviation Institute
(Technical University)
fax (7)-095-4823876
Moscow Russia

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List of participants of IAS-4 with presentations during 7 July 98 (continued)

Romahin Sergeyi Sergeevich
Institute of the Applied Mechanics and Electrodynamics of Moscow Aviation Institute
Phone: (7)-095-1584757
Moscow Russia

Sedoyi Valentin Stepanovich
(1946-08-17)
Institute of High Current Electronics
Phone: (7)-3822-258348
fax (7)-3822-259410
email: sedoi@hcei.tomsk.su
Tomsk Russia

Seo Taewon *(1958-10-13)*
Andong National University
Phone: (82)-571-505756
fax (82)-571-8411630
email: dongjin@anu.andong.ac.kr
Andong
South Korea



Shinohara Hisanori *(1953-10-11)*
Nagoya University
fax (81)-52-7892962
nori@chem2.chem.nagoya-u.ac.jp
Nagoya Japan

Siebenhofer MATTHAEUS *(1955-02-13)*
Montanuniversitat Leoben
Phone: (43)-3842-4610350
fax (43)-3842-265237
email: postm@vtu.co.at
Leoben Austria

Topolskiyi Nikolayi Grigorevich
(1945-04-17)
Moscow institute of fire safety
Phone: (7)-095-2866461
fax (7)-095-2837677
academy@mfire3.munic.msk.su
Moscow Russia

Tsipenko Anton Vladimirovich
Moscow State Aviation Institute (Technical University)
Phone: (7)-095-1584063
Moscow Russia

Varuschenko Raisa Mihayilovna
(1931-03-13)
Moscow State University
Phone: (7)-095-9395396
fax (7)-095-9328846
varushch@thermo.chem.msu.su
Moscow Russia

Vinogradov Georgiyi Alekseevich
(1945-06-10)
Institute of Biochemical physics of RAS
Phone: (7)-095-9380561
fax (7)-095-1374101
GAVIN@DEOM.CHPH.RAS.RU
Moscow Russia



Volkov Igor Andreevich
(1937-01-27)
Russian Institute of Geological Investigations
Phone: (7)-812-2780028\506
fax (7)-812-2755756
email: ins@vnigri.spb.su
St.-Petersburg Russia

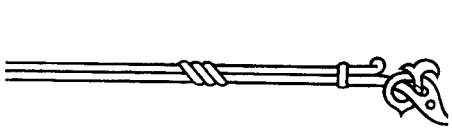
Zaporotskova Irina Vladimirovna
Volgogradskyi State University
Phone: (7)-8442-436380
email:
ivanov@physic.vgu.tsaritsyn.su
Volgograd Russia

Zhigach Alekseyi Nikolaevich
(1963-07-29)
Institute of Energetical Problems of RAS
Phone: (7)-095-9397927
fax (7)-095-1378258
email: ajigatch@chph.ras.ru
Moscow
Russia



Zuev Yuriyi Vladimirovich
Moscow State Aviation Institute (Technical University)
Phone: (7)-095-1584063
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia





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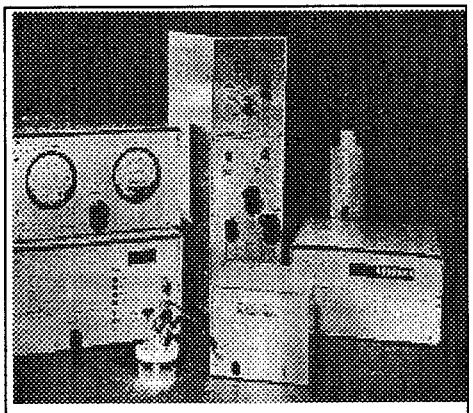
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MULTIPHASE FLOWS

Prof. LEPESHINSKY I.A.

BURNING & COMBUSTION OF AEROSOLS

Prof. PUKHLII V.A.

FILTRATION

Prof. CHUNG J.D.

Prof. LORBER K.E.

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address Belov N 21-117
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tel/fax (095)1474361
BELOV@TEHNO.MMTEL.MSK.SU

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1465. УДК 541.18

EXPERIMENTAL VAPOR-MASUT BURNER WITH CONTROLLABLE FREQUENCY OF ACOUSTIC OSCILLATIONS

ROMAKHIN S.S., PANCHENKO N.N., SHMIRKOV O.V., RUDAKOV V.P., SERGEEVA L.L., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation Institute
125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPMÉ MAI tel.: (095) 158-0020; riame@mai2.rcnet.ru.
(First received 01 April 1998; accepted for presentation during IAS-4)

Efficiency of transformation of the fuel components chemical energy in the up-to-date thermal power plants is substantially determined by intensity of burning and spraying processes occurring in this case. Application of methods of the mixing devices nonstationary operation is one of the simplest engineering solution of the problem [1]. These methods are based on the fact that the media flow mechanisms in the mixing elements and their subsequent dispersion and burning are essentially nonstationary resulting in appearance of new regulated space and time structures [2]. Therewith, quest to damp appearance of the regulated structures at some modes (for example, to prevent appearance of the resonant processes leading to the power plants structures damage) causes their appearance at other modes [3].

In the work [4] a principle is postulated in accordance with which a system always tends to the state with maximal generation of acoustical energy. Such the generalized analysis enables to gain a valuable, with the practical point of view, conclusion: if in one way or another any auto-oscillations are arisen in a system at the modes that are not resonant for the system as a whole, then it enables, firstly, to intensify the processes (for example, the processes of the fuel components mixing and burning) and, secondly, to transfer the main part of the auto-oscillations energy on the mode that is knowingly damped by the system as a whole. This conclusion can be made more clear with the following example. It is known that any furnace system has certain linear sizes determining its volume. During burning of the fuel it can result in arising of the pressure regular oscillations at one or several its fundamental acoustical frequencies. To avoid the parasitic effect, the liquid flow rate oscillations can be generated (for example, with the help of the mixing element) frequency of which differentiates from any fundamental resonant frequency of the furnace system and, at the same time, its value enables to transform the oscillations spectrum by means of concentration of the generated acoustical energy on the given frequency.

To study the intensification processes for dispersion and burning, the vapor-masut acoustic burner has been designed and tested with centrifugal gas and liquid stages and with the controllable generator of the acoustic oscillations in the form of quarter-wave resonator with one closed end plane.

The basic characteristics are the following: masut flow rate - 0.25-0.75 kg/s; degree of regulation of masut flow rate - 3 times; supply masut pressure - $(4\text{-}21)\cdot 10^5$ Pa; vapor flow rate - 0.015 kg/s; supply vapor pressure - $10\cdot 10^5$ Pa; spraying torch conicity angle - 100°; acoustic oscillations frequency - 600-800 Hz.

Analysis of the obtained results has shown high efficiency of the device operation with the turning out from the resonant frequencies in various furnace spaces and high-quality mixing of the viscous liquids with middle and high outflow velocities.

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DISPERSION OF EMULSIONS IN DEVICES FOR HOMOGENIZATION OF DAIRY PRODUCE

ROMAKHIN S.S., BASKAREV B.N., SHMIRKOV O.V., RUDAKOV V.P., MESCHERYAKOV A.A., VOROB'YOV S.V., TSIMIN N.I, CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation Institute
125810, Moscow, GSP-47, Volokolamskoye sh 4, NIIPMÉ MAI tel.: 158-0020; fax.:158-0367; chegis@glasnet.ru.
AS «Mytischinskiy dairy-producing factory», town of Elektrostal' (Moscow region)
AS «Ejsk-milk», town of Ejsk (Krasnodarskiy land)

(First received 20 April 1998; accepted for presentation during IAS-4)

To enhance considerably storage life of the dairy produce as the nonstratified emulsions, the homogenization process is used that is the process of enhancement of dispersion content uniformity by means of fragmentation of the fractions involved and their uniform distribution over the whole volume. One of the homogenization steps is the product dispersion in various stages of the homogenizing injector.

Presently, the homogenizers K5-OGA-1,2; A1-OGM-5 etc. are most generally employed in Russia. The product homogenization process with such homogenizers is realized at the pressure differentials of 150-180 atm on the homogenizing injector valves.

Substantial decrease of the required pressure differentials on the injector can be realized at the expense of turbulizing intensification with the help of the valves having the turbulizing turnings. At modernization of the serial homogenizer A1-OGM-5, the homogenizing injector with labyrinth gap and discharging chamber [1] and the injector with labyrinth gap, discharging chamber and damping cavity [2] have been developed and put into operation.

Flowing of the high-speed flow of the product through the injectors labyrinth gaps enhances the suspensions homogenization efficiency and enables to lower the required pressure differential on retention of the dispersion quality. The availability of discharging chamber in the construction makes the injector resistant to the transversal dynamic loading arising at nonperiodical disturbances of pressure in a some point of the gap. The availability of damping cavities provides the injector location steadiness at influence of the dynamic tangential loadings. These measures allow to stabilize the gap size around the valve axis.

The developed injectors have been put into service on the dairy-producing factories of the towns: Ejsk (Krasnodarskiy land), Podol'sk, Lyubertsy, Mytischi (all of Moscow region).

Modernization of the serial injector differs its simplicity, reliability, minimal expenditures; it does not demand any changes in design of the homogenizer and the modernization is substitution of the saddle and valve.

Exploitation of the injectors has shown that use of such methods of the products turbulizing provides lowering of the necessary pressure differential (it means reduce of energy consumption) by 25-30% in comparison with the serial injector at retention of the homogenization degree and quality of the products reprocessed (of the emulsion dispersity). Therewith the valve exploitation period increases by 1.5-2 times and conditions improves considerably for the homogenizers exploitation in respect to influence on servicing staff of such harmful factors as noise and vibrations. Besides, the service period for the pump and other homogenizer units increases and their wear decreases.

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УДК 541.18

EVALUATION OF LIQUID SPRAYING DISPERSITY BY THE PNEUMATIC SPRAYERS WITH MIXING OF THE COMPONENTS IN THE POROUS ELEMENT.

ROMAKHIN S.S., BAZAROV V.G., SHMIRKOV O.V., RUDAKOV V.P., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation Institute (Technical University). 125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPME MAI tel.: (095) 158-0020; fax.: (095) 158-0367; e-mail: riame@mai2.rcnet.ru.

(First received 12 March 1998; accepted for presentation during IAS-4)

Among variety of the pneumatic sprayers different types the sprayers stand out, the flow-through channels of which have the porous penetrable materials [1,2] and among the latter ones the sprayers stand out with mixing of gas or liquid in a porous mixing element [3]. Due to the high efficiency of heat exchange, monodispersity of the generated ultrafinely-divided flows, uniform distribution of numerous channels over the surface forming the flow etc., it is possible to use such sprayers in various fields of engineering, for instance, in the gas generators with thermal decomposition of unitary fuels in rocket engines building.

Presently, for evaluation of spraying quality the numerous empirical formulas are largely used that describe the drop mean diameter as a function of the mixture components physical parameters (density, viscosity, surface tension), sprayer operation parameters (velocity, components relationship), and geometrical characteristics of its flow-through parts. However, calculation of the liquid drop diameter for the porous sprayers from the known equations, gained for the case of sprayers with similar construction [4], gives the results overstated by a factor of 30-50.

From the different classes of the pneumatic sprayers the internal mixing sprayers with flooded nozzle and with crossed motion of the flows (Shukhov's type of sprayers [4]) are the most similar to each other by their types of the working process organization.

Investigations carried out by Nikiyama and Tanasava [5] enabled to get the empirical dependence that takes into account the special features of gas-dynamic picture of the liquid and gas flow; these features are in the mechanism of the initial preliminary fragmentation of the liquid inside of the sprayer which mechanism differs the Shukhov's sprayer from the sprayers of other types.

Experimental study of various liquids (water, ethyl spirit, glycerin) enabled to calculate a correction factor C allowing to use the equation of Nikiyama-Tanasava for estimation of dispersity of the finely-dividing (permeability is about 0.16) pneumatic sprayers with the error of 8-10%. Mean drop diameter d is calculated from the formula;

$$d = C \cdot d_N = \frac{4 d_N (\dot{m}_l / \dot{m}_g)}{(\dot{m}_l / \nu_l \rho_l d_e)^4},$$

where d_N - mean diameter calculated from the Nikiyama-Tanasava's formula;

$\dot{m}_l, \dot{m}_g$ - flow rates of the liquid and gas

ρ_l - density of the liquid;

ν_l - kinematic viscosity coefficient;

d_e - diameter of the equivalent capillary of the porous material.

Range of the regime parameters variation was the following:

- pressure differentials for liquid and gas - till 0.8 MPa;
- liquid flow rate - till 150 g/s:
- gas flow rate - till 5 g/s.

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1483.
УДК 541.18

GENERATORS OF WATER-FUEL EMULSIONS IN POWER PLANTS

ROMAKHIN S.S., BAZAROV V.G., SHMIRKOV O.V., RUDAKOV V.P., BASKAREV B.N., VAVILOV A.P., MATVEYEV A.G., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation
125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPME MAI: (095) 158-0367; riame@mai2.rcnet.ru.
OAS «Machinbuilding plant», town of Elektrostal' (Moscow region).)

(First received 20 April 1998; accepted for presentation during IAS-4

Preparation and burning up the water- masut emulsions (WME) in the hot-water heaters of the currently available gas-masut thermal power plants (TPP) is one of the most efficient nature protection measure. Therewith, not only volume of the harmful waste to atmosphere decreases, but burning up of the waste water contaminated with masut is provided.

Technologically, the problem of the WME preparation is solved in the simplest way by means of its preparation immediately before the burning up. For this purpose a generator of water-fuel emulsions (emulsifier) is mounted in front of the heat-water heater which demands excessive power of the system for fuel supply since part of the pressure differential is consumed in the emulsifier. If the described way of the problem solution is for some reasons impossible then the vortexing chamber of the centrifugal sprayer can be used as the emulsifier.

The following types of the emulsifiers have been developed:

- emulsifier with coaxial flow of water and fuel and their mixing with the help of porous element (net-shaped glass);
- - the same with rotation of one of the mixture components;
- emulsifier in the form of the two-component gas-liquid centrifugal sprayer with a built-in emulsifying unit;
- emulsifier with a belt of the turbulizers of the gas-liquid mixture;
- the same with a tangential supply of water in front of the belt of the turbulizers;
- emulsifier with a two-step system of the components mixing one of which is the ejecting step.

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In the process of gas-liquid mixture turbulization, dispersity of the water drops depends on the regime parameters, scale of the vortexes, and closeness of the turbulizers disposal in the belt. At the centrifugal emulsification, a liquid insoluble in the ground one, is supplied to the vortexing chamber periphery of the centrifugal sprayer (or to periphery of the liquid centrifugal stage of the emulsifier); this liquid gathers in the drops of some size depending on the surface tension for both liquids, velocity gradient, time of the liquid drop being in the sprayer, relationship between densities of the both liquids, and on many other factors.
Here is list of the main results achieved:

- dispersity of the emulsion	about 20 μm
- start of the emulsion stratification	in 40 min
- pressure losses on the emulsifier	till 2 atm
- pressure losses on the sprayer	till 0.8 atm
- maximal fuel flow rate	2 l/s
- decrease of the nitric oxide concentration	25-30%
- decrease of the benz-a-piren concentration	50-70%



1065.
УДК 541.18

ON SPRAYING OF ELECTRIFIED CAPILLARY JETS

GERTSENSHTEIN S.YA., LYAKHOV A.G., NEKRASOV I.V.

Institute of Mechanics, MSU 119899 Moscow, Michurindki prospekt, 1

(Received 16 December 1997)

Main attention in this work will be given to experimental study of features spraying of a charged aerosol near the unexposed surface. The charged aerosol produced on initiation of corona discharge and subsequent deposition of ions generated in the corona discharge on independently formed drops of aerosol.

The experimental setup consisted of a corona electrode, a high-voltage (10 - 30 kV) power supply, an aerosol generator, a grounded electrode, a grid, and an object for spraying (a rectangular plate and so on). The aerosol generator was constructed according to the model of an atomizer and produced an aerosol jet whose speed considerably exceeded that of the ion wind near the corona point.

The studied object comprised two Getinaks plates covered on one side by copper foil with dimensions 300 mm * 50 mm. The plates were installed so that the foil was on the outer (relative to each other) surface of the plates. The plate-to-plate clearance (2 mm) prevented electrical contact between the plates when they were wetted. Charges collected by the plates leaked out through the resistors, and the voltage across them was measured by an electronic voltmeter. The water collected by the plates drained down and was directed to the measuring vessels.

In particular, the experiments were carried out when the water consumption q=1.6 cm^3/s, the spraying, period was 30 s, the air consumption was equal to 1.4 l/s, and the voltage was varied in the range 0 - 26 kV.

We also carried out quantitative measurements of the current feeding the needle, the currents through both plates, and the water flows falling on these plates.

The currents run off the unexposed I1 and front I2 surfaces is relation to the water consumption q and needle voltage E are given.

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Exchange of Getinaks plates for a fine-mesh wire netting, which intersected the entire cross section of the jet, led to a similar decrease of the charge carrying away by the jet when the water consumption was increased from 0.8 to 1.6 cm^3/s. The amount of water draining off he plates was determined using the measuring vessels. The ratio of water amount fallen on the unexposed surface to that on the front surface Q_1/Q_2 is shown there as a function of the needle voltage.

One of the significant results of this work is that the spraying efficiency is independent of water consumption (within the limits of experimental accuracy). As mentioned above, with an increase of q the needle's feeding current does not change, and the current flowing off the plate actually slightly decreases.

A relationship was also studied between the ratio Q_1/Q_2 and angle of the jet incidence on the plate surface. It is shown that at angle < 45 grad. the ratio Q_1/Q_2 does not change significantly, and at angle = 60 grad. this ratio noticeably increases.

One of the most interesting investigations of this work concerns a study of the distribution of sprayed substance over the unexposed surface of a plate.

It is easy to see that the interests of spraying falls to the center approximately exponentially.

Also the results of new effective way of charged aerosol generating are presented. Aerosol is generated on oscillating string with small drops of liquid exposed in high voltage field.



1459

УДК 541.18

OPTIMIZATION OF THE FLOW-THROUGH CHANNELS GEOMETRY OF MULTIPURPOSE EMULSION GENERATORS ON THE BASIS OF NUMERICAL MODELING

RUDAKOV V.P., ROMAKHIN S.S., BASKAREV B.N., SHMURKOV O.V., SERGEEVA L.L., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation 125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPME MAI tel.: (095) 158-0020; riame@mai2.rcnet.ru.

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At creation of the dispersion media multipurpose generators that are used for organization of the multicomponent finely-divided flows at the low counterpressure (outflow in vacuum), the combined methods of high-quality mixing are employed on the basis of saturation with gas, emulsification and dispersion of various liquids and suspensions. At development of the flow-through channels design of the generators, empirical methods are still used for their working characteristics improvement. Optimization of the flow-through channels geometry for the emulsion generators on the basis of numerical analysis was the goal of present work.

In spite of large variety of the possible constructions of the generators there are only a limited number of the mixing schemes:

- mixing of the gas and liquid components of dispersed mixture by way of saturation of the axial circular liquid flow with the gas bubbles penetrating through the porous element;
- emulsification of the axial circular liquid flow with the heavier liquid drops penetrating from the flow periphery through the porous insert;
- mixing of the circular vortexed flow with the lighter liquid drops which are supplied from the periphery through the porous insert.

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Operation of the aerosol generators which realizes these schemes is based on the physical processes the most important of which are the following:
- the gas bubbles boiling up in the moving liquid flow;
- the viscous liquid droplets motion in a liquid flow with other values of viscosity & density;
- the liquid droplets drift in the vortical flow of another liquid.

Analysis carried out in the present work enabled to substantiate the physico-mathematical model describing in terms of dimensionless parameters the processes occurring in the emulsion channels of the generators with the chosen mixing schemes. The developed model was used at the optimization by way of numerical modeling of the flow-through channels geometry providing the high-quality mixing. As the result, stability domains for existence of the mixing components flow and conditions of realization of maximal possible volumetric share for bubbles phase and droplets mass have been found in circumstances where the gained emulsion is not stratified and with and without of the flow vortexing. Parameters of the flow and the generator channel geometry corresponding to these conditions were realized in construction of different types combined generators. Experimental study of operation of the generators with optimized geometry has shown possibility of the high-efficient mixing (without stratification) of the liquids normally nonmiscible with each other at the mixture nonuniformity size of 10-80 μm along the channel length of less than 0.2 m and at the pressure differential of $1 \cdot 10^5$ - $8 \cdot 10^5$ Pa on the porous insert. The developed generators designs provided the aerosol formations creation at the pressure differential on the spray unit of less than $1 \cdot 10^5$ Pa with spraying dispersion characteristics improved by 15% in comparison with dispersion of the pure (nonemulsified) liquids.



1210.

GENERATION OF AEROSOLS BY THE ELECTRICAL EXPLOSION OF WIRES AT REDUCED AIR PRESSURES

SEDOI V.S.*, VALEVICH V.V.*, KATZ J.D.**

**High Current Electronics Institute, Tomsk, Russia*

***Los Alamos National Laboratory, Los Alamos, NM, USA*

(First received 10 January 1998; in final form 5/2/98, accepted for presentation during IAS-4)

The exploding wire method of particle production, allows us to model the high speed formation of aerosols because of the fast heating and evaporation rates inherent to this technique. The method is also of interest from the viewpoint of controlling the production of aerosols of a particular material with a specific particle size distribution at a specific efficiency.

The electrical explosion of iron, aluminum, titanium, and copper wire has been investigated in air at pressures of from 0.01 to 1 atm. In these experiments the energy density introduced into the material, w, normalized to the sublimation energy of the material, s, and the heating rate were controlled. Particle and agglomerate sizes were determined using transmission electron

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microscopy and laser scattering methods. The specific surface area of the powder was measured by low-temperature adsorption. The phase composition was determined by X-ray diffraction.

The specific energy introduced into a material, w/s, the pressure (density) of the surrounding medium, and the exothermic effect due to oxidation reactions are controlling parameters in particle
formation.

Increasing the energy density increases the internal energy of the material, the expansion velocity and the number of condensation centers, while the final particle size decreases. With an exothermic oxidation reaction, the optimum energy density can be less than the sublimation energy of the material. As a result, metal oxides are formed. As the density of the surrounding medium is increased, the particle size decreases because of an increase in the frequency of collisions and more rapid cooling of the particles.

Electrical explosions of wires, at reduced air pressures, allows for the production of ultra-fine powders of oxides of various metals with particle sizes of less than 50 nm. The method is environmentally safe and does not require excess energy expenditures. The electrical explosion of wire at reduced pressure allows for new possibilities in the production ultra-fine powders.



1476. УДК 541.18

LOW-TEMPERATURE GAS DYNAMIC METHOD OF DIFFERENT COATINGS DEPOSITION ONTO THE SURFACES

NIKITIN P.V., ANDREEV N. A., PROROKOV S.M., SMOLIN A. G.

Moscow Aviation Institute, 4, Volokolamskoe Shosse, 125871, Moscow, Russia, phone 7-095-158-4930, fax 7-095-158-2977 e-mail alt@tk. mainet. msk. SU.

(First received 06 April 1998; accepted for presentation during IAS-4)

This work will describe the analysis of Low-Temperature Gasdynamics Method (LTGDM) developed in Moscow Aviation Institute (MAI), method physical content, the process, accompanying its implementation and its potential capabilities for science and manufacturing.

Utilization of the traditional methods for production of structural materials is always related to large energy expenditures. First of all it is explained by the low efficiency of installations implementing these methods. Due to that during last decade the so-called non traditional methods were under development. Among them are flame and gaseous flame metallurgy, biometallurgy, chemiometallurgy etc. These methods have essential increased efficiency of energy utilization for production of a material mass unit. For example, utilization the electrical arc and high frequency plasma generators for heating in metallurgy allowed to increase efficiency up to 60%. On the basis of these installations application the wide range of different technological operations were developed and introduced to the industry. They allows to sharply increase quality of products together with decreasing of energy expenditures and production duration.

Among these technologies the special role is played by the gas dynamic methods. For example, the gas dynamic plasma methods are widely developed. Namely, for the first time in the industrial metallurgical practice the plasma technology allowed to solve the problem of compatibility barrier for different metals and their derivatives. Mobility and simplicity of this technologics in combination with high heating level of initial products (several thousand degrees)

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gave a chance to create materials with the principally new properties (inter metallides, metallic ceramics etc.). But having mobility and simplicity the gas dynamic plasma method has a number of disadvantages related first of all to utilization of high temperature (plasma) flow.
Later, the method of detonation deposition of coating was developed. In realization this method is simpler and less expensive the plasma one. It is based on utilization of detonation process at the instant burning (blast) of the flammable gases such as acetylene, propane etc. Method of detonation coating deposition refers to the class of high temperature gas dynamic methods. As the plasma one, the detonation method utilizes the gaseous products of blast as the gas carrier with addition of the working medium : air, water vapor, nitrogen etc. The obtained mixture together with the powder portion are heated during blast and are transported at high velocity to a position to produce coating.

Therefore in this method the particles accumulate two types of energy: heating up to the plastification temperature or even to the temperature of melting, and kinetic energy in the course of acceleration by the gas-carrier. The both type of energy play decisive role in shaping of coating.

Together with many advantages the detonation methods has the serious drawback. Due to high temperature (several thousand degrees) the gas-carrier has strong chemical agressivity. This worsens the coating quality and requires special conditions for its liquidation.

The method of low-temperature gas dynamic coating deposition, developed at MAI (Russian patent N2082823) is the development of the cold gas dynamic method of Novosybirsk's Institute of Theoretical and Application Mechanics (USSR Pat. N 161878) and is logical advancement of plasma and detonation methods.

There is developed a new gas dynamic method (LTGDM) for synthesizing of multicomponent materials with the necessary predicted properties. The method is based on the use of supersonic heterogeneous (two-phase) flows .The main idea of this method is that new materials are synthesized as a result of high-speed (M > 1) two-phase flows impact with a barrier (a substrate) . A composition of the material is "taken" from a necessary (in order to get the necessary properties) quantity of chemical elements or chemical elements compounds (metals, oxides, carbides, nitrides and others) as powders with a dispersity from 10 up to 50μm. A necessary spectrum of heterogeneous powders constituted in corresponding mass fractions is premixed in the special gas dynamical nozzle

particles speed would correspond to a computed one but their temperature and static carrier gas temperature wouldn't exceed 20-50 % of the particle material melting temperature. So, in order to get a carrier gas speed exceeding speed of sound in two times, initial temperature doesn't exceed 300°C at pressure 0.5-1,0 MPa. As a result, solid particles acceleration takes place in cold gas flow what excludes particles oxidation and there fore, allows to use air as a carrier gas.

NTGDM will allow to realize super fast technologies without considerable energy costs. For example, it takes several tenths fractions of a second for obtaining of intermetallic material layer Ni Al of a thickness 1 mm by means of CGDM, while using a standard chemical-thermal technology a transition zone of a thickness 60 microns is formed in ovens during 9 hours at temperature ≈ 700°C.

In the laboratory there is developed an effective technology for a production of metal-ceramic materials for the account of additional energy supply during a process of a material synthesis caused by a presence of exothermal chemical reactions in a process of high-speed particles interaction with a substrate.

The use of such method allows to form carbides coatings, borides ones, oxides ones, silicides ones and others, refractory compounds on a substrate.

The obtained types of metal-ceramic materials can be widely used in new technologies owing to high thermal or mechanical properties.

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There is simultated a process of the new materials coating and synthesis by the numerical methods, the two-phase flows structure and the properties of these materials are studied using the modern methods of a diagnostics, such as : laser velocimetry and particle measurements diagnostics, X-ray spectrum microanalysis, contact auto radiogram, high-resolution auto radiogram and others.



1209.

УДК 541.18

PRODUCTION OF SUBMICRON AEROSOLS BY THE EXPLODING WIRE METHOD

V.S. SEDOI, V.V. VALEVICH, AND L.I. CHEMESOVA

High Current Electronics Institute of RAS, 4 Akademichesky Ave., Tomsk 634055, Russia.

(First received 15 February 1998; accepted for presentation during IAS-4)

The major characteristic in production of aerosols is the thermal energy introduced Into the material. Depending on the energy density, the state of the explosion products can vary from liquid to plasma, and the sizes and properties of' the particles formed depend on their states.

The distribution of the energy density over the sample Is also important. The uniformity of heating is provided in the fast electrical explosion mode. The fast explosion is characterized by the following conditions: the energy introduced into the material exceeds its heat of vaporization, and the heating time is shorter than both the time of the action of the capillary forces and the time required for development of magnetobydrodynamic sausage-type Instabilities. Comparing the characteristic time for a given process with the heating time, one can write the corresponding similarity criteria. From these criteria the conditions for uniform heating have been obtained.

The uniform heating conditions impose restrictions on the heating rate. The heating rate is a significant factor in the production of submicron metal aerosols.

Under the uniform heating conditions, the production and properties of powders based on copper, aluminum, titanium, iron, tungsten, indium, platinum and cobalt were investigated. The specific surface area of powders was measured by the low- temperature adsorption method. The shape and size distributions of particles were determined with electron microscopes. The phase composition was determined using X-ray diffraction and electron diffraction methods. Analytical chemistry methods were also used to determine the chemical composition of samples.

With rather low energy consumptibns, under the conditions of uniform Joule heating, ultra-fine powders having narrow size distributions and a count median diameter of 4-50 nm have been produced.



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1474.
УДК 541.18

THE BASIS OF MECHANISM FOR SYNTHESIS THE PROTECTIVE COATS DEPOSITED WITH LOW-TEMPERATURE SUPERSONIC SUPERSONIC HETEROGENEOUS FLOW

NIKITIN P.V.

Moscow Aviation Institute 4, Volokolamskoye shosse, 125871, Moscow, Russia Phone: (095) 158-49-30
Fax: (095) 158-29-77, 158-42-77 E-mail: alt@tk.mainet.msk.su

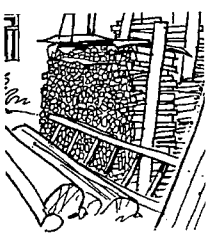
(First received 06 April 1998; accepted for presentation during IAS-4)

In the report are described the behavior basis of formed surface coats produced by means of the Low-Temperature Gas Dynamic Method (LTGDM) developed in Moscow Aviation Institute (MAI). It is shown that particle kinetic energy level plays main role in process of substrate coating formation. The required value of particle kinetic energy is depended on the coating type and itsprognozing properties.

Particles kinetic energy detrmines the level of plastic deformation of the particle and the substrate. During the collision between the high-velocity particle and the substrate there is generated in the volume of interaction zone the train of shock waves which causes a number of the physical-chemical transformations, for example, an extremal rize of pressure and temperature level in the collision zone, quick-flowed processes of heat-, mass-exchange,
deformation hardening processes, etc. Complex action of the factors furthers more intensive dislocation density growth, that creates the necessary conditions to form chemical and mechanical bonds and consequently causes high adhesion and cohesion coat characteristics.

With help of Arrenius equation rising as the mathematical model of the topo-chemical reactions kinetics there was done as analysis of possible processes of coat formation as evaluation attempt of a main values of pressure and temperature levels in contact area of particle and substrate. It was showed that under conditions of very high collision pressure level, realizable in the contact zone one can produce satisfactory performance of cohesion and adhesion coat strngth (up to 65% of the monolitic material) even under room temperature of substrate conditions. The performance will be significantly rise if the substrate has a small preliminary heating.

In paricular, there is revealed by means of metalography and X-ray diffraction methods the significant (up to twice and more) rise of micro-hardness if coat in comparison with the initial material micro-hardness. The micro-hardness rising is stayed stabil even after prolongated annealing coat under temperature of recrystallization of the used materials. There is confirmed the coating and transitional layer influence on the substrate material specmen static strength, for instance, by means of the experiment it is discovered that the strength limit of copper specimens with the NbC+NiAl coats of thicness of 60 microns at the temperature of
20 K will be rised up to 20%., the reology limit is rised up to 2,58 times, the elastic module is rised up to 57%. These characteristics are rised at the temperature of 300 K up to 52%, up to 3,69 times, and up to 57% accordingly.



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1541. УДК 541.18

THE PLASMA RECOMBINATION ON THE DUST PARTICLES IN THE NON-SELF-SUSTAINED GAS DISCHARGE.

V.V. IVANOV, A.F. PAL', T.V. RAKHIMOVA, A.O. SEROV AND N.V. SUETIN.

Moscow State University, Nuclear Physics Institute, 119899 Moscow, Russia,

Troitsk Institute for Innovation and Fusion Research, 142092, Troitsk, Moscow reg., Russia. e-mail: iiv@mics.msu.su, afpal@mics.msu.su

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At the present time the experimental and theoretical aspects of the dusty plasma phenomenon in plasma are being studied intensively [1–3]. In particular the nano- and microparticles initiation and growth in the hydrocarbon plasma have been observed in a number of experiments [4]. However these particles influence on the plasma kinetics has not been examined. We proposed to examine at first the influence of the carbon particles with known phase structure, size and shape on the discharge plasma characteristics. The experiments with the non-self-sustained gas discharge controlled by an electron beam with current density 60 $\mu A/cm^2$ and energy 120 keV in the presence of measured glass carbon microparticles were carried out. The plasma in this type of discharge is sustained by the external ionisation source that excludes the influence of dust particles on the ionisation kinetics and permits to investigate charged particles losses on the microparticle surface directly. The experiments were carried out with the helium at the atmospheric pressure. The powder consisting of glassy carbon balls of 20 - 30 μ m across was used. The dust particle concentration was defined by measuring the laser radiation absorption in the dust cloud.

The observed discharge characteristic may be explained by suggesting the recombination coefficient β equal to $2.5 \cdot 10^{-8}$ cm^3/s and cathode fall equal to 450 V. Addition of the microparticles into the plasma leads to the discharge characteristic changing. The experimental and calculated dependencies of the discharge current density on the microparticles concentration N_d at the different external electric fields is given in Fig.1 (diffusion-drift spherical transport model for electrons and ions with the Poisson equation for electric field was used). The increase of microparticle concentration at the constant external field leads to the increase of plasma volume recombination rate and to the decrease of plasma and current density. The plasma density dependence on the external electric field at small dusty concentrations N_d is connected exclusively with that of corresponding electron drift velocity, but significant deviations from this dependence are observed at large N_d concentrations. This fact is displayed as the weakening of the current density dependence on the N_d as the applied voltage U_{ext} decreases. The calculated dependencies differ significantly from the experimental one at the large N_d only.

To describe the charged particles losses on the microparticle surface the integral coefficient of plasma recombination rate β_d on the microparticle surface may be introduced as $S = \beta_d n_e N_d + \beta n_e^2$, where S is the electron beam ionisation rate, n_e is the electron concentration. The calculated and experimental recombination coefficients dependencies of the applied voltage are closely similar at the middle N_d values but there is significant difference at the N_d greater than 10^5 cm^{-3}



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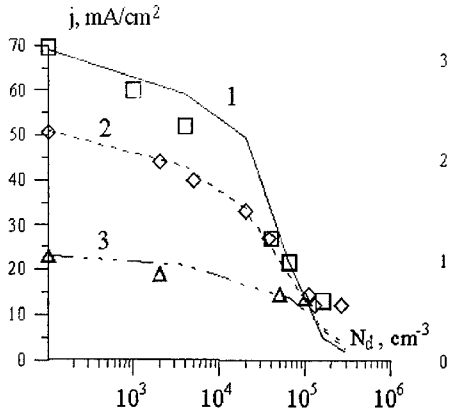


Fig. 1.

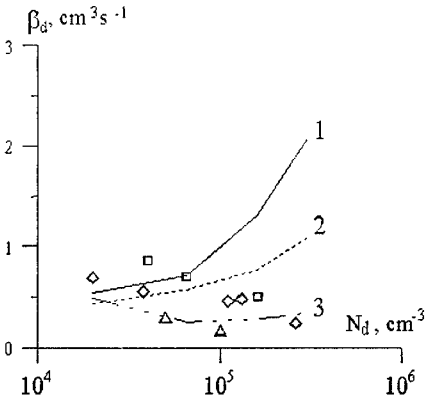


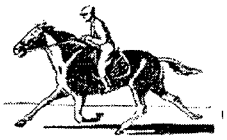
Fig.2.

Fig.1. The calculated (lines) and experimental (symbols) dependencies of the discharge current density on the microparticle concentration N_d at various applied voltage values: 1 is for 940 V, 2 is for 720 V and 3 is for 480 V.

Fig.2. The corresponding to Fig. 1 dependencies for coefficient of plasma recombination on the microparticle surface

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1025.
УДК 541.18

ON SOME TURBULENCE MODEL OF FREE TWO-PHASE JETS

TSIPENKO A.V.

125871 Moscow, Volokolamskoe shosse, 4, MAI, NII NT MAI.

(First received 5 November 1997)

For the theoretical determination of the parameter fields in two-phase jets, there exist a great number of approaches based on the different notion about the discrete fraction, the different approach to taking into account the turbulence. Besides, the engineering practice constantly requires - when modeling such factors as flow nonisotermicity, particle polydispersity, collision of one particle with another, phase transitions, etc. But these factors shade the peculiarities connected with different

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approaches used at constructing models, though the understanding of internal peculiarities of models is necessary at the selection of a concrete model for solving a concrete problem.

In this work an attempt to show the peculiarities of five different approaches to modeling the two-phase turbulent axisymmetric jet is made based on the detailed experiments /5,6/. The model 1 is the Prandtl-Abramovich model of first order. The model 2 is the model of Gavin at al. /3/, the model 3 is the model of Elghobashi at al. /4/. The model 4 is the model of Zaichik at al. /1/, the model 5 is the model of Mostafa at al. /5/ (this is so-called stochastic model). A detailed modelling of experiment was carried out according to the model of authors and also - according to the modified versions of models.

Based on the calculation performed, the following conclusions can be drawn: the best results can be expected from the stochastic model taking into account the interaction of particles but this model is not suitable for the realization on PC at this stage; for obtaining the minimax assessment, the model 1 is the most suitable; for carring out a more detailed calculation, the modification of model 3 is advisable as a most simple one.

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1030.
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SOME RESULTS OF THE INVESTIGATION OF TWO-PHASE JETS

KOSTIUK V.V., LEPESHINSKY I.A., IVANOV O.K., ZUEV YU.V., RESHETNIKOV V.A., VORONETTSKY A.V., TSIPENKO A.V.

125871 Moscow, Volokolamskoe shosse, 4, MAI, NII NT MAI.

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The results are presented concerning the theoretical and experimental work of a joint group of research workers engaged in the two-phase flow investigation performed at the Chair of Air-Breathing Engine Theory (201), MAI, and the Research Institute for Low Temperatures, MAI.

The detailed comparison of the results, obtained according to the Prandtl-Abramovich first order model and its modified version, with the results obtained according to a number of the sufficiently widespread "K-E' models and the stochastic model (SSF), was performed. The results

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of modelling were compared with the experimental results. For an axisymmetrical jet, the Prandtl-Abramovich model is - after corresponding modification - fully acceptable and the results obtained using this model don't differ greatly from the results obtained using "K-E" and SSF models. This permitted to carry out the investigation of vaporization and concentration processes taking into account the drop coagulation and disintegration in the jet using the model of first order.

As a result of theoretical investigation, it was reviewed that on the turbulent characteristics of phase of the two-phase monodisperse water-air jet with gas temperature phase transition, the drop volume concentration in the jet initial cross-section, the air humidity and the diameter of initial part of jet exert an influence.

The computational and experimental work, carried out by the group of research workers, permitted to pass to solving a number of practical problems. In particular, the range of two-phase jet was investigated in the interests of fire-men. Also in the interests of some subdivisions of the Chair, the added gas mass determination problem, arising in the process of designing the ejecting devices (for instance, the jet engine ejector nozzles), was solved.

At present, the greatest attention in the research group is given to the work connected with the coating the part and coupling them together using for this purpose the solid particles accelerated in the flow. As a accelerating gas any gas can be used, including the air. The particles of sputtered material have a low temperature and isn't liable to be oxidized.



1651.
УДК 541.18

ABOUT INFLUENSCE OF HUMIDITY ON BURNING AND COMBUSTION OF ORGANIC DUST IN FILTERS

PUHLIYI V.A., KOLUVAYI A.G., POTEHIN V.G.

(Moscow and Cherkassy) Moscow Aviation Institute, 127349 Moscow, Muranovskaya 17-147, Russia

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It is known that water can be used to stop or slow down burning processes if it is not involved into exothermic reactions with burning materials. Also, humidity can prevent organic dust from combustion. Three aspects of humidity influence on combustion and burning processes can be analyzed:

1. Humidity lows temperature of combustion or burning areas;
2. Humidity lead to increase of time of combustion period because of two reasons: evaporation carries out an energy necessary for combustion; time of dust heating increases and slows down chemical reactions;
3. Evaporation lead to change of concentration of burning materials and slows down chemical reactions if temperature does not changes.

Calorimetric and thermal equations of condition were determined and combustion adiabates for organic damp dust in air were calculated for wide area of humidity values and lower concentrations. The obtained results allow to determine parameters of burning waves, of combustion of normal and compressed mixes. Conditions of self-supported burning without submission of oxygen from the outside were determined.

Burning wave propagation velocity for various humidity values and dust with convective and non convective heat transfer in air are given. Because of long time of evaporation for damp dust (tens of mass percent) laminar burning velocity was small (approximately 1 centimeter per second). Self combustion of such mixes is impossible due to large critical diameters (hundreds of meters).

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The results of present work include thermodynamic and kinetic calculations and can be used for analysis of combustion and burning of organic dust, to prevent filters from explosions. An equation for estimation of minimal ignition energy was suggested.

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FIELD EXPERIMENTAL INVESTIGATION OF EXPLOSION OF ORGANIC DUST IN FILTERS

PUHLIYI V.A., TAUBKIN I.S., PLAHOV S.I., AKHACHINSKII A.V., SAKLANTIN A.R.

Moscow Aviation Institute, 127349 Moscow, Muranovskaya 17-147, Russia

(First received 15 February 1998; accepted for presentation during IAS-4)

Many technological processes include production or processing of disperse (dust) materials and may cause an explosion. Burning of airmixes inside the processing unit leads to pressure increase that can break the unit and explosion of the accumulated dust in a room.

Within the framework of development of the "NPO Tekstilmash" of a complex line of clearing of air at the factories of linen branch the complex of explosive tests of the filter equipment was carried out. The explosive tests of a breadboard model of the drum-type filter and fibre catcher were carried out on the open area. For registration of superfluous pressure on the case of the filter 3 gauges «DD-10» were installed. Signals which from through inductive station «ID-2I» were shoed on the oscillograph «N-117». At the bottom part of the filter 3 kilograms of linen dust were set. Explosion pressure was measured as P = 100 kPa.

The analysis of experimental data showed that beginning of opening of the case of the filter has taken place with superfluous pressure P=46 kPa with the maximal speed of increase of superfluous pressure dP/dt = 460 kPa/s.

Explosive tests of fibre catcher have shown, that the products of explosion of a linen dust successfully are dumped from the device through the extension tube, not putting (except for destruction of a membrane) damages of a fibre catcher case. Therefore, because of the final burning of slowed down dust in the extension tube, pressure increased a little inside the unit case.

The carried out explosive tests of experienced samples of filters have allowed to develop highly effective explosion-proof drum-type filters and fibre catchers for linen production factories.

1488.
УДК 541.18

RESEARCH OF DYNAMICS OF DEVELOPMENT AND SUPPRESSION OF EXPLOSION IN CLOSED VESSELS

A.B. BORDIAKOVSKIY, N.P. KOZHUSHKOV, A.V. GOLOTAYSTROV, V.A. PUKHIIY

(Severodonetsk - Moscow)

(First received 13 April 1998; accepted for presentation during IAS-4)

The results experimental range researches on dynamics of development dust, gas and hybrid mixtures in closed vessels of volume 10 and 50 cubic metres (m^3) and their localization with the help of automatic systems of explosions suppression are held (ASES).

As aeromixtures the following components were used: elevator dust, vitan - 2 M, technical simasin, coal, phtalic anhydride. As fuel for mixtures were used: petrol, acetone, benzol. The hybrid mixtures had the following structure: elevator dust + benzol + air, phtalic anhydride + benzol + air.

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The main characteristics of dynamics of explosions (dust) development are: - The maximum pressure of explosion (P_{max}) for various concentration of investigated dusts makes 0,4 - 0,8 MPa, the obtained significances Pmax are approximately higher 10 %, than Pmax for small laboratory installations;
– The values of middle visible speeds of flame distribution are rather small and make 1 - 5 m/s;
– Time from the beginning of explosion initiation before achieving Pmax depending on concentration and component makes for capacity 10 cubic metres m^3 : 0,6 - 2,2 s, for capacity 50 m : 0,8 - 3,2 s.
– The pressure increase in initial period of development of explosions occurs rather slowly and given slice of time called as "induction" period of explosion development for dust explosions considerably exceeds similar period for gas and hybrid explosions. This feature of dust explosions allows to present less rigid requests to ASES.

The characteristics of hybrid mixtures explosions have their features. It is necessary to mark that insignificant (ultralimited) additions of hybrid mixture hard component in gas mixture intensify its combustion. Explosion pressure appreciably grows and combustion reaction proceeding time is reduced. The maximum pressure of explosion Pmax is displaced in the party of poor mixtures. Increasing of the hard component concentration in the structure of hybrid mixture results to decreasing Pmax, however pressure increasing maximum speed $(dP/dt)_{max}$ is increased and at certain concentration of dust surpasses significance (dP/dt) max for gas (mixtures) explosions. Maximum pressure of hybrid mixture explosion: elevator dust + benzol + air for vessel of volume 10 m" makes 0,7 - 0,9 MPa, time of achievement Pmax -up to 1,0 sec.

Experiments on explosions suppression of combustible mixtures that have been mentioned with the help ASES, which principle of operation consists of detection of initial stage of explosion development by highly sensitive gauges and rapid injection of fire-extinguishing structure, which stops process of explosion development have shown that:
– Aeromixtures explosions are easily suppressed by water and fire-extinguishing powders. Aeromixtures explosion can be practically suppressed at any stage of their development;
– The explosions of gas and hybrid mixtures are successfully suppressed only with the help of fire-extinguishing powders. The most effective are the powders on a phosphorus ammonia salts basis;
– It is most difficult to carry out the explosions suppression of hybrid mixtures with the increased contents of a hard component, that is such mixture where (dP/dt)max reaches the greatest significance.

Experiments of explosions suppression of the above-stated combustible mixtures in vessels of volume 10 and 50 m^3 have shown that minimal explosion-suppressional concentration of fire extinguishing substances are within the limits of 0,6-1,5 kg/m^3 at the residual pressure in capacity after operating of ASES does not exceed 0,05 MPa.

The results of explosions suppression experiments specify that with increasing of a protected vessel volume the explosion-suppressional concentration of fire-extinguishing substance decreases. Theoretical and experimental researches have shown the possibility of using ASES for explosions suppression of acromixtures in big volumes (up to 500 m^3).

1487.
УДК 541.18

RESEARCH OF PROCESSES OF BURNING AND EXPLOSION IN PIPELINES

V.A. PUKHIIY.V.I.VODJANIK, N.P.KOZHUSHKOV, V.N. LITVINENKO

(Moscow - Severodonetsk)

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The results of targe-scale experimental researches on localization of a flame gas and dust of

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mixtures in the long pipeline by a diameter of 500 mm with the help of elements of the automatic system of suppression of explosions are resulted. The circuit of graund installation includes the explosive camera V = 10 m^3, to which the pipeline L = 22 m and diameter of 500 mm is connected. For registration of pressure of explosion in the camera and in the pipeline the induction gauges of pressure PG-10 were used. The passing of front of a flame on a pipe was fixed with the help of photogauges. For fixing an initial stage of development of explosion and the issues of a command signal through the block of management on operation automatic irrigator, carrying out dispersing of the fire-extinguishing powder in the pipeline, were used differential gauges of pressure of a type El-1.

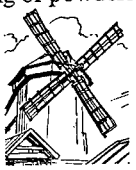
The researches were conducted on gasmixtures (stechiometric structure benzolaeromixtures) and aeromixtures (elevator a dust) mixtures. From the analysis of results of explosion gasmixtures of mixture follows, that the greatest speed of distribution of front of a flame in the pipeline and the greatest pressure in the camera arises at initiation of explosion in a top of the camera. At such conditions it speed of distribution of front of a flame in a pipe on a plot L = 1-2 m. from an end face of a pipe attached to the camera, makes V = 250 rn/s, on a plot L = 3-4 m - 300m/s, on a plot L = 6-7 m - 400 m/s and further on a pipe practically is not increased. Time during which the first photogauge established on distance 1m. from end face of a pipe, fixes passing front of a flame, makes 0,45s. Maximum pressure in the camera makesO,19MPa. At initiation of explosion at the bottom of the camera the speed of distribution of front of a flame in a pipe approximately in 3 times is less, than at initiation of explosion in a top of the camera. The maximum pressure in the camera 0,13 MPa, time of fixing by the first photogauge of front of a flame -1,1 s. Typically is intensive burning out of combustible mixture inside the pipeline, thanking turbulization. The distinction in speeds of movement of combustible mixture and high-temperature products of combustion results that on the certain time interval of process of burning the pressure in the pipeline is sharply increased, exceeding pressure in the camera. Occurs short-term "stopping up" of the pipeline and begins proceeding of gas from the pipeline in the camera. It promotes intensification of burning in the camera and results in sharp increase of speed of increase of pressure. And growth of pressure in the camera.

The analysis of results of explosion aeromixtures shows, that the parameters of explosion are stretched in time in 2-3 times and maximum pressure in the camera little bit below, than for gas explosion. Essential difference dust of explosions from gas is the absence of effect "stopping up" of the pipeline.

The analysis of results of explosion benzolaeromixtures of mixture for want of locatizations of a flame in the pipeline by a way dispersing of the fire-extinguishing of powders shows, that the distribution of a flame on the pipeline makes 3-3,5 m from a point of introduction of a powder in the pipeline. It testifies that occurs the hearthal burning of mixture on length of the pipeline.

Dynamics of development of explosion dust of mixture in the system the camera - pipeline, for want of localizations of a flame in the pipeline by a way dispersing 20 kg fire-extinguishing of a powder during 2-3 s, shows, that the flame in a pipe from a place of introduction of a powder was not distributed more than 0,5 m, for want of it the maximum pressure in the camera has made only 0,03 MPa against 0,14 MPa -similar experience without introduction of a powder.

The conducted experiments have shown basic possibility of localization of a flame in pipelines by a way dispersing of the fire-extinguishing of powders.



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1660.
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STUDY OF THE PERFORMANCE OF DIFFERENT FILTERS UTILIZED IN FILTRATION OF AEROSOLS BY BUBBLING

I.E. AGRANOVSKI [1], T.MYOJO [2], AND R. D. BRADDOCK [1]

[1] *Faculty of Environmental Sciences, Griffith University, Queensland, 4111, Australia. EMail: I.Agranovski@ens.gu.edu.au*

[2] *National Institute of Industrial Health, Kawasaki, Japan.*

(First received 17 June 1998; accepted for presentation during IAS-4)

A new process of air purification has been developed and studied experimentally. The main benefit of this process is the possibility to increase the removal efficiency of fine particles from air streams by utilization of devices which have been historically used only for gases removal. This is very important because it provides a possibility of high efficient simultaneous removal of gaseous and particulate pollutants from exhaust air streams in industry. This process is based on passing of air through the filter, immersed into the liquid. The wet filtration leads to the formation of bubbles within the filter as the carrier gas passes through which provides alternate mechanisms for the removal of aerosols. Experiments are described to investigate the performance of different filters and to compare the efficiencies of the wet and dry filtration.

1435УДК 541.18

THE PULSE CLEANING BEHABIOURS OF GROUP CANDLE FILTER IN A HOT BENCH UNIT

Choi J.-H.*, Seo Y.-G.*, Jeong H.**, Chung J.**

**Dept. Chem. Eng. Gyeongsang National University, 900, Gazwa dong, Chinju 660-701, Korea*

***Korea Electric Power Research Institute, Taejon 305-380, Korea*

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Ceramic candle filters have been widely studied for the application in the advanced coal power plant because of their high filtering efficiency. High collection efficiency is especially important to control the micron particulates which causes the erosion and abrasion of gas turbine in the IGCC and PFBC. Because the filtering volume decreases as the face velocity increases, the operation at high face velocity is very beneficial for any filtering system, while keeping pressure drop low, maintaining collection efficiency high, and sustaining candle life. Pulse jet cleaning is one of the methods to improve the performance of the candle filter. A reliable cake removal and keeping the constant residual pressure drop are essential for the long term operation of the pulse jet cleaning filter. Several factors affect on the reliability of candle filter, including operation conditions, dust properties and the conditions of candle. Some experimental aspects on the pulse operation of candle filter were investigated in this study.

Hot gas stream was prepared with an oil burned exhaust gas in which fly ash from a conventional coal power plant was fed. The aerodynamic mean average size of the particulate was 23 micrometer. And the accumulative volume fraction less than 10 micrometer was 45.9%. Careful attention has to be paid during the mounting of filter element because of the element failure from the thermal and mechanical stress, while preventing the dust leak through the gaskets. The disc typed-spring was used to absorb those stresses. There were no dust leak through tube sheet and on mechanical troubles. The collection efficiency was maintained above 99.9%.

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The pressure drop through the temporary dust cake can be estimated by the measurement of the pressure drop developed after the pulse cleaning at each stage. Under the steady state operation at the constant in temperature, pressure, and face velocity the pressure drop across the dust cake was linear with the change of time because the concentration increases linearly from the constant accumulation. The pressure drop rate was linear with the change of dust concentration and showed a quadratic increase with the change of face velocity. So the pressure drop across the temporary dust cake could be understood well by Lippert's equation. And overall pressure drop across the filter element was well expressed by Darcy's law. Usually, stable value of dimensionless permeability lies between 0.4 and 0.45 for commercial filter element, which reaches after more than 100 hours. So the data we obtained shows only its trend in the short term of experiment. The determination of the suitable conditions for the pulse cleaning is very important for the long term operation. The forces between particles and the filter element is key factors of cake stickiness. The shock pressure difference during pulse jet is the main force to destroy the stickiness. And the cake detachability depends on the pulse amount. Experimental variables which can control the pulse amount are the pulse reservoir capacity, pulse nozzle size, pulse duration, and nozzle design.

The durable base line pressure drop is allowed up to about 1000mmH2O in commercial application. So the pressure drop rate should be lower than 0.002. More than 1 sec was suitable at this condition. We could expect much more pulse effect after a certain duration. The effect of cycle duration at given pulse pressure and pulse duration. The state at which the pulse cleaning is impossible after all when the cycle duration was extended step by step. The fail in cleaning occurred within 1 hr if rR is more than 0.3. The maximum cycle duration decreased sharply as the face velocity increased. In the case the face velocity was more than 4 cm/sec, pulse cleaning was impossible even though the cycle time was less than 2 min. The cleaning effect of two different pulse modes, the collection and the dispersion one were compared. There was not significant different between them. The sequential pulse cleaning with the pulse cycle of 5 seconds after 15 min of long interval was carried out in the collection pulse mode. But the effect was almost similar with that from the regular cycle duration of 5 min was applied in the dispersion mode.

In summary, bench scaled high temperature ceramic candle filter was operated to observe the pulse events. The total pressure drop across the tube sheet was monitored during the pulse jet. The cleaning behaviors were explained well by Darcy's law and the equation proposed by Lippert, et al. The prediction of long term durability of the filter element could be estimated by the pattern of the increase in the base line pressure drop. The pulse duration has a minimum value at a certain condition. The maximum cycle duration was affected much by the face velocity. The operation results at unsteady state shows that the pulse mode was not important on the cleaning effect.



1038.

OPERATION OF HOT BENCH FILTRATION SYSTEM OF DUST REMOVAL FOR ADVANCED GOAL UTILIZING COMBINED SYSTEM

Choi J.-H.[1], Park G.-W.[1], Jeong H.[1], and Chung J.-H.[2]

[1]Dept. of Chem. Eng., Gyeongsang National University, Chinju 660-701, Korea,

[2]Korea Electric Power Research Institute, Taejon 305-380, Korea

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Candle filter is one of the most promising system for a particulate removal et high temperature such as IGCC and PFBC. In order to develop the design technology of ceramic candle filter system, it is very important to optimise the pulse cleaning system and to understand

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the behaviour of pressure drop developing to depend much through the filter element during the operation. These characteristics i on the property of filter element, mounting of filter element, dust properties, a d operation conditions.

Our purposes: was to obtain the design data for a commercial filter system. For this aim, a dench scaled test facility mounted seven candle elements of 1m length was burned gas behavior and Jet cleaning ested. The hot gas stream was prepared by the mixing of an oil and fly ash from a conventional power plant. Pressure drop pressure development in the filter element inside during the pulse as observed in the several operation conditions.

The analysis of pulse nozzle system was also carried out by FLUENT program.

1202

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EXPERIMENTAL RESULTS OF HIGH TEMPERATURE FILTRATION AND DUST CAKE ANALYSIS BY CERAMIC CANDLE FILTER

JIN DO CHUNG [1], JOO HONG CHOI [2], C. KANAOKA [3]

[1] Hoseo Univ., [2] Gyeongsang Univ., [3] Kanazawa Univ.)

Baebang-Myun, Asan, Chungnam, 336-795, Korea, Dept. of Environmental Eng. Hoseo University, E-mail:jdchung@dogsuri.hoseo.ac.kr, Tel: 82-418-40-5463, Fax: 82-418-40-5460, contact person Prof. Jin Do Chung.

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Keywords: High Temperature Dust Removal, Ceramic Candle Filter, Pressure Drop, Dust Cake, Darcy Eqn.

A number of gasification systems are approaching commercial readiness for use in integrated gasification combined cycle(IGCC) power plants. The primary advantages of IGCC systems are higher energy conversion efficiency and superior environmental compliance when compared to all other coal-based power generation options. In an IGCC system, particulate matters must be removed before the raw gas is burned in the gas turbine to protect the turbine blade and to control particulate matters emissions. It is also important to note that the particulate matters removal process must be carried out by incorporating high temperature gas cleanup for optimization of IGCC system. In an IGCC system, hot gas is introduced to the combustor at about 430 ^o C and a pressure of typically 25 bar. The gas temperature is much lower than the PFBC system, which is operated at about 800-900 ^o C and 10 - 15 bar. Advanced cyclone, cross flow filter, granular bed filter, electrostatic precipitator, and candle filter have been developed for particulate matters collection on the advanced coal power generation system. Ceramic rigid filters and granular bed filter among them have the best potential.

A ceramic candle filtration system has been operated under the high temperature in order to obtain the design data for a pilot unit of integrated gasification combined cycle(IGCC) and high temperature gas cleanup facility.

A candle elements of 0.5m length were mounted on the tube sheet by using the specially designed filter holder. The compressed air was used for the stream gas carrying dust injected from a screw feeder and heated by an electrical heating unit. The compatibility of the filtration system involving element mounting technology was checked. Some operation results were obtained. The behaviour of the pressure drop, the pulse cleaning events, and the dust cake of the filter element were investigated in this study.

In this paper, collection and release mechanisms of dust on and from a rigid ceramic porous candle filter are studied by measuring the evaluations of pressure drop and dust layer thickness during filtration, and time behaviour of pressure inside and outside the element after the injection of compressed cleaning air and the movement of released dust.

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1251.
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NON DESTRUCTIVE EXAMINATION BY TXRF (TOTAL REFLECTION X-RAY FLUORESCENCE) OF AIR NUCLEOPORE FILTERS

CICARDI C., GALLI A., MILAZZO M.

Instituto di Fisica Generale Applicata Via Celoria 16, Milano 20133

(First received 10 February 1998; accepted for presentation during IAS-4)

Some multielement analysis of airborne particulate on nucleopore filters have been performed using the method of TXRF which allows non destructive examination as well as PIXE analysis, but is obtained in much more simple and economic way.

Quantitative analysis is based on comparison with Fly Ash Standard BCR CRM 038 and we found agreement with PIXE results.

Possible influence of aerosol particle diameter in quantitative analysis is been investigated at present.

1416
УДК 541.18

THE MODIFICATED PETRYANOV'S FILTER FOR DIRECT RADIOMETRY OF ALPHA-RADIONUCLIDES IN AEROSOLS

NEKRASOV V.V.*, OGORODNYKOV B.I.*, SURIN N.M.**

** Karpov's Physical-Chemistry Insto, 103064, Russia, Moscow, Vorontcovo pole, 10 nekrasov@cc.nifhi.ac.ru*

*** Institute of Oceanology, RAS, 117218, Russia, Moscow, Nachimovskiy prospect, 36*

(First received 31April 1998; accepted for presentation during IAS-4)

Polymeric fiber materials - Petryanov's filters (PF) - are frequently used at the quantitave analysis of radionuclide contents in aerosol. These filters have high effeciency of catching of aerosol particles of any sizes [1,2]. The average thickness of filtering materials at all analytical filters does not surpass 3-3.5 mg/cm2, i.e. does not exceed rundown of alpha-particles with energy 5MeV. This circumstance eases the factor of absorption of alpha-particles in volume of filter, though and it is not enough. The decision of the problem is some simplified by use of specially developed many-layer filters, containing layers from superthin fibre. In this layer the absorption of alpha-radiation is relatively not large and occurs under known law, enabling to calculation quantity of radionuclides, accumulated by the filtering material [3]. However and in this case the direct reception of energy spectrum of sample is rather problematic. Frequently analytical PF are used for enrichment of sample with its subsequent analysis by traditional radiometric methods in a combination with preliminary chemical allocation and concentrating . Thus significant errors connected with correct account of losses at chemical allocation are appeared. At radiometry of samples with low-activities the liquid scintillators are usually applied (to realize of spherical-geometry experiment). In this case the error called by the account of solubility of sample in used scintillator is added. Moreover, the similar method is practically not aplicable for control of concentration of short-living radioactive isotopes. New type of filtering material, enabling to conduct accumulation of sample and radiometry of alpha-active aerosol without processing of sample and practically in spherical-geometry, are developed on the basis of PF by the authors of the present message. The proposed approach consists in transfer of radioactive emission of sample in optical emission directly in the filter material. The optical emission (radioluminescence, excited by alpha-particles) is not weakened by polymeric material and can be registered by standard photoelectronic devices.

The proposed material can be used in the complex analysis of radioisotope composition of

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accumulated sample by methods of alpha- beta- gamma-coincidence spectrometry. Record sensitivity can be obtained in this case. For example, the accounts show, that at selection of sample in course of 1000 seconds with pumping rate 3 cm/s the sensitivity on 241Am will be 2x10-15 Ci/m^3.

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1178

NUMERICAL ANALYSIS OF FLOW FIELD IN THE CERAMIC CANDLE FILTER USED IN INTEGRATED GASIFICATION COMBINED CYCLE

Seo, Taewon

(Andong National University)

Choi, Joo-Hong

(Gyeongsang National University)

Chung, Jae-Hwa, Jeong, Hyun-Il

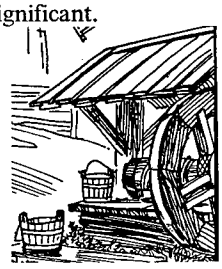
(Korea Electric Power Research Institute)

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The regulation of the exhausted gases contained CO_2, SO_x, and NO_x becomes more and more stringent in the world and this regulation is forced to study the clean coal technology to minimize the environmental contamination. Because of the stringent regulation to protect the earth by the fully-developed countries the next generation of firing system to be constructed in the next century is either IGCC (Integrated Gasification Combined Cycle) or PFBC (Pressurized Fluidized-Bed Combustion).

The IGCC has increasing attention as the clean coal power plant system to minimize the environmental contamination and to increase the thermal performance. The removal of the particulate contained in the hot gas is important to protect the gas turbine. The particulate produced in the combustion process of IGCC have been gotten rid of by ceramic candle filter. To increase the performance of the filtering process is of importance to get uniform velocity profile in the candle filter. The objective of this study is to analyze the velocity and pressure distribution in the candle filter and to investigate the effect of the porosity and the length of the filter. It is assumed that the flow field in the candle filter is axi-symmetric and steady-state.

K-ε model in the flow field and Darcy's law in the porous region are adapted in the numerical calculation. It is found that the effect of the porosity in the flow field is negligibly small while the effect of the filter length is significant.



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m^3/min and at that of water of 1.0-2.0 l/min the regime of working liquid emulsification occurs in the rising gas flows. At the regime the maximal purification of the gas is achieved, but the pressure losses in the filter increases by 1.5-2 times. Efficiency of the industrial waste gases purification from solid particles, oil particles, plasticisers and low-molecular compositions (LMC) is of 98.7-99.8% at the magnitudes of the solid particles initial concentration of 96-38 g/m^3 , that for the oil particles, plasticisers and LMC is of 50-200 mg/m^3 , and that for the working liquid is of 200-300 g/m^3 . The particles sizes were in the range of 100-1 μm. Total pressure losses in the filter at the emulsification regime are of 80-120 mm of water column at the working liquid concentration of 200-300 g/m^3 .

The main contribution to the filter resistance at the emulsification regime inserts the diaphragm (approximately 50%), however, its cross section variation does not practically influence the filter resistance.

Increase of the gas temperature in the range of 290-390 K does not practically lead to any change of the filter characteristics. The gas temperature losses in the filter amounts to 70% at the liquid phase concentration not less than 200 g/m^3 .

During these experiments it was marked that formation and retaining of the emulsification regime depend substantially on the order and way of the working liquid supply in the filter. Mounting of a thin cylinder at the filter outlet decreases as this dependence as the demands on precision of manufacturing of the section for pouring of liquid into the filter; besides, it widens the zone of the filter stable operation.

1098

WET ELECTROSTATIC PRECIPITATION OF FINE PARTICLES

Siebenhofer M., Lorber K. E.

Institut fur Entsorgungs- und Deponietechnik Montanuniversitut Leoben, Austria

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Particle precipitation has been an important role in off-gas purification since industrial activities have become an important factor in environmental issues. While precipitation by settling was the major dust separation process for a long period, a significant progress was made with the invention of particle precipitation by dry ESP. The treatment of large gas flow rates and the treatment of off-gas with high dust load has been possible since then.

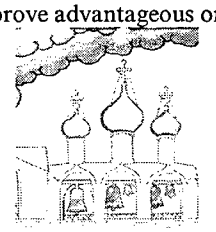
But electrostatic precipitation has always had some specific limiting properties which affect its application negatively. Gas temperature, moisture of the gas and the specific electrical resistance must not deviate strongly from the design specification. A rapid loss in collection efficiency has to be accepted in case of out-of-specification operation. The particles to be precipitated must nearly have ideal adhesion properties since they must be collected at the precipitation electrode on one hand and they must be removed by rapping without redistributing in the off-gas on the other hand. The geometry of the precipitator does not permit deviation of electrode distances and the electrical insulation has to consider the application of high voltage under increased thermal, mechanical and electrical stress inside the ESP. As a matter of fact, particle precipitation is still a major challenge in modern off-gas purification. Many processes cause the formation of an increased amount of submicronic particles. On the other hand, air borne particles with low sedimentation properties are a significant health risk because of their respiratory properties, their high catalytic activity due to several photocatalytic gas phase reactions, and their adsorptive properties for gaseous pollutants.

Modern off-gas purification therefore has to pay increased attention to the efficient precipitation of submicronic particles. Filtration techniques can cover a wide range of efficient

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particle separation in industrial application. Dust collection by filtration is increasingly preferred over electrostatic precipitation. Even in the field of waste incineration filtration is state of the art meanwhile. Is therefore any application left for electro precipitation in modern off-gas purification? As demonstrated by several examples, it is. But application focusses on wet electro precipitation. This precipitation technique does not suffer from most of the above mentioned limits and disadvantages of dry ESP. Wet electro precipitation does not have to consider the specific electrical resistance of the particles to be removed. The adhesive properties of the dust do not limit the precipitation as the collecting electrode is formed by an aqueous film which can be renewed continuously.

The paper presents several results of industrial application of wet electrostatic precipitation The application considers the precipitation of quartzite aerosols as well as sodium chloride aerosols from off-gas of incineration processes and high temperature conversion processes. Soot particles, as well as paraffinic aerosols formed by condensation have been succesfully removed by wet electrostatic precipitation. Even mixed organic/inorganic aerosols are collected at aqueous precipitation electrodes. The examples demonstrate, that wet electrostatic precipitation does not have general applicability but may still prove advantageous or exclusive in specific application.



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HIGH TEMPERATURE REGENERATIVE MULTILAYER METALCERAMIC FILTERS FOR HIGH EFFICIENCY COLLECTION OF RADIOACTIVE AEROSOL PARTICLES IN NUCLEAR FUEL AND RADIOACTIVE WASTE REPROCESSING

A.V.ZAGNITKO[1], N.M.TROTSENKO[1], V.N.PRUSAKOV[1], V.G.GNEDENKO[1], A.N.KOSAYKOV[2], Y.O.CHAPLIGIN[3], G.I.PYSHKO[3],

[1]Russian Research Center "urchatovInstitute, Sq.Kurchatov 1, Moscow, 123182, fax:095 1941994, zagnitko@imp.kiae.ru;

[2]Urals Electrochemical Integrated Plant, Novouralsk, Russia;

[3]Siberia Oil and Gas Stock Company, Moscow, Russia.

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The new types of regenerative metalceramic, all metal and all ceramic filter materials have been developed for high efficiency collection of radioactive microcontaminants with particle size exceeding of 0.01 micron. Filter materials have the anisotropical structure usually consisting of the finely porous metallic, cermet or ceramic layers attached to a coarsely porous reinforced cermet base. They are produced in the form of disc and leaf as well as of cylindrical tubes 80-1000 mm in the length. Outer diameter of cartridges is of 16-40 mm. Filter elements were made of nickel, stainless steel and aluminium oxide. They may be used for prefiltration, fine purification and ultrafine filtration of air and process gases from radioactive disperse microcontaminants.

The materials are manufactured in three make-ups [1], namely:
MCF-P is for gas prefiltration with efficiency E > 99 % with respect to particle size D more than 1.5 micron under differential pressure drop ΔP0 is of about 10-15 mm H2O; MCF-F is for fine

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gas cleaning with efficiency E>99.9999 % for particle with D > 0.01 micron at ΔP_0<100-120 mm H_2O;

MCF-U is for ultrafiltration of air and process gas with efficiency E > 99.9999999 % with respect to the most penetrating aerosol particles of 0.1 micron in size at ΔP_0 of 140-180 mm H_2O.

Here ΔP_0 is the differential pressure drop of filter materials at air filtration rate U of 1 cm/s and air temperature of 20 ^{0}C ; E is the collection efficiency of aerosol particles at U = 5 cm/s. As a rule, the filter element differential pressure ΔP is a linear function of gas flow rate. At a constant gas temperature and face flow rate U < 15 cm/s its value can be calculated with practically sufficient accuracy using equation $\Delta P = U \times \Delta P_0$.

Developed filter elements have strong mechanical strength and corrosive properties as well as they endue the high temperatures up to 1000 ^{0}C (in oxidising atmosphere of air for Al_2O_3 material), abrupt pulsed gas flow and action of strong alpha-, beta- and gamma-radiation and neutron flow.

On the basis of produced filter elements a standard size series has been drawn for cermet modules with optimised construction at volume flow rate of gas from 1 up to 2000 m^3/h. The nuclear safe filter modules have been also developed for high efficiency filtration of air from radioactive aerosols in Atomic Power Stations. The regeneration of filter elements and modules for prefiltration and fine purification of gases are performed periodically by back pulsing of pure air or process gas. As a result, the differential pressure of material after regeneration differs from initial value of ΔP_0 not more than 20-40 %. Herewith the filter elements endue more than 1000 regeneration cycles.

At present the sintered metal, metalceramic and ceramic filters are used for fine purification of air and process gases in different fields of Atomic Industry, namely: fluorination procedure, "pure purge" process, electrolysis, reprocessing of nuclear fuel, gas cleaning in high temperature gas reactor, etc. Some problems concerning the air cleaning in Chernobyl Atomic Power Station, high efficiency collection of high disperse aerosol particles at fluorination procedure of nuclear fuel and waste enriched by U-235, gas ultrafiltration from plutonium aerosols, as well as high temperature filtration of I, C, Mo, Pt, Ag, Rh , Tc, Ru disperse microcontaminants from LiF - BeF_2 or LiF - NaF molten-salts will be discussed in considerable detail. It is well known [2], that these molten - salts are used in Molten-Salt Reactor.

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STUDY OF THE EXPLOITATION CHARACTERISTICS FOR THE GAS-DYNAMIC VOLUMETRIC FILTER OF EMULSIFIER TYPE

SHMIRKOV O.V., RUDAKOV V.P., ROMAKHIN S.S., BONDAREVA N.V., CHEGIS I.L.

State Research Institute of Applied Mechanics and Electrodynamics of Moscow Aviation Institute
125810, Moscow, GSP-47, Volokolamskoye shosse, 4, NIIPME MAI tel.: (095) 158-0020 riame@mai2.rcnet.ru.

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Developed lately means of «wet» purification of smoke-consuming gases from solid particles trap to 90-95% of the particles with the sizes till 15 μm. The basic techniques for reaching of the purification level are the following: vortexing of the flow for rejection of the particles to the walls, smooth and stepwise resistors for the particles deposition, intensive sprinkling for the particles wetting and washing off. Using of the devices for purification of the smoke-consuming gases at a middle region power plant enabled to decrease the solid particles ejection to some tens of tons per a day. Application of them demands to supply power about 1-2 MW and several hundreds tons of water per a day. Besides, these devices are low-efficient for trap of the particles with the sizes less than 15 μm.

In the given work the results are presented that have been gained at calculated and experimental study of an up-to-date device for the «wet» purification of gas, namely, of a volumetric gas-dynamic filter of emulsifier type, having high productivity and efficiency at comparatively low consumption of energy and low consumption of water. The filter is designed to trap the solid particles in the industrial waste gases, the vapors of plasticisers and oils, the toxic components. It represents a tube with length-diameter relation of 15:1; the tube is made of the composition materials, resistant to erosion and to the alkali-acid components. At the filter inlet a vortexer is mounted of the spade type. On distance of the order of some calibers from the vortexer a diaphragm is placed. From above, over the internal wall the working liquid is supplied.

Study of the gas-dynamic filter characteristics have shown that at the gas flow rate of 4.0-6.6 m^3/min and at that of water of 1.0-2.0 l/min the regime of working liquid emulsification occurs in the rising gas flows. At the regime the maximal purification of the gas is achieved, but the pressure losses in the filter increases by 1.5-2 times. Efficiency of the industrial waste gases purification from solid particles, oil particles, plasticisers and low-molecular compositions (LMC) is of 98.7-99.8% at the magnitudes of the solid particles initial concentration of 96-38 g/m^3, that for the oil particles, plasticisers and LMC is of 50-200 mg/m^3, and that for the working liquid is of 200-300 g/m^3. The particles sizes were in the range of 100-1 μm. Total pressure losses in the filter at the emulsification regime are of 80-120 mm of water column at the working liquid concentration of 200-300 g/m^3.

The main contribution to the filter resistance at the emulsification regime inserts the diaphragm (approximately 50%), however, its cross section variation does not practically influence the filter resistance.

Increase of the gas temperature in the range of 290-390 K does not practically lead to any change of the filter characteristics. The gas temperature losses in the filter amounts to 70% at the liquid phase concentration not less than 200 g/m^3.

During these experiments it was marked that formation and retaining of the emulsification regime depend substantially on the order and way of the working liquid supply in the filter. Mounting of a thin cylinder at the filter outlet decreases as this dependence as the demands on precision of manufacturing of the section for pouring of liquid into the filter; besides, it widens the zone of the filter stable operation.

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List of participants of IAS-4 with presentations during 7 July 98

Andreev Nikolayi Alekseevich
Moscow State Aviation Institute
(Technical University)
Phone: (7)-095-1584930
fax (7)-095-1584930
email: alt@tk.mainet.msk.SU.
Moscow Russia

Arsenteva Irina Petrovna
Moscow Evening Metallurgical Institute
fax (7)-095-3611446
email: andreeva@ipmt-hpm.ac.ru
Moscow Russia

Bazarov Vladimir Georgievich *(1939-05-02)*
Moscow State Aviation Institute
(Technical University)
Phone: (7)-095-1584770
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia

Belov Nikolay Nikolaevich
(1947-05-04) Aerosol Technology Ltd.
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Chernozatonskiyi Leonid Aleksandrovich *(1943-10-01)*
Institute of Chemical Physics of RAS *Phone*: (7)-095-9397486
fax (7)-095-1370050
email: cherno@sky.chph.ras.ru
Moscow Russia

Choi Joo-Hong *(1955-03-22)*
Gyeongsang National University
Phone: (82)-591-7515387
fax (82)-591-531806
email: jhchoi@nongae.gsnu.ac.kr
Chinju
South Korea



Chung Jin Do *(1960-09-23)*
Gyeongsang National University
Phone: (82)-418-405463
fax (82)-418-405460
jdonchung@dogsuri.hoseo.ac.kr
Asan South Korea

Druzhinina Anna Ivanovna
Moscow State University
Phone: (7)-095-9395396
fax (7)-095-9328846
varushch@thermo.chem.msu.su
Moscow Russia

Fedorov Andreyi Vladimirovich
Moscow institute of fire safety
Phone: (7)-095-2822150
fax (7)-095-3624241
Moscow Russia

Gertsenshteyin Semen Yakovlevich
Moscow State University
Phone: (7)-095-9395136
fax (7)-095-9390165
Moscow Russia

Heusler Gero *(1969-07-09)*
Max-Born-Institut
Phone: (49)-30-63921218
fax (49)-30-63921229
email: heusler@mbi-berlin.de
Berlin Germany

Lavrov Vitaliyi Vladimirovich
Moscow State University
Phone: (7)-095-9395248
fax (7)-095-9391240
email: rftrst@cityline.ru
Moscow Russia

Lebedev Nikolayi Gennnadievich
Volgogradskyi State University
Phone: (7)-8442-433556
ivanov@physic.vgu.tsaritsyn.su
Volgograd Russia

Lepeshinskiyi Igor Aleksandrovich *(1937-08-15)*
Institute of Low Temperature
Phone: (7)-095-1584063
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia

Lorber Karl E. *(1945-02-03)*
Montanuniversitat Leoben
Phone: (43)-3842-4610350
fax (43)-3842-4610352
enttech@grz08u.unileoben.ac.at
Leoben Austria



Milazzo Mario *(1937-02-23)*
Instituto di Fisica Generale Applicata
Phone: (39)-2-2665468
fax (39)-2-2665717
email: Mario.Milazzo@mi.infn.it
Milano Italy

Nekrasov Igor Vladimirovich
Institute of Mechanics of Moscow State University
Phone: (7)-095-9395136
fax (7)-095-9395136
email: Nekrasov@inmech.msu.su
Moscow Russia

Pokropivnuyi Alekseyi Vladimirovich
Moscow Physical & Technological University
Dolgoprudnii MR
Russia

Popov Mihail Yurevich
Institute of Spectroscopy of RAN
Phone: (7)-095-3340855
fax (7)-095-3340886
email: popov@ntcstm.msk.ru
Troitsk Russia

Prin Elena Maratovna
Institute of Chemical Engineering Khimtekhnologiya
Phone: (380)-6452-93829
fax (380)-6452-25367
email: prin@ixt.sed.lg.ua
Ceverodonetsk Ukraine

Puhliyi Vladimir Aleksandrovich
Moscow State Aviation Institute
(Technical University)
fax (7)-095-4823876
Moscow Russia

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List of participants of IAS-4 with presentations during 7 July 98 (continued)

Romahin Sergeyi Sergeevich
Institute of the Applied Mechanics and Electrodynamics of Moscow Aviation Institute
Phone: (7)-095-1584757
Moscow Russia

Sedoyi Valentin Stepanovich
(1946-08-17)
Institute of High Current Electronics
Phone: (7)-3822-258348
fax (7)-3822-259410
email: sedoi@hcei.tomsk.su
Tomsk Russia

Seo Taewon *(1958-10-13)*
Andong National University
Phone: (82)-571-505756
fax (82)-571-8411630
email: dongjin@anu.andong.ac.kr
Andong
South Korea



Shinohara Hisanori *(1953-10-11)*
Nagoya University
fax (81)-52-7892962
nori@chem2.chem.nagoya-u.ac.jp
Nagoya Japan

Siebenhofer MATTHAEUS *(1955-02-13)*
Montanuniversitat Leoben
Phone: (43)-3842-4610350
fax (43)-3842-265237
email: postm@vtu.co.at
Leoben Austria

Topolskiyi Nikolayi Grigorevich
(1945-04-17)
Moscow institute of fire safety
Phone: (7)-095-2866461
fax (7)-095-2837677
academy@mfire3.munic.msk.su
Moscow Russia

Tsipenko Anton Vladimirovich
Moscow State Aviation Institute (Technical University)
Phone: (7)-095-1584063
Moscow Russia

Varuschenko Raisa Mihayilovna
(1931-03-13)
Moscow State University
Phone: (7)-095-9395396
fax (7)-095-9328846
varushch@thermo.chem.msu.su
Moscow Russia

Vinogradov Georgiyi Alekseevich
(1945-06-10)
Institute of Biochemical physics of RAS
Phone: (7)-095-9380561
fax (7)-095-1374101
GAVIN@DEOM.CHPH.RAS.RU
Moscow Russia



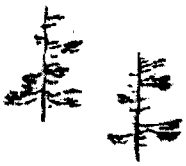
Volkov Igor Andreevich
(1937-01-27)
Russian Institute of Geological Investigations
Phone: (7)-812-2780028\506
fax (7)-812-2755756
email: ins@vnigri.spb.su
St.-Petersburg Russia

Zaporotskova Irina Vladimirovna
Volgogradskyi State University
Phone: (7)-8442-436380
email:
ivanov@physic.vgu.tsaritsyn.su
Volgograd Russia

Zhigach Alekseyi Nikolaevich
(1963-07-29)
Institute of Energetical Problems of RAS
Phone: (7)-095-9397927
fax (7)-095-1378258
email: ajigatch@chph.ras.ru
Moscow
Russia



Zuev Yuriyi Vladimirovich
Moscow State Aviation Institute (Technical University)
Phone: (7)-095-1584063
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia



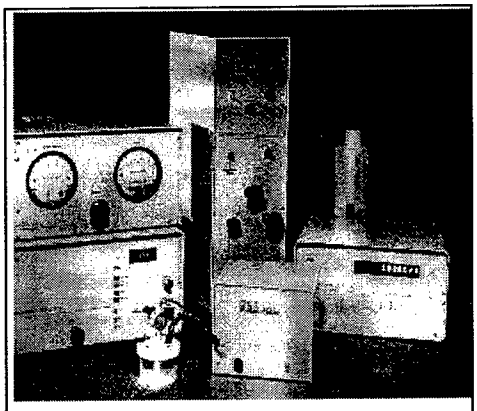


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1400.
УДК 541.18

DETAIL APPROACH TO DESCRIPTION OF NANOOXIDES CONDENSATION GROWTH DURING METALS COMBUSTION

ALTMAN I.S.

Institute of Combustion, Odessa State University, Odessa, Ukraine

(First received 04 April 1998; accepted for presentation during IAS-4)

As it is known the nanooxides are the main part of the products of the metals gas phase combustion. Description of the processes of the condensation growth of oxides has great applied (for the gas-dispersed synthesis) and general theoretic importance. Existing now condensation models describe nucleation and don't pay enough attention to kinetics of the nucleus condensation growth. As a rule it's considered that condensation is proceeded in quasi-equilibrium regime. But the recent author's experimental investigations (with Yu.L.Shoshin) show the essential non-equilibrium of nanooxides optical characteristics during their condensation growth. This causes interest to consideration of detail mechanism of processes accompanying condensation growth.

In this work the growing oxide particle is considered as the aggregate of two non isothermal subsystems - system of electrons and system of phonons. It is shown that the processes of the gas molecules adsorption and desorption are nonreversible during condensation growth of particle. The energy of these processes is transferred through two different channels. The system of kinetic equations describing the heat transfer between electrons and phonons subsystems and the evolution of the adsorption and desorption energy is formulated. The analysis of probable solutions of this system shows that in the oxide particles having some size the electrons system becomes cool. This leads to decrease of adsorption rate and therefore to the stopping of the oxides condensation growth. The obtained result apparently explains the absence of large oxide particles at the products of metals combustion (when there is the gas-phase combustion).

This work was sponsored by the Ukraine Ministry of Education and partially by INTAS (grant 96-2334).



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EXPERIMENTAL STUDY OF ULTRA-FINE MGO PARTICLES DURING THEIR CONDENSATION GROWTH NEAR THE BURNING MAGNESIUM PARTICLE

ALTMAN I.S., SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

(First received 01 April 1998; accepted for presentation during IAS-4)

The nanooxides synthesis during combustion causes interest for study of condensation processes, which are accompanying the gas- and vapor-phase metal combustion. The satisfactory experimental information about condensation growth of nanooxides during combustion does not exist at present. It is known in dust flames the metal particles may burn individually. That's why, possibly, condensation in burning metal dust takes place as if it was during combustion of single metal particle.

In this work the method of study of ultra-fine condensed products during combustion of single metal particle is proposed. The method is based on the synchronous two-dimensional laser scanning of the region near the burning particle and one-dimensional scanning of radiation

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emitted by system. The method allows to obtain information about local extinction caused of ultra-fine products of combustion and about of nanooxides emission characteristics. The method is used for study of properties MgO ultra-fine particles forming during combustion of magnesium particle with radius r - 1 nm.

It is shown that the creating of ultra-fine oxides take place only in thin zone with width - 100 pm on distance - r from the magnesium particle surface. The upper experimental estimation for time of the MgO particles condensation growth is obtained. The conclusion is done: there are growing and ungrowing MgO particles in condensation zone; radiation is emitted by growing ultra-fine particles only. The optical characteristics of growing MgO particles are essentially nonequilibrium. The experimentally estimated time of their relaxation to equilibrium value is about 5 ms.

The obtained results can materially change the existing conception of the processes of the particles condensation growth from the gas.

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1503.
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INFLUENCE OF CERAMIC PARTICLES ON MECHANICAL BEHAVIOUR OF ALUMINIUM NANOCOMPOSITES

N.F.KUZMINA, R.K.ISLAMGALIEV, R.Z.VALIEV.

Institute of Physics of Advanced Materials, Ufa State Aviation Technical University, Ufa 450000, K.Marksa 12, Russia, valiev@ipfm.rb.ru

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Recently a number of special methods of mechanical deformation such as torsion straining under high pressure and equal channel angular (ECA) pressing were developed for formation of nanocrystalline structures in various metals and alloys. This approach termed severe plastic deformation (SPD) [1] implies large plastic deformations under high applied pressures at relatively low temperatures (usually less than 0.4 T_m). The SPD procedure has a number of advantages as compared to other methods, namely, condensation in inert atmosphere [2] and ball milling [3]. One of these advantages is a possibility to fabricate massive specimens free of residual porosity and impurities. In addition, the obtained bulk specimens can be successfully used for thorough structural characterization and investigations of mechanical behaviour. Moreover, the SPD procedure can be applied for formation of nanostructures in various metals, alloys and intermetallics using both starting monolithic ingots and powders.

The method of SPD was used in the present work for formation of nanostructures in metal matrix composites [4]. These materials had recently aroused interest among experts in material science due to expectation of a number of attractive properties such as high microhardness, high strength, elevated thermal stability, good wear resistance and high strain rate superplasticity .

Two kind of initial metal matrix composites were used in this paper: Al6061 +10%Al_2O_3 and Al2009 + 15%SiC. These composites have been prepared by liquid metallurgy route. In this case, ceramic particles were added to a melt of matrix alloy and the melt was cast into billets. Chemical composition of Al6061 and Al2009 matrix alloys was: Al-1,0%Mg-0,6%Si-0,3%Cu-0,2%Cr and Al-3,7%Cu-1,3%Mg-0,25%Si, respectively.

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Two techniques of SPD were used in order to introduce the nanostructure into bulk samples of aluminium composites. First, initial material were subjected to SPD under the pressure 1,2 GPa. This resulted in fabrication of samples, 20 mm in diameter and 1 mm in thickness. Second, composites were subjected to quenching from 490-520°C, the SPD under the pressure 3,5 GPa and ageing at 80°C. This procedure resulted in specimens of 13 mm in diameter and 0,3 mm in thickness.

The structure of samples was examined by JEM -100B transmission electron microscope. Electron diffraction patterns were taken from an area of 2 μm2. The grain size was determined by dark field images as a mean value of the maximum grain size and its cross-dimension. Mean grain size was obtained by averaging of more than 100 grains. Microhardness was measured by a Vickers diamond pyramidal indenter with a load of 0.1 kg. Tensile specimens were pulled to failure in air at strain rates 10^{-4} - 10^{-3} c^{-1} using a testing machine "Instron" operating at a constant rate of cross-head displacement.

TEM investigations of composites processed under 1,2 GPa revealed the formation of uniform structure with a mean grain size of matrix alloy of 0.3 μm and of 0,1 μm in Al6061 and Al2009 composites, respectively. Analogous studies of composites processed under 3,5 GPa, showed the formation of more disperse structure with a mean grain size of about 70 nm in both matrix alloys Al6061 and Al2009.

The Al_2O_3 ceramic powders in Al6061 nanocomposite had equi-axed shape with a size from 0.2 μm to 5 μm. At the same time, the SiC particles in Al2009 nanocomposite had the plated shape with maximum sizes up to 10 μm and its cross-dimension up to 0.5 μm.

Typical electron diffraction patterns of nanocomposites fabricated by SPD under 3,5 GPa revealed the numerous spots positioned in the form of circles. Same diffraction patterns were observed also in various metallic materials subjected to SPD. Moreover, recent direct measurement of grain misorientations [5] indicated on significant fraction of high angle boundaries in the structure of specimens processed by SPD.

According to their structure, the samples of nanocomposites revealed the differences in their mechanical behaviour. For example, the samples processed at 1,2 GPa showed only the moderate microhardness 1200 MPa (Al6061) and 1700 MPa (Al2009) as well as tensile strength 420 MPa (Al6061) and 550 MPa (Al2009).

At the same time, nanocomposites subjected to SPD under the pressure 3,5 GPa demonstrated the elevated thermal stability up to 250°C and in 2-3 times higher microhardness in comparison with initial samples. Moreover, ageing of nanocomposites at 80°C during 6 hour increased the value of microhardness in Al2009 composite up to very high level of 3300 MPa. In this sample, the value of microhardness was significantly more than microhardness of 2500 MPa in commercial aluminium alloys [6,7] processed by SPD. The elevated strength properties of aluminium nanocomposites were confirmed also by direct tensile tests. For example, tensile strength of Al6061 nanocomposite (690 MPa) was higher than tensile strength of usual commercial aluminium alloys . At the same time, samples of Al2009 nanocomposite were brittle. Apparently, the plated shape of SiC particles in Al2009 nanocomposite leads to the limited ductility, although it is favourable to very high microhardness.

A number of conclusions may be reached from this investigation. First, nanostructures may be successfully fabricated in aluminium composites by severe plastic deformation. Structure of matrix alloys in these materials is characterized by a mean grain size of 70 nm and micron size of ceramic powders. Secondly, the samples of aluminium nanocomposites exhibit an attractive mechanical behaviour, a namely, high microhardness (3300 MPa), high tensile strength (690 MPa) and elevated thermal stability (up to 250°C). Third, the level of strength properties depends not only on a mean grain size of matrix alloy but also on morphology of ceramic particles. Although the plated shape of particles leads to very high microhardness it results in a brittle

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sample. In order to obtain simultaneously high strength and ductile samples of aluminium nanocomposites it is preferable to use ceramic particles with equi-axed shape. Firth, the processing of nanocomposites by SPD under imposed pressure 3,5 GPa in combination with preliminary quenching and subsequent ageing leads to higher mechanical properties in comparison with processing at 1,2 GPa.

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1636.
УДК 541.18

PRODUCTION OF HIGH-DISPERSED OXIDES OF ELEMENTS BY "TECHNOLOGIC COMBUSTION" METHOD IN REACTORS BASED ON COMBUSTION CHAMBERS OF LIQUID-PROPELLANT ROCKET ENGINES

S.N.BUYNOVSKII, L.A.GAPONENKO, V.G.GERLIVANOV, E.A.CHERNYSHEV.

SRC RF GNIIChTEOS, Moscow

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Intensive and environmentally safe process for element oxides production on the ground of thermal interaction of organoelement compounds with oxidizers in highlyefficient compact reactors are being developed in SRC RF GNIIChTEOS. Small-size combustion chambers (CC) of liquid-propellant rocket engines (LPRE) employment as technically elaborate chemical reactors is promising for technologic processes.

The outlook for such engines use as chemical reactors demonstrated their peculiarities: high capacity potential; excellence of operation arrangement, providing highly efficient component burnings; no need in significant outside energy sources; relative simplicity and compactiness of the design; the possibility of considerable increase of CC operation resource due to calorific intensity drop on retention of high capacity; units and assemblies suitable for process equipment of commercial plants. The use of thermal and corrosion-resistant structural materials in combinations with limited reaction product stay in CC provides minimum affect of reactor wall material on endproduct purity.

The experimental research was conducted at a multipurpose process plant where a modified CC of small-size LPRE of a reclaimed rocket was employed as a chemical reactor.

Pilot lots of ultra-dispersed high-pure iron oxide pigments of various colour grades were produced; the analysis of their physical-chemical and applied properties proved high quality of the pigment qualities. Positive results were obtained when they were applied on polymers in the context of packing materials for food industry, parfumery and cosmetics, decorative paints etc.

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Technologic processes of titanium, silicon, lead and other element oxides have been tested by means of "technologic combustion» of their organic compounds with oxygen and air. At simultaneous use of several raw components the possibility of mixed oxide production was demonstrated.

The developed processes have no sewage and are environmentally safe in terms of influence on the atmosphere.



1064.
УДК 541.18

THERMODYNAMIC INVESTIGATION OF THE ALTERNATIVE FREONS R-122 AND R-122A

VARUSHCHENKO R.M.,DRUZHININA A.I.,PASHCHENKO L.L.

Thermochemical Laboratory, Department of Chemistry, Moscow State University, 119899 Moscow, Russia.

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Keywords: Freons, Thermodynamics, vapour pressure, heat capacity.

This work was carried out under the program of the complex investigation of the alternative Freons by experimental and estimation methods in the wide temperature range from helium up to critical temperatures. The hydrogen containing Freons $CF_2ClCHCl_2$ (R-122) and $CFCl_2CHFCl$ (R-122a) are used as solvents and starting materials for fluoroorganic synthesis instead of environmentally unacceptable chlorofluoroethane $CF_2ClCFCl_2$ (R-113), that destroys ozone layer in the stratosphere. The literature data on the thermodynamic properties of the hydrogen containing Freons are scarce and need to be refined.

The next properties of Freons were studied by experimental methods:
- the low-temperature heat capacities, the temperatures, the enthalpies and entropies of the phase transitions,
- the saturated vapour pressures and the enthalpies of vaporization over the moderate ("atmospheric") range of pressure,
- the densities of liquids at the room temperatures,
- IK and KP spectra of the molecules [1].

The experimental data were used as a basis for estimation of the set of properties in wide temperature range using the Clausius-Clapeyron equation and the corresponding states law.

The heat capacities were measured by adiabatic calorimetry. The apparatus consists of the automatic vacuum calorimeter, data acquisition and control system, and PC. The volume of the substance under study is about 1 cm^3. The temperature of the calorimeter is measured with the accuracy ± 0.01 K by rhodium-iron resistance thermometer [2]. The heat capacities were measured over the temperature range from 5 K to 325 K with mean accuracy ± 0.2 percent. It was found that both Freons were in the forms of glasses, supercooled liquids, partially crystalline, and liquid states. For the first time, the melting temperatures of these Freons have been determined. The thermodynamic functions $\{S°_m(T)-S°_m(0)\}$, $\{H°_m(T)-H°_m(0)\}$ and $\{G°_m(T)-H°_m(T)\}$ have been estimated at T = 298.15 K. The contributions to the residual entropies at T = 0 caused by disorder of configurational and conformational nature have been found on the basis of calorimetric and spectroscopic data for the both Freons. The values $S°_m(298.15\ K)$ for the R-122a determined by both methods are agreed in the error limits, that showed their reliability.

The saturated vapour pressures in dependence of temperature were determined by comparative ebulliometric technique over the pressure range from 11 kPa to 102 kPa. The apparatus consists of a differential ebulliometer and the manometric system [3]. The temperature

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of the (liquid + vapour) equilibrium was measured by means of platinum resistance thermometer at 20 fixed pressures maintained automatically by means of a mercury-contact manometer. The values of the fixed pressures were obtained by calibration of the manometer with standard substances (water and decane) for which the vapour pressures are well known. The accuracy of the temperature and pressure measurements ($\pm<0.01$ K and $\pm\leq 26$ Pa) keeps pace with the present-day advances. The values-(pT) were treated by least-square method (LSM) using orthogonal functions. The next equations were obtained:

$$\ln(p) = A + B/T + C\ln(T) + DT, \quad (1)$$

$$\Delta_v H = R(-B+CT+DT^2)\,\Delta Z \pm \{s(\Delta_v H)+\Delta(\Delta Z)\Delta_v H\}, \quad (2)$$

$$\Delta C_p = C_p^o - C_p(\text{liq}) = R(C+2DT)\pm\{s(\Delta C_p)\}, \quad (3)$$

where ΔZ is the difference of the compression factors of gas and liquid (the value ΔZ takes into account vapour deviation from ideality). Equations (1)-(3) were employed for calculation of the normal boiling temperatures Tn.b., enthalpies of vaporization at T = 298.15 K and Tn.b., and the differences ΔC_p.

If it was possible, the enthalpies of vaporization were determined by both calorimetric and estimation methods with the accuracy $\pm(\leq 0.5$ and $\leq 1.5)$ percent, respectively. The values ΔvH found by two independent methods agree within error limits, which proves their reliability. The ΔC_p differences are negative in agreement with the physical meaning of these values.

Experimental data of Freons were used for estimation of the saturation vapour pressure for the whole temperature ranges of liquid phases. To extrapolate safely the pT-values towards the triple point, they were treated simultaneously with the low temperature differences $\Delta C_p = C_p^o - C_p(\text{liq})$ found by spectroscopic and calorimetric methods:

$$\ln\{p/p(m)\} = A + B/T + C\ln(T) + DT \quad (4)$$

$$\Delta C_p/2R = \{C_p^o - C_p(\text{liq})\}/2R = C/2 + DT$$

where p(m) is the mean pressure within the range of pT-data. The errors of extrapolation in the temperature interval $T_{ext}\leq 100$ K are within (1 to 10) percent. The correlation of the vapour pressure and densities of liquids according to the corresponding state law (CSL) allowed us to estimate the critical parameters T_c, P_c, and V_c and to extrapolate pT-values to critical region with uncertainties (from 1 to 5) percent. The critical parameters can be used for estimation of many thermodynamic properties by the (CSL).

The thermodynamic properties of Freons and their fluorinated and hydrogen- substituted analogues were analyzed depending on the some structural parameters of the liquid phase. The conclusion was drawn that the values $\Delta_v H$, Tn.b., and T_c vary regularly in accordance with the dipole moments and the coefficients of molecular packing, that is, the parameters determining the intermolecular interaction energy and short-range order in the liquid phase, which proves consistency and reliability of the considered thermodynamic data in the series of halogenated ethanes.

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UNSTEADY- STATE PROCESSES IN AEROSOL OF CATALYST

GLIKIN M., KUTAKOVA D., PRIN E.

State Design and Research Institute for Chemical Engineering, KHIMTEKHNOLOGIYA
Post address: Dzerzinsky st.1, Severodonetsk, 349940 UKRAINE
Fax 38 06452 25367, EMAIL: prin@himn.etalon.lugansk.ua

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Keywords: catalytic surface, intradiffusion retadations, aerosol of fine mild catalytic particles

The task to produce and to maintain the optimal structure and state of a catalytic surface during a chemical conversion process is the main problem in catalysis as it gives a possibility to control the rate and selectivity of chemical reactions.

Solving this problem for carrier catalysts has been complicated because of chemical conversion rate decrease owing to the intradiffusion retardation, catalyst pores plugging by cocks, polymers, salts and blocking active catalytic surface by these materials. Some of the problems are related to insufficient efficiency of existing methods of catalyst regeneration, limited range of carriers and their modification choice; complicated preparation; high cost. In the processes on the fluidized and moving bed, catalyst attrition is observed even when using updated carriers because of their limited strength and thermal resistance.

The investigations led to the new organization of gas-phase heterogeneous catalytic chemical conversions based on the use of fine-milled active catalytic material filling the reaction volume as aerosol and creating quasistructures of the catalyst. This catalytic system recycling in the reaction unit may be an individual chemical compound, mechanic mixture or alloy of individual chemical compounds.

The expected effect after the use of the catalytic small-particle aerosol can be associated with the following:

– the increased activity of the fine-grained catalyst compared to the conventional systems; by escaping the catalysis intradiffusion stage;
- expanding the outer contact surface;
- providing the equal access to the active surface; controlling the catalyst concentration in the reaction volume during the synthesis;
- high mechanic strength and thermal resistance of catalytic material; possibility to remove cocks and salt products from the catalyst surface by mechanical processing.

Chemical conversions on the fine-like catalyst (without any carrier) have been performed for the reactions of reduction, vinylation, deep and partial catalytic oxidation of organic and inorganic compounds.

The laboratory research results show unexpected substantial aerosol catalyst activity increase compared to the best samples of carrier catalytic systems for fluidized and fix bed modes.

The analysis of possible reasons of this phenomenon was carried out for two of the best carrier catalyst samples (Pt...-Al_2O_3, 0.6% Pt, $CuCrO_4$/...-Al_2O_3, 30% $CuCrO_4$) and aerosol catalyst based on iron oxide 3.

The investigations were performed on the laboratory unit in the reactor of flow type (D=50mm) under the test reaction condition of acetic acid deep oxidation. Herein the conversion degree was up to 99.98-99.99% with the carbon monoxide content of 20 mg/m^3 and absence of incomplete oxidation products in the off-gasses.

The results of comparison of acetic acid oxidation on the classical catalytic system and on the aerosol of catalyst show extremely high activity of iron oxide aerosol catalyst. It exceeds the activity of industrial samples by five orders.

Herein the operation concentration of iron oxide was about 3 g/m^3, while it reaches 4 kg/m^3

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for the platinum catalyst and 200 kg/m^3 for copper- chromic catalyst.

The experimental data analysis allows to suppose that particle dimensions amount to several nanometers. The up-to-date scientific visions of the change of nano-size particle surface properties (such as electronic deficiency) gives all the grounds to suggest that this is the main reason of such considerable activity increase of aerosol of iron oxide catalyst.



1526.
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ANALYSIS OF THE HIGHDISPERSED METALS AND OXIDES POWDERS

I.ARSENTYEVA[1], N.TALIAN [2], B.IORDOVICH [3], D.KRSMANOVICH [3], E.SOKOLOVA[1]

[1] *Moscow State Evening Metallurgy Institute, Lefortovsky Val 26, Moscow 111250, tel(095) 1266477*

[2] *Belgrad University, Inst of Chemistry, Technology&Metallurgy, Njegosheva 12, 111000 Belgrade, Yugoslavia*

[3] *Kraguevaz University, Technology Institute, Svetog Save 65, 32000 Chachak, Yugoslavia*

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The following powders' gradation is represented in the sintering physics:

a) ultra dispersed powders (UDP), particle size d_p ~ 1-500 nm;

b) fine dispersed powders (FGP), d_p ~ 1-50 μm;

c) coarse dispersed powders (CDP), d_p > 1-50 μm.

UDP and FDP are the highdispersed powders. After production physical-chemical and structural parameters of the powders have considerable influence on particles' behavior at different stages of method for powder metallurgy, that is after pressing and further sintering the pellets. In this connection fine analysis of the powders showed be performed at the initial stage. Table 1 gives the main methods enabling to analysis of the high dispersed powders after their production.

Table 1. High dispersed powders' methods of the analysis.

Methods of investigations	Physical-chemical and structural powders' parameters
Transmission electron microscopy (TEM)	Estimating size, form and characteristic properties of particle surface
Scanning electron microscopy (STEM)	
Qualitative and quantitative metallography processing	
AES investigation	Chemical analysis of heterogeneity of powder surface, molecular structure of surface
RSCA investigation	
IR-spectroscopy	
Transmission electron microscopy (TEM)	Investigating internal fine structure
X-ray structural analysis	
X-ray spectral analysis (EDS)	
Reduction melting in vacuum or with glass carrier	Determining the content of detrimental impurities (O,C,N) (for metallic powders)

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1350.
УДК 541.18

CONSOLIDATION OF ULTRADISPERSED POWDERS SYNTHESIZED FROM AEROSOLS

NIKOLIC N., MILOSEVIC O., MANCIC L.

Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Yugoslavia

SRECKOVIC T., MARINKOVIC B., RISTIC M.M.

Centre for Multidisciplinary Studies, University of Belgrade, Yugoslavia

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The development of novel materials eventually leads to an expansion of new methods for the synthesis of powders with the desired properties. A rising increase of research for the applications of materials with the characteristics of the ultradispersed structures is evident. Polycrystalline ultradispersed oxide powders were synthesised from aerosols by the spray pyrolysis and freeze-drying method. X-ray diffraction, differential scanning calorimetry, infrared spectroscopy and scanning electron microscopy were used for particle characterisation. The obtained submicronic and nanostructured powders were reactive, homogeneous, high-purity and with a narrow particle size distribution. Consolidations of powders up to high densities were performed through the compacting of dispersed powders and sintering of the obtained compacts in order to achieve materials with the improved properties. Nonisothermal sintering process was analysed using dilatometric data. The sintered pellets were characterised with XRPD, SEM and BET method. The obtained results were discussed in terms of particle morphology.



1399.
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GAS-DISPERSED SYNTHESIS OF THE METAL OXIDES NANOPOWDERS

POLETAYEV N.I., ZOLOTKO A. N., VOVCHUK J.I., FLORKO A.V., ALTMAN I. S.

Institute Combustion, Odessa State University, Odessa, Ukraine

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At this work the possibilities of obtaining the metal oxides nanopowders are considered by the combustion methods. The gas-dispersed synthesis (GDS) method is based on combustion of dust clouds of metal particles in a laminar plume (it can be premixed plume - like Bunzen's burner or nonpremixed two-phase plume - like Burke-Shuman's diffusion burner). The obtained powders are well desagregated, have the spherical morphology, narrow gradation, average size of particles - 0.04 -0.1 microns. To obtain pure oxide powders of Al, Zr, Ti, Fe, Mg etc. by GDS

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method it is necessary to use not less pure microdisperse metal powders which are frequently obtained from the appropriate oxides. However, unique properties of obtained nanopowders, and also the technological virtues of the method GDS (very low expenditure of energy, has one stage, ecological cleanness) do a line-up an oxide - metal-oxide quite acceptable for a commercial production. The method GDS allows also to obtain multicomponent oxides by burning mechanical mixtures of powders of metals and their alloys.

The influence of basic macroparameters of a plume (fuel and oxidizer concentration, metal particles dispersion) and also thermal structure of the combustion zone on disperse and phase characteristics of the combustion products have been investigated by experiment for aluminum. For the definition of temperatures of condensed and gas phases in combustion zone the spectral methods were employed and for the analysis of the combustion products the disperse and x-ray-methods were used. It is shown, that nanopowder of alumina (average size of particles 0.04-0.07 microns, y-crystal phase), which properties depend little on variation of parameters of synthesis, accounted for no less than 99.5 mass persents of the products. The rest (- 0.5 %) compose the oxide particles, which sizes are about fuel sizes.

For powders of the high-boiling metals, such as Fe, Zr, Ti it is proved the possibility of their gas-phase combustion (under the temperatures of gas and condensed phase in combustion zone, which is lower than temperature of the metal boiling) with formation of oxide nanopowders of these metals (average size of particles - 0.02-0.05 microns). Zr, Fe, Ti particles burn heterogenetically in two-phase plumes with a low content of oxygen in carrying gas flow with generation oxide particles, which sizes are of the order of particles sizes of the initial fuel. Increase of oxygen concentration in particles dust clouds of these metals (more than 40-50 %) result in sharp increase of yield nanopowder fraction of the combustion products, i.e. intensification of gas-phase reactions.

On the bases of the obtaining results it is initiated an attempt to mechanism of formation and growth of particles of a condensed phase in combustion, with the supposition about the heterogeneous mechanism of condensation. Calculated value of an average size of oxide particles and its dependence on dust clouds parameters are obtained. The comparison of experimental and theoretical outcomes is produced which has confirmed a validity of the accepted supposition.

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1397

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KINETICS OF FREE VOLUME CHANGES OF THE $FE_{89.8}NI_{1.5}SI_{5.2}B_3C_{0.5}$ AMORPHOUS ALLOY

MARICIC A.[1], RADIC S.[2], RISTIC M. M.[3]

[1] *Technical Faculty, , Cacak Yugoslavia*

[2] *Institute of Technical Sciences of SASA, Knez Mihailova 35, Beograd, Yugoslavia*

[3] *Serbian Academy of Sciences and Arts, Beograd, Yugoslavia*

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Changes of physical properties of amorphous alloys (AMA), under the influence of external parameters (temperature, magnetic field, mechanical strain) have been the subject of a great number of papers published up to now [1,2,3]. The correlation between thermal, kinetic, electrical and magnetic effects during the crystallization process in non-isothermal and isothermal conditions have been investigated for different amorphous alloys based on iron. In this paper the

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kinetics of the change of free volume of the $Fe_{89.8}Ni_{1.5}Si_{5.2}B_3C_{0.5}$ amorphous alloy in temperature regions about 100° lower than the crystallization temperature was determined using the DSC method [1]. Measurements were performed of linear expansion of the amorphous ribbon in isothermal conditions at temperatures: t_1=370, t_2=400 and t_3=450°C.

In these temperature regions the structural relaxation process takes place, decreasing the concentration of frozen defects of the vacancy type to a size characteristic for the metastable state at the given temperature. This process leads to a redistribution of atoms at shorter distances compared to the selected ones. So, this is an activating process and it occurs significantly faster at the temperature close to the glassification temperature..

The rate at which the unstable amorphous structure approaches the metastable structure at a certain temperature $T<T_g$, is proportional to the degree of instability.

If the difference $V-V_0$ determines the degree of instability, where V and V_0 are values of the free volume for the amorphous and metastable state at the temperature T, respectively, then:

$$\frac{d(V-V_0)}{dt} = -\frac{1}{\tau}(V-V_0) \qquad (1)$$

where τ is the relaxation time, which characterizes defect mobility, whose diffusion movement determines how the amorphous alloy approaches the metastable state.

So,

$$\frac{V(t)-V_0}{V(0)-V_0} = \exp\left(\frac{1}{\tau}\right) \qquad (2)$$

or

$$V(t)-V_0 = A\exp\left(\frac{1}{\tau}\right) \qquad (3)$$

where:

$$\tau = \tau_0 \exp\left(\frac{E}{kT}\right) \qquad (4)$$

Exchanging relation (4) in (3) and a double logarithm gives the dependence:

$$\ln\left[\ln(V(t)-V_0)\right] = \ln B\frac{E}{kT}$$

where E is the activation energy.

The experimentally obtained dependence $\ln[\ln(V(t)-V_0)]$ on T^{-1} is linear, and the activation energy was determined as E=90 kJ/mol from the tangent of the slope. The value obtained is approximately two times higher than the activation energy of diffusion for the amorphous alloy $Fe_{80}B_{20}$ investigated in [4]. However, though both alloys are based on iron their composition is essentially different. Values of the process rate constant were determined at the temperatures of 370, 400 and 420°C.

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1424.
УДК 541.18

KINETICS OF ISOTHERMAL CHANGES IN ELECTRIC RESISTIVITY AND LINEAR EXPANSION OF THE FAST COOLED AlSi10Mg ALLOY

SIMEUNOVIC R., MITROVIC N., JORDOVIC B.

Technical Faculty, Cacak, Yugoslavia, cmm@elab.tmf.bg.ac.yu

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Lately, interest has increased in glassy metals (MG) as an especially attractive category of metallic materials, due to their exemplary physical, chemical and technical properties. Several methods have been developed for obtaining amorphous alloys in different forms (ribbons, wires, powders). In each case the obtained structure is not ordered or it is ordered at short distances [1]. Electrical properties which change with temperature, following structural changes stand out among physical and physico-chemical properties of metallic glass [2].

In this paper the process of structural stabilization with changes in the relative specific electric resistivity and the thermal coefficient of linear expansion in dependence on temperature has been observed.

A commercial composition of the AlSi10Mg alloy in the form of ribbons 35-70 μm thick and 1-3 mm wide was investigated. The ribbons were obtained by fast cooling of the alloy melt using the melt-spinning method [3] in the Department for Amorphous Systems of the Joint Laboratory for Advanced Materials of SASA at the Technical Faculty Cacak. Measurements of the specific electric resistivity were performed using the four-point method. The same method was used for measuring isothermal changes of resistivity in regions of the exo-energy system stabilization. The coefficient of thermal expansion was measured using a dilatometer with a sensitivity of 10^{-5} m.

All measurements were performed in hydrogen flow in the temperature interval starting with the room temperature up to temperatures 50 K higher than the temperature of system stabilization.

Results of measurements of the electrical resistivity and coefficient of thermal expansion in dependence on the temperature show that structural organization takes place in the temperature interval of 450-500 K. Structural organization is accompanied by a rapid decrease of specific electric resistivity and increase of the temperature coefficient of linear expansion. An expressed correlation exists between the electrical resistivity and thermal coefficient of linear expansion.

Measurements of changes of electrical resistivity in isothermal conditions at temperatures of 473 and 498 K show that the dependence $\rho(\tau)$ has an exponential form:

$$\rho(\tau) = \rho_0 \exp(-k\tau)$$

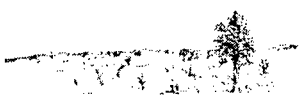
where: ρ_0 - is the starting specific resistivity at the temperature of isotherm recording.

Constants k_1 and k_2 of the process rate were determined from the slope of $(\Delta \ln\rho)/(\Delta\tau)$, indicating that structure stabilization takes place in two stages.

Process activation energies were determined from the known relation:

$$E = R\left[\frac{\Delta \ln k}{\Delta(1/T)}\right].$$

Obtained values for the activation energy of the first and second stage of structural stabilization are E_1=36.52 kJ/mol and E_2=24.9 kJ/mol, respectively. Corresponding rate constants were also determined. Results of investigations show that due to the high cooling rate an unstable structure with a certain organization degree of atoms at short distances and saturation of the Al solid melt



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is obtained. Thus, the stabilization process of the obtained structure is complex, which is shown by corresponding changes in electric resistivity and the thermal coefficient of linear expansion.

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1309.
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MECHANICAL PHENOMENA AT SHOCK AND DESTRUCTION OF METALLIC NANOPARTICLES STUDIED BY MOLECULAR DYNAMICS SIMULATION

POKROPIVNY V.V.*, SKOROKHOD V.V.*, POKROPIVNY A.V.**, KRASNIKOV Y.G.**

** Institute for Problems of Materials Science, 252142 Ukraine, Kiev, Krzhyzhanovsky str.3*

***Moscow Institute of Physics and Technology, 141700 Russia, Dolgoprudny, Institutsky str.3*

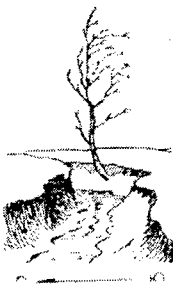
(First received 23 February 1998; accepted for presentation during IAS-4)

The processes of iron nanoparticles shock are computer simulated at the atomic level by molecular dynamics technique. The correlation between the structure transformation and variations of energy and force of adhesion, adhesive bond number, viscosity of contact is analysed. The adhesive-vibratory effect is observed. Acoustic and optical phonon spectra for vibrations of mass centres and single atoms are calculated.

Velocity dependent change of atomic mechanisms of shock interactions is discussed. During a shock with small velocity the joint action both the adhesive forces and impact pressure leads to joint dynamically steady vibratory and translation movement. At higher velocity, when the atomic processes of relaxation and shock occur simultaneously, vibrations are shown to transform into inelastic flow, amorphization and fracture of nanoparticles. At a near-sound velocity the particles are shown to smash into splinters.

The concept of new devices is proposed based on the resonance principle of powders compacting and coating activation by means of ultrasound treatment synchronized with shock influence.

The problems of interatomic potentials design and development of this technique for nitride and boride (TiN-TiB2) nanoparticles are discussed.



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METHODS OF PRODUCTION OF THE ULTRADISPERSED POWDERS

M.I.ALYMOV*, I.P. ARSENTYEVA**

Baikov Institute of Metallurgy and Materials Science, RAS

Leninsky prospect 49 , Moscow, 117911, Russia, tel: (095)135-8641; e-mail: alymov@ultra.imet.ac.ru

***Moscow State Evening Metallurgy Institute, Lefortovsky Val 26, Moscow 111250, Russia;tel:(095) 1266477*

(First received 15 April 1998; accepted for presentation during IAS-4)

The ultradispersed powders (UDP), nanocrystalls, serve the base for developing and wide introducing the modern high technologies into practice. At present this branch of science and technology appears to be the most quickly world-wide progressing one in terms of volume of financing. In view of the above, Russia keeps not only the priority in this field, but possesses a higher level of physical knowledge on the peculiarities of the UDP structure and properties as a special type of the solid matter. So, the numeral experiments carried out have proved that the UDP atomic structure acts as on intermediate link between the crystal and amorphous ones. High surface energy, small particles size and their production methods have come to be the reason for such a phenomenon. In Table 1 there are given the main UDP production methods for different materials and the scope of their production in the world.

Table 1. Methods of obtaining of UDP.

Method of production	UDP	Average size of particle, nm
Plazmochemical	Metals and compounds	10-300
Evaporation-condensation	Metals and compounds	1-100
Eelectrical explosion of conductors	Metals and compaunds	5-1000000
Shock-wave synthesis	Diamond-graphite, synthesized diamonds	10-100
Electrochemical	Metals	80
Cryochemical synthesis	Oxides	3-150 m2/g
Decomposition of unstable compounds	Metals and compounds	1-40
Reduction pyrolysis	Metals and compounds	10
Decomposition from solutions	Metals and compounds	20-80
Sol-gel	Oxides	5-1000
Liquid phase reduction	Metals	20-40
Gas-phase reactions	Metals and compounds	6-600
Heterophase synthesis	Metals and compounds	20-200
Synthesis based on hydroemulsions	Metals	<10
Vacuum extraction	Concentrates of fruit, extraction of medicament grass	



1346.
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NANOSTRUCTURE CERAMIC OXIDE SYNTHESIS FROM THE AEROSOL

MILOSEVIC O.*, MANCIC L.*, NIKOLIC N.*, RISTIC M.M.**

**Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Yugoslavia*

***Center for Multidisciplinary Study, University of Belgrade, Yugoslavia*

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The aerosol spray pyrolysis method was applied for submicrometar to nanosized ceramic

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oxide powder synthesis using a wide range of compositions. Particles formed by homogeneous or heterogeneous nucleation from aerosol generated by twin fluid and ultrasonic atomizers, the later operating at 1.7 and 2.5 MHz. Recent research has focused on controlled powder synthesis, with the purpose of ensuring control over particle purity, shape and size distribution. X-ray diffraction, infrared spectroscopy, differential scanning calorimetry, particle size analysis, scanning and transmission electron microscopy were used for particle characterization. Tailoring of the powder size, morphology, chemical and phase composition was possible by controlling the solution and process parameters. Control of the mechanisms of droplet generation, coagulation and evaporation/drying stages enabled the production of different particle morphologies. In the case of twin fluid derived powders the appearance of hollow spheres with a complex surface structure composed from primary crystallites is dominant. Nanosized and submicronic dense spherical particles are obtained ultrasonically. Control over the particle size and shape uniformity as well as structural homogeneity in multicomponent systems is established by maintaining the aerosol density below 10^8 droplets/cm^3. The phenomenon of funicular agglomeration in submicronic multicomponent powders was explained by the mechanisms of particle formation and interparticle sintering in the presence of a liquid phase. Assuming that a certain particle morphology forms during the first stage of spray pyrolysis, the empirically obtained particle size and morphologies were discussed in the context of the modeling of evaporation stage. The developed model gives a good description of phenomenon of mass and heat transfer and is in agreement with the obtained experimental results and numerical prediction.

1504.
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STRUCTURE AND MECHANICAL BEHAVIOR OF NANOCOMPOSITES PROCESSED BY SPD CONSOLIDATION OF METALLIC AND CERAMIC POWDERS

I. V. ALEXANDROV, Y. T. ZHU*, G.I.RAAB, N. M. AMIRKHANOV, R. K. ISLAMGALIEV, R. Z. VALIEV

Institute of Physics of Advanced Materials, Ufa State Aviation Technical University, Ufa 450000, K. Marksa 12
**Los Alamos National Laboratory, Los Alamos, NM 87545*

(First received 13 April 1998; accepted as accompanied publication for IAS-4)

The procedure of processing nano- and submicrocrystalline metals and alloys termed severe plastic deformation (SPD) [1,2] implies large plastic deformations under high applied pressures. Recently it has been shown that severe plastic deformation can provide formation of nanocrystalline structures having high angle grain boundaries [1,2]. Special methods of mechanical deformation were developed and used for this purpose such as torsion straining under high pressure, equal channel angular (ECA) pressing and others. Recently it has been shown that SPD deformation also facilitates consolidation of ultra disperse powders in massive samples with a density close to the theoretic one [3].

The results of investigations of structure, thermal stability and mechanical behavior of ultrafine-grained Cu and Al samples fabricated by SPD consolidation of powders and composites on their base containing up to 5 volume % of SiO_2 and Al_2O_3 particles are given in the present work.

Micropowders of Cu, Al with a mean particle size of 30 and 50 micrometers correspondingly were used as starting materials for consolidation. A mean particle size of SiO_2 and Al_2O_3 was 20 and 50 nm, respectively.

The process of massive samples fabrication consisted of two stages - precompacting of powders in a vacuum chamber and subjecting the prepared precompacts to SPD by torsion under

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the pressure 1.5 GPa and 6 GPa at room temperature. This resulted in fabrication of samples, 20 mm in diameter and 1 mm in thick and samples of 10 mm in diameter and 0.2 mm in thick.
TEM investigations of Cu base samples processed at 1.5 GPa revealed the formation of uniform structure with a mean grain size of about 150 nm. At the same time in the case of Al-base samples a mean grain size was equal to 120 nm.

Analogous studies of structure of Cu base samples subjected to SPD under high pressures equal to 6 GPa revealed the formation of more disperse structure and high density of dislocations equal to more than 10^{14} m^{-2}. A mean grain size estimated by dark field images was approximately similar and equal to 60 nm both in the pure Cu samples and in the nanocomposites on its base. Studies of structures of Al and Al+5%Al_2O_3 samples processed under higher pressure revealed a mean grain size of about 200 nm.

Values of microhardness of Cu and Cu+5%SiO_2 samples fabricated by SPD consolidation under pressure 1.5 GPa were equal to 1850 MPa and 1800 MPa, respectively. On the other hand, in Cu and Cu+5%SiO_2 samples fabricated by SPD under a high pressure of 6 GPa larger values of microhardness equal to 2600 MPa and 2800 MPa, respectively were observed. These values remained unchanged in both cases till the temperature 200 °C.

The microhardness of Al and Al+5%Al_2O_3 samples processed by SPD consolidation under the pressure 1.5 GPa was 1200 MPa and remained unchanged up to 450 °C. The results of investigations of thermal stability of Al and Al+5%Al_2O_3 samples processed under 6 GPa were rather unusual. It happened that in an initial state after SPD their microhardness was equal to 440 MPa and 560 MPa, respectively, that is significantly smaller than in samples processed under lower pressure. Following annealing resulted in an increase of microhardness at temperatures above 300 °C where an active growth of grains occured. It was assumed that such a change in microhardness can be connected with the superplastic behavior observed in the deformed alloy already at room temperature and the transition to an usual state after annealing.

"Stress-Strain" curves of Cu and Cu+5%SiO_2 samples processed by SPD under the pressure 1.5 GPa and subjected to elongation at a strain rate of 10^{-4} s^{-1} showed that at room temperature a strength of samples was sufficiently high and yield strength exceeded 300 MPa, however their behavior was rather brittle. Elongation to failure equal to several percent was revealed during deformation at 200 °C. Further increase in temperature of deformation to 300-400 °C resulted in a significant increase of ductility but decrease of flow stress.

Room temperature elongation at a rate of 10^{-3} s^{-1} of the Cu sample fabricated by SPD under high pressure of 6 GPa showed that small ductility and very high strength is typical for it. Short time annealing at T=200 °C for 3 min led to a significant increase of ductility and a record increase of flow stress to 790 MPa. It is important to note an unusual character of "stress-strain" curves of this nanostructured Cu displaying in the absence of a stage of steady plastic flow.

At the same time, as seen from the stress-strain curves, the characterized by strong strain hardening mechanical behavior of these samples, significantly differed from the characterized by an absence of strain hardening in a wide strain rate range behavior of utrafine-grained Cu with a grain size of about 200 nm, fabricated by SPD from monolithic ingots [4].

Room temperature tensile tests of Al and Al+5%Al_2O_3 samples fabricated under the pressure 1.5 GPa like similar processed Cu samples revealed a limited ductility equal to 1-2%. An increase in the temperature of deformation led to a significant rise of ductility of these materials at relatively low flow stress. For example, during elongation at T=300 °C the plastic flow stress of the Al sample fabricated by consolidation of micropowders was 60-65 MPa and the ductility was about 40%. In the Al+5%Al_2O_3 composite the flow stress was higher by 10-15% and the ductility was a bit smaller. An important specific feature of the deformation behavior of these materials was a significant strain rate sensitivity of flow stress. At T=400 °C an elongation to failure of

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about 200% was revealed in the composite at low flow stress equal to 20 MPa and the parameter of strain rate sensitivity of flow stress was equal to 0.35.

Apparently, the presence of even a very small porosity in ultrafine-grained materials fabricated by SPD consolidation results in their strong brittleness at room temperature. This is evidently true for explanation of low ductility of Al and Al+5%Al_2O_3 samples revealed during their elongation at room temperature. At the same time superplastic-like deformation is observed in ultrafine-grained Al at higher temperature, that was indicated from elevated elongation to failure and strain rate sensitivity of flow stress. One can assume that in the case of full density of these samples and in the presence of a very stable fine grains superplasticity should be enhanced in Al and/or Al compositions. This is very attractive from a practical point of view since superplasticity in ultrafine-grained metallic materials takes place at relatively low temperatures and/or high strain rates [5]. It seems that the improvement of thermal stability by optimal content and size of oxide particles will be useful for a solution of this task.

Thus, the obtained results testify that SPD consolidation of Cu and Al powders and their 5% compositions with nanopowders of oxides allow us to process samples with ultrafine-grained structure whose specific features substantially depend on applied pressure during severe torsion straining. An increase in pressure from 1.5 GPa to 6.0 GPa leads to differences in nanostructure formation in Cu and Al. Moreover, the combination of very high, record strength and some ductility is revealed in samples of nanocrystalline Cu having a full density, that is very advanced for practical application of this material. However, the presence of only several percent of residual porosity leads to their brittleness at room temperature. In addition, typical features of superplastic flow were observed in ultrafine-grained Al samples during their tensile tests at high temperatures. One can expect outstanding superplastic properties of these nanomaterials at achieving full density of these samples.

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1402.
УДК 541.18

SYNTHESIS OF ULTRAFINE ZnO PARTICLES IN DIFFUSION (ZnO DUST+ PROPANE)/O_2 FLAME

SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

(First received 01 April 1998; accepted for presentation during IAS-4)

In the present work the method of ultrafine zinc oxide synthesis by burning zinc dust/propane mixture is proposed. The concentric burner with separated fuel and oxidizer flows was used to obtain a laminar flame. The zinc dust / propane mixture was created by electrodynamical dust dispersing system which provided laminar flow with dust concentrations 0.1-10 kg/m3 . The pure oxygen as an oxidizer was used. The structre of obtained diffusion flame was studied

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experimentally. Two brightly luminous zones formed during combustion: yellow inner zone and distanced on 0.5-1.5 cm outer zone which color changed from blue to green and yellow by gradual increasing of dust concentration. Experiments with focused He-Ne laser beam scattering have shoved the presence of condensed phase only behind the inner luminous zone (initial zinc particles) and in- and beyond outer zone (zinc oxide particles). When a small water droplet was inserted between luminous zones a bright radiance appeared near and under the droplet which looked like "flame" of the same color as outer zone. The radiance evidently was caused by zinc oxide vapor condensation due to cooling by water evaporation. Analogous radiance appeared when thin jet of cool nitrogen was blown between zones. The results recounted above lead to the next conclusions about the flame structure. Zinc particles completely evaporated and zinc vapor oxidized in common diffusion front with propane (inner luminous zone). The outer luminous zone is the zone of zinc oxide vapor condensation.

The increase of dust concentration in zinc/propane jet led to the increase of zinc oxide particles mean diameter. The changirig of color of zinc oxide condensation zone can be explained by disproportional growth of radiance' self-absorption by oxide particles for different wavelengths. Because of specific spectral dependence of zinc oxide emissivity this effect must lead to nonuniform increase of radiation towards the short wavelength end of the spectrum.

The zinc oxide powders obtained at low dust concentrations haven't shown luminescence when UV irradiation, but powders obtained at high dust concentrations have shown yellow luminescence. It is believed that high heat release in condensation zone in second case provides long residence time of zinc oxide particles at high temperatures. The excess oxygen introduced into zinc oxide particles in high-temperature post-condensation zone is responsible for the luminescence.

The proposed method of ultrafine zinc oxide synthesis doesn't require external energy sources. The laminar regime of burning provides approximately uniform conditions of oxide particles growth. The method provides a simple way to regulate the mean diameter of oxide particles by regulation of zinc dust concentration.



1351
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THE CHARACTERIZATION OF $SMCO_5$ POWDER

TALIJAN N., MILUTINOVIC-NIKOLIC A., JOVANOVIC Z.

Institute of Chemistry, Technology and Metallurgy, Njegoseva 12, Belgrade, Yugoslavia

(First received 19 March 1998; accepted for presentation during IAS-4)

In the course of studying the field of permanent magnetic materials of the Sm - Co type, it was noticed that although the properties of the final magnet strongly depend on the character and behaviour of the starting SmCo5 powder, the methods for powder characterisation have not yet been systematised.

If the SmCo5 powder is to be used in the production of sintered SmCo5 magnets it should be of the following characteristics: the samarium content must be in the interval from 32 to 39 mass%; the minimal content of the SmCo5 phase must be 95-97 mass %. [1] For achieving high magnetic performances it is necessary that the particle size of the starting powder be between 1 - 10 μm. [1] It is very difficult to align particles larger than 10μm, and particles smaller than 1μm are easily oxidised. In both cases the magnetic properties decrease. The oxygen content in the starting powder is between 200 - 2000 ppm depending on the process of powder synthesis. The allowed oxygen content in the final sintered magnet is 0.6-0.8 mass %, and it requires continual oxygen analysis, not just of the starting powder but also of all the steps in the production of

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sintered SmCo5 magnets, specially the milling of SmCo5 powder. [1]
After considering all the experimental results obtained during the investigation of the synthesis of sintered SmCo5 magnets, a selection of appropriate methods for the characterization of the starting SmCo5 powder was made. [2]

The suggested methods were confirmed experimentally as being necessary for the reliable and adequate characterization of the SmCo5 powder used as the starting powder for the production of sintered SmCo5 magnets. The selected methods include: X-ray Micro Analysis using EDS for chemical analysis; Scanning Electron Microscopy with appropriate software for the quantification of the images for microstructure and morphological characterisation; X-ray diffraction analysis for the qualitative identification of the SmCo5 phase and calculation of the crystalline lattice parameters and TGA for estimating the thermal stability of the SmCo5 powder; oxygen content using a LECO device, as well as magnetic measurements. Some of the results of the characterization of the SmCo5 powder obtained using the chosen methods are presented in this paper. [2]

It was confirmed by micro-X-ray spectral quantitative analysis using the corresponding energy dispersion spectra that the obtained samarium content (38 mass %) corresponds to the projected chemical composition enabling optimal magnetic properties.
The morphological characteristics of the starting and milled powders were investigated for different milling times using SEM analysis with appropriate software for the quantification of the visual informations. By comparison of the observed particles size with the results of magnetic measurements it was possible to examine the influence of the milling time on the change of the particle dimensions and relative change of coercivity. It was found that for all the investigated milling times (up to 120 minutes) the decrease in particle size was followed by an increase in the coercivity. In the same time, increase in the oxygen content was acceptable up to a milling time of 60 minutes. [3]

X-Ray diffraction analysis was used to quantitatively determine the phases present in the starting and optimally milled powder. Only the SmCo5 phase was identified by X-ray diffraction. In this way a minimal amount of 95 mass % of SmCo5 was confirmed. [2,3]

The parameters a and c of the hexagonal crystalline lattice of the SmCo5 phase were calculated on the basis of the obtained diffractograms for the initial and milled powder. The experimentally calculated values of the parameters a and c of the SmCo5 hexagonal crystalline lattice of the starting powder and milled powder differ from the standard values by less than 0,2%. [2,4] Applied milling conditions did not induce defects in the crystalline lattice of the SmCo5 powder.

The thermal stability of the $SmCo_5$ powder in a static air atmosphere was investigated by thermogravimetric analysis (TGA) using a DuPont Thermal Analyzer. Investigation of the behaviour of the SmCo5 powder during heating was carried out using fresh samples of SmCo5 powder for each of the investigated temperature cycles. It was found by TGA that oxidation of SmCo5 was negligible below 200 C. X-Ray diffraction of the residues remaining after thermogravimetric analysis of the SmCo5 powder, heated at 240 C, showed only the presence of the SmCo5 phase. Different crystal forms were identified by X-ray diffraction depending on the maximal heating temperature. The following phases were identified: Sm2O3, Co, CoO, Co3O4

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and SmCoO3. According to the TG and X-ray results, for each of the investigated temperatures, the corresponding chemical reactions were established. [5]

Based on the obtained experimental results of testing the character and behaviour of powder of the intermetallic compound SmCo5 and by processing of the experimental results, the most suitable technological parameters are designed for all steps in the procedure of obtaining the sintered SmCo5 magnets.

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1658
УДК 541.18

THE STUDING OF FORMING PROCESSES OF ULTRAFINE POWDER OF FE-CO ALLOYS BY METHOD CHEMICAL DISPERSING

DZIDZIGURI E.L., LEVINA V.V., RYZHONKOV D.I.

MISA 117936, Moscow, Leninsky av, 4

(First received 10 June 1998; accepted for presentation during IAS-4)

In order of produsing of ultrafine (UF) alloys.

Were studied the peculiarities of phase compositions and structure of UF composition Fe-Co obtained by method cjmbining chemical dispersing and obtains of complex hydroxides or mixses hydroxides with its further reduction with hydrogen at the temperature 460 °C/

Methods of X-ray analysis with an X-ray difractometer "Rigaku" (Fe k alfa radiation) were used in phase analysis, precision lattice constant measuring, determination of the apparent phisical expansion for the purpose of mosaic units.

1346.
УДК 541.18

ULTRA-FINE POWDERS OF METALS, PRODUCED BY EVAPORATION-IN-FLOW TECHNIQUE.

JIGATCH A.N., LEYPUNSKY I.O., KUSKOV M.L, VERZHBITSKAYA T.M.

Institute of Energy Problems of Chemical Physics RAS.

117829 Russia Moscow B-334, Leninsky pr-t, 38, bd.2 E-mail ajigatch@chph.ras.ru

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A generator to produce the plum of ultra fine powders of metals and/or metal oxide with concentration as great as 10^{10}:10^{13} 1/cm^3 is proposed. Ultra fine powders of metals and metal oxides were produced, using evaporation-in-flow technique from the free-levitating drop, suspended between the coils of HF-inductor (this technique is a further improvement of Gen-Miller technology [1]). The powders of Ag, Cu, Ni, Al, either Al_2O_3 and NiO with juvenile particle

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surfaces and particle sizes within the range 5:200 nm were generated in inert gases (He, Ar) or in a mixture of inert gas with oxygen.

Particle samples were trapped directly from the gas flow by electron microscope grids (for TEM evaluations), by silicon plate (for electronography investigations) or by perforated stainless foil boats -- for adsorption and TPD/MS (temperature programmed desorption with mass-spectrometric analysis of desorbed products) experiments.

Electron microscopy investigation of particles size and shape were carried out using Philips EM 430 ST microscope to evaluate the dependence of particles array structure parameters on particle size. The analysis of structure characteristics for particles of different sizes were carried out by means of electronographic techniques too.

Probe gas technique with further TPD-MS analysis were used to investigate the dependence of active surface sites concentration and energy characteristics on particle sizes.

The dependencies of average particle sizes on gas flow parameters (the flow speed, inert gas pressure and gas type) and the drop temperature and size were evaluated. It was found, that the average particle size decreases with the decrease of the drop temperature (the drop temperature increases sharply with the increase of its size under the device conditions being constant), the flow speed increase and the gas pressure decrease. Helium as the carrying gas generates less particles, than argon. The nucleation kinetics in particle formation was investigated. Naturally, characteristics of all these dependencies are determined by a character of the evaporated metal.

The particles of the following minimal size parameters were generated and investigated:

Pair: "carrying gas - metal"	Average particle size <R>
Al – He	2.8
Al – Ar	7.0
Ag – He	4.7
Ag – Ar	10
Ni – Ar	3.7
Cu – Ar	14

Particle size distribution was found to obey logarithmically normal law with ?R/<R>=1. The shape of particles was near the spherical one, but the less particles was edged and had the shape with the fifth order of symmetry. Twins and more complex particles assembles were observed too.

The experiments on adsorption such probe gases as carbon dioxide and water vapour were carried out. It was found, that energy characteristics of adsorption active sites on the surface of ultra fine (<r><10 nm) and relatively "rough" (<r>~100 nm) differs from each other significantly. E.G., maximum of TPD curve splits to "two-headed" shape and moves towards higher temperatures for "ultra fine" particles both for water and for carbon dioxide on the surface of silver.

These probe gas adsorption showed less reactionability of cold metal particles surface, than it might be expected.

This work was supported by grants: DNA001-96-C-0051, DSWA001-C-98-0002 (Defence Special Weapons Agency, USA) and RFBR 96-15-97318 (Russian Foundation for Base Research).

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ULTRAFINE TIO2 PARTICLES SYNTHESIS BY COMBUSTION OF TITANIUM DUST IN O2+N2 (PREMIXED AND SEPARATED REAGENTS JETS)

SHOSHIN YU.L.

Institute of Combustion, Odessa State University, Odessa, Ukraine

(First received 01 April 1998; accepted for presentation during IAS-4)

The experiments with laminar premixed flame of titanium dust / (oxygen+nitrogen) mixtures stabilized on 2.5cm diameter Bunzen-type burner was carried out. These experiments have demonstrated for the first time that at high oxygen concentrations the titanium particles' burning can be partly in gas phase regime with formation of considerable quantity of utrafine oxide. When oxygen volume concentration in dust/gas mixture was 40% the part of ultrafine titanium oxide was about 30% from the whole oxide quantity. The increase of oxygen volume concentration above 40% lad to flame slipping into dust feeding system.

To settle the problem of safe titanium dust burning with pmpose of ultrafine titanium dust production the combustion of thin titanium dust jet with separate reagent and oxidizer flows was experimentally studied. Vertical titanium dust / nitrogen laminar jet was formed using electrodynamical dust dispersing system. Dust jet diameter was 1-2mm. The outlet hole of dust supplying system was surrounded by concentric tube with diameter 15mm trough which oxygen was supplied. Oxygen volume spending was much more than nitrogen volume spending. In case of low dust flow velocities the flame stabilized in outlet hole. When dust flow velocity was gradually increased suddenly flame out took place and flame stabilized in distance 10-50mm from outlet hole, depending on dust flame velocity. By wariating of dust flow velocity it was possible to establish stable distanced flame at dust mass concentrations 0.3-10kg/m . The ratio of distance between flame and outlet hole to dust jet diameter reached 0 times at dust jet diameter 1mm. It is believed that the main reason of distanced flame stabilization is diffusional dissipation of nitrogen from a dust jet, which lead to increase of flame propagation velocity along the dust jet when retiring from outlet hole. Estimated oxygen volume concentrations in the axis of dust jet near the flame front was 20-90% depending on experimental parameters. Therefore, inspite of separate reagents feeding, the flame in fact was premixed or, at high dust concentrations, of intermediate premixed-diffusion type. The part of ultrafine titanium oxide was more than 80% from the whole oxide quantity.

The proposed method of ultrafine titanium oxide synthesis is safe and eliminates the problems of conductive heating of a burner and thermophoretic storage of ultrafine oxide on parts of the burner. Probably this method can be used also for ultrafine zirconium oxide synthesis as the parameters of zirconium and titanium burning are close.



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List of participants of IAS-4 with presentations during 7 July 98

Andreev Nikolayi Alekseevich
Moscow State Aviation Institute (Technical University)
Phone: (7)-095-1584930
fax (7)-095-1584930
email: alt@tk.mainet.msk.SU.
Moscow Russia

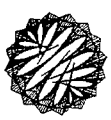
Arsenteva Irina Petrovna
Moscow Evening Metallurgical Institute
fax (7)-095-3611446
email: andreeva@ipmt-hpm.ac.ru
Moscow Russia

Bazarov Vladimir Georgievich *(1939-05-02)*
Moscow State Aviation Institute (Technical University)
Phone: (7)-095-1584770
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia

Belov Nikolay Nikolaevich *(1947-05-04) Aerosol Technology Ltd.*
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Chernozatonskiyi Leonid Aleksandrovich *(1943-10-01)*
Institute of Chemical Physics of RAS *Phone*: (7)-095-9397486
fax (7)-095-1370050
email: cherno@sky.chph.ras.ru
Moscow Russia

Choi Joo-Hong *(1955-03-22)*
Gyeongsang National University
Phone: (82)-591-7515387
fax (82)-591-531806
email: jhchoi@nongae.gsnu.ac.kr
Chinju
South Korea



Chung Jin Do *(1960-09-23)*
Gyeongsang National University
Phone: (82)-418-405463
fax (82)-418-405460
jdonchung@dogsuri.hoseo.ac.kr
Asan South Korea

Druzhinina Anna Ivanovna
Moscow State University
Phone: (7)-095-9395396
fax (7)-095-9328846
varushch@thermo.chem.msu.su
Moscow Russia

Fedorov Andreyi Vladimirovich
Moscow institute of fire safety
Phone: (7)-095-2822150
fax (7)-095-3624241
Moscow Russia

Gertsenshteyin Semen Yakovlevich
Moscow State University
Phone: (7)-095-9395136
fax (7)-095-9390165
Moscow Russia

Heusler Gero *(1969-07-09)*
Max-Born-Institut
Phone: (49)-30-63921218
fax (49)-30-63921229
email: heusler@mbi-berlin.de
Berlin Germany

Lavrov Vitaliyi Vladimirovich
Moscow State University
Phone: (7)-095-9395248
fax (7)-095-9391240
email: rftrst@cityline.ru
Moscow Russia

Lebedev Nikolayi Gennnadievich
Volgogradskyi State University
Phone: (7)-8442-433556
ivanov@physic.vgu.tsaritsyn.su
Volgograd Russia

Lepeshinskiyi Igor Aleksandrovich *(1937-08-15)*
Institute of Low Temperature
Phone: (7)-095-1584063
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia

Lorber Karl E. *(1945-02-03)*
Montanuniversitat Leoben
Phone: (43)-3842-4610350
fax (43)-3842-4610352
enttech@grz08u.unileoben.ac.at
Leoben Austria



Milazzo Mario *(1937-02-23)*
Instituto di Fisica Generale Applicata
Phone: (39)-2-2665468
fax (39)-2-2665717
email: Mario.Milazzo@mi.infn.it
Milano Italy

Nekrasov Igor Vladimirovich
Institute of Mechanics of Moscow State University
Phone: (7)-095-9395136
fax (7)-095-9395136
email: Nekrasov@inmech.msu.su
Moscow Russia

Pokropivnuyi Alekseyi Vladimirovich
Moscow Physical & Technological University
Dolgoprudnii MR
Russia

Popov Mihail Yurevich
Institute of Spectroscopy of RAN
Phone: (7)-095-3340855
fax (7)-095-3340886
email: popov@ntcstm.msk.ru
Troitsk Russia

Prin Elena Maratovna
Institute of Chemical Engineering Khimtekhnologiya
Phone: (380)-6452-93829
fax (380)-6452-25367
email: prin@ixt.sed.lg.ua
Ceverodonetsk Ukraine

Puhliyi Vladimir Aleksandrovich
Moscow State Aviation Institute (Technical University)
fax (7)-095-4823876
Moscow Russia

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List of participants of IAS-4 with presentations during 7 July 98 (continued)

Romahin Sergeyi Sergeevich
Institute of the Applied Mechanics and Electrodynamics of Moscow Aviation Institute
Phone: (7)-095-1584757
Moscow Russia

Sedoyi Valentin Stepanovich
(1946-08-17)
Institute of High Current Electronics
Phone: (7)-3822-258348
fax (7)-3822-259410
email: sedoi@hcei.tomsk.su
Tomsk Russia

Seo Taewon *(1958-10-13)*
Andong National University
Phone: (82)-571-505756
fax (82)-571-8411630
email: dongjin@anu.andong.ac.kr
Andong
South Korea



Shinohara Hisanori *(1953-10-11)*
Nagoya University
fax (81)-52-7892962
nori@chem2.chem.nagoya-u.ac.jp
Nagoya Japan

Siebenhofer MATTHAEUS *(1955-02-13)*
Montanuniversitat Leoben
Phone: (43)-3842-4610350
fax (43)-3842-265237
email: postm@vtu.co.at
Leoben Austria

Topolskiyi Nikolayi Grigorevich
(1945-04-17)
Moscow institute of fire safety
Phone: (7)-095-2866461
fax (7)-095-2837677
academy@mfire3.munic.msk.su
Moscow Russia

Tsipenko Anton Vladimirovich
Moscow State Aviation Institute (Technical University)
Phone: (7)-095-1584063
Moscow Russia

Varuschenko Raisa Mihayilovna
(1931-03-13)
Moscow State University
Phone: (7)-095-9395396
fax (7)-095-9328846
varushch@thermo.chem.msu.su
Moscow Russia

Vinogradov Georgiyi Alekseevich
(1945-06-10)
Institute of Biochemical physics of RAS
Phone: (7)-095-9380561
fax (7)-095-1374101
GAVIN@DEOM.CHPH.RAS.RU
Moscow Russia



Volkov Igor Andreevich
(1937-01-27)
Russian Institute of Geological Investigations
Phone: (7)-812-2780028\506
fax (7)-812-2755756
email: ins@vnigri.spb.su
St.-Petersburg Russia



Zaporotskova Irina Vladimirovna
Volgogradskyi State University
Phone: (7)-8442-436380
email:
ivanov@physic.vgu.tsaritsyn.su
Volgograd Russia

Zhigach Alekseyi Nikolaevich
(1963-07-29)
Institute of Energetical Problems of RAS
Phone: (7)-095-9397927
fax (7)-095-1378258
email: ajigatch@chph.ras.ru
Moscow
Russia



Zuev Yuriyi Vladimirovich
Moscow State Aviation Institute (Technical University)
Phone: (7)-095-1584063
fax (7)-095-1582977
email: aet@tk.mainet.msk.su
Moscow Russia



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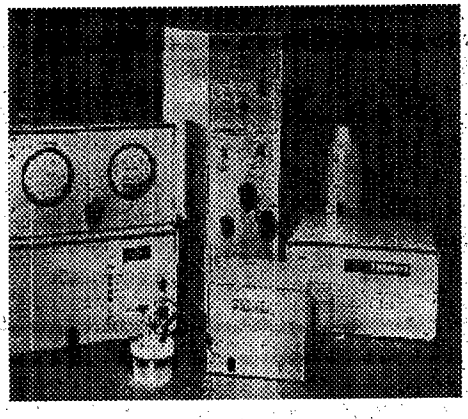
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address Belov N 21-117
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MODEL FOR PROPAGATION OF AEROSOLES OF VARIOUS ORIGIN UNDER THE CONDITIONS OF FOREST VEGETATION

KOLESNIKOV E.YU., IVLEV L.S., EFREMOV M.N.

Scien ific Research Ins i e of Physics, S a e Uni ersi y of Sain -Pe ersß rg, R ssia;

S a e Technical Uni ersi y of Mari A onomo s Rep blic, Yoshkar-Ola, R ssia.

(First received 04 June 1998; accepted for presentation during IAS-4)

A model for description of polluting impurity propagation in the lower atmosphere sublayer is proposed.

Simplifying assumptions are as follows:

a) the impurity transport is described within the quasi-stationary approximation;

b) the change of orientation of wind velocity vector is ignored, allowing to seek a solution for two-dimensional problem ("plane problem") and estimating the concentration q(x,z) as q(x,y) ~ $\exp\left(-y^2/2\sigma_y^2\right)$. In addition, the technique of variables splitting has proved to be efficient for obtaining a complete spatial field of concentrations $q(x,y,z)=q_1(x,z)q_2(x,y)$

c) the impurity transport is considered under the conditions of neutral thermal stratification;

d) the thermal vertical floating (up-drifting) of a torch is not taken into account; This may be accounted for by introducing the effective altitude of the source of atmosphere pollution.

e) the estimation domain is assumed to be horizontally homogeneous (uniform), so that $\frac{\partial K_{ij}}{\partial x} = 0$ holds.

f) the forest is approximated by a continuum (a continuous medium) with regularly ordered roughness elements;

g) the specific features of transient boundary layer resulting from the effect of a wind stream over-running the forest are neglected.

The considered model is a parametrical. The estimation domain is subdivired into two subdivided into two subdomains: I - up to the border of a forest which has a smooth lower boundary; II - the forest area including the upper aerial layer over the forest.

The model is based on the balance equation. An advective flow is represented by sedimentation and transport of the impurity acted upon by the field of the wind of medium strength.

The diffusion term in balance equation is expressed by the local concentration gradients of impurity with regard for the tensor character of turbulent diffusion coefficient.

Tensor components K_{ij} are estimated by the corresponding Reynolds tensor. A simple relation connecting the specific energy of turbulence and dynamic velocity is proposed for the case of most typical conditions in the lower atmosphere sublayer.

This allowed to obtain $K_{iz}(z)$ in analytical form. The "sewing" of thermodynamical modes of atmosphere for two layers of subdomain II, namely: inside the forest and above it according to the present model, is achieved owing to the continuity of vertical profile of $K_{iz}(z)$.

The vertical ascending of average velocity of wind within the subdomain 1 is represented by traditional logarithmic function.

Similar relation has been obtained for the second subdomain on the basis of estimated profile of $K_{iz}(z)$ and empirically obtained pattern for the path of mixing inside the wood, which was accurately checked and proved to be reliable. Vertical profile of the wind average velocity within

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the disturbance layer above the forest (up to the altitude of 1,5 h_{ij}) was approximated by the linear function.

An empirical relation for the capture coefficient β and the experimentally detected linear dependence of the impurity "sedimentation flow" on the wind average velocity are introduced in the present model. The model has provided a particularly detailed description considering a bilateral deposition of impurity presumably on both sides of the surface.

According to the model the set of equations are linear partial differential equations of the second order of a hyperbolic type. The equations which hold for subdomain I and II differ from each other in the actual prescription of the vertical profiles of the wind velocity and the components of tensor K_{ij}, the sink of impuruty occuring specifically inside the second subdomain. After the diffusion equations had transformed into the finite difference equations the numerical solutions were obtained by PC iteration Gauss-Seidel technique involving accelerating factor ω.

The calculations based on the proposed model allow to compare the profiles of impurity concentration under the conditions both inside and outside the forest. The vertical profile of impurity concentration can be estimated at a variety of distances from the source of atmosphere pollution.

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THE OPTICAL CHARACTERISTICS OF MODEL AEROSOLS IN THE ATMOSPHERES OF EARTH, MARS AND VENUS: METHODICAL QUESTIONS AND RESULTS OF ACCOUNTS

M.YA MAROV, V.P. SHARI

M.V. Keldysh Jns i e of Applied Ma hema ics, R ssia Academy of Sciences, Mi sskaya sq., 4, Moscow, 125047, R ssia; fax: + 7-095-9720737 maro @ spp keldysh r

(First received 29 April 1998; accepted for presentation during IAS-4)

For IBM compatible PC special technique and its program realization was developed for the evaluation of complete set of spectral properties of light scattering by polydisperse system of spherical particles (Mie scattering) including volume coefficients and angular dependences of elements of phase matrix. The respective algorithms are based on the classical approaches of light scattering theory (see, e.g., [1]). A broad parametric study for the various model aerosols was performed. This technique was earlier successfully applied for the analysis of nephelometric measurements made by Venera 9-14 spacecraft, which allowed to identify structure and physical properties of the Venus cloud deck [2,3].

Further development of this approach was focused on further expansion of these opportunities with raising efficiency of numerical evaluation of the problems involved, and targeted to set up of data banks for the characteristics of light scattering by aerosols of a natural and antropogeneous origin in the atmosphere of the Earth [4,7]. In this regard the problem of evaluation of Mie coefficients for relatively large particles closely related to wide distributions of particles by sizes for real aerosols was successfully solved. The program (MONO) involves characteristics of single spheres and allows to check the correctness of a method selected for their account, while the program (POLI) for polydisperse case allows to accomodate different patterns of distribution of particles by radii, including modified gamma-distribution, log-normal distribution and their sums, as well as exponent distribution Junge etc.. Utilization of additional service programs allows also to display the computed angular dependences of elements of a complete phase matrix or frequency dependences of volume factors on the screen of monitor or print them out.

Special attention was given to the accounting of light scattering characteristics of particles in

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partially absorbing media. The technique made possible to evaluate optical characteristics of water-oil emulsions and was earlier accepted as the Manual by the USSR Ministry of petroleum industry (ID 39-3-680-82). The experience acquired is pertinent for the control of sea aerosols and detection of oil pollution of the ocean.

In the databank basic models of aerosols adopted in 1978 by the Working group of Standard Radiating Atmosphere (SRA) and Radiation Commission of International Association of Meteorology and Atmospheric Physics (IAMAP) and additionally specified in 1984 [8] were adopted. The optical characteristics of typical atmospheric aerosols for 61 wave lengths from 0.2 to 40 μm were included: meteoric dust at the top atmosphere (h>30 km); background aerosols and volcanic ashes in the stratosphere; near-surface boundary layer of the troposphere above continent and sea surface for the conditions of a pure atmosphere, as well as urban aerosols of the polluted atmosphere. The models of continental, urban and sea aerosols represent combinations of four basic components: water soluble particles; insoluble dust particles of soil origin; carbon aerosols of antropogenic aerosols or particles of sea sprays. These components make a basis for the databank formation and storage. For each component the complete set of optical characteristics of single scattering including volume scattering, absorption and extinction coefficients is incorporated, beeing accompanied by all elements of a phase matrix for scattering angles from 0 through 180 degrees with a step of 1 degree. They can be used for an estimation of aerosol component contribution in radiation transfer and relevant climatic effects. Some results of calculation of model aerosols optical characteristics in Earth's atmosphere were published as Keldysh Institute Proceedings [4].

Within the framework of technique developement for the Europen global ozone monitoring using the method of star occultation by the atmosphere (Global Ozone Monitoring by Occultation of Stars, GOMOS) the continuous efforts were paid to fill up the databank by the optical characteristics for the global background aerosols of all basic layers in the height range from15 to 50 km [5] This analysis was focused on the specific patterns of height distribution and latitudinal and seasonal variations, with the involvement of chemical structure and physical properties. The respective parameters of stratospheric and mesospheric aerosols, including particles effected by volcanic eruptions, meteoric dust, and noctilucent clouds in the wide range of waves lengths were accurately specified. To simplify the reference and the results of measurements evaluation for the inverse problem solution, analytical polinomial function were introduced, which approximate spectral dependences of the volume characteristics of the radiation transfer in the wave lengths range 0.2-1 μm.

A comprehensive analysis of light scattering for a number of wave lengths and various physical properties of dust particles in the atmosphere of Mars and model aerosols of the Venus clouds was performed [6]. The particles of mineral dust of Mars were simulated by silicates and limonites, whereas aerosols in the atmosphere of Venus – by sulfuric acid droplets and particles of crystal sulfur. The influence of a various degree of absorption by Martian aerosols on the spectral characteristics of light scattering were considered. In turn, for each of four modes of the Venusian clouds a complete matrix of light scattering for the wave length of 0.63 μm along with the spectral dependence of IR opacity of clouds in the wave lengths from 2 up to 40 μm was investigated in detail. The main goal was to estimate the contribution of clouds in the net flux of thermal radiation and aerosol contribution to runaway greenhouse on Venus. For each of the three basic layers of the Venus clouds the comparison of angular dependences of elements of matrixes for each mode of aerosols composing these layers was carried out. These results form the basis of the comparative-planetology section of the database, essentially expanding the information on optical properties of aerosols of atmospheres of the planets of the terrestrial group and create important basis for correct interpretation of the ground-based astronomical observation and future space flights.

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1252.
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PHOTOSTIMULATED CONVERSIONS OF METHANE ADMIXTURES IN THE AIR MEDIUM

MUSTAFAEV I. *, MAMMADOVA I. **

*Ecological Socie y of "RUZGAR", 124/128 G.Garaye a e. 370119 Bak , Azerbaijan

** Sec or of Radia ion Researches, Azerbaijan Academy of Sciences ,

31-a H.Ja id a e 370143 Bak , Azerbaijan

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Methane emissions into the atmosphere as a results of natural and industrial processes constitute about 50 mln tonnes in a year. Owing to high diffusion abilities methane easily spreads to the middle and upper layers of the atmosphere and takes part in photostimulated physico-chemical reactions. Under certain conditions the participation of methane in this processes may considerably influence on the rate and direction of chemical reactions, and at the end make contribution to decomposition of ozone layer, "greenhause effect", formation photochemical smog and etc.

The results of investigation of kinetics and mechanism of vacuum-ultraviolete photostimulated conversions of methane in the air medium are conducted in this paper. Obtaining of informations on kinetics in this reactions allows to predict the influence of methane admixture on chemical processes in the atmosphere.

Experiments were carried out at ranges of changes concentration of methane in the air 0.01 - 99,5 % , total pressure of gasephase mixture are 0,04 - 100 kPa and irradiation time 10 - 300 minutes. As a sources of VUV -radiation the Kr and Xe rezonanse lamps were used.The wave lenght of VUV- radiation were 123 nm and 147 nm and the radiation flow was 4-4,5 10^{15} quant/s. As a index of processes are determined rate and quantum yields of formation H_2, CO, C_2H_4, C_2H_6, O_3, also decomposition of methane admixture. It is established, that at the dependence on wavelength and methane concentration in the air medium, methane is decomposed

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to direct and indirect processes:

C_4H + radiation _____ CH_2 + H_2 (or CH_3 + H) (1)

C_4H + O (D) _____ CH_2O + H_2 (or CH_3O +H) (2)

Such as under radiation with wave length 123 nm and [CH_4] more than 0,1 % reaction (1) dominate from (2), being at the 147 nm and [CH_4] less than 99,5 % atoms O(D), formed at the photochemical decay oxygen are of vitial importance in photochemical methane decomposition processes. It has been shown, that at the methane concentrations [CH_4] more than 0.05 % in the air medium occurs sharply decrease of photolitical ozone concentration at the expense of decrease of its generation rate at the presences of methane in processes of radiation absorption and in the reaction with precursors of ozone. At the changes of methane concentration in the irradiation mixture 0.1-51 % the quantum yields of ozone are changed at limits 0,35- 10^{-4} molec/quant at the 123 nm wave length radiation and 0,4- 10^{-3} molec/quant at the 147 nm.

As results of analysis are obtained ratio of constants rates of reactions:

$O(P) + CH_4$ _____ $CH_3 + OH$(a)

$O(P) + O_2$ _____ $O_3 + M$ (b)

Finding that K_a/K_b = 942.8 .These results satisfactorly correspond with changes literature datas.

Given kinetical scheme of happened reactions of methane mixture with air under VUV-radiation.The kinetical schemes include 161 reactions of 41 particles. At the basis this kinetical scheme are calculated kinetics for formation stable products (H_2, CO, O_3, C_2H_4, C_2H_6, NO_x, aldehydes, alcohols, organic acids and etc) and the activity intermediate particles (O, H, CH_3, CH_2, OH, X* and etc). The calculation dependence of yields these products at the wide changes ratio components and irradiation time are obtained.Comparisons of calculation and experimental results on formation O_3, CO, H_2 were carried out.The satisfactorly (to 20 %) agreement among these results is observed.

The discussion of experimental and calculation results are adduced.

1254.

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PHASE EVOLUTION OF ATMOSPHERIC CLOUDS." NEW CONCEPTION BASED ON EXPERIMENTAL DATA

ANATOLY N. NEVZOROV

Cen ral Aerological Obser a ory, Dolgopr dny, Moscow Reg., 141700 R ssia do d@adonis.iasne.r

(First received 24 February 1998; accepted for presentation during IAS-4)

The present knowledge of two-phase microstructure and phase evolution of clouds at negative temperatures being basically a priori, is in poor general agreement with the factual evidence and is only weakly progressing under limited possibilities of field experiment. Representative comprehensive measurements performed in the late 80s with the CAO aircraft instrumentation have revealed a. series of new unexpected peculiarities of phase and disperse composition of such cold clouds:

l. In clouds consisting of only supercooled water drops as commonly accepted, actually ice fraction is usually detected with particles less than 20 to 30 mkm in size and up to tens of thousands per a litre in concentration.

2. Bath purely ice and mixed, by definition, clouds integrated here as ice-containing clouds (ICC), equally practically always carry liquid droplets up to tens and hundreds micrometers in size. The liquid phase in ICC persists at temperatures down to at least - 55°C. As to mass and numerical content, the droplet 5 action is comparable' with ice one and exhibits positive spatial correlation with this.

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3. Just listed represents the complete set of' signs of. condensation equilibrium between both condensed phases in mixed clouds which include almost without exception all ICC. As this takes place, in all ICC the relative air humidity proves to be lower than saturated relative to liquid water.

4. It is found from the comparison of magnitudes of microphysical parameters determined through the use of different physical methods, that the substance of ICC liquid droplets has the refractive index between 1.8 and 1.9 and hence the density 2.1-2.2 g.cm^{-3}, and the evaporation heat about 550 J/g at - 30'C. It is important to add thereto that the known phenomenon of coloured gloria on a mixed cloud top can be elementarily interpreted as the first-order bow formed on big enough spheres having the refracting index close to 1.83.

The conclusion is justified from all sides that the liquid droplets in ICC are comprised not of usual supercooled water, as it is generally agreed, but of a specific amorphous phase of water, or A water. This water state is distinguished by the absence of intemolecular hydrogen bonds, and is known from laboratory experiments as both solid and melted amorphous ice. The amorphous water has the vitrification/softrening temperature 135 K and the flowability limit at about 150 K (-120'C). In melted state, this is capable of spontaneous crystallization with transforming to usual ice I.

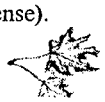
The analysis of great totality of both known and newly obtained experimental facts, based on the fundamentals of the physical chemistry, leads to the following conclusions.

Having the lowest condensation enthalpy of all condensed phases of water, the A-water can nucleate only though direct condensation from vapour. At the same time, A-water plays the genetic role of an intermediate phase, or polymorphous substance of two-step phase change in ice deposition processes by the Ostwalds rule. This statement is confirmed by the existence of quasi-liquid transition layer on the surface of ice particles, responsible as such for the condensation equilibrium between ice and A-water particles. At the absence of active crystallization centre in a nucleus of condensation of A-water, it stays in metastable form of liquid droplet.

The permanent coexistence in ICC of droplets of A-water and ice particle;. in comparable concentrations being by orders different from these of the known ice-forming nuclei, suggests the universal dominant role of the mechanisms of condensation and partial ciystallization of A-water in formation of ICC. Essential independence of average concentrations of both ice and liquid particles of temperature, including lower than -40oC (gives the indication of' uniformity of microphysical processes forming ICC microstructure.

It was found in recent years that the icing of water clouds can be resulted from not only commonly accepted freezing of supercooled droplets, but also from their evaporation accompanied by regeneration of former nuclei of condensation of ordinary water into the secondary ice forming nuclei. As follows from our data this evaporation-reactivation mechanism forms the nuclei of both condensation and subsequent crystallization of A-water and is far more productive in ice generation than the freezing mechanism. The abundance in the atmosphere of cloudiness layers with vapour supersaturation relatively to ice implies that the A-water condensation nuclei are usually absent in dry air, and possible obligatory condition for their natural generation is the intermediate condensation of ordinary water.

In a water cloud, the secondary nuclei are capable to be collectively generated under the lowering of environmental humidity, sufficient for though the smallest droplets to evaporate. The originated thereon particles of A-water and ice are first very slowly growing to sizes of order of 20 mkm. This just gives the most real explanation of many-hours lifetime, as observed, of supercooled water clouds which are in fact in unstable "latent-mixed" state. As the gravitational fall of growing particles accelerates, the slowest molecular diffusion mode of Bergeron phase re-condensation converts to increasingly fast convective mode, completed by the avalanche-type process of full evaporation of ordinary water with vapour deposited on A-water and ice particles (Bergeron -Fiodeiseo process in extended sense).



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The terminal stage of the phase evolution of a cloud, called above ICC, is the equilibrium three phase system. The utilitarien definition of ICC may be either or both colloidally stable mixed cloud and "quasi-ice" cloud in which a part of disperse ice stays in the metastable form of intermediate liquid condensate.

The content of A-water in ICC averages between 60% and 80% of total water content at all temperatures down to -55oC. The droplet effective diameters vary in most cases within the limits 20 mkm and 100mkm. The droplets of A-water have as a whale a dominant impact on diverse optical properties of ICC, far from excluding cirrus clouds even at temperatures lower than -40'C.

The conclusions suggested are deduced solely from the analysis of wide totality of reproducible observational evidence and experimental data as well as of scientific fundamentals. These not only refine the basic conceptions of the physics of cold clouds but also put forward comprehensive explanations for numerous poorly understandible phenomena involved.

1197.
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THE TRACE GASES IN ATMOSPHERE OVER LAKE BAIKAL.

POTEMKIN OF V., KHODHZER T.

Limnological Institute, Siberian Division of RAS, Irkutsk, Russia 664033 Ulan-Batorskaja St. 3

(First received 26 January 1998; accepted for presentation during IAS-4)

Key words: gases, atmosphere, sulphur dioxide, nitrogen dioxide, ozone.

During 1993-1996 there were conducted natural measurements of concentrations of sulphur and nitrogen dioxide and ozone in near-water layer of atmosphere. Measurements were done with the help of correlative mass-spectrometer and ozonometer M-124. The operation principle of the spectrometer is based on the measurement of relative difference of intensity of optical radiation in two sets of narrow spectral ranges which correspond to maxima and minima of absorption of investigated gas. The device calibration was regularly done by the setting of optical quartz cuvette with the certain amount of gas on the way of received radiation. The observations were carried out with simultaneous registration of meteodata and visibility distance.

Background content of gases in atmosphere over Lake Baikal in summer time is average 1-7 mkm/m*3 for sulphur dioxide and 0.5-2.5 mkm/m*3 for nitrogen dioxide.

Increased values of concentrations of sulphur and nitrogen dioxide are observed close to industrial and agricultural sources (Baikalsk, Severobaikalsk, Ust-Barguzin). High concentration of gases was observed in train and chimney of discharges of Baikalsk town with the fast decrease towards the lake which was due to wind direction along the coast. Increased values of nitrogen dioxide were observed in the region of river Selenga and Barguzin Bay (to 10 mkm/m*3).Along river Angara from Lake Baikal to Irkutsk city the concentrations of nitrogen dioxide increase, but these values are lower than accepted ones for settlements (20 ppb). In Central Baikal these values were not registered at all.

There were observed daily concentrations during sunny days with maximum of 13-18 hours.

1410.
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THE INVESTIGATION OF THE INFLUENCE OF CLOUDS AND PRECIPITATIONS ON THE PROCESSES OF SCAVENGING THE AEROSOL FROM THE TROPOSPHERE

N.E. VEREMEI, YU.A. DOVGALUK, A.D. EGOROV, M.A. ISHENKO, YU.PH. PONOMARYOV, A.A. SINKEVICH, D.D. STALEVICH, V.D. STEPANENKO, K.S.KHVOROSTOVSKY

The Main Geophysical Observatory, Saint-Petersburg sinkev@main.mgo.rssi.ru

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The results of complex investigations of interactions of aerosol with clouds (fogs) and precipitations are considered. The effectivity of this process is evaluated. The evaluations of time variations of humid scavenging coefficient obtained from the data of nature, laboratory and numerical experiments are presented. The purpose of this work is to summarize the results of complex investigations of dynamics of humid scavenging the aerosol by clouds and precipitations, carried out by specialists of MGO during last years.

Nature experiments. Their purpose is to obtain the data of the effectivity of aerosol scavenging by precipitations in polluted industrial region and in ecologically clear region. The measurements were carried out in warm seasons of 1993 - 1994 and in cold period of 1997 at the meteorological station of MGO (Saint-Petersburg) and also in summer 1996 in ecologically clear region at the east of Leningrad Oblast (at the Field Experimental Base in Turgosh). Photoelectrical counter PC.GTA and lidar LIVO were used for measuring aerosols.

In 1993 - 1994 it was 13 days with precipitations during the aerosol measuring. The precipitations were of different intensity and continuance and were related to different synoptical situations. Aerosol measurements were carried out during 39 days. Aerosol concentration changed about 2 - 3 times a day; from day to day these variations reached 30 times. It was determined by air mass transfer, the wind near the Earth surface and local aerosol sources.

The data of measurement were subdivided on 4 groups for evaluation of the influence of cloudiness and precipitationregime on aerosol particle concentration. The 1-st group - the days when cloudiness was nonsignificant (related to heat covection) or clouds were abscent at all. From this group the days with significant cooling were selected in the 2-nd group. Convection during the days of the 2-nd group was weak. The days of the 3-rd group are that of significant cloudiness, more often stratiform, related to the frontal situation or the warm sector of the cyclon. The great cloudiness and inversion layers in the atmosphere prevented the development of convection. The days of the 4-th group are that with precipitations in the period of observations (more often - from convective clouds).

In some days synchronic measurements of coefficient of weakening radiation and that of particle concentration were carried out with making use of lidar and photoelectric counter respectively. Observations demonstrated good agreement between time variations of these characteristics.

Lidar sounding data demonstrated, that when finishing precipitations some period of scavenging the atmosphere was observed. 17 days with precipitations were analysed. The days were selected in particular groups: the days with weak precipitations of small continuance - into the 1-st group, those with weak but long precipitations - into the 2-nd one, those with significant but short-time precipitations - into the 3-nd one and the days with significant and long-time precipitations were selected into the 4-th group. The effect of scavenging was the most distinct in the long-time intensive precipitations. Data available show that The effect of scavenging takes place in 1 - 2 hours - in the case of long-time precipitations (the 2-nd and the 4-th groups). In the 3-th group significant but short-time precipitations did not result in long-time effect. In average this effect was being observed in 30 min.

In winter 1997 were 22 days when measuring the concentration of aerosol particles $d > 0.3$ mkm were carried out (about 70 measurements a day). During 5 days measurements were performed in snow. For example on 18.03.1997 it was snowfall of weak and measurable intensity in Saint-Petersburg. Before and after precipitations the concentration of particles of all sizes increased, but during precipitations it decreased. Scavenging coefficient was approximately equal for particles of all sizes and it-s value was about 7,0 (-3) -- 8,0 (-3) /s.

The experiment of 10.08.96 carried out in Turgosh was shown as an example of aerosol measurement in ecologically clear region. Precipitations were in the form of rain (by portions). The results of the experiment showed that during intensive precipitations great increasing the

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the diffractometrical spectrometer DFS-12. The preciseness of determination is 10-10 mgr/m^3. The results of the analysis are given in the table.

As it is seen from the table despite the place and time of the samples taking utmost possible concentration (UPC) of benzopyrene exceeds the limit for one order and even more. It is set that the pollution of the atmospheric air can exceed UPC for two orders. The degree of the air pollution with the carcinogens depends on the air flow direction, what is seen from the experiment data of the simultaneous analyses of the benzopyrene content in the air samples at the factory territory and 2miles from it.

Nevertheless the pollution of the environment with the carcinogens is not only a result of gases amission . One of the possible and really existing ways of the soil and water pollution with the carcinogens is the soot which is the component of the solid emissions of the factory and which made approximately 289,902 tons/year.

It should be pointed out that the the Dashiv factory soot analysis showed that in 1 kg of soot there is 880 mkg only of the benzopyrene.

The study of the pollution of the adjoining to the factory territory (area of 12 km^2) for carbon showed, that the anomalies for the carbon are characterised by the medium contrast, maximum concentration (Kk = 3,57) was registered at the distance of 1 km from the factory.

The results obtained on the pollution of the city Striy atmospheric air with benzopyrene showed that the concentration of the carcinogens considerably exceeds UPC. Nevertheless, if the concentration of benzopyrene as a result of the jams while the intensive city traffic (8.00a.m. - 16.00p.m.) exceeds UPC 54-58 times, and at a diminution of the traffic flow (evening - night) benzopyrene concentration decreases approximately 5-5,6 times, but anyway exceeds the UPC for one order , the analysis of the air carried out in the settlement zone showed the considerable impact of the industrial enterprises on its pollution with carcinogens. Thus the content of benzopyrene varies from 37,2 to 167,7ngr/m3. This fluctuation can be connected only with the direction and strength of wind from which the degree of distribution (concentration) of the carcinogens in the air of the region depends.

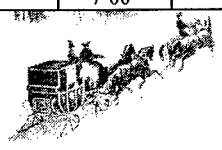
Thus, the analysis held allowed to conclude that one of the main reasons of the increase of the malignant tumours in the region is the pollution of the atmospheric air with polycyclic aromatic substances.

By now the activity of The Dashiv Soot Plant is suspended.

* Serth R.W., Hugnes Th.-Environ. Sci. Technol., 1980, v.14, p.298-301

Observed area The time of the air selection The time of the air selection Concentration found

#	Observed area The time of the air selection (beginning)		The time of the air selection Concentration found (end)	
1	The factory entrance	14`00``	21`00``	20.7
2	-//-	21`40``	7`25``	128.2
3	-//-	7`30``	14`00``	16
4	Two miles from the factory	14`20``	21`10``	65.5
5	Striy city, the zone of the intensive traffic	22`20``	8`00``	10.2
6	-//-	8`00``	14`30``	57.7
7	-//-	14`30``	21`30``	54.5
8	Striy city, the settlement zone	15`20``	23`20``	166.7
9	-//-	23`25``	11`55``	37.2
10	-//-	7`00``	15`00``	37.5



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1506.
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COMPLEX AEROSOL PROGRAM OF THE INSTITUTE OF ATMOSPHERIC OPTICS SB RAS, TOMSK, RUSSIA

V.E ZUEV

Institute of Atmosphere optics, Tomsk, Russia, zuev@iao.tomsk.su

(First received 20 April 1998; accepted for presentation during IAS-4)

The complex aerosol program contains the following major scientific areas:

1. Systematic laser sensing of aerosols using the unique Siberian lidar station.
2. Laser sensing of aerosols of natural and anthropogenic origin in different regions using the unique aircraft-laboratory.
3. Laser sensing of aerosols above the sea and ocean surfaces using the instrumentation installed on board the research vessels.

As a rule, the aerosol sensing is made in combination with the other characteristics of the atmosphere including the meteorological parameters and various gases both of natural and anthropogenic origin. Thus, the Siberian lidar station, owing to the simultaneous use of the five telescopes with the receiving mirror diameters from 0.3 to 2.2 m, as well as lasers with the wavelengths 1064, 532, 683, 628, 353, 308, 289 and 271 nm, makes it possible to obtain not only standard profiles of scattering cross sections but the particle size spectra and aerosol particle concentration in the altitude range from 0 to 50 km with simultaneous measurement of profiles of temperature, ozone and nitric oxides. In particular, using this station we investigated volcanic aerosols erupted from the Mt.Pinatubo volcano started from the first aerosol cloud over the Tomsk (06.07.1991) and ending with disappearance of volcanic aerosol traces late in 1995.

A well instrumented aircraft-laboratory AN-30 capable of continuous long distance flight during 9 hours has made it possible to investigate the ecological atmospheric conditions over 108 cities of our country. The airborne equipment consists of 15 different instruments and systems including a sun spectrometer, a chromatograph, nephelometers, a spectrophotometer, a lidar, a radiometer, an infrared system, a system for determination of pH and chemical composition of aerosol particles (up to 30 different atoms and ions), a central computer.

Over many years from 1988 to 1995 the Institute of Atmospheric Optics took part in 7 expedition voyages of research vessels over a period of 46 days in 1988, 62 days in 1989, 83 days in 1991, 19, 73, 26 and 29 days in 1995.

Over this period a great body of data was obtained and analyzed on the integrated aerosol optical thickness in 25 water areas of the Atlantic ocean from equator to 60 N and from 80 W to 20 E. The data were obtained and interpreted on the spectral dependence in the wavelength range from 0.4 to 12 mkm in the five typical water areas as well as the meridian dependence of the integrated optical thickness. In parallel with the data on the integrated aerosol optical thickness the data were obtained on the vertical thickness of water vapor for different ocean areas as well as the data on carbon dioxide concentration over the water surface. Together with the above results a great body of data on the oil slicks pollution of the ocean surface were obtained. The measurements of all the above-mentioned characteristics were made using the instrumentation created at the Institute of Atmospheric Optics, namely, aerosol lidars, radiometers, laser fluorimeters and other devices.



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984.
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THE EFFECT OF MAN FACTOR ON ATMOSPHERIC ECOLOGY (AEROSOL POLLUTION)

ANDREYEV E.

All-Russian Vavilov Scientific Centre SOJ ; Birjevaya linia, 12, St-Petersburg, Russia

(First received 18 November 1997; accepted -9.02.98 for presentation during IAS-4)

The advantages in studies of the Earth atmosphere allow to understand clearer the effect of man factor on atmospheric processes which determine its state and radiative properties. Modern scientific knowledge at the Earth atmosphere may outline the four main negative effects of man factor on environment: stratospheric ozone depletion, acid rain , toxicity and global warming. The atmospheric aerosol takes active part in these processes due to its chemistry and optical characteristics. The presence of aerosol particulates in atmosphere stimulate different chemical reactions on their surfaces. So the chemical composition of atmosphere changes. The aerosol particulates effect also on radiation processes in atmosphere. Annual release of polluting chemicals in continental U.S. by industrial activity shows a scale of effect on environment [1].

Table 1.

Sourse	Quantity (kilotons)
Heating and power generation	33000
Transportation	9100
Industrial processes	6100
Rockets	3

The particulates contribute a significant part of this release. As an example, annual contributions (in kilotons) of the most important gases released in stratosphere by different sources are shown in the table 2.

Table 2.

Source	Cl	H_2O	H_2	Nox
Industrial	300			
Volcanoes	100-1000			
Natural	7.5	15600	340	280
Rockets	0.79	3.25	0.2	0.016

Note: chlorine data are global, other data for northern mid -latitudes. The properties of aerosol particulates as catalysts are known insufficiently. Studies indicate that the rate of the catalysis of ozone depletion by fine fraction of particulates depends on their surface area, and that the threshold surface area for ozone depletion is 5...10 mcm^2/cm^3. It should be noted that the lifetime of particulates in the stratosphere is on the order of 1...2 years. This phenomenon was seen during the eruption of volcanoes El-Chichon in 1981. Another problem of aerosol pollution is global actinometric measurements and its influence on optical characteristics of atmosphere [2]. The concentration of particulates can reach 10^{10} particles on cm^2 of vertical column in the atmosphere of industrial zones and megapolices. The spectrophotometric observations indicate that the atmosphere above such regions remains strongly turbid during a long time without natural purification. Under strong aerosol pollutions of air the radiation absorption by aerosols can reach values to be compared with those for molecular absorption by all atmosphere gases. So

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one should take into account aerosol atmospheric component when considering such phenomena as "green-house' effect and rainfall at forecasting a local weather. Analysis of different aspects of aerosol pollution shows the necessity for studies of optical and physical properties of aerosol particulates from different souses and operative optical monitoring of aerosol pollution of atmosphere above industrial regions.

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1054.
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MATHEMATICAL MODELLING OF DISTRIBUTION OF ECOLOGICAL RISK ZONES IN ATMOSPHERE AND ON THE UNDERLYING SURFACE FROM AIR ANTHROPOGENIC SOURCES

ARGUCHINTSEVA A.V.

Irkutsk State University, Russia

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At present the standard methods of air pollution estimate are able to calculate absolute concentrations of ingredients for concrete meteorological situations. Usually the joint realization probability of all meteorological parameters of these situations is approximately equal 0. In contrast to such approach the mathematical models considered in this work take into account the probabilistic distribution function of the stable climatic characteristics of the region and all wind situations. These models are a special case of solution of boundary problem with the random coefficients for description of natural processes dynamics. In order to calculate a probability of realization for some solution it is evidently necessary to consider a set of solutions for various combinations of random values of coefficients, initial and boundary conditions.

The behaviour of these coefficients is determined by multi-dimensional function of probability density. A concrete form of theoretical density function may be established from a minimal discrepancy with an empirical distribution law (assigned on the base of external factors for the problem under consideration). The problem solving is considerably simplified when analytical solutions are used for the differential equations of transport and turbulent diffusion. The results will enable to perform a probabilistic evaluation of studied phenomenon, e.g. frequencies of the given criterion exceeding. Such the results may be following: probability of appearance of various climatic extrema, probability of exceeding indicated norms for the pollutants and for duration of living organisms stay (residence) in such dangerous zones. In addition a quantity of pollutants deposited on the surface (soil, water bodies) from sources can be evaluated for the studied time interval. Problems of the second pollution of surface can be solved.



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DMS OXIDATION IN A NON-REMOTE LOCATION

BARTHELMIE R.J. [1] **, PRYOR S.C.** [2]

[1] *Climate and Meteorology Program, Indiana University, Bloomington IN 47405 USA*

[2] *Dept. of Wind Energy and Atmospheric Physics, Rise National Laboratory, Denmark.*

(First received 27 February 1998; accepted for presentation during IAS-4)

The role of biogenic sulfur (S) emissions in the chemistry of the marine boundary layer is important because of the potential climate feedback mechanism of aerosol sulfate formation. Most previous studies, both experimental and numerical, have focused on the remote marine boundary layer where the hydroxyl radical addition or abstraction reactions are the most important pathways for dimethyl sulfide (DMS) oxidation. However, it has also been suggested that the nitrate oxidation pathway is important in less remote locations (Yvon et al., 1996).

We examine spatial aspects of the relative importance of DMS oxidation pathways and discuss the implications for the relative abundance of various DMS oxidation products in coastal locations. An amended version of the DMS mechanism of Hertel et al. (1994) has been implemented in the Inorganic and Secondary Organic PARTicle model (ISOPART) (Pryor and Barthelmie, 1998), a lagrangian model in which gas and aerosol chemistry are fully coupled. Evaluation of this mechanism in the remote marine atmosphere suggested that it is conservative in its conversion of DMS to sulfur dioxide and non-sea salt sulfate but produces relatively large concentrations of methyl sulfonic acid (MSA) and methane sulfinic acid (MSEA) (Capaldo and Pandis, 1997).

In this application to the Lower Fraser Valley (southwestern British Columbia/northwestern Washington State). comparatively high concentrations of N compounds means that abstraction by the nitrate radical is the dominant oxidation pathway, except where trajectories originate and terminate over the ocean. During the simulation period the inclusion of DMS emissions and chemistry increases sulfur dioxide concentrations in the domain by up to 28% and sulfate concentrations by up to 10%. Further results will be presented showing the spatial variability of DMS chemistry in response to meteorology and emissions patterns, and the contribution of biogenic S emissions to secondary aerosol concentrations.

Acknowledgements

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1626. УДК 541.18

NITROGEN OXIDES AND OZONE IN THE ATMOSPHERE OF CITIES

BEZUGLAYA E. YU. , SMIRNOVA I. V.

Main Geophysical Observatory, St. Petersburg

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Of pollutants released to the atmosphere with anthropogenic emissions from industry, power plants and transport nitrogen oxides are among the most important. They form basically in the process of organic fuel combustion at high temperatures which then change to NO_2. The reactions

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with participation of nitrogen oxides in the atmosphere and photochemical processes lead to 0_3 formation Until recently, the urban air pollution level was believed to be determined by the amount of emission released into the urban air basin and by local conditions of transport and dispersion of pollutants over the given territory.

This study has been made to get a more complete idea on the location latitude effect upon NO_2 concentrations. For this purpose regression analysis was be made on the mean concentrations of NO_2 in Russian cities depending on the site latitude. Analysis shows that the mean many-year concentrations of NO_2 in cities on the territory of Russia increase noticeably southward, the mean latitudinal NO2 concentrations increase between 70o N and 40 o N (12 - 33 ppb). The eoeffcient of correlation between the NO_2 concentrations in cities and the latitude of the location is 0.66.

The correctness has been checked against the data of major European cities [The Air Quality in Major European Cities, 1995] from the data of Russia [E.Bezuglaya, 1991] and the USA [National Air Quality, 1992] for 1990. The largest values of NO_2 concentrations clearly increase southward by the factor of more than 3 from 8 ppb near 64° N to 60 ppb on 38° N. The coef5cient of correlation between the NO_2 concentrations and the latitude of the location for major cities is 0,79.

The observed distinct increase in the nitrogen dioxide concentration from north to south is related with the differences in total solar radiation intensity as well as the differences in NOx concentrations. Within the latitudes under study the total solar radiation changes by the factor of more than two and the mean NO_2 concentrations also increase by the same factor. On the average for a year the content of NO_2 in NO_x at a given latitude can be predicted rather accurately.

These limiting values increase appreciably from the location latitude 70° N to 50 N and very slightly at smaller latitudes. The low concentrations of NOx contain more than 50% of NO_2, if NOx concentration is higher than 50 ppb a part of NOx in the form of NO_2 decreases. The mean limiting values of NO_2 with NOx =100 ppb are equal to 25 ppb at latitudes 60-70° N, and 45 ppb at latitudes 40-50° N. At high latitudes the emissions of nitrogen oxides from industrial sources are usually low, therefore the limiting concentrations of NO_2 in the urban atmosphere are not observed.

An increase in the total concentration of nitrogen oxides is also observed which can be explained by the effect of natural NO_x emissions. In the territory of Russia they account for about 40% of the sum. of anthropogenic and natural emissions.

Ozone concentrations are related with NO_2 concentrations and NO/NO_2 ratio. The relationship between the annual mean concentrations of NO_2 and 0_3 (ppb) can be seen from the data for 25 cities of Europe [Air Quality...1995]. The correlation coefficient is equal to 0.714.

To be able to forecast ozone concentrations in Russia cities, the regression equation obtained was checked against the mean concentrations of NO_2 and 0_3 (ppb) in St. Petersburg

According to the calculations, the highest summer concentrations of 0_3 (up 26 to 30 ppb) are observed on the territory of cities located to the south of 55° N. Forecasted ozone concentrations differ from observed ones by 10-20%.

1514.
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THE INFORMATION-ANALYTICAL COMPLEX FOR THE ACCOUNT OF AEROSOL EMISSIONS IN THE ATMOSPHERE

A.I. DEGTIAREV[1], A.D. NAUMOV[2], V.P.VALTERAN [3]

[1] *Institute of geography*

[2] *Hydrometeocenter of Russia Russia, Moscow e-mail: anaumov@mskw.mecom.ru*

[3] *Gaspromavia RAO Gasprom*

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Aerosol emissions of an antropogehic derivation transferred in the boundary layer of the atmosphere with the help of particular meteorological conditions are one of the main sources of

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pollution of the air. The antropogenic load on the condition of an environment more and more increase. therefore, a forecast and a monitoring of pollution in the atmosphere become one of actual problems at present time.

The informational-analytical complex (IAC) of Hydrometcenter of Russia permits to make calculations of the concentration of polluting substances (PS) in the atmosphere from one or some sources of pollution. IAC include:

* the data base of pollution sources;
* the data base of meteorological conditions;
* the base of actual polutions in the atmosphere (if such ones are present);
* a account model of distribution PS in the atmosphere - OND-86 (Berlyand method);
* the account model of distribution PS in the atmosphere - it is the Gauss statistical model for a constantly acting source;
* the account model count of distribution PS in the atmosphere - it is the Gauss statistical model for a instant source;
* the account model of distribution in the atmosphere - it is the Gauss statistical model for a temporarily acting source;
* the archive of account results;
* the comparison block of account results;
* the visualization of account results.

The data base of polluting sources includes the information about a source power[g/s], a height of a source and its diameter [m], and also a speed of aerosol emission [m/s].

The data base of meteorological conditions must include the information a wind velocity on a level of 10 m temperature of the surface, snow conditions, all clouds in the bottom layer of the atmosphere (if such information is present), and a rouhtness of the surface (a field, a wood, buildings etc.).

The data base of observations contains the data about time, the measured concentrations of pollution at the control region, names of pollutants.

The data of control measurings can be used for comparison with results of model accounts.

The calculations of distribution PS in the atmosphere can be made with the help one of the following models: OND-86 - is applied for design and construction of industrial enterprises and their reconstruction, and with ecological examination.

The OND-86 is developed in GGO institute, St.-Petersburg.

There are 3 versions of the Gauss statistical model of caring in the atmosphere. The variants of the models used in the complex take into account condition of stratification of the atmosphere, a quality of the surface, time of the day and the availability of snow cover. The models can be used for the monitoring and the forecast of the content in the atmospheric air for gas and aerosol derivation.

The Gauss models take into account particular meteorological conditions. For example, the values of maximum concentration PS in the undersurface layer of the atmosphere changes some times from dependence under conditions of stratification of the atmosphere. Besides from dependence on the condition of the surface the distribution of maximum concentration PS change considerably too The models can be used for an ecological monitoring a forecast-express of the atmospheric condition of the air near sources of pollution.

The results of calculations are presented in digital and graphic sights, as fields of the concentration of polluting substances at the given high-altitude level, schedules of high-altitude sections, temporary changes of concentration in the points of the settlement area.

The offering program-information complex permits to decide a enough wide circle of practical tasks of simulation for distribution processes of industrial sources emissions of pollution.

The dialogue mode of a mutual relationship of the user with the complex enables to execute accounts on various source data, variants of the models and reduces number of errors of input

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information. Used in the complex the settlement model is not deprived defects and therefore is constantly modified.

It is necessary to emphasize, that the unification of intermodular relations permits, without specific efforts, to increase the information environment of the complex, to include new variants of the models and blocks of processing and display of account results. It permits to consider the offering complex, as a "opened system" for users, admitting expansion and improvement of the complex without participation of developers.

The first version of IAC was developed in State institute for applied ecology (see proceedings of IAS-3 in AEROSOLS journal). The further development of the complex was conducted in Hydrometeocentre of Russia, Institute of a global climate and ecology and Institute of geography. Accounts on the base of IAC were made for ecological monitoring of Kurgan (town). IAC was used for an estimation of gas-aerosol emissions at designing of Artur D.Littl company for gas pipeline in region of Uralsk. On the basis of accounts on IAC ecological valuations of pollution of a air the enterprises AO " Odincovo factories" were executed. Accounts of pollution of the atmospheric air were conducted together with MosCHMC institute.



1446. УДК 541.18

GLOBAL CHANGES OF COMPOSITION AND TEMPERATURE OF THE ATMOSPHERE CAUSED BY SULFUR DIOXIDE DISCHARGES INTO ENVIRONMENT

DYOMINOV I.G.[1], ZADOROZHNY A.M.[1], ELANSKY N.F.[2]

[1] Novosibirsk State University, Novosibirsk, 630090, Russia;

[2] Institute of Atmospheric Physics, RAS, Moscow, 109017, Russia

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A two-dimensional zonally averaged model is used to examine global changes of composition and temperature of the troposphere and stratosphere caused by sulfur dioxide discharges into environment, which are due to the mount Pinatubo eruption and regular flights of supersonic aviation in the period of 1990 - 2015. The model self-consistently calculates diabatic circulation, temperature, and distribution of 45 gas constituents and distribution of condensed particles in a sulfate aerosol layer. To adequately represent the main features of sulfate aerosols of the atmosphere with sizes in an interval $0.0064 < r < 5.2$ microns, a rather complete scheme of photochemical changes of sulfur compounds has been used along with the most important microphysical processes including nucleation, condensation, evaporation, and sedimentation. To take into account gas component sinking on aerosol particles surface, six heterogeneous chemical reactions are used. The calculations are made for the latitudes from the North to South poles at altitudes from 0 to 50 km. It is shown that megaton discharges of sulfur dioxide in the atmosphere during the Pinatubo eruption result in significant changes of temperature, gaseous and aerosol composition of the troposphere and stratosphere. For example, by the end 1991 we have in tropics (30°N - 20°S) at altitudes of 22 - 24 km a -2.5-3.5K increase in temperature, while at altitudes of 5 - 8 km a -0.8-1.0K decrease in temperature. It is caused by the intense absorption of solar radiation by aerosol particles from powerful eruptive stratospheric clouds. These clouds play a role identical to that of polar stratospheric clouds leading to form the ozone hole. At the surfaces of particles forming these clouds comparatively inactive HCl and $ClONO_2$ transform itself into more active chlorine components. In -100 days after eruption this results in a 5-7% decrease in total ozone at latitude of 35°N-25°S. An autumn transport of eruptive aerosols to higher latitudes brings about a significant variation of ozone in the polar region. This effect is

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most pronounced over Antarctic where the spring 1992 decrease in total ozone receives a 15 - 18% addition in comparison with 1991. It is the result of the sharp decrease of the ozone at the heights of 11 - 13 km and 17 - 28 km. Powerful discharges of sulfur dioxide from the Pinatubo eruption significantly increase the aerosol optical thickness of the stratosphere. This leads to a - 0.28K decrease in monthly mean global temperature at the Earth's surface by the end of 1992.

Calculations of global impact by regular flights of 500 supersonic aircraft on gaseous and aerosol composition of the troposphere and stratosphere are carried out with the two values of nitrogen oxide emission index ($EI(NO_x)$), 15 g and 5 kg of NO_2 equivalent per 1 kg of fuel. Emission index for SO_2,H_2O, CO, CO_2 and CH_4 are adopted to 0.4; 1230; 1.5; 3160 and 0.2 g per 1 kg of fuel. Averaged global fuel consumption is 80 megaton a year. The ratio of a mean speed of flights to the sound velocity (Mach number) is 2.4. Calculations are carried out with account taken for SO, injection into the atmosphere from aircraft engines as well as without this injection at all. Three kinds of sulfur compounds emission are used: as gas (100% SO,), as gas/particles mix (90% SO_2 Grid 10% SO_2 converts into aerosol particles), and as 100% particles. The size of sulfate particles is taken to be 0.01 microns.

It is shown that it is necessary to take into account the processes involving atmospheric aerosol particles in order to be able to adequately estimate global change gaseous composition of the atmosphere by regular flights of supersonic aviation. Thus, consideration of heterogeneous surface processes on particles of background ($EI(SO_2)=0$) sulfate aerosol layer leads, in the entire region, to a significantly lower ozone destruction than consideration of only gas-phase reactions. It is the result of heterogeneous conversion of NO_x(NO+NO,) into HNO_3 leading drastic weakening of destructive effects of the nitrogen cycle on ozone.

Thus aerosol sulfate particles are a buffer in the atmosphere, that is, weaken the effects of aviation on the ozone layer. When sulfur dioxide injection by supersonic aviation is present, such a buffer characteristic of sulfate aerosols significantly depends on the kind of sulfur compounds emissions, NO_x emission index value, and odd chlorine background content. The kind of emission of sulfur compounds defines a character of changes of effective surfaces of sulfate aerosols.

The results of self-consistent model calculations show that without SO, emission ($EI(SO_2)=0$) the impact of aircraft exhausts on a background value of sulfate aerosol surface density is hardly noticeable. This fact allows us to take into account only sulfur compounds emission for estimation of supersonic aviation impact on the sulfate aerosol layer of the atmosphere. This estimation gives a significant (about 35%-50%) increase of aerosol surface density in the lower Northern stratosphere following sulfur compounds injection in the gaseous form (100% SO,). Gas/particle (90% SO_2/10% particles) mix gives a still more significant increase (up to 75%). When all SO, converts into sulfate particles, the latter causes a catastrophically great (-100% - 200%) increase in aerosol surface density in a wide range of latitudes (90°N - 20°S). All these effects are caused mainly by increased H_2SO_4 content and nucleation, condensation, and coagulation.

In light of all the above results, estimates of global ozone changes by 2015 due to regular flights of supersonic aviation show that for the two examined chlorine background contents (3 ppbv and 2 ppbv) sulfur injections accompanying those of nitrogen oxides lead to a decrease of prognostic depletion of total ozone in the Northern Hemisphere. Thus, for NO_2 and SO_2, emissions from aircraft engines anticipated in near future (that is, with $EI(NO_x) = 15$ and with $EI(SO_2) = 0.4$) sulfate aerosol layer is a buffer in the atmosphere of the Northern Hemisphere for every kind of sulfur compounds emission, that is, it leads (due to heterogeneous and microphysical processes) to the weakening of impact of regular flights of supersonic aviation on the ozone layer of the atmosphere.



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1026.
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AEROSOL EMISSION FROM CONTAMINATED STRIP OF SOIL DURING HARROWING AND TRUCK MOVING

GARGER E.K.

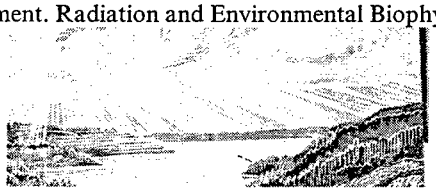
Institute of Radioecology UAAS Tolstoy St. 14 252033 Kiev, Ukraine

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Measurement of ^{237}Cs air concentration and "hot" particles for simulation of agricultural works (harrowing) and driving of vehicles along a dirt track into the exclusive Chernobyl zone allowed to estimate the emission flux and rate using solution of the turbulent diffusion equation for a dust strip[1]. Measurements were conducted by the gradient installation at the 1.0, 1.8, 2.5, 3.5 m heights and impactor with the aerodynamic cut off diameters 2.0, 4.0, 7.0, 12, 20, 30 μm [2]. Experiments were carried out from two strips with the density contamination by ^{237} Cs 0.31 ± 0.05 , 0.56 ± 0.06 [Mbq m^{-2}] and also the density of number "hot" particles 27.10^{-4} [m^{-2}], 60.5 x 10^{-4} [m^{-2}] respectively.

Vertical flux of ^{237} Cs for six experiments was varied from 22.2 ± 5.0 to 460 ± 90 [mBq m^{-2} s^{-1}] depending on a kind of vehicles and meteorological conditions. The emission rates have values from $0,07x10^{-6}s^{-1}$ to $1,5x10^{-6}$ s^{-1} and were by three-four orders of magnitude higher than for the wind resuspension conditions. "Hot" particles were measured in the third experiments that was given estimations of the emission rate ($1.1\text{-}2.5)x10^{-6}$ s^{-1}.

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1471
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ENVIRONMENTAL DAMAGE OF FLY ASH FROM THERMOELECTRIC POWER STATIONS FOR THE LIVING ORGANISMS - MODELLING WITH ULTRADISPERSED METAL POWDERS

GLUSHCHENKO N.N., BOGOSLOVSKAYA O.A., OLKHOVSKAYA I.P.

Institute for Energy Problems of Chemical Physics, Russian Academy of Sciences Leninskii prospect, 38, b.2, 117829, Moscow, Russia. Fax.: (095) 1378258, E mail: nnglu@chph.ras.ru

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As statistic data show, hundreds thousands tons of industrial fly ash and aerosols pollute the atmosphere. Industrial fly ash contains a great variety of inorganic compounds, including such elements as Mn, Cr, Cu, Ni, Pb, Hg, Cd, V etc., effecting negatively on the people health.

The data of laboratory studies form the base for the correct estimation of heavy metals damage for the human being. So our colleges from the Rostov University tested ecological situation in the vicinity of the Novocherkassk's coal power station (Rostov-on-Don) and showed that the zone of extreme metal content in the atmosphere sediments was within 3 km area from the station, Sb, Cs, Ni, Co, Cd, Hf, La concentrations exceeding the fone contents by 10-20 , Sr,

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Mo, Eu, U - by 5-8 fold. Biogeochemical analysis had shown that the Ti, V, Cr concentrations in plants in 60-280 times exceeded fone values, and Ni, Cu, B contents were 3-8 times larger than fone. Copper contents in wheat grown as far as 5 km distance from the powers station in 1,5 times exceeded the safe level. Ti, V, Cr, Ni, Zr, Ba contents in grain were 4-60 times larger than mean fone values. We have studied dispersivity, chemical composition and solubility of fly ash samples. Particles with size 0-5 micron appeared to present 41% of total amount. Particles of fly ash consisted from SiO_2, Al_2O_3, Fe_2O_3 and trace elements Pb, Zn, Cu, Mn, Cr, Ni, Cd etc. Washout analysis with different solvents (2N HCl or ammonia-acetate buffer, 200C, 7 days incubation) showed the following sequence of elements contents in the rinsing fluids: Fe (83%)>Cr>Ti>Ni>Mn>Pb>Zn>Cu=Co. The fly ash toxicity was similar to iron ultradispersed powder (UDP) toxicity. We suggest UDP metals for modelling of ecological effects of environmental pollution with fly ash of thermoelectric power station wastes. The specialties of UDP's administrated in the organism are: 1) a prolonged action on the biological targets due to a gradual dissolution in biofluides and 2) a great variety of ionic forms of metals as well as metal complexes with biochelators. The size of metal UDP particles are similar to fly ash particles. So the use of UDP metals allows us to estimate the contribution of individual components of fly ash to total biological effect. We studied the action of fly ash components on the growth of inoculated melanoma B-16. Zn(100mg/kg), Ag(10mg/kg), Al(10mg/kg), Cu(10mg/kg) appeared to stimulate tumor growth up to 35% in comparison with untreated tumor mice. Zn (5 mg/kg), Cu (0,1 mg/kg), Fe (2 mg/kg) did not affect melanoma B-16 growth. We have studied the effect of UDP metals on the life time of AKR-mice a model of spontaneous carcinogenesis. The total doses were close to the greatest tolerance doses. It was found that Cu and Zn UDP administration reduced animal's life up to two times. Radioactive aerosols are known to include a non-radioactive components such as Fe. The contribution of a non-radioactive constituents was studied in experiments with simultaneous action of radioactivity and Fe UDP. It was found that a combined effect of Fe UDP in doses (0,5-1,0) mg/kg and fractionated irradiation (1Gr and 2Gr, total dose 8Gr) decreased the lifetime of the irradiated mice by 1,5-2 fold. The investigation of total effect of iron UDP and fractionated irradiation of mice showed that essential changes took place in the system of cyclic nucleotides: in thymus (a radiosensitive organ) c-AMP contents decreased in two times, in liver (a radioresistent organ) c-AMP changes were less pronounced.

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AIR QUALITY AND ITS HEALTH CONSEQUENCES IN CENTRAL BALIKESYR TOWN

TALAT KOC

Department of Geography Education, Balykesir University, Necatibey Education Faculty. Balykesir, TURKEY.

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Air pollution is one of the important problems specifically of towns. Recently, the problem of air pollution is rapidly growing in the central Balykesir town.

One of the important negative effects of air pollution is the increase in health problems. For example, upper respiratory diseases are the most common related to the low levels of air quality. This study takes this problem into consideration and investigates the relationship between the air quality and the number of patients who register for upper respiratory problems in the period of 1990 and 1995. The aim of this study is to draw attention to the relationship between the two mentioned above and relate deaths.

Among the elements of air quality only sulphur dioxide (SO_2) and particule matters (PM) are measured in the central town. This measurement is done by the Laboratory of Public Health and the Directorate of Environment. For the air quality research, the average values of SO_2 and PM are taken into consideration. These values were weekly and yearly between 1990 and 1995. For the problems of health research, weekly number of patients who were applicant to the health units

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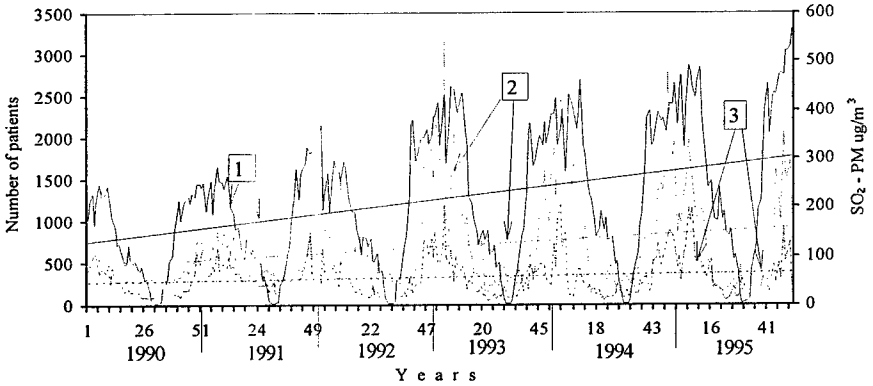
in the central town and suffer from upper respiratory diseases were investigated. Nevertheless, the problem of not being able to determine the number of patients who lived in the central town was emerged. Therefore, this problem needs to be considered in mind.

In Balykesir central town, air quality and Number of Patient Applicants (NPA) values are investigated in the six year period of 1990-1995. Changes related to time in the air quality and NPA values and relationships between the two are attempted to find out with the help of correlation coefficient.

There have been found obvious fluctuations in the air quality and NPA values in Balykesir central town (Figure: 1: NPA values and linear trend; 2: SO_2 values and linear trend and 3: PM values and linear trend). While in the warm period, air quality increases and NPA values decrease; in the cold period air quality decreases and NPA values increases. Table show the relationship of 59% and 78% between the NPA values and SO_2 and PM values.

There is a tendency to increase in the SO_2 and PM values in the period of 1990-1995. While the average SO_2 value of 70 $\mu g/m^3$ in 1990 increased 86% in 1995 and reached to 130 $\mu g/m^3$; the value of 44 $\mu g/m^3$ PM increased 61% and reached to 71 $\mu g/m^3$. With parallel to the changes in air quality, while the weekly total of NPA was in 819 in 1990, it reached to 1718 with a 110% increase rate. Zaim's work (1997) which reported better air quality standards in big cities of Turkey in the period of 1990-1993 is invalid for the Balykesir central town. Figure shows the changes in air pollution and NPA values with regard to time and tendency lines. While the tendency of increase for the NPA is y= 3.3 x + 739.4, for SO_2 is y= 0.2 x + 79.7 and for PM is y= 0.1 x + 47.6. The correlation coefficient for NPA and SO_2 is 70%; for NPA and PM is 65% in the 1990-1995 period (see table).

As well as other studies this research also showed that there is a close relationship between the air quality and human health. It was noted earlier that in many cities in Turkey as well as in Balykesir only SO_2 and PM values are measured. However, in addition to these values, other air quality parameters should be measured in order to prepare a base for the more detailed research.



The effects of air quality on health come out in short or long term. Upper respiratory problems may be due to air quality as well as other factors. The results of SO_2 and PM values and relationship with the NPA values which reach 78% in a year is a confirmation of this effect. As well as yearly changes in the air quality the changes in the period of a year also show the close relationship between the air quality and NPA values (see table).

Balykesir central town is one of the settlements which have low levels of air quality due to the effects of physical environment (Koc, 1997). There is more negative tendency in the air quality when the 1990-1995 period is taken in to consideration. Therefore, there is need to prevent the negative effects of air pollution.

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One of the most important consequences of air pollution is its negative effects on human health. Particularly, upper respiratory system and the patients who suffer from related diseases are the most effected in the short run. In Balykesir, there have been found that there is a close relationship between SO_2 and PM values and the number of patient applicants (NPA). There might be deaths in the continuation of decrease in the air quality and in the case of strong reverse movements of air. It should be noted here that there is a need to study the reasons detail behind the deaths.

Although there is the need for cities to allow a good environment to live in, Balykesir, is difficult to say, has a good air quality environment. If the increase in air pollution continues, Balykesir like many cities which have this problem, disasters related to the air pollution should be expected. Therefore, it is suggested that detailed studies should be on the way for a better environment in Balykesir.

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Correlation coefficient (%) between number of patients and SO_2 - PM		
Years	SO_2	PM
1990	67	73
1991	71	73
1992	63	70
1993	75	74
1994	71	59
1995	78	60
1990-1995	70	65

1598.
УДК 541.18

PHYSICAL TECHNIQUES OF ULTIMATE ANALYSIS IN ENVIRONMENTAL MONITORING

V.I.KOUDRYASHOV, L.S.LVLEV

Institute of Physics of St. Petersburg State University, Russia

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Physical techniques of ultimate analysis such as fluorescent X-Ray (RFA) and neutron-activation (NAA) analyses allow simultaneous determination of 2030 elements in each analysis, the measuring time not exceeding several minutes. Both techniques provide low measuring thresholds and high sensitivity, RFA being non-invasive technique. Practically no sample conditioning is required in the majority of analyses. The application of these techniques provides data on a space-time distribution of elements over the environment under investigation which is of great interest and meets the needs of ecological surveillance and problems of climate.

As an example, the analysis of atmosphere samples and deposits collected in Mexica in course of determination of lower atmosphere optical-meteorological parameters after the eruption of

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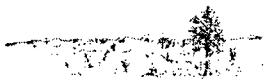
Popocatepetl and Colima volcanoes in 1994-1995 has revealed that the effect of the outburst of volcanic matter dominated the environment ranging up to 600 km over the period of several months. It was not until the beginning of the rains season that the composition and concentration of elements in the atmosphere changed.

Daily measurements of elements concentration dynamics in the atmosphere taken at Kemerovo town (in 1990) in addition to rather routine data on variations of elements content and degree of air pollution allowed to detect the supply of certain metals into the atmosphere produced by technogenic sources operating for a short period of time during the night hours (approximately at 0 o'clock).

The mapping of industrial and some other technogenic pollution has been revealed and recorded during synchroneous measurements at a variety of observation points in course of ANZAG-87 experiment in Alma-Ata city. Ultimate analysis has revealed the directions of pollutant cloud drifting which appeared above the city, as well as approximately estimate the velocity of its propagation (as far as 25-30 km from the city the concentration peak levels of elements such as Zn,Pb,S were recorded every 3-5 hours). Introducing of the enrichment factor into the data processing technique allowed in a number of cases to separate the effect of natural supply of pollutants from technogenic supply.

In the course of investigation of industrial facilities area pollution beyond the city of Cheboksary (in 1993), vegetation defoliage and snow coverage allowed to detect a ring structure of pollution area (2-3 rings) containing various elements ranging up to 50 km outside the city.

Ice sediments (deposits) analysis in the Pamir, Tien-Shan, and Altai, conducted on samples collected during the scientific- research expeditions, in 1984-1994, from large areas, has indicated the presence of sulphur and heavy metals, revealing a certain effect of industry on atmosphere pollution over the Central Asia territory in 1972-1992.



1359. УДК 541.18

PROBLEMS OF THE DIESEL PARTICULATES ASSESSMENT AND REDUCTION

KUTENEV V.F., ZVONOW V.A., KORNILOV G.S.

Russian Diesel Institute, phone 7-095-1541301 fax 94430030

(First received 23 March 1998; accepted for presentation during IAS-4)

The diesel engines are being largely applied as power units for various vehicles since they have the highest thermal efficiency in comparison with the other heat engines and are capable to provide a wide range of power output. However, in re cent times air pollution caused by the diesel exhaust gases of the motor vehicles has created a serious problem in the developed countries.

The major toxic pollutants of the diesel exhaust include nitrogen oxides and particulates. The diesel particulates consist of solid and liquid particles of various composition. The solid particles of soot formed during the fuel combustion have also an electric charge. To assess the emission of the diesel particulates the following methods at present are widely used:

— measurement of smoke of the diesel exhaust;

— measurement of specific mass emission of the particulates per a unit of work done.

The most widespread smokemeter is of a light extinction type (opacimeter). The opacity of the exhaust gas in a measuring chamber of the device is determined by means of the loss of intensity of a light emitting source. In the actual operating conditions smoke measurements are made at increased revolutions of the idle mode of an engine and at free accelerations.

The mass emission of the automobile diesel particulates is determined on the basis of bench tests results carried out under the 13-mode test cycle that corresponds to actual operating conditions. The particulates are collected by means of a filter from the exhaust gas that has been

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preliminary diluted with air and cooled (to the temperature lower that 52oC) in a special tunnel.

In the Russian State Research Centre NAMI a set of devices has been developed to measure a smoke level of the diesel exhaust mass emission of diesel particulates. The portable microprocessor smokemeter IDP-2 is designed for smoke measurements of diesel powered automobiles under actual operating conditions. A power supply of the device is from an accumulator of 12V. The stationary microprocessor smokemeter IDS-3 is intended for smoke measurements during bench tests of a diesel engine and has a remote control.

Both of the mentioned smokemeters have microprocessors, software of those ensures the following: statistical processing of smoke measurements data; an automatic adjustment of the device; a self mulfunction diagnosis.

Metrological features of the smokemeters comply with the international standards. The portable smokemeter IDP-2 has been undergone the state acceptance tests and has been certificated for application in Russia. The stationary smokemeter IDS-3 is being prepared for the acceptance tests and certification. A prototype of the minitunnel for mass assessment of the diesel particulates is passing various types of laboratory tests. In comparison with minitunnels being in use it has the following distinctive features:

— an advanced system of the isokinetic gas sampling from an exhaust pipe of diesel engines designed on the basis of a swirl valve;

— advanced designs of gas flow meters and pressure measurement devices.

The minitunnel as a whole and its separate systems are designed to comply with the international standards. To reduce diesel particulate emission measures to modify the combustion in side the cylinder or to trap particles by means of special filters incorporated in the engine exhaust system are applied.

A prototype of the electromechanical filter based on combination of mechanisms of electrostatic precipitation of the particles and their trapping by filtration has been developed in NAMI centre. Preliminary tests of the filter have confirmed it's high trapping efficiency (over 80%) at very low pressure drop.

At present thorough investigations of the filter are being carried out.

135e.
УДК 541.18

REMOTE SENSING OF FOREST FIRES AND THE DIRECT RADIATIVE FORCING OF FIRE SMOKE

LI Z.

Canada Centre for Remote Sensing, Ottawa, Canada

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Smoke aerosols produced by fires modify the earth's radiation budget. The direct impact is referred to as direct radiative forcing (DRF). Until now, studies dealing with the DRF of fire smokes have focused on the top of the atmosphere in tropical regions. This study investigates atmospheric DRF due to smoke from boreal forest fires. The presentation include two parts. Part I deals with the detection of forest fires by satellite. Part II is concerned with the determination of DRF by fire smoke.

A fire detection algorithm was designed to monitor active fires using individual AVHRR images across the Canadian boreal forest zone. It takes advantage of information from multi-channel AVHRR measurements to determine the locations of active fires on satellite pixels of about 1 km^2 under clear sky or thin cloud conditions. Daily fire maps were obtained showing all fires across Canada except for those obscured by thick clouds. This was achieved by first composting all the AVHRR scenes acquired over Canada and then apply the fire detection

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The results of complex investigations of interactions of aerosol with clouds (fogs) and precipitations are considered. The effectivity of this process is evaluated. The evaluations of time variations of humid scavenging coefficient obtained from the data of nature, laboratory and numerical experiments are presented. The purpose of this work is to summarize the results of complex investigations of dynamics of humid scavenging the aerosol by clouds and precipitations, carried out by specialists of MGO during last years.

Nature experiments. Their purpose is to obtain the data of the effectivity of aerosol scavenging by precipitations in polluted industrial region and in ecologically clear region. The measurements were carried out in warm seasons of 1993 - 1994 and in cold period of 1997 at the meteorological station of MGO (Saint-Petersburg) and also in summer 1996 in ecologically clear region at the east of Leningrad Oblast (at the Field Experimental Base in Turgosh). Photoelectrical counter PC.GTA and lidar LIVO were used for measuring aerosols.

In 1993 - 1994 it was 13 days with precipitations during the aerosol measuring. The precipitations were of different intensity and continuance and were related to different synoptical situations. Aerosol measurements were carried out during 39 days. Aerosol concentration changed about 2 - 3 times a day; from day to day these variations reached 30 times. It was determined by air mass transfer, the wind near the Earth surface and local aerosol sources.

The data of measurement were subdivided on 4 groups for evaluation of the influence of cloudiness and precipitationregime on aerosol particle concentration. The 1-st group - the days when cloudiness was nonsignificant (related to heat covection) or clouds were abscent at all. From this group the days with significant cooling were selected in the 2-nd group. Convection during the days of the 2-nd group was weak. The days of the 3-rd group are that of significant cloudiness, more often stratiform, related to the frontal situation or the warm sector of the cyclon. The great cloudiness and inversion layers in the atmosphere prevented the development of convection. The days of the 4-th group are that with precipitations in the period of observations (more often - from convective clouds).

In some days synchronic measurements of coefficient of weakening radiation and that of particle concentration were carried out with making use of lidar and photoelectric counter respectively. Observations demonstrated good agreement between time variations of these characteristics.

Lidar sounding data demonstrated, that when finishing precipitations some period of scavenging the atmosphere was observed. 17 days with precipitations were analysed. The days were selected in particular groups: the days with weak precipitations of small continuance - into the 1-st group, those with weak but long precipitations - into the 2-nd one, those with significant but short-time precipitations - into the 3-nd one and the days with significant and long-time precipitations were selected into the 4-th group. The effect of scavenging was the most distinct in the long-time intensive precipitations. Data available show that The effect of scavenging takes place in 1 - 2 hours - in the case of long-time precipitations (the 2-nd and the 4-th groups). In the 3-th group significant but short-time precipitations did not result in long-time effect. In average this effect was being observed in 30 min.

In winter 1997 were 22 days when measuring the concentration of aerosol particles $d > 0.3$ mkm were carried out (about 70 measurements a day). During 5 days measurements were performed in snow. For example on 18.03.1997 it was snowfall of weak and measurable intensity in Saint-Petersburg. Before and after precipitations the concentration of particles of all sizes increased, but during precipitations it decreased. Scavenging coefficient was approximately equal for particles of all sizes and it-s value was about 7,0 (-3) -- 8,0 (-3) /s.

The experiment of 10.08.96 carried out in Turgosh was shown as an example of aerosol measurement in ecologically clear region. Precipitations were in the form of rain (by portions). The results of the experiment showed that during intensive precipitations great increasing the

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the diffractometrical spectrometer DFS-12. The preciseness of determination is 10-10 mgr/m^3. The results of the analysis are given in the table.

As it is seen from the table despite the place and time of the samples taking utmost possible concentration (UPC) of benzopyrene exceeds the limit for one order and even more. It is set that the pollution of the atmospheric air can exceed UPC for two orders. The degree of the air pollution with the carcinogens depends on the air flow direction, what is seen from the experiment data of the simultaneous analyses of the benzopyrene content in the air samples at the factory territory and 2miles from it.

Nevertheless the pollution of the environment with the carcinogens is not only a result of gases amission . One of the possible and really existing ways of the soil and water pollution with the carcinogens is the soot which is the component of the solid emissions of the factory and which made approximately 289,902 tons/year.

It should be pointed out that the the Dashiv factory soot analysis showed that in 1 kg of soot there is 880 mkg only of the benzopyrene.

The study of the pollution of the adjoining to the factory territory (area of 12 km^2) for carbon showed, that the anomalies for the carbon are characterised by the medium contrast, maximum concentration (Kk = 3,57) was registered at the distance of 1 km from the factory.

The results obtained on the pollution of the city Striy atmospheric air with benzopyrene showed that the concentration of the carcinogens considerably exceeds UPC. Nevertheless, if the concentration of benzopyrene as a result of the jams while the intensive city traffic (8.00a.m. - 16.00p.m.) exceeds UPC 54-58 times, and at a diminution of the traffic flow (evening - night) benzopyrene concentration decreases approximately 5-5,6 times, but anyway exceeds the UPC for one order , the analysis of the air carried out in the settlement zone showed the considerable impact of the industrial enterprises on its pollution with carcinogens. Thus the content of benzopyrene varies from 37,2 to 167,7ngr/m3. This fluctuation can be connected only with the direction and strength of wind from which the degree of distribution (concentration) of the carcinogens in the air of the region depends.

Thus, the analysis held allowed to conclude that one of the main reasons of the increase of the malignant tumours in the region is the pollution of the atmospheric air with polycyclic aromatic substances.

By now the activity of The Dashiv Soot Plant is suspended.

* Serth R.W., Hugnes Th.-Environ. Sci. Technol., 1980, v.14, p.298-301

Observed area The time of the air selection The time of the air selection Concentration found

#	Observed area The time of the air selection (beginning)		The time of the air selection Concentration found (end)	
1	The factory entrance	14`00``	21`00``	20.7
2	-//-	21`40``	7`25``	128.2
3	-//-	7`30``	14`00``	16
4	Two miles from the factory	14`20``	21`10``	65.5
5	Striy city, the zone of the intensive traffic	22`20``	8`00``	10.2
6	-//-	8`00``	14`30``	57.7
7	-//-	14`30``	21`30``	54.5
8	Striy city, the settlement zone	15`20``	23`20``	166.7
9	-//-	23`25``	11`55``	37.2
10	-//-	7`00``	15`00``	37.5



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SOME RESULTS OF MEASUREMENTS OF UV-B IRRADIATION AND OTHER PARAMETERS INFLUENCED BY AEROSOL LOADING OVER DELHI

S.K.PESHIN, R.C.BHATIA, S.K.SRIVASTAV, S.P.PEROV*, G.M.KRUCHENITSKY*

National Ozone Center, India Meteorological Department, Lodi Road, New Delhi, e-mail: peshin@imd.ernet.in

Central aerological observatory, 141 700 Moscow, Dolgoprudny, Pervomayskaya, 3, e-mail: sperov@per nifhi.ac.ru

(First received 20 May 1998; accepted for presentation during IAS-4)

Global changes of the ozone layer, cloudiness, radiation, possible UV-B and UV-A trends, global warming and reaction of the biosphere (i.e. vegetation's parameters) for last decades are intensively discussed [1-4]. One of the most important tools to determine climatological values and long-term changes as well as short-term is oscillations of these parameters which modulate UV (the total ozone amount, cloudiness, aerosol loading and other factors). Models that simulate typical values and prediction of changes in UV radiation for different atmospheric conditions need to be used [3].

The Ozone Center of India Meteorological Department started the observations of spectral irradiance of global solar UV-B (320-290 nm) in Delhi (28.6 N,77.2 E) by using Brewer Ozone Spectrophotometer (#089) since 1994. The calibration of the instrument were performed in 1994 in Canada.

Observations: Total ozone amount by Dobson/Brewer, vertical distribution of ozone by ozone sounds manufactured by IMD, IMD took part in the international intercomparison of ozone sounds at Julich, Germany-1996, UV-B by Brewer, Global and diffuse radiation by pyranometer. IMD participated in the international intercomparison of Dobson spectrophotometer at Tisukuba, Japan-1996 and Pyranometer international intercomparison at Davos (Switezerland-1996). Other meteorological observations were also taken into account for this study.

Examples: Integrated global radiation from 1-25 April 1998 max. 12/4/98 clear day 25 MJ/M2,Min. 21/04/98 dusty 15 MJ/M2,Mean 21 MJ/M2, Integrated diffuse radiation values: Max. 15/04/98 13 MJ/M2, Min. 13/04/98 6 MJ/M2, Mean value: 9 MJ/M2.

On 22/04/98 extensive ozone and radiation measurements were taken showing the following results: Total ozone amount shows diurnal variations with period about six hours and the difference maximum and minimum was about 7 DU. Diffuse and UV-B radiation shows variations (UV-B more detailed). Maximum UV-B radiation observed in the month of April,8,1996 about 3MJ/M2 Ozone sonde flight taken on 22-04-1998 shows the following results: Temperature profile was peculiar for this season as there were two tropopause. Ozone sonde also showed two maximum values on the troposphere which is unusual for April month. It may be due to El Nino [5]. All analysis of data shows negative trend. More analysis will be continued for this year under Indo-Russian cooperation in the Meteorology and Ozone/Aerosol studies.

First the combined observations of such important parameters as UV-B irradiation (diffuse and global), O_3, total irradiation, turbidity were carried out in Delhi which is one of the biggest magapolics in tropics. The population of Delfi is round about 12 million and vehicles are about 2.4 million.

Analysis of data obtained shows that in spite of constant meteorological and climatological parameters in this part of India, evident negative trend in UV-B irradiation was obtained for last two years possible reason and mechanisms of that will be discussed.

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1415
УДК 541.18

POTENTIAL EFFECTS OF AIR POLLUTANTS ON THE FOREST

LEVENT SAYLAN, ORHAN SEN, HUSEYIN TOROS

Istanbul Technical University, Department of Meteorology, 80626, Maslak, Istanbul/TURKEY

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1. INTRODUCTION

The air pollution is important problem of Istanbul, which is the biggest city of Turkey with the population of 12 million. The source of the pollutants in Istanbul can be divided two main groups. One of them is the heating during winter and industrial activities. Second important source is the emission from the motor vehicle traffic.

Growing air pollutant lead to research relation between air pollution and forest in last years all over the world. For this reason a lot of countries build stations for measure of air pollution. The aim of these studies are determination of the source for the air pollution and protection from their harmful effect. Unfortunately, there is no air pollution station systems over Turkey. Especially, the importance of the air pollution determination is well appriciated when the heavy traffic of the city considered. The biggest forest around Istanbul is "Belgrad Forest", which is main oxygen source of the life. Belgrad forest is under the pollution because of the highways near the forest and recreational areas.

Pollution is not only effected by emission, but also is effected by the other sources like long range transportation. For example, it was calculated that about 70 % of sulfur deposition are imported from the other countries in Austria. In 1980 the presence of NOx in Canada had increased 1 million ton per year because of transportation (Keith et al., 1989; Adriano et al., 1989).

In this study, the effects of some air pollutants like COx, HC, Pb, NOx, SOx because of heavy traffic have been investigated through the Belgrad Forest area in Istanbul for a short time period, due to the fact that the major source of the air pollution in Istanbul is the emissions from vehicles (Sahin et al, 1995).

2. CALCULATION OF THE EMMISIONS FROM VEHICLES

In this study, two different methods are used to calculate the emissions from vehicles to the atmosphere. First method is based on the emission from gasoline and diesel engines. The second method is based the vehicle speed (Mellanby, 1991). Therefore, the average motor vehicle speed is assumed 60 km/hour for the calculation of emissions and Table 1 is used to estimate the emission source from the fuel type.

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Table 1. Average motor vehicle emissions depend on fuel type (g/km).

Fuel type	CO	HC	NOx	PM	SOx	Pb
Diesel	16.1	1.8	3.0	0.05	0.05	0.2
Motorine	0.72	2.2	16.5	1.5	2.0	-

The following equation is used to calculate the values in Table 1.

$E=2E_F * N_V * d$

Where, E_F is Emission factor; N_V is number of motor vehicle; d is distant and the coefficient 2 is for two ways.

3. RESULTS AND CONCLUSION

During the period of this study , the cars are counted according to type of the fuel consumption. Figure 1 shows the number of cars type of fuel used for the vehicle.

During this study, five different routes are carried out to calculate motor vehicle emission in Belgrad forest. In addition to this, the total emission value of these routes is also summarized in Table 2.

As seen in Table 2, the all pollutants not change much in the week days. In contrast the concentration of pollutants increase about 4 times for HC, 3 times for NOx, Pb, CO and 2 times for PM and SOx during weekend. The most of these pollutants come from diesel engines. The total Carbon Monoxide (CO) emission changes from 494 to 534 kg/day except weekend. The same way, the total Hydra Carbon (HC) deposition is about 700 kg per week. Total Nitrogen Oxygen (NOx), PM and SOx reached 1150 kg, 48 kg, 48 kg per week, respectively. The total Pb is calculated 64 kg per week. These results show that the CO deposition occurs as the very the very important part of the calculated pollutants.

The risk of the air pollution on other living organisms as well as the forest can be better predicted if longer observations are made throughout the winter .

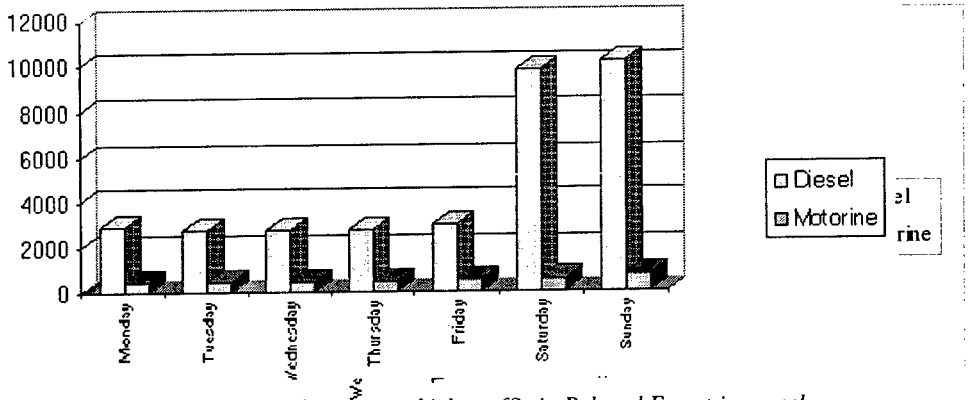


Figure 1. Number of the motor vehicle traffic in Belgrad Forest in a week.

Table 2. Daily total emission from motor vehicle in Belgrad forest (kg/day).

Days	CO			HC			NOx			PM			SOx	Pb		
	D	M	T	D	M	T	D	M	T	D	M	T	D	M	T	M

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Monday	508	4	512	57	4	61	95	4	99	2	4	6	2	4	6	6
Tuesday	495	4	498	55	4	59	92	4	96	2	4	5	2	4	5	6
Wednesday	491	4	494	55	4	59	91	4	95	2	4	5	2	4	5	6
Thursday	495	4	499	55	4	59	92	4	96	2	4	5	2	4	5	6
Friday	529	5	534	59	5	64	99	5	103	2	5	6	2	5	6	7
Saturday	1725	5	1730	193	5	198	321	5	326	5	5	10	5	5	10	21
Sunday	1786	6	1792	200	6	205	333	6	339	6	6	11	6	6	11	22

D: Diesel fueled, M: Motorine fueled, T: Total

These air pollutants cause the acid precipitation. According to Eruz and others (1995) 42.51 % of the total precipitation during winter season is acidic in Belgrad forest. Acid precipitation has direct and indirect affects on trees. Direct affects change the mineral uptake and damage to tissues of plant. Indirect affects can cause to change mineral nutrient availability, increase the toxic materials and decrease the frost resistance of trees. All of these affect can cause a tree to die. Increased soil acidity can result in increased solubility of heavy metals. NOx, CO, SOx Pb and HC may influence photosynthesis and respiration, insect pest of trees in Belgrad forest. It is necessary to estimate the main source of the air pollutants.

As a result, it is necessary to build a measuring and monitoring system of atmospheric pollution in the future not only for Belgrad forest, for all forest area of Turkey.

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1301.
УДК 541.18

METAL OXIDES - THE MAIN COMPONENTS OF TROPOSPHERIC SOLID AEROSOLS UNDER THE EARTH'S ATMOSPHERE CONDITIONS

ZAKHARENKO V.S., PARMON V.N.

Boresko Ins i .e of Ca alysis, No osibirsk 630090, R ssia

(First received 20 February 1998; accepted 1/6/98 for presentation during IAS-4)

The tropospheric solid aerosols contains considerable concentration of insulator oxides such as SiO_2 , Al_2O_3 , MgO, CaO, but being in a "pure" state, these oxides are able to absorb light

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efficiently only in the wavelengths region shorter than 300 nm. For these insulator oxides to absorb the solar radiation with the wavelength > 300 nm, they need to be sensitized to this spectral region. Sensitization of the metal oxides in atmospheric conditions is possible as a result of surface compounds formation, e.g., after adsorption of gas phase components of the atmosphere.

The composition of the adsorbed layer of the aerosol oxide is determined either by a relatively high concentration of the corresponding compounds in the atmospheric gas phase or by selectivity of the adsorption by components of the solid aerosol. It may be expected upon formation of the adsorbed layer on the surface of insulator oxides that these will be sensitized to the solar radiation reaching the Earth's troposphere.

For example, the atmosphere exposed magnesia was found to absorb light with wavelengths shorter than 400 nm with maximum at 360 nm [1], while such absorption being absent on the magnesia samples exposed to a rigid oxygen-vacuum pretreatment.

After long ageing in ambient air, calcium oxide powder also starts to absorb at wavelengths 300-400 nm. This absorption band decreases drastically after rigid oxygen-vacuum treatment of the sample at conditions like those for MgO.

In this work we studied photostimulated adsorption of "methane" and "ethane" set freones (CF_2Cl_2 - freon 12, CF_3CH_2F - freon 134a, respectively) on the surface of the air-exposed calcium oxide at room temperature in presence of water vapour and/or dried air.

Under the atmospheric conditions calcium oxide reacts with water vapour and transmutes to calcium hydroxide. Calcium oxide being suspended in water transforms totally to calcium hydroxide which was used to cover the reactor wall made of molybdenum glass. When the reactor wall, covered with hydroxide calcium, are exposed to ambient air for long time, hydroxide converts partly to calcium carbonate due to presence of CO_2 in the air. After soldering to a high-vacuum setup, the reactor was evacuated at room temperature for several hours.

Such prepared surface calcium hydroxycarbonate does not adsorb freones 12 and 134a in the darkness, being able, however, to adsorb solely freon 134a under the illumination. The photoadsorption activity of the calcium hydroxycarbonate with respect to freon 134a is observed at the wavelengths shorter than 400 nm, in the range of the optical absorption of air-exposed CaO.

When the freon photoadsorption occurs in presence of air, dried preliminary by its passing through a trap cooled with liquid nitrogen, the quantum efficiency and the action spectrum of the freon 134a photoadsorption change only slightly. Photoadsorption of oxygen from air is observed too, the red edge of this photoadsorption locating at 360 nm ; note, that the same red edge has been reported for the oxygen photoadsorption on CaO exposed to rigid oxygen-vacuum treatment.

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List of participants of IAS-4 with presentations during 8 July 98



Ackermann Ingmar J *(1967-06-24)*
Ford Forschungszentrum
Aachen
Phone: (49)-241-9421205
fax (49)-241-9421301
email: iackerma@ford.com
Aachen
Germany

Andronova Natalia G.
University of Illinois at Urbana-Champaign
email:
Natasha@uiatma.atmos.uiuc.edu
Urbana
USA

Aristova Elena Nikolaevna *(1961-03-22)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@kiam.ru
Moscow
Russia

Arking Albert *(1932-11-05)*
Johns Hopkins University
Phone: (1)-301-2992478
fax (1)-301-2992479
email: arking@aa.gsfc.nasa.gov
Baltimore
USA

Barthelmie Rebecca *(1963-06-22)*
Indiana University
Phone: (1)-812-8554083
fax (1)-812-8551661
rbarthel@othello.ucs.indiana.edu
Bloomington USA

Belov Nikolay Nikolaevich *(1947-05-04)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Belov Pavel Nikolaevich *(1977-05-02)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Degtyarev Aleksandr Iosifovich *(1947-09-13)*
Institute of Geography RAN
Phone: (7)-095-9503919
fax (7)-095-2879826
anaumov@mskw.mccom.ru
Moscow Russia

Garger Evgeniyi Konstantinovich *(1937-02-06)*
Institute of Radioecology (Ukraine Sci.Academy)
Phone: (7)-044-2205313
fax (7)-044-2209346
email: garger@garger.pp.kiev.ua
Kiev
Ukraine

Goldin Vladimir Yakovlevich *(1924-06-25)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@KIAM.RU
Moscow
Russia



Hamill Patrick *(1936-04-29)*
San Jose State University
Phone: (1)-408-9245241
fax (1)-408-9242917
email: hamill@light.arc.nasa.gov
San Jose USA

Ivlev Lev Semenovich *(1936-05-21)*
Sankt-Petersburgh State University
Phone: (7)-812-4287349
email: vlas@aero.phys.pu.ru
St.-Petersburg
Russia

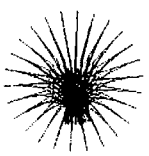
Kashkin Valentin Borisovich
Phone: (7)-3912-494987
fax (7)-3912-433918
email:
root@kashkin.krasnoyarsk.su
Krasnoyarsk
Russia

Kiseleva Margarita Sergeevna *(1928-12-01)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189900
fax (7)-812-2183720
St.-Petersburg
Russia

Kogan Vladimir *(1948-07-05)*
Battelle Memorial Institute Columbus
Phone: (1)-614-4247970
fax (1)-614-4244185
email: koganv@battelle.org
Columbus USA

Kuznetsova Irina Nikolaevna *(1954-01-20)*
Phone: (7)-095-2559804
fax (7)-095-2556301
Moscow
Russia

LI ZHANQING *(1963-09-17)*
CANADA CENTRE FOR REMOTE SENSING
Phone: (1)-613-9471311
fax (1)-613-9471406
email: li@ccrs.emr.ca
Ottava Canada



(continued)

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List of participants of IAS-4 with presentations during 8 July 98 *(continued)*



Lobanova Galina Ivanovna *(1936-11-20)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189946
fax (7)-812-2188179
St.-Petersburg
Russia

Naumov Aleksandr Dmitrievich *(1949-12-13)*
Phone: (7)-095-9446246
Moscow
Russia

Nguyen Ba Cuong
CENTRE DES FAIBLES RADIOACTIVITES
Phone: (33)-1-69088503
fax (33)-1-69087716
PARIS
France

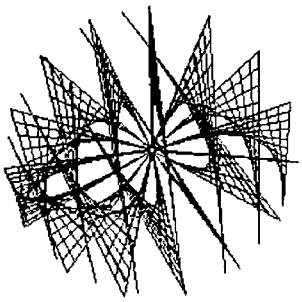
Pryor Sara *(1967-10-19)*
Indiana University
Phone: (1)-812-8555155
fax (1)-812-8551661
email: spryor@indiana.edu
Bloomington
USA

Rublev Alekseyi Nikolaevich *(1953-12-24)*
RNC of Nuclear Energy KURCHATOVASKY INSTITUTE
Phone: (7)-095-1967687
fax (7)-095-1941994
email: rublev@imp.kiae.ru
Moscow
Russia

Rusina Elena Nikolaevna *(1946-02-18)*
The Arctic and Antarctic Research Institute
Phone: (7)-812-3523081
fax (7)-812-3522688
email: aaricoop@aari.nw.ru
St.-Petersburg
Russia

Schlesinger Michael E.
University of Illinois at Urbana-Champaign
email:
schlesin@uiatma.atmos.uiuc.edu
Urbana
USA

Shakina Natalya Pavlovna *(1937-10-14)*
Phone: (7)-095-2555101
fax (7)-095-2556301
anaumov@mskw.mecom.ru
Moscow
Russia



Shevchenko Vladimir Petrovich
Institute of Oceanology of RAS
Phone: (7)-095-1247737
fax (7)-095-1245983
email: vshevch@geo.sio.rssi.ru
Moscow
Russia

Shilkov Aleksandr Viktorovich *(1958-03-20)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: SergePol@KIAM.RU
Moscow
Russia

Shilkova *(1958-02-04)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@kiam.ru
Moscow
Russia

Stenchikov Georgiy L.
University of Maryland
Phone: (1)-310-4055370
fax (1)-310-3149482
email: gera@metosrv2.umd.edu
College Park



USA

Suhinin Anatoliyi Ivanovich
Forest Institute Sibirian Branch of Acad. of Sci.
Phone: (7)-3912-494092
fax (7)-3912-433686
email: fire@ifor.krasnoyarsk.su
Krasnoyarsk
Russia

Zaharenko Valeriyi Semenovich
Institute of Catalysis of RAS
Phone: (7)-3832-355764
fax (7)-3832-355756.
email: SOLAR@catalysis.nsk.su
Novosibirsk
Russia



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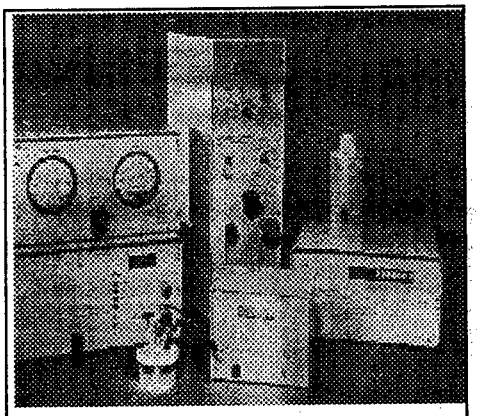
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AEROSOLS IN STRATOSPHERE & OZONE

Prof.essor HAMILL P.

AEROSOL & CLIMATE

Prof.essor ARKING A.

Academician, Prof.essor KONDRATIEV K.Ya.

Prof.essor SCHLESINGER M.E.

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address Belov N 21-117
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SOME MEASURED ELECTRICAL PARAMETERS AND SOME DERIVED AEROSOL PARAMETERS IN THE TROPICAL STRATOSPHERE OVER INDIA

S.P.GUPTA [1], S.P.PEROV [2]

[1] PRL, Ahmedabad 380009, India (Fax: 0090-079-6560502, e-mail: spg@prl.ernet.in)

[2] CAO, Moscow 141700, Russia (Fax: 7-095-5763327, e-mail: sperov@per.nifhi.ac.ru)

(First received 01 May 1998; accepted for presentation during IAS-4)

Low latitude middle atmospheric electrodynamics has a number of interesting features such as low flux of Galactic Cosmic Rays (GCR) due to high cut-off rigidities (R), higher solar electromagnetic radiation intensities and mesospheric ionization, large scale convection and widespread lightning phenomena, equatorial waves Kelvin and Rossby, powerful tidal and gravity waves, higher tropopause level and special characteristics associated with the equatorial electrojet. These special features play a vital role in governing the electrodynamics of the global middle atmosphere. In India, a well-coordinated multi-institutional campaign was organized under MAP (Middle Atmosphere Program) to carry out balloon and rocket borne experiments to measure electrical parameters of the middle atmosphere. The measured parameters include electron/ion densities and mobilities, polar ion conductivities and electric fields. The experiments were carried out during different seasons and solar activity epochs. The results obtained from these investigations are discussed and compared with similar measurements over middle latitude stations to assess the integrated effect of the global atmospheric electrodynamic phenomenon [Chakravarty et al.,1997].

A series of ion concentration measurements in the atmosphere was performed by the Central Aerological Observatory [Ermakov et al, 1991, Ermakov et al. 1993, Ermakov et al., 1998]. The ion concentration (n) was measured with balloon-borne ion aspiration chambers (like Gerdien capacitor): It is a metallic rectangular box 300 mm in length with an air inlet 230x50 mm sq. A flat plate inside the box made up of a central electrode for collecting light negative ions. The voltage 15 V was applied between the central and external electrodes, and the current between these electrodes produced by the light negative ions was measured. Small routine aerological balloons were used, and the air flow through the chamber was maintained by their lifting. The ascent speed of balloons was defined by radar. The expression n= I/(eUS), where I is the central electrode current, e is the electronic charge, U is an air flow rate, and S is the inlet area of the chamber.

The observations were conducted at different latitudes for time period near the last maximum solar activity (no SPE's or Forbush decreases took places during balloon launchings). The key observations (for analysis followed) were carried out in May -June 1990 (Indo/USSR Joint Ozone Campaign) from TERLS, Thumba with geographic coordinates 8 N, 77 E at the geomagnetic equator (R=17.3 GV). The launching dates: May 8/9 (2 - day and night), May 24 (2), May 25 (3) and June 6/7 (2). Wind (W) measurements were done simultaneously by radar tracking the same radiosonde and temperature (T) measurements were made by standard thermometer. The low variability of n (10%) was observed near tropical hygropause (20 km). Some profiles of n, T and W show a wavelike structure and a good correlation between them. They seem to be interpreted as being due to gravity waves, tides and dynamical disturbances (i.e., May 8/9 profiles of n were very different possibly due to severe tropical cyclone AP - May, 1990).

Analysis of all data obtained (45 obs. at Antarctica site, Russian sites at middle lat.) was

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based on relative latitudinal changes of both n and the intensity of ionizing GCR particles in the atmosphere. The results argue that at the stratospheric altitudes (10 - 30 km) the relationship between the ion production rate q and n is linear rather than square law as is commonly accepted [Ermakov et al. 1998]. It means that instead of two order chemical reaction we have one order reaction which is typical for aerosol light ion [Perov, 1998] or atom/molecule attachment/recombination. So b (in q=bn, instead q=ann as is commonly accepted) is: b=3,14(nv)(NRR), where N - concentration of aerosols with mean (effective) radii R, v - mean thermal velocity of light ions [Perov, Khrgian 1980]. Then the important information about aerosol parameters could be derived from measurements of n and I (q is proportional to I). But for the geomagnetic equator I (and q) are enough stable at the given altitudes because a relatively small seasonal variations of thermodynamical parameters in the lower and middle tropical stratosphere.

Conclusions: 1. Relatively large spatial-temporal variations in the conductivity and light ion concentrations in the stratosphere over Hyderabad and Thumba observations caused mainly by dynamics of the atmosphere rather then accuracy and others factors. This will be demonstrated by influencing gravity waves and tropical cyclone disturbances. 2.The important aerosol combined parameter (value ~ NRR) was very stable (constant) at altitudes 15 - 30 km for all the latitudes of both hemisphere where balloon launching were conducted for the period 1988-1992 (exclude. SPE & F.E.) from.

Recommendations. 1. Small, economical and sensitive multi-sensor (T, W, ozone, aerosol, electrical parameters) could be developed for both balloon and small rocket [Ermakov et al., Vasilyev et al.] routine sounding the atmosphere for studying dynamical and photochemical short-term and long-term as well as other processes in the middle atmosphere. 2. Balloon experiments at a site like Hyderabad for intercomparison of both Indian and Russian techniques used for electrical parameters measurements with a correlative measurements of aerosol parameters by both remoute (ground-based and space-born) and in-situ instruments are very desirable.

Acknowledgements

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MICROPHYSICAL PROCESSES AFFECTING THE FORMATION OF THE BACKGROUND STRATOSPHERIC AEROSOL

Hamill P.

Physics Department San Jose State University San Jose, California, USA

(First received 13 January 1998; accepted for presentation during IAS-4)

We consider the characteristics of the background stratospheric sulfate aerosol layer and show how microphysical processes along with transport can lead to the observed properties of the layer.

It is generally believed that the source of the stratospheric sulfate particles is binary nucleation of sulfuric acid and water to form solution particles. This process would take place preferentially in the tropical upper troposphere and the particles would then be transported by updrafts into the lower stratosphere.

We show results of nucleation studies based on the classical heteromolecular nucleation theory as adapted for the presence of hydrates. However, in the upper troposphere, environmental conditions are such that the critical nucleus is very small, containing just a few molecules of sulfuric acid. Under these conditions, a nucleation process may not be necessary, and the direct coagulation of hydrates may be the dominant mechanism for sulfate particle formation. We compare the two processes and show how they can affect the size distribution of the aerosol in the lower stratosphere.

The particles remain for most of their lifetime in the "tropical stratospheric reservoir" where they grow larger by means of condensation and coagulation. We show that these processes alone do not lead to the observed size distributions. To match the observed size distributions requires the mixing of older and newer air parcels.

That is, fresh aerosol particles will be much smaller than particles that have been in the stratosphere for long periods of time. However, a simple mixing of air masses still does not yield expected results. It is necessary to include the sedimentation of particles to get size distributions that are in agreement with measurements.

The transport of the aerosol particles to mid-latitudes can be studied using data from the SAGE II satellite system. We show that this process leads to a gradual lowering of the aerosol layer. The data also suggest a decrease in the particle number density. We suggest that this decrease is accomplished by several different mechanisms, such as sedimentation of larger particles and the removal of particles near the tropopause by cumulus clouds that pierce into the stratosphere. However, as suggested by recent studies in stratospheric dynamics, the most important removal process is probably non-isotropic transport through tropopause folds.

The aerosol particles that are carried to very high latitudes will be trapped in the polar vortex during the winter months. As the temperature decreases, these sulfate particles may serve as condensation nuclei for the formation of polar stratospheric cloud particles. We consider the formation of ternary system particles and show that modeled results agree with observations of the clouds by the SAM II satellite system during periods of time when ternary system particles are expected to exist.

In summary, we show how nucleation, condensation, coagulation, and sedimentation along with transport can account for the observed properties of the stratospheric aerosol layer.



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УДК 541.18

MICROPHYSICAL PARAMETERS OF STRATUS CLOUDS

IVLEV L.S. [1], MELNIKOVA I.N. [2]

[1] St Petersburg State University, Physical Institute,
Ulyanovskaya Str., 1, Petrodvorets, St Petersburg, 198904, Russia, Tel. +7-812-4284572, 5529554
[2] Research Centre for Ecology Safety, Russian Academy of Sciences,
Korpusnaya Str., 18, St Petersburg, 197110, Russia

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This presentation is the continuation of earlier studies on theoretical and applied aspects concerned the vertical profiles determination of the stratus cloudiness radiative, optical and microphysical characteristics from airborne cloud sounding data. The retrieval of microphysical natural stratus clouds parameters is necessary for problems connected with cloudiness structure, dynamics and modelling investigation and with ecological monitoring of the atmosphere pollution. Main parameters of cloud aerosols are mean radius and spectral values of the refractive index imaginary part.

The methodology of the stratus cloud optical and microphysical parameters (optical thickness, single scattering albedo, mean radius and refractive index imaginary part) retrieval was proposed earlier by the authors on the basis of airborne radiative measurements at the cloud top and base data. The cloud layer was considered without taking into account vertical inhomogeneity of optical and microphysical parameters.

It is known that atmospheric aerosols (including aerosols of anthropogenic origin) accumulate in low clouds and their vertical distribution is variable. Thus it is important either to determine averaged microphysical parameters of the whole cloud and obtain their vertical variations with purpose of the aerosols pollution and features of their distribution studying in cloudy conditions. Here the methodology above mentioned applied to airborne radiation experiments data, which were accomplished in extended stratus clouds above the Ladoga Lake (24 Sept. 1972 and 20 Apr. 1985) and the Kara Sea (1 Oct. 1972). Spectral downward and upward irradiances were measured at clouds top and base and inside clouds. Spectral values of volume scattering and absorption coefficients, the complex refractive index imaginary part and mean radius were obtained in cloud layers between measurements levels.



1596.
УДК 541.18

AEROSOLS AS A CAUSE OF OZONE'S VARIABILITY IN SPACE AND TIME

L.S. IVLEV [1], V.P. CHELIBANOV [2]

[1] Institute for Physics, St Peterburg State University, Russia
[2] OPTEC Ltd, St. Petersburg, Russia chel@lekmedial.spb.su/Fax: 7-812-2185159, 7-812-3277222

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The time variability of ground ozone content has as regular (pseudoperiodical) so unregular character. The first type of variability is caused by sunearth connections as well atmosphere general circulation and wave motion. The statistic analysis of ozone experimental data has been carried out to determine different fluctuation periods from minute to season variations for various climate regions from polar to tropical latitudes.

Daily, 48 hours and season variations are shown evidently. The variations with shorter periods depend on many factors including observation latitude, profile and type of ground

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surface. An interference of wave processes of different origins which is responsible for period duration changes is assumed to exist. A special attention was paid to the nature of fluctuations with periods from 5 to 7 minutes. The second type of variability is caused by aperiodic atmospheric processes in particular by discharging ozone destructing and ozone generating substances of different concentrations and flow rates into atmosphere. Sources of aerosols of different nature as well nitrogen oxides, organic substances have a special significance. Experimental data on ozone concentrations in dependence of aerosols and nitrogen oxides are considered.



985.
УДК 541.18

ALTITUDINAL AND SPECTRAL PROFILES OF ATMOSPHERIC AEROSOL EXTINCTION IN 0.4-12.0 μM REGION: STRATOSPHERIC BALLOON EXPERIMENTS

KISELEVA M., RESHETNIKOVA I., KAZBANOV W.

S. J. Vavilov State Optical Institute, Birjevaya 12, 199034, St.-Peterburg, Russia

(First received 10 January 1998; accepted for presentation during IAS-4)

Spectral atmospheric transmittance in the region 0.4-12.0 μm based on balloon experiments has been analysed and generalized. These experiments have been carried out up to 35 km height by authors of this report during of last ten-twelve years in different geographical regions (Russian, Kazakhstan , France) and different periods of volcanic activity. Altitudinal and spectral dependencies of atmospheric aerosol extinction in region of two atmospheric windows (0.4-0.8 μm and 8.0-12.0 μm) was considered. The influence of volcanic activity on atmospheric aerosol extinction spectra was noted. The approximate method of effective aerosol parameters and concentrations of aerosols has been developed. This method was used for the approximation of effective radius and concentrations of atmospheric aerosol particles. The comparison of data obtained in this work with modern publication ones was carried out. The influence of volcanic stratospheric aerosols on the stratospheric ozone concentration was discussed. The anticorrelation dependence ozone concentration versus aerosol extinction for level of H = 20 km was discovered.

1103

ULTRAVIOLET MODEL OF VOLCANIC CLOUDS FOR REMOTE SENSING OF ASH AND SULFUR DIOXIDE

Krotkov N.A.*, Krueger A.J.**, Bhartia P.K.**

**Raytheon STX Corporation, Lanham, MD 20706 U.S.A.;*

***Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, MD 20771*

(First received 18 January 1998; accepted for presentation during IAS-4)

The Total Ozone Mapping Spectrometer (TOMS) instruments have detected every significant volcanic eruption from November 1978 through December 1994 on the Nimbus 7 and Meteor-3 satellites and since July 1996 on the new satellites, TOMS-Earth Probe and ADEOS. We apply a radiative transfer model to simulate the albedos of these fresh eruption clouds to study the limitations of the present SO2 algorithm which assumes an absorbing cloud

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above a scattering atmosphere. The conditions are found to be approximated when the total absorption optical depth is less than 2 (i.e., 100 DU SO2 at 312 nm or 300 DU SO2 at 317 nm).

The spectral dependence of the albedo of a non-absorbing Rayleigh atmosphere can be specified by only two parameters which are uniquely different when ash or sulfate aerosols are present in the stratosphere. However, the interaction between ash scattering and SO2 absorption within a volcanic cloud produces a non-linear effect at strongly absorbing wavelengths that accounts for overestimation of sulfur dioxide in ash-laden volcanic clouds by the Krueger et al. (1995) algorithm. Correction of this error requires knowledge of the ash properties.

A method for determining two of the ash parameters from the longer TOMS wavelengths is described. Given the altitude of the cloud, surface reflectivity, and an estimate of effective variance of the ash size distribution, the optical thickness and either the effective radius or the index of refraction can be deduced. The ash retrievals are also needed to evaluate the tephra/gas ratio of eruptions and to compare the ash properties of different volcanoes.

Key words: measurement and monitoring of aerosols; stratospheric aerosols (sulfate and volcanic ash); multiple scattering and absorption of ultraviolet radiation by aerosols; non-spherical aerosols (volcanic ash); volcanic inputs to the atmosphere; volcanic hazards (ash avoidance by aircraft).

More information: see the following NASA web pages:
http://jwocky.gsfc.nasa.gov http://skye.gsfc.nasa.gov

982.
УДК 541.18

BALLOON - BORNE STUDIES OF AEROSOL OPTICAL PROPERTIES OF FREE ATMOSPHERE AT ALTITUDES UP TO 30 KM IN VISIBLE AND NEAR IR SPECTRAL RANGES

LOBANOVA G.I., MIRSOEVA L.A., POPOV O.I.

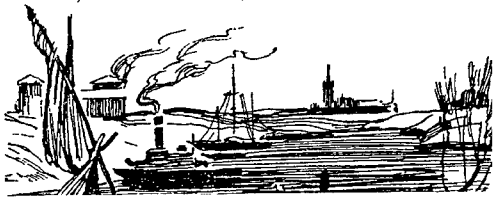
All- Russian scientific centre "SOI named after S.I.Vavilov"; Birjevaya linia, 12, St-Petersburg, Russia.

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During long period the balloon-borne experiments were fulfilled by SOI to measure spectral radiances of cloudless day sky at altitudes up to the 30 km and in the spectral region 0.4-3.2 mcm. The authors made also the balloon-borne investigations of radiance phase functions for day sky [1] and atmospheric transparency [2]. These studies allowed to get the information about altitudial and spectral dependencies of aerosol scattering factor in free atmosphere. Measuring instruments (grating spectrometers with tracking system) were calibrated absolutely in units of spectral radiance. The experiments were carried out in middle latitude region of Russia in summer. The measured values of altitude and spectral dependencies of atmospheric aerosol scattering factor were compared with literature data.

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1307.
УДК 541.18

OZONE CONTENT, ATMOSPHERIC AEROSOLS AND CLOUDS IMPACT ON SURFACE UV RADIATION: SIMULATIONS AND OBSERVATIONS

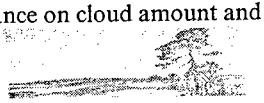
MELNIKOVA I.N. [1], VAROCOS K. [2], GUSCHIN G.P. [3], NOSKOVA V. [4],

[1] Res. Centre for Ecology Safety, Russian Academy of Sciences, Korpusnaya Str., 18, St.Petersburg, 197110,
[2] Athens, Greece, [3] Voeikov Main Geophysical Observatory, Karbysheva, 7, St. Petersburg, 194018, Russia,
[4] St. Petersburg Technical Univ., Dept. of Mechanical Phys., Politechnical Str., 29, St. Petersburg, 194100

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Calculations of surface UV-irradiance (total and diffuse) were accomplished for different atmospheric ozone, aerosols and surface albedo models. Results were compared with data of ground and aircraft spectral measurements of UV-radiation flux. The influence of atmospheric aerosols and albedo on ratio of the diffuse radiation to the total one at visual and UV wavelengths is determined.

The evaluation of cloud impact on surface UV-radiation is obtained from routine UV-radiation measurement data. One can suppose that surface UV-irradiance may increase slightly under condition small cloud amount comparing the case clear sky by reason of reflection and scattering of solar radiation from cloud sides. Then with growing of cloud amount surface UV-irradiance decrease. The elaboration of three-years set of data of UV-irradiance measured in St.-Petersburg and Athens is undertaken. The influence of solar zenith angle is taken into account. The dependence of surface UV-irradiance on cloud amount and solar zenith angle is presented.



1429.
УДК 541.18

SOOT AEROSOL IN THE LOWER STRATOSPHERE: ABUNDANCE AND CLIMATIC IMPLICATIONS

PUESCHEL R.F., STRAWA A.W.

NASA Ames Research Center, Moffett Field, CA 94035-1000. Phone:650.604.5254. Fax:650.604.3625.
Email: rpueschel@mail.arc.nasa.gov

(First received 31 March 1998; accepted for presentation during IAS-4)

Soot aerosol has been of interest in connection with a proposed commercial supersonic fleet that would more than double the direct injection of aircraft emissions into the lower stratosphere. We determined an average surface area of soot aerosol of (4.6+2.7)e-3 μm^2 cm^{-3} in the northern hemisphere when approximating soot particles by equivalent spheres. Accounting for the fractal nature of soot increased this value 20-fold. The abundances in the southern hemisphere were lower by one order of magnitude. The data were compiled from fourty Ames wire impactor aircraft samples from pole to pole, between 0 and -200 degrees western latitude, and between the tropopause and 20 km altitude

A "decadal" average value of (2-5) μm^2 cm^{-3} for the total aerosol was derived from the 1979-1981 and late 1984-1990 SAM/SAGE satellite data sets [1] which exclude the major El Chichon effects but include at least seven other volcanic injections. That's why this "decadal" average exceeds by one order of magnitude a "background" value that we derived from our in situ samples in agreement with satellite observations [1] in 1979.

In order to compute the optical properties of the stratospheric aerosol, we applied the

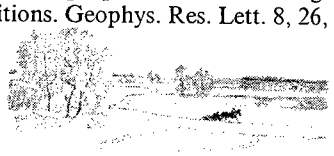
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Maxwell-Gannett function to determine a "gray" refractive index of 99% by mass of sulfuric acid/water droplets that are mixed externally with 1% by mass soot particles. The single scatter albedo of this mixture is close to 0.98 at mid-visible, and about 0.94 at near-infrared wavelengths. In contrast, a pure sulfuric acid/water aerosol has a single scatter albedo of one at mid-visible, and of 0.98 at near-infrared wavelengths. Pollack [2] concluded that impurities reducing the single scatter albedo to 0.98 or less at solar wavelengths would change the sign of climate forcing from cooling to heating. Thus it appears that increased emission of soot aerosol into the stratosphere by a proposed supersonic or enlarged subsonic commercial fleet could prove problematic.

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1256.
УДК 541.18

AEROSOL-OPTICAL CHARACTERISTICS OF THE ATMOSPHERE IN HIGH AND TEMPERATE LATITUDES OF RUSSIA

RADIONOV V.F., RUSINA YE. N.

The Arctic and Antarctic Research Institute 199397, St. Petersburg, Bering St., 38

(First received 13 February 1998; accepted for presentation during IAS-4)

The features of the space and time variability of the aerosol extinction characteristics in the atmosphere of high and temperate latitudes of Russia were investigated in the regions that are not directly exposed to the influence of industrial sources. For this purpose the series of monthly means of the aerosol optical depth at a wavelength of 500 nm (AOD) and a selectivity indicator of aerosol extinction (wavelength exponent-WE) were analyzed at 13 Arctic and 6 mid-latitude stations of background atmospheric monitoring over 1972 to 1995 period.

The monthly means of aerosol optical depth in polar and background conditions of mid-latitudes of Russia are close by value and do not exceed AOD=0.25.

The variability of the aerosol optical depth within a year depends on latitude and is governed by different factors. The spring maximum of aerosol pollution recorded everywhere at the Arctic stations is a result of the increased aerosol export from the continent due to a pronounced meridian transfer in the wintertime. By the summer the Arctic atmosphere is purified and the minimum optical aerosol depth is observed in September. On the contrary, at mid-latitudes "normal" annual variations occur with AOD maximum during the spring-summer period.

At most stations under consideration there was no pronounced trend of the aerosol optical depth. A significant increase in AOD was recorded only at the mountainous North-Caucasian station Pyatigorsk-1 and at three Arctic stations (Dikson, Uyedineniya and Kotel'ny Islands).

At all background stations without exception, AOD increases with appearance of aerosol of volcanic origin in the atmosphere. The relative response value increases from South to North. Up to the present time the contribution of natural sources to aerosol pollution of the atmosphere still remains decisive.

During the period under study mean values of the wavelength exponent varied within 1.0-1.2, i.e. were by 15-23% below WE=1.3 assumed by Angstrom for average conditions. This

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indicates some displacement in aerosol size distribution to coarse-dispersed particles, probably, under the influence of antropogenic factors.

Like AOD, the wavelength exponent responses to large volcanic eruptions (such as El-Chichon and Pinatubo). The WE value decreases.

It was unexpected that unlike AOD, the tendencies in the change of the WE at mid-latitudinal stations turned out to be different. In particular, at two of them (Pyatigorsk-1 and Turukhansk), more clean initially a significant negative trend of WE was recorded . This can be related to the increased aerosol pollution in the observation regions. At most background stations in the late 1980s-early 1990s there was a transfer of the anomalies of annual means of WE to negative values. To determine the causes of this phenomenon additional studies are required.

Due to high sensibility to random errors of measurements the wavelength exponent is still badly studied and because of that it is of a special interest. However performing such experimental investigations will demand for high-precision spectral measurements of solar radiation.



1555.

УДК 541.18

VARIABILITY IN OZONE LAYER PARAMETERS OVER TERLS MEASURED WITH ROCKET, GROUND AND BALLOON INSTRUMENTS: OZONE, AEROSOL, NEGATIVE ION CONCENTRATIONS, TEMPERATURE, WIND

B.H.SUBBARAYA [1], A.JAYARAMAN [1], S.LAL [1],

S.P.PEROV [2], V.I.ERMAKOV [2], G.M.KRUCHENITSKY [2], S.F.TIMASHEV [2]

[1] *PRL, Ahmedabad 380009, India (fax:91- 79- 6560502 , e-mail:jraman@prl.ernet.in)*

[2] *CAO, Moscow 141700, Russia (fax: 7-095-5763327, e-mail: sperov@per.nifhi.ac.ru)*

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Three Indo/ USSR Ozone Campaigns were successefuly carried out in March-April of 1983, November-December 1987 and January-June 1990 at TERLS (Thumba Equatorial Rocket Launching Station), 8 N, 77 E and over equatorial part of the Indian Ocean (1990) from ship-born rocket and balloon facilyties. The last campaign had correlated with the worldspread international campaign DYANA: India and USSR took part in that. Many results and findings obtained from those campaigns as well as descriptions of insruments used have been presented at International meetings and published in international journals [Ahariya et al., 1984; Subbaraya, 1987; Seshadri at al., 1988; Subbaraya et al., 1989; Perov, 1992 a, b; Krishna Murthy et al., 1992; Ishov et al., 1992; Offermann et al., 1994; Subbaraya et al., 1994a, 1994b; Perov et al., 1996, 1998]. We give here the summary of the most important scientific results and conlusions after careful analysis of all sets of observations obtained by all means.

1. Remarkably large variabilities in ozone profiles (0 - 75 km), which were never reported early for tropics, had been established. It seems to be due to very strong dynamical forcing (energy, momentum, mass transport), mainly from the tropical troposphere (deep convection, thunderstorm, tropical cyclon etc.) as well as from the stratosphere itself with perturbations in ozone, water vapour, carbon dioxide, aerosol which are the more important trace constituents that play a direct role in the middle atmosphere chemistry and radiation budget.

2. Day-night variations in the mesosphere show the nighttime increase that is found to be altitude dependent with typical values of 10 - 20% at 45 km and 55 km, and a factor of 3 - 4 at altitudes 65 - 70 km. A variability in the values of ratios of night/day ozone concentrations observed in separate sets of rocket flights reflects corresponding changes in water vapour and in dynamical parameters (tides, gravity waves (GW), equatorial planetary waves (EPW)).

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3. Total ozone (TO) diurnal variation with minimum during the noon period has been observed with the help a Brewer spectrophotometer throughout the operational time of 12 March - 23 May 1990, which included three 30-days periods of solar activity with double amplitude of about 120 units of the Ottawa Index (2.8 GHz) with background value of 130 units. While the pattern of this variation remained generally the same, the amplitude of this main harmonics (with variable period 250 to 500 min), varied from day to day from 4 to 15 D.U., representing a change of 1.6 - 4% in TO. The daily average values show a seasonal increase from 265 to 280 D.U. A series of synchronous measurements of TO have been conducted at the Lake IssykKul` , Kurgyzstan, located at the same longitude of 77 E like Thumba, but at 42.6 N. Statistically proved correlation between the variations of daily mean TO over the Lake Issyk Kul` and Ottawa Index has been revealed. In the Thumba case such a correlation can not be considered statistically proved [Ishov et al., 1992]. The most important results of statistically careful analysis of all data sets at Thumba are that the amplitudes (1 to 15 D.U.) and periods (5 to 500 minutes) of variations in TO show a good correlations with the well known 27 days (in our case 30 days) solar activity periodicity. This seems to confirm the dynamical nature of TO oscillations and their connection with vertical wind variations caused by GW and tides [Perov et al. 1996]

4. Six/seven rocket launchings and five/seven balloon launchings from research ship "Academician Shirshov" were conducted on three days (Jan. 31, Feb. 21 and March 11 1990) in the equatorial region (Indian Ocean/Arabian Sea). Using the temperature and wind data from these launchings, the diurnal and semi-duirnal tide components in wind and temperature in the middle atmosphere are obtained and are compared with theoretical predictions. It is found that significant departures with factors of 10 to 100 at different heights (at height of 28 km for which theory gives deep minimum even up to 1000) occur between observed and theoretical values [Krishna Murthy et al., 1992]. Evidence of 8 hrs and may be 6 hrs harmonics has been demonstrated [Perov et al., 1992]. This confirms the findings given above (3.). Such a strong tidal wave seems to be considered as a dynamical forcing on the ozone profiles. Analysis of all rocket flights data (obtained by 3 types of optical and 2 types in-situ (chemiluminescent) instruments as well as by balloon ozonesondes for different time of day and night shows two O3 maxima (morning and evening) and O3 minimum at noon, as measured by Brewer instrument, at the altitudes above 28 - 30 km.

5. The data collected during the intensive observation period of the second phase of Indo/USSR Ozone Campaign in December 1987 have been utilized to study various interesting features of ozone variations over India. The effect of the weather systems including western disturbances on the TO and its profiles has been studied [Seshadri et al., 1988; Perov, 1989, 1992]. From the results of the series of rocket measurements of wind , temperature (T), ozone and atomic oxygen (odd oxygen - Ox) concentrations for the period 3 - 7 December 1987 one may note a periodic variability of the parameters indicated in the layer between 20 and 90 km: a conventionally adopted period is about 4 days. Spatial-temporal characteristics of the variations observed in the atmospheric parameters allow to identify them as equatorial planetary Kelvin waves. Following conclusions may be drawn from the all data analysis: the values of amplitudes both of odd oxygen and temperature increases with height up to 90 km; the amplitudes of T and Ox and their phases are not consistent with the theory treating the photochemical equilibrium of ozone in the upper stratosphere and in the mesosphere, the vertical profiles of the amplitudes obtained would represent superposition of several wavelenghs: 16 km, the biggest; 10 km, 20 and 40 km, which may correspond to Kelvin (and possibly Rossby) waves and tidal waves as well in equatorial region overThumba. Amplitudes of equatorial waves in T and in wind recorded above 40 km are found to exceed the values that were reported earlier; amplitudes of values dOx/Ox (increasing with the height from 10 - 20% at



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30 - 40 km to 80 - 100% at 80 - 90 km) have been recorded in such waves for the first time. Two important conclusions may be drawn from the evidence on the vertical structure of the variance in wind, T and Ox. The first conclusion concerns the height regions of the atmosphere where such waves are generated: our results say about two possible layers connected with disturbances in the region near upper troposphere (tropopause) and in the 35 - 40 km layer. The second conclusion to be drawn regards to a possible existing system of interactive quazi-stationary waves in the layer 20 - 40 km.

6. One of the important aspects of stratospheric aerosol problem of analysing the specific features of heterogeneous processes involving aerosols of polar stratospheric clouds (and possibly aerosols near very cold tropical tropopause) is the effect of metastable nitric acid dihydrat and hydrat on the kinetics of reactions under considerations (Timashev et al., 1994). Dynamic supertemperature fluctuations determining decomposition of some molecules, ion clusters etc. can arise in the high energycontent medium of aerosol particles as a result of collisions of these particles initiated by acoustogravity and gravity waves, natural sonic noises in the stratosphere, and various geodynamic phenomena. The rocket observations dated August, 25 (Antarctica) and December, 3 and 5(Thumba) in 1987 were made in experiments in which the state of aerosols was determined by passing a flow of air containing aerosols through a special flow reactor isolated from external light sourses. The state of aerosols was monitored by observing light pulses emitted by them and interpreted as radiative de-exitation of initially highenergy-content aerosols. The concentration of the particles had a maximum at tropopause in all the three flights.

7. Relatively large (upto 50%) spatial-temporal variability of aerosols parameters (derived from key series of balloon soundings to study light negative ion profiles over Thumba at the geomagnetic equator has been interpreted by influencing GW and tropical cyclon disturbances [Gupta and Perov,1998].

All the findings reported above were published/presented before they have been confirmed by satellites (i.e.UARS, ASTROSPAS-CRISTA) and lidar observations (France) except 6, 7, and in part 3, 4.

Recommendations: Correlative (validation) programme of ground-, balloon- and aircraft-based observations together with satellite overpasses must be carried out in India because our results show evidence for large variability in ozone, aerosol etc. demonstrating some serious methodical problems of middle atmosphere observations in tropics by satellite technique even for TOMS observation over Indian stations [Bojkov et al., 1996].

Acknoledgements

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1403.
УДК 541.18

REGIONAL AEROSOL MODELLING WITH A EULERIAN MODEL

INGMAR J ACKERMANN, HEINZ HASS

FORD RESEARCH CENTRE AACHEN

DENNEWARTSTR.25 D-52068 AACHEN GERMANY ph.:49 241 9421 205 e-mail: iackerma@ford.com

(First received 30 March 1998; accepted for presentation during IAS-4)

The particulate matter suspended in the troposphere is strongly linked to numerous air pollution problems. Aerosol particles serve as cloud condensation nuclei and therefore influence the chemistry and spatial distribution of precipitation. In case of evaporating clouds the cycling of aerosol particles through clouds leads to a physically and chemically modified aerosol system. Heterogeneous processes within as well as on the surface of particles have the potential to modify the concentration levels and the spatial distribution of most acidic and photochemical air pollutants found in the atmosphere. Due to their light scattering properties aerosol particles have a strong impact on the radiative budget of the atmosphere. This in turn might effect the photochemistry by changing the photolysis rates of important reactions. Additionally submicrometer particles can be inhaled and therefore might be a cause for adverse health effects.

Hence, a more accurate modelling of air pollution has to consider atmospheric aerosol processes. In contrast to gas phase substances it is not sufficient for an aerosol to predict the chemistry of the system to capture the effects mentioned above, since these are additionally influenced by the physical characteristics of the particle population, e.g. number and size of the particles or mixing degree and phase state. Therefore this paper describes an approach to model particle formation, transport and deposition with respect to aerosol chemistry as well as aerosol dynamics for the use in regional chemistry transport models.

The Modal Aerosol Dynamics Model MADE for Europe has been developed from the Regional Particulate Model (RPM, Binkowski and Shankar, 1995), adapted for European conditions and implemented into the Eulerian chemistry transport model EURAD (EURopean Air pollution Dispersion model, Hass et al., 1995; Ackermann et al., 1995). The size distribution of the submicrometer aerosol is represented by two overlapping intervalls (modes) assuming a lognormal distribution within each mode. Coagulation is treated within each mode as well as between the modes. Aerosol mass can be increased by direct emission of particles, the formation of new particles from the gas phase (nucleation) and by growth due to condensation.

In previous versions aerosol chemistry was restricted to the sulfate-nitrateammonia and water system. Since secondary organics comprise a major portion of the atmospheric aerosol we will describe the extension of MADE to organic substances in the aerosol phase. This allows to study the formation of secondary organic particles, their impact on the size distribution of the aerosol population and the response of the gas phase chemistry to the formation of particles on

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a regional scale over Europe.

Addtionally we will describe the extension of the model towards a more complete coverage of particle chemistry -by adding elemental carbon, primary organics and PM2.5- and particle size range -by adding the coarse mode aerosol particles. New developments to incorporate aerosol-cloud interactions in the model will also be presented.

The simulations will be performed with a prototype version of the aerosol code from the USEPA-Models3 system, thus providing a test case for this new community model platform. Results will be presented for an episode in July 1994 for an European domain and subdomains nested into this grid with a finer resolution.



1092.
УДК 541.18

RADIATIVE FORCING BY VOLCANIC AEROSOLS FROM 1850 THROUGH 1994

ANDRONOVA N.G. [1], ROZANOV E.V.[1], YANG F.[1],
SCHLESINGER M.E.[1], STENCHIKOV G.L.[2]

[1] *Department of Atmospheric Sciences, Univ. of Illinois at Urbana-Champaign, Urbana, Illinois 61801*

[2] *Department of Meteorology, University of Maryland, College Park, MD 20742*

(First received 10 January 1998; accepted for presentation during IAS-4)

We use our detailed radiative transfer model and observations of the time evolution of the latitude-altitude distributions of zonal-mean optical properties for the Pinatubo aerosol to calculate the time evolution of its radiative forcing. We represent the zonal mean of this radiative forcing in terms of the zonal-mean optical depth of the Pinatubo aerosol, together with the solar insolation at the top of the earth's atmosphere, the planetary albedo in the absence of the aerosol, and the surface-air temperature. We use this representation, together with the volcano optical depths compiled by Sato et al. [1993] to calculate the radiative forcing by volcanic aerosols from 1850 through 1994.

1055.
УДК 541.18

THE INFLUENCE OF AEROSOLS ON ATMOSPHERIC ABSORPTION OF SOLAR RADIATION

ARKING A.

Johns Hopkins University Baltimore, MD 21218 USA

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There has been an ongoing debate over the last few years concerning the source of a discrepancy between observations and theoretical calculations of the amount of solar energy absorbed by the atmosphere. Based on a quasi-global, multi-year set of ground-based observations, combined with satellite measurements of top-of-the-atmosphere flux, absorption is 0.24 (expressed as a ratio with respect to incident flux at the top of the atmosphere). Models underestimate that absorption by 0.05 to 0.08. Some studies have attributed the discrepancy to clouds, while others have shown that the discrepancy is independent of clouds and, instead, correlated with column water vapor. At this point, the source of the discrepancy remains a mystery. Here, we examine the role of aerosols in atmospheric absorption, and test the possibility that aerosols account for some or all of the discrepancy. We use the output of chemical transport models to study the effects of three broad categories of aerosols: sulfates, mineral dust, and carbonaceous aerosols. We find that the discrepancy is not correlated with

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either sulfates or mineral dust, but there is a small but significant correlation with respect to carbonaceous aerosols.

However, based on their amount and distribution, the carbonaceous aerosols could only account for a small fraction of the discrepancy. To account for a major fraction, the total aerosol burden would have to be predominantly carbonaceous, with single scattering albedos ~0.75 or smaller, a highly unlikely situation at the vast majority of observation sites.

1351.
УДК 541.18

MODELING THE ATMOSPHERIC CYCLE AND THE RADIATIVE EFFECT OF SAHARAN DUST

BALKANSKI Y.[1], GUELLE W.[1], SCHULZ M.[2], CLAQUIN T.[2,1], MARTICORENA B.[3], BERGAMETTI G.[3], CHAZETTE P.[1], PELON J.[4]

[1] *Laboratoire des Sciences du Climat et de l'Environnement, Unite mixte CEA-CNRS, CE Saclay Bat 709, F-91191 Gif-sur-Yvette, France.*

[2] *Institut für Anorganische und Angewandte Chemie, Universitat Hamburg, Germany*

[3] *Laboratoire Interuniversitaire des SystXmes Atmospheriques, Universite Paris XII, Creteil, France.*

[4] *Service d'Aeronomie du CNRS, 4 Pl. Jussieu, F-75252 Paris, France balkansk@lsce.saclay.cea.fr*

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Recent advances in the physical description of the source of mineral aerosol together with global aerosol transport model that describe the size distribution of aerosols have allowed for a considerable improvement in the description of the atmospheric cycle of dust. Here, we present several years of simulation of Saharan dust transport using analyzed winds from the European Center from Medium Range Forecasts (ECMWF). We compare the results of the model with several types of observations:

* Meteosat geostationnary satellite
* Ground measurements of aerosol concentration
* Lidar profile obtained during the Sofia-Astex-Mage experiment near the Azores

The agreement found between the seasonal variations of mineral concentrations at 3 sites: Barbados Island (13°10°N, 59°30°W), Sal Island (16°40°N, 22° 55° W) and Iza (28° 20° N, 16°29° W), suggests that the transport and principal removal processes are well represented in the model. Furthermore, on a shorter time scale, most of the episodic events of dust transport from the Sahara are captured by the model. We also examine the Lidar profiles that give us precise information about the vertical distribution of this aerosol which main features are captured in the simulation. Concurrently to the Lidar measurements, radiative measurements estimated the flux at the top of the atmosphere. These encouraging results have lead us to estimate the direct radiative impact of the mineral aerosol over Northern Africa and the Northern Atlantic. The top of the atmosphere net radiative effect over the region averages less than 1 Wm^{-2} over the region of study but the distribution of the forcing shows a very large contrast between warming exceeding 20 Wm^{-2} over Africa and cooling exceeding 10 Wm^{-2} over the Eastern Equatorial Atlantic Ocean.



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1285.
УДК 541.18

THE INFLUENCE OF AEROSOL ON THE FLUXES OF SOLAR RADIATION IN THE ATMOSPHERE, CLOUDS AND ON THE EARTH SURFACE.

E.M. FEIGELSON, I.A. GORCHAKOVA, O.A. SHILOVTSEVA.

Obukhov Institute of Atmospheric Physics, Russian Academy of Atmospheric Physics, Russian Academy of Sciences. Moscow State University. Address: 3, Pyzhevsky, Moscow, 109017, Russia. Tel: 7-095-9511347; Fax: 7-095-9531652 e-mail: Gor@omega.ifaran.ru

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1. The influence of aerosol on the visual radiation coming to the earth surface. Comparison of measurements performed in the Moscow University(MU) and calculations published in the book "Calculation of the Brightness of Light in the case of anisotropic scattering"- E.M. Feigelson and coauthors. Transactions of the Institute of Atmospheric Physics. N1,N2. 1960.1963. Translated from Russian by the consultants Bureau, inc. New York.

Measurements of Phar($380 \leq \lambda \leq 710$nm) on the earth surface and of the atmosphere optical thickness (λ=550nm) were performed on the Meteorology Observatory of MU for the period 1980-1990 years. The average data are compared with the results of calculations in the above-mentioned book. Results of comparisons are perfect.

2. The influence of aerosol on the fluxes of integral solar radiation was investigated in cases of cloudy and clear atmosphere on base of the results of measurements performed at the experiment of 1996 year on the Zvenigorod Scientific Station of IAP. In the experiment direct measurements were the integral solar fluxes at the surface and optical thickness of the whole atmosphere, the water vapour, liquid water contents in the clouds, the height of the lower clouds boundaries. The distribution of the temperature and humidity by height and time in the layer (0-30km).

Absorption of solar radiation by gases H_2O, CO_2,O_2 in the neighbourhod of infrared part of the spectrum and of aerosol [1] have shown that the effect of the latter is essential and depends on the choosen aerosol model.

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1571.
УДК 541.18

ATMOSPHERIC AEROSOL OPTICAL PROPERTIES MEASURED THROUGH THE NASA AEROSOL ROBOTIC NETWORK (AERONET)

BRENT HOLBEN [1], DIDIER TANRE [2], YORAM KAUFMAN [1], ALEXANDER SMIRNOV [1,3], TOM ECK [1,4], ILYA SLUTSKER [1,3], OLEG DUBOVIK [1,3], BRIAN MARKHAM [1], NADER ABUHASSAN [1,3]

[1] *NASA Goddard Space Flight Center, Greenbelt, Maryland, USA, asmirnov@spamer.gsfc.nasa.gov*

[2] *Lab. d'Optique Atmospherique, Universite des Sciences et Technologies de Lille, Lille, France*

[3] *Science Systems and Applications, Inc., Lanham, Maryland, USA*

[4] *Raytheon STX Corporation, Lanham, Maryland, USA*

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Assesment of the radiative forcing suffers mainly from uncertainty in the spatial and temporal distribution of the spectral aerosol optical depth. A better understanding of aerosol

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processes and radiative forcing can be achieved by a combination of satellite observations on spatial and temporal distribution of the aerosol loading, combined with global three-dimensional modeling of the aerosol sources, transport, evolution and sinks, and with ground based measurements of aerosol optical parameters in the vertical atmospheric column. The development of the AERONET is essential to narrow the uncertainties in the aerosol direct forcing.

The validation of satellite-derived inversion procedure over the oceans and continents requires accurate and spatially extensive estimates of the atmospheric optical thickness in different geographical regions.

Since 1993 a federated network of ground-based automatic sun and sky scanning spectral radiometers (AERONET) has measured total column aerosol optical properties from 340 to 1020 nm at a variety of globally distributed locations.

A multi-year record of aerosol optical properties has been analyzed for background (Mauna Loa, Hawaii), rural (Greenbelt, Maryland), biomass burning (Cuiaba, Brazil), desert (Cape Verde), urban (Aire Adour, France), and marine (Bermuda) aerosol regimes. Seasonal variations of aerosol optical depth are analyzed. Peculiarities of optical properties associated with the Asian and Saharan dust transport, biomass burning, and heavy summer aerosol loading conditions on the East coast of the US are presented.

1363
УДК 541.18

CHARACTERISTICS OF AEROSOL AT THE NORTHERN OKLAHOMA

KATO S.[1], CHARLOCK TH.P.[2], CLOTHIAUX E.E.[3], LONG C.L.[4], CHARLES N.[5] MACE C.N.[5], ACKERMAN T.P.[3]

[1]. Hampton University, Hampton, Virginia, U.S.A.
[2]. NASA Langley Research Center, Hampton Virginia, U.S.A.
[3]. The Pennsylvania State University, University Park, Pennsylvania, U.S.A.
[4]. NOAA/ARL/SRRB, Boulder, Colorado, U.S.A.
[5]. University of Utah, Salt Lake City, Utah, U.S.A.

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Recent studies indicate that theoretical computations of the diffuse component of downward shortwave irradiance significantly exceed measurements at the surface under clear-sky conditions. This discrepancy leads to the uncertainty in estimating the total surface irradiance under clear sky condition. Because aerosol optical properties are temporally and spatially variable, uncertainties in the optical properties of aerosols contribute to uncertainties in irradiance computations.

To investigate the possible role of aerosols in this discrepancy at the Atmospheric Radiation Measurement site in northern Oklahoma, U.S., we relate ground-based measurements of direct and diffuse broadband irradiance, as well as aerosol spectral optical thickness, to meteorological parameters such as relative humidity, wind speed, and wind direction. When available, we analyze lidar backscattering returns for information about the aerosol profile.



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1104
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SATELLITE ESTIMATION OF SPECTRAL SURFACE UV IRRADIANCE IN THE PRESENCE OF TROPOSPHERIC AEROSOLS 1: CLOUD-FREE CASE

Krotkov N.A.*, Bhartia P.K.**, Herman J.R.**, Fioletov V.***, Kerr J.***

*Raytheon STX Corporation, Lanham, MD 20706 U.S.A.

**Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, MD 20771

***Atmospheric Environmental Service, Downsview, Ontario, Canada

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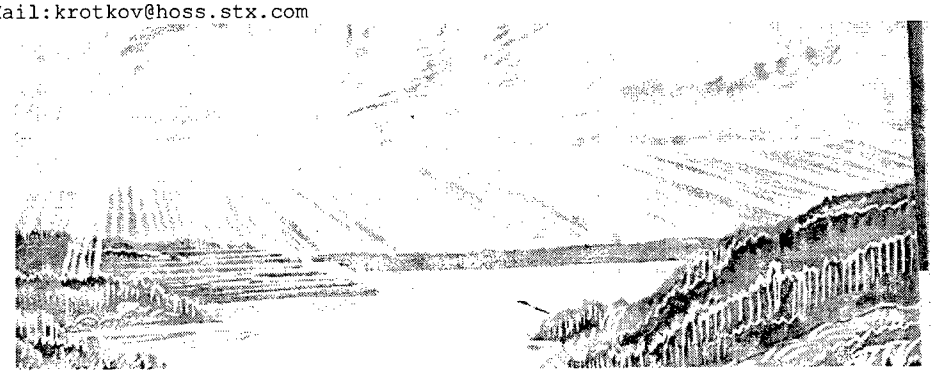
The satellite algorithm for determining the surface UVA(320-400nm) and UVB(290-320nm) flux in cloud-free conditions is discussed including the estimate of the various error sources (uncertainties in ground reflectivity, ozone amount, ozone profile shape, surface height, and aerosol attenuation). The presence of aerosols tends to reduce the logarithm of the UV flux linearly with aerosol optical depth. The slope increases with aerosol absorption and solar zenith angle. Using Brewer #14 measurements of UV flux and aerosol optical depth on clear days at Toronto the estimated slope falls in the range 0.2 to 0.3 (aerosol single scattering albedo about 0.95). It is shown that the Brewer measured spectral dependence of UVB (or UVB/UVA flux ratio) can be accurately reproduced using just total column ozone amount and the solar flux spectrum. The Brewer #14 measurements of absolute UVA flux can be reproduced with the aerosol model derived within uncertainties of the instrument calibration.

We have applied the algorithm to the data collected by the Total Ozone Mapping Spectrometer (TOMS) instruments that have been flown by NASA since Nov. 1978. It was demonstrated that in the absence of clouds and UV-absorbing aerosols, TOMS measurements of total column ozone and 380nm (or 360nm) radiances can provide estimates of surface spectral flux to accuracies comparable to that of typical ground based instruments. A newly-developed technique using TOMS aerosol index data also allows estimation of UV flux transmission by strongly-absorbing aerosols. The results indicate that over certain parts of the Earth, aerosols can reduce the UV flux at the surface by more than 50%. Therefore, the most important need for reducing errors in TOMS derived surface UVB spectra is to improve the understanding of UV aerosol attenuation.

Key words: measurement and monitoring of aerosols; tropospheric aerosols (dust, smoke); multiple scattering and absorption of ultraviolet radiation by aerosols.

More information: see the following NASA web pages:
http://jwocky.gsfc.nasa.gov http://skye.gsfc.nasa.gov

Corresponding author address: N.A.Krotkov, Raytheon STX Corporation 4400 Forbes Blvd., Lanham, MD 20706-4392;Phone: (301)-7945075; FAX: (301)-4411853, EMail:krotkov@hoss.stx.com



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1058.
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DIRECT RADIATIVE FORCING AT THE SURFACE BY SMOKE AEROSOLS DETERMINED FROM SATELLITE AND SURFACE MEASUREMENTS

LI Z., KOU L.

Canada Centre for Remote Sensing 588 Booth Street Ottawa, Canada K1A 0Y7

(Received 16 December 1997)

Direct radiative forcing (DRF) of aerosols is an important climatic parameter measuring the influence of aerosols on earth's climate. Observational studies of aerosol DRF usually suffer from a shortage of in-situ measurements of aerosol optical properties. This study introduces a new approach to determine surface DRF due to fire smoke under any sky conditions using satellite and surface measurements.

The method requires no observation of aerosol optical properties. It is based on a satellite inversion algorithm which retrieves surface net solar radiation in the visible spectrum (400-700nm). The algorithm was first validated under a variety of sky conditions ranging from clear, to smoky and cloudy skies. The accuracy of retrieval is found to be primarily affected by absorbing aerosols such as smoke. With the measurements of aerosol optical thickness, the effect can be well accounted for. Without correction for this effect, the difference between observed and estimated APAR is a good estimate of DRF due to aerosols. Over the remote boreal forest region in western Canada where this study is conducted, fire activities dominate the variation of aerosol loading during the summer season. Following this concept, instantaneous, daily and monthly mean DRF due to smoke aerosols are computed. The monthly mean DRF caused by smoke reaches a maximum value of -26.0 W/m^2 during the period of active burning in July 1994, as compared to the total radiative forcing of -76.7 W/m^2 due to the combined effect of both smoke and clouds in the same month and region.



1062.
УДК 541.18

A PROGRAM TO STUDY THE EFFECT OF AEROSOLS ON ATTENUATING THE SOLAR RADIATION IN TAIWAN (1994)

CHUNG-MING LIU ET AL.

Department of Atmospheric Sciences, National Taiwan University, Taipei, Taiwan, R.O.C. liucm@ccms.ntu.edu.tw

(Received 8 February 1997)

Aerosols are effective on scattering the solar radiation. The surface aerosols would hence affect the local visibility and attenuate the solar flux. This project intends to gradually set up observation program in Taiwan to analyze the effect of surface aerosols on the solar radiation field. In the first few years, we have selected the Tainan area for study. It is because that the area is flat and with a uniform distribution of air pollutants. Climatological data show that during September - April, Tainan was dry and clear, with a prevailing northerly, poor visibility and high levels of PM10, i.e. aerosols with diameter < 10mm; whereas during May-October, this area was wet and cloudy, with a variable wind, good visibility and low PM10 levels. Hence, we have selected the autumn, winter and spring seasons as the target period for the future intensive study period.

During February - March 1995, instruments were set up at Tainan-Yukang Meteorological Station to measure the surface solar flux, the aerosol composition and the aerosol optical

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properties. The Solar Spectrum System set up by the Yankee Environmental Systems, Inc., was used, which contains a automated multifilter rotating shadow-band radiometer (MFR-6) to measure the solar intensity in 415, 500, 600, 665, 862 and 940nm with an interval of 10nm each. Meanwhile, a TSP (Total Solar Pyrheliometer) was set up to provide a standard total solar flux dataset to be intercompared with those estimated by MFR-6. The data acquisition system is YESDAS-2. Meanwhile, a sky video-taping system was set up in along with a ceilometer, to assist in the determination of the clear-sky condition. Only the data collected during a clear-sky condition, will be used to study the effect of local aerosols on the attenuation of the solar flux. Otherwise, the scattering effect by cloud particles on the solar radiation is far more important than that by aerosols.

A Scanning Mobility Particle Sizer (SMPS), TSI model 3934, was set up to determine the number spectrum of aerosols with diameter between 0.025 -Ц 0.5mm, which was then compared with the number spectrum data collected simultaneously by a PMS probe for aerosols with diameter of 0.1 -Ц 10 mm. Meanwhile, an Integrating Nephelometer, TSI model 3563, was set up to determine the light scattering coefficient (m-1) of aerosols. The instrument is sensitive enough to measure the scattering coefficient as low as to 10-7m-1, and can provide the total and the backward scattering coefficient of aerosols in the band of the red, green and blue color, respectively.

In order to determine the composition of aerosols, a GBM-2000H high volume sampling system was set up to collect the aerosol samples. The filter used was Whatman 41 (20x25 cm). Since only a Hitachi Z-8100 polarized Zeeman AAS was available during the experimental period, only the concentration of the elements of Al, Fe, Mn, Na, Mg, Zn, and Pb were determined. The data of Pb, Na and Al were used as an indicator of the anthropogenic, marine and crustal influence.

Currently, the datasets collected during February-March 1995 are still under detailed analyses. A preliminary report to the National Science Council with a project ID no. NSC84-2621-M002-037 is available form the author. The whole research team contains: Chung-Ming Liu, Fei-Jan Lin (Institute of Oceanography, National Taiwan University), Chung-Teng Lee (Graduate Institute of Environmental Engineering, National Central University) and Hsiu-Wu Chang (central Weather Bureau).



1296.
УДК 541.18

MODEL OF OPTICAL WEATHER IN THE SURFACE ATMOSPHERIC LAYER AND ITS AEROSOL SECTION

PHILIPPOV V.L., MAKAROV A.S., IVANOV V.P.

The Federal Research & Production Centre The State Institute of Applied Optics Kazan, TR 420075 RU

(First received 03 March 1998; accepted for presentation during IAS-4)

Keywords: Atmospheric attenuation, optical weather, optoelectronic systems

The paper concerns one of the important aspects of usage and development of IR optoelectronic systems for remote geophysical measurements, namely the problems of optical atmospheric radiation attenuation modelling with allowance for considerable daily, seasonal and regional features of its aerosol component. The material originality is stipulated by a provided opportunity to present quantitatively spectral values of radiation attenuation components under any weather conditions in the most variable part of the atmosphere, i.e., in the lower troposphere at a height up to 5 km. The authors have determined an interrelation (to be predicted and expressed in terms of mathematical relations)

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between meteorological situation parameters, i.e., weather conditions in the agreed-upon sense, and optical atmospheric properties. It enabled to use the term "optical weather" in the paper title.

The model structure consists of sections determining the environmental properties under the conditions of clear cloudless atmosphere, in different aerosol states (haze, fog, dust, smoke) and in falling the hydrometeors (rain, snow, drizzle).

Some results are compared with measurements known from European OPAQUE Programme publications.

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1421.
УДК 541.18

THE EVALUATION OF THE APPLICABILITY OF THE CONTINENTAL AEROSOL MODEL FOR RADIATIVE CALCULATIONS

RUBLEV A.N.[1],CHUBAROVA N.YE.[2],TROTSENKO A.N.[1],TREMBACH V.V.[2],ZAHAROVA P.V.[3]

[1]. *Russian Research Center Kurchatov Institute, Russia, (rublev@imp. kiae.ru)*

[2]. *Meteorological Observatory, Moscow State University, Russia*

[3]. *Moscow State Academy of Instrument-Industry and Informatics*

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One of the ways for the testing of used models and methodologies in radiative transfer is direct comparisons of the calculated and observed solar fluxes. The experimental data were taken from two independent surface radiometry databases with various types of instrumentation obtained in different geographical regions. The first database includes solar radiation data and supporting meteorological information obtained in meteorological observatory of Moscow State University (MO MSU) in 1995 and 1996, the second one is based on solar radiometer data collected during american experiment CAGEX (1-in April 1994, 2 - October 1995 in Oklahoma). The comparisons between measured and modeled radiative fluxes were carried out for clear sky conditions. For model calculations within the shortwave SW spectral region the Monte-Carlo technique is applied in combination with line-by-line methods which account for selective absorption of the atmospheric gases.

Vertical profiles of atmospheric parameters were specified according to well-known model "midlatitude summer" proposed in [1]. The modification of water vapor and ozone content was carried out by multiplying the mass concentration profile by a constant. The vertical profiles of atmospheric aerosol lower than 12 km were taken according to CONT-1 [2] and according to BSA stratification - for the 12-20km layers. Variations of aerosol optical thickness were defined in the near-surface layer (0-2km). The aerosol attenuation was not taken into account in the layers above 20km. The analysis of the discrepancies between measured and modeled diffuse radiation shows that they vary for separate cases in the similar ranges: -24 - +15 W/m^2 and-17-+12 W/m^2 - respectively for Moscow and Oklahoma. The extreme low values observed in Moscow can be explained by the specific meteorological conditions when absorbing aerosol particles would accumulate in atmosphere (i. e. August 1996). We draw attention to the fact that the differences between calculations and measurements of diffuse irradiance vary in the same range in spite of different types of instruments utilizing in Russia and in the USA with

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independent calibration technique and in spite of different geographical regions in which the experiments were carried out. On the whole some overestimation of calculated solar fluxes obtained by our model computations in comparison with direct and diffuse irradiance measurements are observed. But they are not large. Maximal difference between measured and modeled global irradiance does not exceed 1% or 0.7% from the extraterrestrial value. Therefore after converting to the daily averaged solar radiation absorption, it makes up about 3W/m2, e. g. 5-10 times less than the biases of 15-30 W/m^2 between the experimental data and the climatic models estimates mentioned in [3].

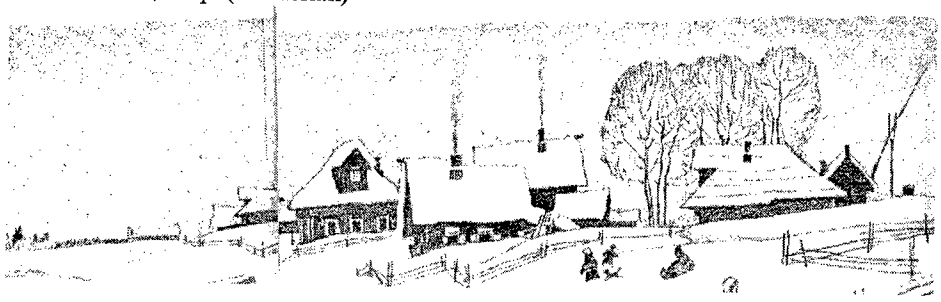
Using the benchmark database of calculated solar fluxes the daily averaged absorption of solar radiation Q was directly obtained. The simulations were done for clear sky conditions of midlatitude summer utilizing the continental aerosol model with vertical profiles CONT-I [1] and total aerosol optical thickness 0.23 using the averaging by zenith solar angle. Q was shown to be 25-27% in relation to the extraterrestrial solar flux at the upper boundary of atmosphere depending on the day of the year. This estimates are in a good agreement with mean value Q=25% which was calculated by A. Arking on the basis of ground and satellite data for clear sky conditions [3]. According to climatic models the average atmospheric absorption is about 17% [3]. The comparisons of experimental and calculated SW fluxes indicate that there are no significant biases between them at least in clear sky conditions.

The application of continental aerosol model CONT-1 is considered to be reasonable for the estimation of solar fluxes in these regions. It should be stressed that CONT-1 contains 90% of water-soluble particles [2]. They are responsible for the single scattering albedo A=0.9 in visible spectral range which to a great extent determines the level of diffuse irradiance. Optical characteristics of water-enveloped particles have a weak dependence on their generating chemical substances and are mainly determined by water optical properties. The predominance of these particles in the atmosphere may be the main reason of the wide application of this aerosol model.

The based on good coincidence of calculations with the experimental estimates of the scattering fluxes both in Moscow and in Oklahoma natural aerosol had such value A even for the cases, when the relative humidity was equal 30-40%. Sideways this contradicts with the data [4], of which follows, that at such humidity the aerosol drops transform to solid particles, the distribution of particle dimensions narrows, and their mean radius become to 2-3 time less than initial one. All that according to our calculations, based on the Mie's theory, decreases the single scattering albedo at least up to values A=0.2-0.3. This work was supported by American foundation CRDF (grant RG2-126).

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1257.
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URBAN-MARINE AND MINERAL-DUST AEROSOL PROPERTIES, RADIATIVE EFFECTS AND CLOSURE STUDIES OVER THE ATLANTIC OCEAN: AN OVERVIEW AND SELECTED RESULTS FROM TARFOX AND ACE-2

RUSSELL P. B.[1], LIVINGSTON J. M.[2], SCHMID B.[3], HIGNETT P.[4], DURKEE P. A.[5], HOBBS P. V.[6], GASSO S.[6], HEGG D.[6], STOWE L. L.[7], BATES T. S.[8], QUINN P. K.[8], HAMILL P.[9],

[1] NASA Ames Research Center, Moffett Field, CA 94035-1000 USA

[2] SRI International, Menlo Park, CA 94025 USA

[3] Bay Area Environmental Research Institute, San Francisco, CA 94122 USA

[4] United Kingdom Meteorological Office, Meteorological Research Flight, DRA Farnborough, Hampshire, GU146TD, UK

[5] Naval Postgraduate School, Monterey, CA 93943-5114 USA

[6] University of Washington, Seattle, WA 98195 USA

[7] NOAA/NESDIS, Office of Research and Applications, NSC, Washington, DC

[8] NOAA-Pacific Marine Environmental Laboratory, Seattle, WA 98115 USA

[9] Physics Department, San Jose State University, San Jose, CA 95192 USA

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Aerosol effects on atmospheric radiation are a major source of uncertainty in understanding the past climate and predicting climate change. To help reduce this uncertainty, the 1996 Tropospheric Aerosol Radiative Forcing Observational Experiment (TARFOX) and the 1997 second Aerosol Characterization Experiment (ACE-2) measured the properties and radiative effects of anthropogenic aerosols over the Atlantic Ocean. TARFOX focused on the urban-industrial haze plume flowing from the eastern United States over the western Atlantic, whereas ACE-2 studied aerosols carried over the eastern Atlantic from both European urban/industrial and African mineral sources. These aerosols often have a marked influence on the top-of-atmosphere radiances measured by satellites. However, the accurate derivation of both optical depths and radiative flux changes, or radiative forcing, from the satellite-measured radiances remains a difficult challenge for the wide range of aerosol types and properties present.

In TARFOX, sensors and samplers on four aircraft, land sites, and ships measured optical depth spectra, aerosol composition, microphysics and optical properties, and radiative fluxes during many overpasses by different satellites. Closure studies show that the aircraft-measured flux changes agree with those derived from the aerosol measurements using several modeling approaches. Essential to obtaining this agreement is modeling the aerosols as moderately absorbing--i.e., having midvisible single-scattering albedo between about 0.90 and 0.95. These values are in accord with the aircraft measurements of (1) aerosol absorption and scattering coefficients, (2) unexpectedly large carbonaceous fractions of aerosol composition, and (3) unexpectedly large aerosol humidification factors.

In ACE-2, European urban-marine and African mineral-dust aerosols were measured by sunphotometers on the Pelican aircraft and the Research Vessel Vodyanitskiy, and by sensors on NOAA satellites. We present a comparison of the optical depths derived from the NOAA-14 satellite data with those measured by our fourteen- and six-channel sunphotometers. We find that the excellent agreement for urban-marine aerosols is degraded when African dust is present. Using the sunphotometer data during ascent and descent of the aircraft, we also obtain extinction profiles for separated layers dominated by African dust and urban-marine aerosols, respectively. The extinction profiles allow us to obtain size distributions for both these

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aerosol types, showing the distinctive differences between them. These optical depth and size spectra are combined with model complex refractive index spectra to calculate radiative flux changes induced by the different aerosol layers. By combining solar beam transmission measurements in the 0.94-micron band with those at neighboring wavelengths, we also determine water vapor columns and profiles, which are shown to agree well with aircraft in situ measurements.



1436.
УДК 541.18

A COMPUTER CODE SYSTEM ATRAD FOR EFFICIENT PRECISE CALCULATIONS OF ATMOSPHERIC RADIATION.

SHILKOV A.V., SHILKOVA S.V.

Institute for Mathematical Modelling of the Russian Academy of Science, Moscow

(First received 30 March 1998; accepted for presentation during IAS-4)

The report is devoted to computer code system ATRAD (ATmospheric RADiation) for numerical calculations of atmospheric radiation transfer in climate studies. Mathematical methods for numerical modelling are submitted. Calculation results are presented.

A specificity of the Earth atmosphere and connected problems are the following:
A)Heterogeneity of altitude profiles of optically active gases.
B)Very large number of molecular absorption lines (resonances) (10^4 - 10^5).
C)Presence of cloud layers where the optical thickness with respect to absorption and scattering at particles changes sharply and temporal varying of cloudiness and aerosols.

The existing computer codes, solving these problems, are divided on poles apart:
1) "Line - by - Line" calculations of radiation spectra. These codes provide precision control at all stages of transport equation solving and use real microscopic cross-sections of radiation scattering and absorption as a data. Their disadvantages are large calculation time and difficulties at change of calculation variants.
2) "Semi empirical methods and codes" applying in climate studies. These methods are economical and permit the fast change of variants. Their disadvantages are the using of roughened model optical constants for wide spectrum parts as a data and precision uncontrollability.

The System ATRAD, being developed by the authors, has "Line - by - Line" calculation precision (1) and "Semi empirical methods and codes" efficiency (2). The data are microscopic cross-sections of radiation scattering and absorption (HITRAN - 92). The integration of these two qualities is achieved by application of a number of mathematical methods.

For the molecular absorption heterogeneity problem (A) solving, a procedure of energy scale division at resonance carriers is proposed. We call a pooling of spectrum intervals, at which absorption lines of gas "t" lie, a resonance carrier of gas "t". For the Earth atmosphere, it is enough to divide the energy scale at three carriers: H_20, $C0_2$ and 0_3. The radiation transfer calculations are made independently inside the boundaries of each carrier.

For the problem (B) solving, method of Lebesque averaging of radiation microscopic cross-sections and intensity with respect to photon energies is used. The averaging is performed over energy points with equal absorption. So there are practically no precision losses. As a result, instead of transport equation calculations in 10^5 - 10^6 spectrum points, we solve the averaged transport equation in 10 - 10^2 conventional spectrum units.

For the problem (C) solving, quasi diffusion schemes and schemes with quasi analytical interpolation with respect to space variable were developed. Quasi diffusion schemes have given

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the fast and precise solution of transport equation with prevailing scattering and strong temporal varying of particle concentrations. Schemes with quasi analytical interpolation with respect to space variable have given the fast and precise solution of transport equation with presence of cloud and aerosol layers where the optical thickness of cells changes sharply. These schemes don't require space mesh retirement and/or model consideration of cloud layers. Schemes are constructed on the base of analytical solving transport equation inside uniform cells, then connection of conditions at cell boundaries and reconstruction of the solution in the whole region.

The numerical calculation results, showing the efficiency of ATRAD Code System in comparison with "Line - by - Line" calculations are presented.

The work is done at the financial maintenance by ISTC (project N115-95).

1214.

THE IMPACT OF AEROSOLS ON SOLAR UV ACTINIC FLUX & HOTOLYSIS RATES

STENCHIKOV G., DICKERSON R., KONDRAGUNTA S., PARK R.

Department of Meteorology
3433 Computer and Space Sciente building
Univesity of Maryland
College Park, Maryland 20742-2425

(First received 04 February 1998; accepted for presentation during IAS-4)

A high mixing ratio of photochemically produced ground level ozone (photochemical smog) is the most typical characteristic of air pollution in highly populated urban regions. At the same time, the optical depth of fine aerosol particles on smoggy days can reach 2 in the near UV spectral bands. Sulfate and some organic aerosol particles scatter solar radiation back into space and cool the surface, but can increase the UV actinic flux, which is proportional to photon number-density in the atmosphere. This means that with the same number of photons arriving at the top of the boundary layer, aerosols simultaneously increase the number of reflected photons and the number of photons in the boundary layer.

Observations and theoretical calculations with MIE code and Discrete Ordinate radiative transport (DISORT) model based on observed aerosol size-number distributions show that UV-scattering particles in the boundary layer accelerate photochemical reactions and ozone production, but UV-absorbing aerosols, such as mineral dust and soot, inhibit photochemical processes.



1215.

RADIATIVE FORCING AND CLIMATE RESPONSE FROM THE 1991 MT. PINATUBO AEROSOL CLOUD

STENCHIKOV G.*, KIRCHNER I., ROBOCK A.***, GRAF H-F.****

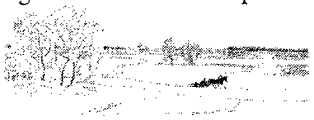
**University of Maryland, College Park, MD, US*
***Max Planck Institute for Meteorology, Hamburg, Germany*
****Rutgers University, New Brunswick, NJ, US*

(First received 05 February 1998; accepted for presentation during IAS-4)

We developed a zonal mean, monthly mean data set of stratospheric aerosol radiative characteristics for two years after the Mt. Pinatubo eruption. To calculate the aerosol parameters for the entire radiative spectrum, we combined SAGE II aerosol extinctions for

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1.02 microns, provided by Larry Thomason, and CLAES/ISAMS retrieved effective radii provided by Don Grainger. This is the first global data set with vertically dependent effective radius. Using this data we calculated aerosol radiative forcing and climate response with ECHAM-4 general circulation model. We found more small aerosol particles above the 10 mb than expected for the first year after the eruption. The solar NIR heating appears to be more significant than it was found previously especially at the top of the aerosol layer, because small particles are relatively more absorbing. Ozone depletion and the QBO significantly modify the observed stratospheric temperatures. The changes in stratospheric temperature and dynamics force the tropospheric circulation from the top. The tropospheric dynamic response produces a significant portion of the climate variation especially in the winter. This dynamic response is sensitive to the stratospheric heating and sea surface temperature.



581.
УДК 541.18

ON INFLUENCE OF ATMOSPHERIC AEROSOL OPTICAL PROPERTIES ON RADIANCE CHARACTERISTICS OF THE EARTH IN NEAR IR SPECTRAL RANGE AT OBSERVING FROM SPACE.

VESELOV D.P., LOBANOVA G.I., MIRSOEVA L.A., POPOV O.I., SEMENOVA V.I.

All-Russian scientific centre "SOJ named after S.J.Vavilov"; Birjevaya linia, 12, St-Petersburg, Russia.

(First received 18 November 1997; accepted 09.02.98 for presentation during IAS-4)

The method and software are developed to calculate radiative characteristics of the system the Earth- Atmosphere due to reflection by underlying surface and singly scattering by atmosphere of sun radiation in the spectral range 1-3.0 mcm at observing from space. The software uses the data-base of optical characteristics of earth surface, tropospheric clouds and atmosphere. A special attention was paid to atmospheric aerosol which is the most changeable components of atmosphere. In calculations the different combinations of models for nearground, atmospheric, stratospheric and mesospheric aerosols were used. The choice of aerosol models is found to control substantially a radiance level of the system the Earth-atmosphere.

1353.
УДК 541.18

CALCULATION OF ANISOTROPIC SCATTERING OF SOLAR RADIATION IN ATMOSPHERE (MONOENERGETIC CASE).

ARISTOVA E.N., GOLDIN V.YA.

Institute for Mathematical Modelling of RAS

(First received 01 January 1998; accepted for presentation during IAS-4)

The strong anisotropic scattering, including scattering with forward-peaked indicatrix (small angle scattering), is very important at the solar radiation transport in atmosphere containing aerosols. In the paper, a method of radiation transport calculation at strong scattering anisotropy is developed. And scattering indicatrix is used without approximation, directly, for example according the data from [1].

Radiation intensity in the method is represented as a sum of three components: 1) non-scattered solar radiation, including specularly reflected from the Earth surface one (analytical solution), 2) small angles scattered direct solar radiation and its specularly reflected part (with

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multiple scattering); (high-accuracy representation of this component with real indicatrix is obtained), 3) all the rest radiation, the method of calculation of which is based on our papers [2,3].

The method makes it possible to consider also real anisotropy of reflection from the Earth surface [2]; because of lack of data ,we restricted ourselves by linear combination of specular and diffusive reflection.

The results of calculation of several problems in monoenergetic case for plane approximation of atmosphere are presented.

Problems for different angles of incidence of solar radiation in cloudless atmosphere as well as at presence of cloudiness are considered. An appearance of "inner boundary conditions" for radiation intensity at inner and outer cloud boundaries as natural consequences of complete solving the problem in non-homogeneous medium is interesting.

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List of participants of IAS-4 with presentations during 8 July 98



Ackermann Ingmar J *(1967-06-24)*
Ford Forschungszentrum
Aachen
Phone: (49)-241-9421205
fax (49)-241-9421301
email: iackerma@ford.com
Aachen
Germany

Andronova Natalia G.
University of Illinois at Urbana-Champaign
email:
Natasha@uiatma.atmos.uiuc.edu
Urbana
USA

Aristova Elena Nikolaevna *(1961-03-22)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@kiam.ru
Moscow
Russia

Arking Albert *(1932-11-05)*
Johns Hopkins University
Phone: (1)-301-2992478
fax (1)-301-2992479
email: arking@aa.gsfc.nasa.gov
Baltimore
USA

Barthelmie Rebecca *(1963-06-22)*
Indiana University
Phone: (1)-812-8554083
fax (1)-812-8551661
rbarthel@othello.ucs.indiana.edu
Bloomington USA

Belov Nikolay Nikolaevich *(1947-05-04)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Belov Pavel Nikolaevich *(1977-05-02)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Degtyarev Aleksandr Iosifovich *(1947-09-13)*
Institute of Geography RAN
Phone: (7)-095-9503919
fax (7)-095-2879826
anaumov@mskw.mecom.ru
Moscow
Russia

Garger Evgeniyi Konstantinovich *(1937-02-06)*
Institute of Radioecology (Ukraine Sci.Academy)
Phone: (7)-044-2205313
fax (7)-044-2209346
email: garger@garger.pp.kiev.ua
Kiev
Ukraine

Goldin Vladimir Yakovlevich *(1924-06-25)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@KIAM.RU
Moscow
Russia



Hamill Patrick *(1936-04-29)*
San Jose State University
Phone: (1)-408-9245241
fax (1)-408-9242917
email: hamill@light.arc.nasa.gov
San Jose
USA

Ivlev Lev Semenovich *(1936-05-21)*
Sankt-Petersburgh State University
Phone: (7)-812-4287349
email: vlas@aero.phys.pu.ru
St.-Petersburg
Russia

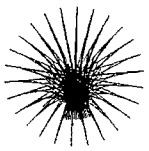
Kashkin Valentin Borisovich
Phone: (7)-3912-494987
fax (7)-3912-433918
email:
root@kashkin.krasnoyarsk.su
Krasnoyarsk
Russia

Kiseleva Margarita Sergeevna *(1928-12-01)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189900
fax (7)-812-2183720
St.-Petersburg
Russia

Kogan Vladimir *(1948-07-05)*
Battelle Memorial Institute
Columbus
Phone: (1)-614-4247970
fax (1)-614-4244185
email: koganv@battelle.org
Columbus USA

Kuznetsova Irina Nikolaevna *(1954-01-20)*
Phone: (7)-095-2559804
fax (7)-095-2556301
Moscow
Russia

LI ZHANQING *(1963-09-17)*
CANADA CENTRE FOR REMOTE SENSING
Phone: (1)-613-9471311
fax (1)-613-9471406
email: li@ccrs.emr.ca
Ottava Canada



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Lobanova Galina Ivanovna *(1936-11-20)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189946
fax (7)-812-2188179
St.-Petersburg
Russia

Naumov Aleksandr Dmitrievich *(1949-12-13)*
Phone: (7)-095-9446246
Moscow
Russia

Nguyen Ba Cuong
CENTRE DES FAIBLES RADIOACTIVITES
Phone: (33)-1-69088503
fax (33)-1-69087716
PARIS
France

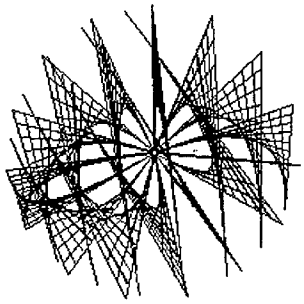
Pryor Sara *(1967-10-19)*
Indiana University
Phone: (1)-812-8555155
fax (1)-812-8551661
email: spryor@indiana.edu
Bloomington
USA

Rublev Alekseyi Nikolaevich *(1953-12-24)*
RNC of Nuclear Energy KURCHATOVASKY INSTITUTE
Phone: (7)-095-1967687
fax (7)-095-1941994
email: rublev@imp.kiae.ru
Moscow
Russia

Rusina Elena Nikolaevna *(1946-02-18)*
The Arctic and Antarctic Research Institute
Phone: (7)-812-3523081
fax (7)-812-3522688
email: aaricoop@aari.nw.ru
St.-Petersburg
Russia

Schlesinger Michael E.
University of Illinois at Urbana-Champaign
schlesin@uiatma.atmos.uiuc.edu
Urbana
USA

Shakina Natalya Pavlovna *(1937-10-14)*
Phone: (7)-095-2555101
fax (7)-095-2556301
anaumov@mskw.mecom.ru
Moscow
Russia

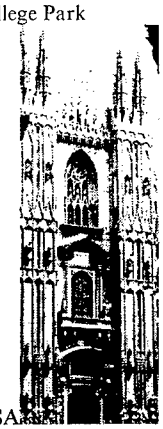


Shevchenko Vladimir Petrovich
Institute of Oceanology of RAS
Phone: (7)-095-1247737
fax (7)-095-1245983
email: vshevch@geo.sio.rssi.ru
Moscow
Russia

Shilkov Aleksandr Viktorovich *(1958-03-20)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: SergePol@KIAM.RU
Moscow
Russia

Shilkova *(1958-02-04)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@kiam.ru
Moscow
Russia

Stenchikov Georgiy L.
University of Maryland
Phone: (1)-310-4055370
fax (1)-310-3149482
email: gera@metosrv2.umd.edu
College Park



USA

Suhinin Anatoliyi Ivanovich
Forest Institute Sibirian Branch of Acad. of Sci.
Phone: (7)-3912-494092
fax (7)-3912-433686
email: fire@ifor.krasnoyarsk.su
Krasnoyarsk
Russia

Zaharenko Valeriyi Semenovich
Institute of Catalysis of RAS
Phone: (7)-3832-355764
fax (7)-3832-355756.
email: SOLAR@catalysis.nsk.su
Novosibirsk
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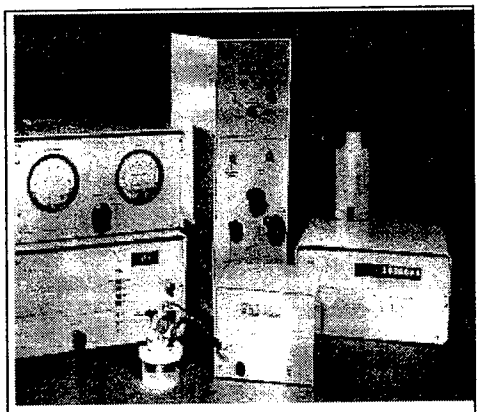
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1529
УДК 541.18

THE ROLE OF MARINE SPRAY AND AEROSOLS ON THE AIR-SEA EXCHANGE OF HEAT AND GASES

G. L. GEERNAERT, L. L. S. GEERNAERT

Ny Tofegaards ej 22, DK-3650 Ols ykke, Denmark E-MAIL: GLG@dm .dk

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Heat and gas exchanges are central to modelling and assessments of regional climate and marine eutrophication. Nitrogen, carbon, and heat exchange furthermore play central roles in coastal marine biomass dynamics. In order to model the exchanges of these compounds (and heat), the classical approach used Monin-Obukhov similarity theory and/or simple deposition velocities derived from laboratory or other limited studies. In this presentation, the full set of dynamical equations are used to assess the roles of source and sink terms as height dependent functions in the transport equations. Horizontal inhomogeneity is maintained as an important term in the equations, thus introducing flux divergence and the need for specifying internal boundary layers. Calculations for various scenarios will be presented, and uncertainties will be documented in order to highlight the research needs for the next decade.

1530
УДК 541.18

THE EFFECT OF INTERNAL STRUCTURE OF THE RADIALLY NON-UNIFORM PARTICLES OF MARINE AEROZOLE ON LIGHTSCATTTERING

KOKORIN A.M.

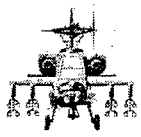
S.-Peterburg Branch of P.P.Shirshov Institute of Oceanology Russian Academy of Sciences
199053, 1-Line W.O.,30. kokorin@gk3103.spb.edu

(First received 01 June 1998; accepted for presentation during IAS-4)

In this work an accurate solution of the problem of difraction on an anti-reflection sphere (ARS) is used for the assessment of the influence of internal structure of oceanic aerosol particles on lightscattering characteristics. The ARS is a two-layered sphere with a homogenious non-absorbing nucleous and an inhomogenious shell, with a power law of the inhomogenety behaviour. For the calculations of the properties of lightscattering the conventienal model of the marine aerozole was used (SPA, 1984). The model is a combination of the two components: (1) "WATER-SOLUBLE" with the soluble particles of calcium sulphate and organic substance and (2) "OCEANIC" with particles of salt. The results of the numerical modelling are considered for the three possible mechanisms of changes in the ensemble of aerozole particles in the variable field of the atmosphere humidity: a) uniform swelling of the whole volume of a particle accompanied by decreasing the refraction index (the model of a homogenious sphere); b) enlarging of a particle with partial soluting of the initially dry solid nucleous (the model of ARS); c) enveloping of a particle by a water shell with the remaining non-soluble nucleous (the model of the two- layered sphere). The results of the calculations showed that the lightscattering coefficients of the polydispersed systems of particles for the three cases considered above are very close in magnitude. The angular properties of lightscattering are much more sensitive to the internal structure of particles. The phase functions for the all three cases practically do not differ for the humidity less than 70 percent. For the magnitudes of the humidity exeeeding 70 percent the phase funstion for ARS-model in the range of the large angles of scattering qualitatively and quantitatively differ from that for the models of the two-lagered and homogenious spheres.

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For example for the "Water-Soluble" fraction the largest difference in the scattering intensity (40 percent and even more) is observed in the range of backscattering angles. For the "Oceanic" fraction the difference in some cases can be egual to even more than 200 percent. So for the magnitudes of the humidity exceeding 70 percent the effect of the internal structure of particles of the ARS - type on the phase function becomes essential in the range of large angles of scattering. In addition the large differences in the behaviour of the degree of linear polarization are observed for all considered models. Conditious were reveiled for which an effect of depolarization com be observed for the case of an ARS-model of "Oceanic" fraction.



1670.
УДК 541.18

POLYDISPERSE AEROSOL INFLUENCE ON THE SCAVENGING COEFFICIENT

MIHAELA MIRCEA, SABINA STEFAN [1]

Na ional Ins i e of Me eorology and Hydrology, B chares

[1] *Uni ersi y of B chares , Fac l y of Physics, B chares*

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OUTLINE OF THE PROBLEM

The scavenging coefficient for an aerosol particle of radius 'a' (monodisperse case), is defined as (Pruppacher and Klett, 1978):

$$\Lambda(r) = \pi \int_0^\infty r^2 E(a,r) n(r) dr \qquad (1)$$

where r is the drop radius, E (a,r) is collection efficiency and n(r)dr is the number concentration of rain droplets having the radius in the range [r, r+dr].

Taking into account the polydispersity of aerosol, the integral scavenging coefficient over the whole aerosol spectrum is given by:

$$\Lambda(a,r) = \int_0^\infty \Lambda(a) n(a) da \qquad (2)$$

where n(a)da is the number concentration of aerosol particles with radii a to a+da.

The removal of the aerosol particles with radii between 0.001 μm and 10 μm could be described by three mecanism: Brownian diffusion, interception and inertial impaction. The corresponding collection efficiencies are given in Table 1. In the case of Brownian diffusion, the diffusion coefficient was approximated by $D \cong 1{,}3 \times 10^{-16} a^{-2}$ (a in cm, D in $cm^2 s^{-1}$).

Table 1. The mathematical expressions of collection efficiencies E(a,r) for Brownian diffusion, interception and inertial impaction.

Brownian diffusion (Slinn,1971)	$\left(0{,}65 \times 10^{-12}\right)\left[\frac{10^{-7}}{a^2 r^2} + \frac{1}{a^{4/3} r}\right]$
Interception (Fuchs,1964)	$3\frac{a}{r}$

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Interception (Fuchs,1964)	$3\frac{a}{r}$
Inertial impaction (Slinn, 1974)	$\left[\frac{S-\frac{1}{12}}{S+\frac{7}{12}}\right]^{3/2}$

The parameter S in Table 1 is a function of dimensionless Stokes parameter:

$$S = \frac{2}{9}\frac{r^2\rho_p}{a\rho_a}\frac{V_t}{\upsilon} \qquad (3)$$

where ρ_p and ρ_a are the mass density of the particles and air, V_t is the raindrop terminal velocity and ν is the kinematic viscosity of air. For the raindrops with radii between 0.01 and 0.1 cm the terminal velocity is approximately proportional to r (Gunn and Kinzer, 1949) and the Stokes parameter becomes:

$$S = 0{,}10\text{x}10^{8}a^{2}\rho_p \qquad (4)$$

(a in cm, ρ_p in g cm^{-3}).

Considering the collection efficiencies from Table 1, the Gamma distribution function with four parameters for raindrops (A,α,β,γ) and aerosol particles ($A_0,\alpha_0,\beta_0,\gamma_0$) were obtained the following expressions for the scavenging coefficients in the monodisperse (M) and polydisperse (P) case:

Brownian diffusion (DBM):

$$\Lambda(r) = 0{,}65\text{x}10^{-12}\pi\left[\frac{10^{-7}}{a^2}\frac{A}{\gamma}\beta^{\frac{\alpha+1}{\gamma}}\Gamma\left(\frac{\alpha+1}{\gamma}\right)+\frac{1}{a^{4/3}}\frac{A}{\gamma}\beta^{-\frac{\alpha+2}{\gamma}}\Gamma\left(\frac{\alpha+2}{\gamma}\right)\right] \qquad (5)$$

Interception(IM):

$$\Lambda(r) = 3a\pi\frac{A}{\gamma}\beta^{-\frac{\alpha+2}{\gamma}}\Gamma\left(\frac{\alpha+2}{\gamma}\right) \qquad (6)$$

Inertial impaction (IIM):

$$\Lambda(r) = \pi\left(\frac{S-\frac{1}{12}}{S+\frac{7}{12}}\right)^{3/2}\frac{A}{\gamma}\beta^{-\frac{\alpha+3}{\gamma}}\Gamma\left(\frac{\alpha+3}{\gamma}\right) \qquad (7)$$

Brownian diffusion (DBP):

$$\Lambda(a,r) = \frac{0{,}65\text{x}10^{-12}\pi}{\Gamma\left(\frac{\alpha_0+i+1}{\gamma}\right)}\left[\frac{10^{-7}A}{\gamma}\beta^{-\frac{\alpha+1}{\gamma}}\Gamma\left(\frac{\alpha+1}{\gamma}\right)\beta_0^{\frac{2}{\gamma_0}}\Gamma\left(\frac{\alpha_0+i-1}{\gamma}\right)+\frac{A}{\gamma}\beta^{-\frac{\alpha+2}{\gamma}}\Gamma\left(\frac{\alpha+2}{\gamma}\right)\beta_0^{\frac{4}{3\gamma_0}}\Gamma\left(\frac{\alpha_{+i-}+i-\frac{4}{3}}{\gamma_{0_0}}\right)\right] \qquad (8)$$

Interception(IP):



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$$\Lambda(a,r) = 3\pi\frac{A}{\gamma}\beta^{-\frac{\alpha+2}{\gamma}}\Gamma\left(\frac{\alpha+2}{\gamma}\right)\beta_0^{-\frac{1}{\gamma_0}}\frac{\Gamma\left(\frac{\alpha_0+i+2}{\gamma_0}\right)}{\Gamma\left(\frac{\alpha_0+i+1}{\gamma_0}\right)} \qquad (9)$$

Inertial impaction (IIP):

$$\Lambda(a,r) = \frac{\pi\frac{A}{\gamma}\beta^{-\frac{\alpha+3}{\gamma}}\Gamma\left(\frac{\alpha+3}{\gamma}\right)}{\frac{A_0}{\gamma_0}\beta_0^{-\frac{\alpha_0+i+1}{\gamma_0}}\Gamma\left(\frac{\alpha_0+i+1}{\gamma_0}\right)}\int_0^{\infty}\left[\frac{S-\frac{1}{12}}{S+\frac{7}{12}}\right]^{3/2} a^i n(a)da \qquad (10)$$

In the above derivations i represents the order of aerosol (i=0 for the number probability density function).

RESULTS

Table 1 and 2 presents the values of the scavenging coefficient computed for maritime (Hudson, 1986) and continental (Junge and McLaren, 1971) aerosol using the equations (5÷10). The total number of aerosol particles and the mean radius used in computation was: for the maritime aerosol N =215 cm^{-3} and a_m=0,59μm, for continental aerosol N = 54221 cm^{-3} and a_m=0,018μm . The scavenging coefficient for inertial impaction was computed using Romberg method.

Table 2. Scavenging coefficients, Λ(s-1), for maritime and continental aerosol in the monodisperse case (ρp=1g cm-3).

	maritime aerosol			continental aerosol		
	DBM	IM	I IM	DBM	IM	I IM
heavy rain (100÷500mm/h)	$3{,}25\ 10^{-2}$	$4{,}88\ 10^{-7}$	$1{,}07\ 10^{-2}$	$3{,}14\ 10^{-1}$	$1{,}56\ 10^{-7}$	$1{,}07\ 10^{-2}$
moderate rain(5÷100mm/h)	$3{,}25\ 10^{-1}$	$1{,}42\ 10^{-6}$	$9{,}22\ 10^{-3}$	3,15	$4{,}59\ 10^{-7}$	$9{,}22\ 10^{-3}$
light rain(1÷5mm/h)	649,9	$1{,}32\ 10^{-4}$	$3{,}96\ 10^{-2}$	6290	$4{,}25\ 10^{-5}$	$3{,}96\ 10^{-2}$

Table 3. Scavenging coefficients, Λ(s-1), for maritime and continental aerosol in the polydisperse case (ρp=1g cm-3).

	maritime aerosol			continental aerosol		
	DBP	IP	I IP	DBP	IP	I IP
heavy rain(100÷500mm/h)	$1{,}46\ 10^{-2}$	$9{,}76\ 10^{-7}$	$1{,}07\ 10^{-2}$	$1{,}42\ 10^{-1}$	$3{,}14\ 10^{-7}$	$1{,}07\ 10^{-2}$
moderate rain(5÷100mm/h)	$1{,}46\ 10^{-1}$	$2{,}85\ 10^{-6}$	$9{,}22\ 10^{-3}$	1,41	$9{,}19\ 10^{-7}$	$9{,}22\ 10^{-3}$
light rain(1÷5mm/h)	292,48	$2{,}65\ 10^{-4}$	$3{,}96\ 10^{-2}$	2831	$8{,}5\ 10^{-5}$	$3{,}97\ 10^{-2}$

As can be seen from Table 1 and 2 the polydispersity of the aerosol has no influence in the case of inertial impaction, but it increases the interception scavenging coefficients and decreases the scavenging coefficients for Brownian difussion. Parameterization of the scavenging coefficient taking into account a specified polydispersity of rain and aerosol are more appropriate to use for computing the concentration of pollutants in rainwater and for comparison with the field

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measurements.

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1425.
УДК 541.18

SEASONAL VARIATION OF AEROSOL DEPOSITION FROM BIOGENIC SULFUR GASES IN REMOTE MARINE ATMOSPHERE AT AMSTERDAM ISLAND IN THE SOUTHERN INDIAN OCEAN

NGUYEN B. C.*, MIHALOPOULOS N., SCIARE J.*, BABOUKAS E.****

**Laboratoire des Sciences du Climat et de l'Environnement. DSM/LSCE Unit Mixte de Recherche CEA-CNRS. Bât 709 - Orme des Merisiers 91191 - Gif-sur-Yvette Cedex. France.*

***Department of Chemistry, University of Crete, P.O. Box 1470, GR- 71409 Heraklion, Greece.*

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Biological activity of phytoplankton and zooplankton in surface seawater, over 3/4 of the Earth's surface, releases about 15 to 40 Tg S/year (1 Tg=10^{12}g) of DMS into the atmosphere . This gas rapidly oxidizes in the atmosphere to give methane sulfonic acid (MSA), dimethylsulfoxide (DMSO) and sulfur dioxide (SO^2) which subsequently reacts to form non sea-salt-sulfate (nss-SO_4^{2-}) . These aerosols (MSA, DMSO and nss-$SO_4$2-) can act as cloud condensation nuclei (CCN), influencing albedo and therefore the Earth's climate.

Due to its importance in atmospheric chemistry, considerable effort has been made in the last few years to better understand the seasonal variation in DMS and its oxidation products.
We present results of simultaneous measurements taken over a 2 to 4 year period in order to assess whether there is a link between oceanic and atmospheric DMS, atmospheric SO_2, and wet deposition of MSA, DMSO and nss-SO_4^{2-} .

A continuous record of SO_2 in the atmosphere (1989-1990) and of MSA and non-sea-salt-sulfate (nss-SO_4^{2-}) in rainwater and DMS at the ocean surface and in the atmosphere (1987-1990) were performed at Amsterdam Island (37°S 77°E) . Covariations are observed between the

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oceanic and atmospheric DMS concentrations, atmospheric SO2 concentrations, wet deposition of MSA, nss-SO_4^{2-}. A comparable summer to winter ratio of DMS and SO_2 in the atmosphere and MSA in precipitation were also observed. During the last 2 years from December 1995 to February 1997, measurements of MSA and DMSO in rainwater were also performed. DMSO concentrations ranged from 7.0 to 369 nM, with a distinct seasonal variation. The mean concentrations during the summer and the winter periods were 90 nM and 25.6 nM respectively. The observed DMSO seasonal cycle is in line with the observations of DMS in the atmosphere and MSA in rainwater, measured simultaneously during the reported period.

However, the summer to winter ratio of DMSO is significantly lower than that observed for DMS and MSA. The DMSO to MSA ratio and its observed seasonal variability are also presented. The implications on the biogenic sulfur cycle are discussed.

1390
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THE ROLE OF AEROSOLS IN DRY DEPOSITION TO COASTAL WATERS

PRYOR S.C. [1], BARTHELMIE R.J. [1,2], GEERNAERT L.L.S. [2],
ELLERMANN T. [3], PERRY K.D. [4]

[1] Clima e and Me eorology Program, Indiana Uni ersi y, Blooming on, IN 47405, USA.
[2] Dep . of Wind Energy and A mospheric Physics, Rise Na ional Labora ory, DK.
[3] Dep . of A mospheric En ironmen , Na ional En ironmen al Research Ins i e, DK.
[4] Crocker N clear Labora ory, Uni ersi y of California a Da is, CA, USA.

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Model calculations of N deposition to seas around Denmark indicate that roughly 1/3 of total N enters via atmospheric pathways and 3/5 of the total atmospheric deposition derives from aerosol matter (Hertel, 1995). Measurement and modeling of aerosol dry deposition is confounded by the myriad of processes which determine the deposition velocity. However, it is known that aerosol diameter is critical and it has been suggested that hygroscopic growth close to the surface plays an important role in determining deposition fluxes (Slinn and Slinn, 1980). Aerosols also play a key role in determining the gaseous flux due to heterogeneous chemistry on aerosol surfaces (particularly reaction of HNO3 with NaCl to yield aerosol $NaNO^3$ and HCl vapor).

Herein, we examine the role of aerosols in dry deposition processes using size segregated and chemically speciated aerosol measurements collected during April and May of 1997 on the Swedish Island of Ostergarnsholm in the western Baltic under the Air-Sea Exchange Process Study (ASEPS). Aerosol size distributions (Dp: 0.5 - > 20 pm) were measured continuously using a TSI aerodynamic particle sizer. Size resolved aerosol measurements for chemical analysis were undertaken using a 10 stage Micro-Orifice Uniform Deposit Impactor (MOUDI) (Size segregated Dp: 0.056 - 18 pm) and a 3 stage Davis Rotating Universal-size-cut Monitoring (DRUM) impactor (Size segregated D,: 0.069 - 2.5 pm). Aluminum foil substrates (47 mm) coated with silicon spray were used in the MOUDI to facilitate analysis for N species (Zhuang and Huebert, 1996). The sampling period was 24 hours in duration except during periods of extreme weather when filters were exposed for 48 hour periods. The filters were analyzed by ion chromatography for NO^-, SO_4^{2-}, Cl^-, Na^+, NF_4^+, Ca^{2+}, K^+, Mg^{2+} and MSA (methane sulfonic acid) using a solution of oxalic acid. A greased mylar

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impaction substrate was used for the DRUM impactor and was analyzed for Na through U using PIXE analysis to provide 6 hour average concentrations. In addition to the two impactors, filter samplers were also used to give bulk composition data for NO3-, SO42-, Cl-, Na+ and NF^{4+}.

The implication of these data is that NH^{4+} is principally present at (NH4)2SO4/NH_4HSO_4 in the fine faction of the aerosol, while significant amounts of NO3- are associated with larger aerosols. These data will be used with algorithms from Slinn and Slinn (1980) to estimate dry deposition of N-compounds based on the 24 hour average aerosol data. Note: It is acknowledged that the temporal resolution for the aerosol data is not ideal for this purpose, data are to be collected on a shorter time scale during the summer of 1998 in order to facilitate this analysis. Our investigations shows the molar ratio of Na^+ to Cl^- (by aerosol diameter and sampling day) and shows that during the first portion of the study, when the meteorological conditions were dominated by cyclone passages and measured HNO_3 concentrations were low, the molar ratios on the stages with large sea spray contributions were close to 1. Later in the sampling period when ridging dominated the meteorological conditions and observed HNO3 concentrations increased, the molar ratio on stages 2-6 increased providing some evidence for volatization of HCl vapor from sea salt aerosols (note this is also the period of highest aerosol NO^{3-}). These findings and other analyses related to calculation of N deposition will be discussed along with issues relating to measurement considerations.

Acknowledgements

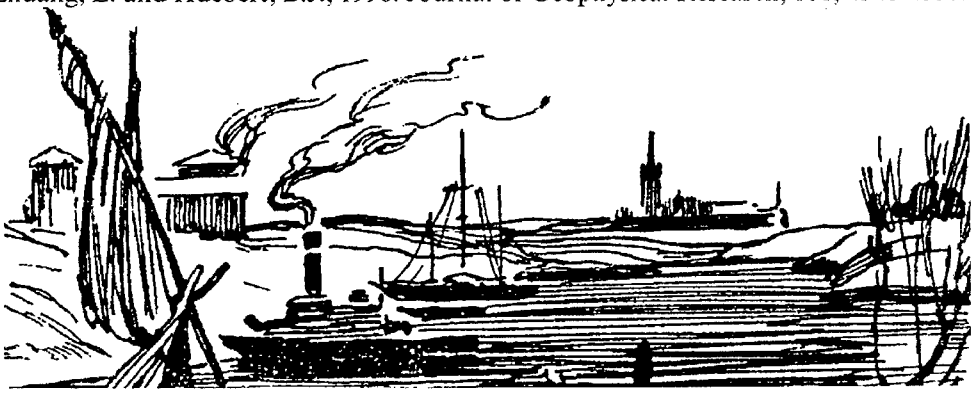
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COMPOSITION OF AEROSOLS IN THE MARINE BOUNDARY LAYER IN THE RUSSIAN ARCTIC

V.P. SHEVCHENKO*, A.P.LISITZIN*, R.STEIN**, A.A.VINOGRADOVA***, V.V.SMIRNOV****, V.N.LUKASHIN*

* P.P.Shirshov Institute of Oceanology of RAS, Moscow, Russia; e-mail: shevch@geo.sio.rssi.ru

** Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

*** Institute of Atmospheric Physics of RAS, Moscow, Russia

**** Institute of Experimental Meteorology, Obninsk, Russia

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Traditionally riverine input was assumed to be the main geochemical pathway of terrestrially and anthropogenically derived compounds from their sources top the aquatic environment, but there is much evidence that atmospheric inputs contribute significantly to marine areas. Numerous studies have shown that aerosols in the Arctic are of importance for atmospheric chemistry and climate. But up to now aerosols of the Russian Arctic were studied little.

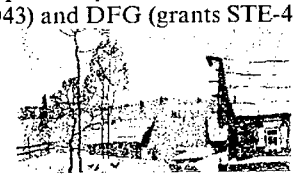
In 1991-1997 during 10 expeditions 126 samples of aerosols have been collected by nylon meshes and by filtration of air through Whatman-41 and AFA-HA in the Laptev, Kara, Barents and Norwegian Seas. Aerosol size distribution has been measured by PC-218 photoelectrical particle counter.

In general, there is a much greater number of small particles (with sizes from 0.5 μm to 2 μm) in comparison to large particles. Over the open water an increase of the wind velocity stimulates the concentration growth of coarse (>5 μm) particles in the spectrum. This could testify the input of sea salt particles from the sea surface microlayer by wind and the importance of these particles for the chemical composition of marine aerosols. In ice-covered areas we find an increase of concentrations of fine particles (from 0.5 μm to 2 μm), especially at low temperature. It can be explained by formation of ice microcristals.

In August-October 1993, the mass concentration of the coarse fraction of the Kara and Barents aerosols which are not soluble in water, varied from 0.02 to 0.48 $\mu g/m^3$ (0.15 $\mu g/m^3$ in average); in the Laptev Sea concentration of insoluble aerosol particles was 0.04-0.09 $\mu g/m^3$ at the end of July 1995. These values are similar to those measured in the North Atlantic (Duce et al., 1991). In most of samples organic matter (fibers of vegetation, pollens, diatoms) and mineral particles are the main component. Content of organic carbon varies from 7.54 to 26.9 % (17.6 % in average).

The mean concentrations of most of the chemical elements are within limits known from literature for other Arctic regions. Concentrations of heavy metals in our samples are higher than in the Antarctic and the remote ocean regions, but they are much lower than those from seas in highly industrialized regions. Temporal variations of the element concentrations are caused by various air masses coming to the studied area. The increase of concentrations of some elements in remote areas covered by ice could be explained by resuspension of particles from sediment-laden sea ice.

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1138.
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VARIABILITY FACTORS OF AEROSOLS AND AEROIONS IN POLAR ATMOSPHERES

SMIRNOV V.V.*, RADIONOV V.F.** , SHEVCHENKO V.P.***

*Institute of Experimental Meteorology, 82 Lenin str., Obninsk, Russia 249020

**The Arctic and Antarctic Research Inst., 38 Bering str., St. Petersburg, Russia 199397

***Institute Oceanology, 36 Nachimov str., Moscow, Russia 117851

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1. The complex regular measurements of the aerosol dispersity and air ion spectra mobility were proceed in the Western (Franz-Joseph Archipelago, Zigler Island, March - April 1994), Central (Laptev Sea, summer 1995) and Eastern (Wrangel Island, March - April 1985) Arctic and the Antarctic (Molodezhnaya station, January-May 1983). Aerosol size range is from 0.004 to 10 μm, as well as aeroion mobility from 0.00032 to 5 cm^2 / V. s.

2. In contrast with the Antarctic, the Arctic atmosphere is distinguished high concentrations of small size particles (D<0.1 μm). But in contrast with ecological satisfactory little cities at the Central Russia (Zvenigorod, Obninsk) the Arctic air is much cleaner, although the counting N and mass M concentration of the particles D> 0.5 μm turn out to be equal: N = 4 - 8 cm^{-3}, M = 30 - 50 μm / m^3. For reference: at the surface air of arid zones N = 20 - 100 cm^{-3}, M = 100 - 300 μm / m^3 [1].

3. The size spectra of the polar aerosols above a snow surface is conservative with regard to the changes in relative humidity, solar and gamma-beta radiation and wind direction variations. The moderate and strong wind (U = 8 - 30 m/s) stimulates a concentration growth for coarse (D = 0,5 -1 μm) and large (D> 3 μm) particles. Fine particles (D<0.1 μm) are conservative to wind speed but the strong frost (T = -20...-35 °C) stimulates a increasing its concentration.

4. Practically independently from the weather situation and local time the size modes of D = 0.025, 0.15 and 1.5 μm are well-pronounced. Only at the strongly cooled and windless air one more mode appears between D = 0.5 and 0.9 μm. It is important to note that in the generalized size spectra of aerosols measured at the high-latitudinal Canadian Observatory Alert, the Moscow` suburb and Tadjikistan semi-deserts there are also present modes in the size area D = 0.01, 0.1 and 2-3 μm [2]. This allows us to speak about a possible similarity in the mechanisms of the formation and evolution of polar and continental aerosols in spite of significant differences in the character of the underlying surface: the continual snow cover in the Arctic, vegetation cover on the soils in middle latitudes, eroding soils on the arid zones.

The previous conclusion is made more convincing by the results of the measured relative spectral variations F(D) = MSD(D)/N(D), where MSD (D) is the mean square deviation of the aerosol concentration from the mean value N(D). So, the function F(D) depends very little on the wind direction. Thus, in most continental regions the aerosol concentration for cumulative fraction D = 0.1-0.3 μm fluctuates very little but for the very fine and very coarse continental aerosols the concentration fluctuations are about an order of magnitude larger [2, 3]. However, for the spring Arctic at weak winds (less than 5 m/s) the variability function F(D) for coarse particles are also small. This provides some key to the understanding the possible general mechanism of the polar-born aerosol formation - wind erosion of the snow cover and gas-aerosol conversion in very cold air.

6. As the exist presentations [4] possible to identify three mobility groups of polar ions: heavy 0.00032 - 0.001, intermediate 0. 02 - 0.2 and light 0.5 - 2.5 cm^2 / V.s. Correlation between

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concentrations of ions within the groups approximately such, either as for continents. In general event concentrations of negative and positive aeroions approximately correspond to the quasineutral atmosphere model. The main factors of variability in the concentration of aeroions are air temperature, wind speed and intensity of inversions above snow surface. Probably, it is the increase in wind speed that stimulates the known effect of contact electrization of aerosol particles at collisions with each other and the snow surface with the shift of the equilibrium toward negative charges. The largest effect on heavy aeroions is produced by stratification of the surface troposphere layer at anticyclones.

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УДК 541.18

INFLUENCE OF DYNAMIC ATMOSPHERIC CONDITIONS ON THE CONCENTRATIONS AND PARTICLE SIZE DISTRIBUTION OF THE MARINE AEROSOL

ZIELINSKI T., ZIELINSKI A., PISKOZUB J.

Institute of Oceanology, Polish Academy of Sciences

ul. Powstancow Warszawy 55, 81-712 Sopot ymon@iopan.gda.pl

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Keywords: Aerosol, Size distribution, Concentration, Coastal area, Breaker zone.

This paper presents the results of research, which started in 1992, and has been dedicated to determination of aerosol dynamics in the marine boundary layer over coastal areas of the southern Baltic under various hydrometeorological conditions by means of the lidar method. In the marine boundary layer over the breaker zones of the southern Baltic aerosol size distribution function and aerosol concentration depend on wind speed, direction and duration. The results obtained indicate that for northerly winds it can be assumed that the particles which occur in the marine boundary layer above the breaker zones of the southern Baltic are marine aerosols. In the other cases, especially with southerly winds the particles are a mixture of marine aerosols and particles of the land origin. With southerly winds the aerosol concentrations, masses

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and fluxes in the marine boundary layer above the breaker zones are significantly higher than in the case of northerly winds and also they do not differ substantially with offshore distance, even though the wind speeds are lower than the southerly winds. It was revealed that in the case of northerly winds the breaker zone could be easily distinguished from aerosol concentrations, masses or fluxes which were higher when compared with these of the open sea. In the case of southerly winds it is not as easy to determine the range of the breaker zone because the mean concentration of aerosols is constant along the sounding path. Also, the aerosol concentrations are higher in the case of southerly winds even though the wind speeds are lower for theses winds.

The lidar method allows for determination of variations of aerosol size distribution function, aerosol fluxes and their residence times as a function of two different formulae for roughness length coefficient including developing roughness and fully developed roughness, diverse sea bottom types with various slopes and different weather conditions with changing wind velocity, direction and duration.

The procedure has been verified experimentally on several types of Baltic Sea bottoms and it allows for the good estimation of aerosol dynamics in the coastal zone provided that wind conditions and the sea bottom type are known.



УДК 541.18

ON THE OPTICAL METHOD REGISTRATION OF THE AIR RADIOACTIVE EJECTION OF NUCLEAR POWER STATION

AVAKYAN S.V., VORONIN N.A., IL'IN V.V., SEROVA A.E., STARCHENKO A.N., TCHARUHCHEV A.V.

All-Russian Scientific Center "S.J. Vavilov State Optical Institute", 199034, St. Petersburg, Russia;
Scientific Research Institute of Complex Mask of Optical-Electronic Devices,
188537, Leningrad region, Sosnovy Bor, Russia.

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In this paper the investigation of the possibilities of the registration by optical-electronic devices of the radioactive air ejection of nuclear objects with taking into account the optical air fluorescence mechanizm from [1] are carried out. It is known the radioactive gas and aerosol ejections during and after accident at the atomic power-station are very dangerous source of environmental pollution. These ejections are spread by meteorological air flows over considerable distances (up to several thousands km and more). Therefore the dissipation and settling of radioactive nuclides are occurred over very large area.

Existing remote sensing methods of the registration of radioactive clouds don't provide necessary information. The radar as and lidar methods detect the aerosol component of the ejection that often does not allow selecting the signal from the radioactive air ejection or a thunderstorm cloud and the aerosol (smoke) component which exists also above the thermal power-stations. The measurements of gamma-radiation from the radioactive nuclides are possible only at a distance ~ 100 m.

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The fact that Chernobyl ejection was detected in first time outside the former USSR (Sweden, Uppsala) by abnormal changes in the parameters of the atmospheric electricity in the radioactive cloud came from Chernobyl [2] confirms the importance of the registration of the ionizing ejection component for the purpose of identification of its radioactive origin. However discussion of the possibility of using this method for the nuclear ejection registration [3] has come to the conclusion that electrical data are not sufficient for determination of the cause of the observed abnormal spatial changes in the atmospheric electricity because there are too many physical processes which can provoke them.

In [1] the optical method of registration of radioactive air ejection by means of particular bands of atmospheric fluorescence with very high threshold of excitation was presented. There are three emission bands which are quite prominent and lie in the blue range of spectrum. It is important that they are absent in other events of natural and technological air emissions, besides short time lightning. It should be mentioned that just blue fluorescence of the air was observed above Chernobyl nuclear power plant.

The intensity of these emissions is much higher than background, especially at night. The transformation ratio from gamma-radiation flux to the visual one (for three bands) is 10^{-1} - 10^{-2} and for accident the intensity of optical emission (for radioactive cloud of 10^5 - 10^6 Ci) could be approximately 10^{13} - 10^{15} photons.s^{-1}.

The preliminary estimate can be made by making use of this data on the emission intensity. At the small size of a cloud (~100 m) the intensity of optical emission in the blue spectral range will be (1 - 100)(10^{-8} W, which at the distance R=1 km give the irradiance 10^{-12} - 10^{-10} W.m^{-2}. Measurements of these small intensities are difficult because there is a background radiation, especially during day-time.

For reduction of the background influence and for increase of the signal-to-noise ratio in the working spectral ranges the high performance spectroradiometric apparatus will be used. In the first experiments the spectroradiometer "Luch-1", which has been made before is supposed to be used. The characteristics of the apparatus "Luch-1" are: spectral range - 200 - 1100 nm, the entrance pupil - 0.06 - 0.07 m^2, the focal length of the objective lens - 1200 mm, the width of entrance slit - 0.1 - 4 mm, the viewfield angle - 0.1 - 3 mrad, dynamic range of photo-received devices - 10000, the spectral resolution - 0.5 - 10 nm, the scan speed - 5 nm/c, the range of the measured brightness (with 1 mm slit) - 10^5 - 10^8 W.$sr^{-1}m^{-3}$, the range of irradiances - 10^{-12} - 10^{-5} W.m^{-2}.

We are planning to develop special apparatus equipped with CCD TV camera (threshold flux is 10^{-14} - 10^{-13} W) for measurements of the energetic characteristics of the optical emission of the radioactive air ejection (cloud) in the night. This approach allows the standard apparatus to be used for longterm registration, measurements and information processing.

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1581.
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COMPLEX METHOD FOR SOLVING THE PROBLEMS OF DECONTAMINATED SOLUTIONS WASTE RECOVERY

TATIANA DOVBISHEVA

Belar ssian S a.e Poli echnical Academy, Ecology Depar men . Pr.Skariny,65, Minsk, Belar s. Tel.: 375/172/ 399265 Fax: 337/017/2313617

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Accident of Chernobyl is largest on scales manufacturability accident from ever having by a place on a planet. It radioactivity wing touch the practically whole of northern hemisphere. All territory of Belarus was subjected of radioactivity of pollution. The area of a territory, where density of pollution Cs^{137} exceeds 37 kBk/m² makes 46.45 thousand km². On polluted territories at present some millions the person lives and is engaged by industrial activity.

At fulfilment of the national program of liquidation of consequences of accident on Chernobyl there was necessity of realisation of radioactive decontamination of work in a polluted zone.

As a result of realisation of decontaminate of processing of various objects of industrial and municipal purpose during last years significant volumes fulfilled of radioactive decontamination of solutions, containing alongside with of radioactivity were formed by pollution (predominate Cs^{137} and Sr^{90}) of surface active substances, of complexing agents, as well as ions of salts. Active fulfilled of radioactive decontamination solutions it is necessary of reclaim.

At present these solutions reclaim of grouting with subsequent of burial of radioactive waste in burials, that certainly increases their quantity at a territory of Belarus.

Within the framework of the national program of liquidation of consequences of accident on Chernobyl in of Belarussian state politechnical academies are developed ways of clearing fulfilled of radioactive decontamination of solutions from of complexing agents, such as ADTA and of oxalic acid as well from of surface- active substances.

These development permit together with salvaging of radioactivity of pollution of sorption to create complex installation for salvaging fulfilled of radioactive decontamination of solutions, that will allow in some times to reduce quantity of radioactive waste, being a subject of burial of radioactive waste in burial.

1713.
УДК 541.18

RADIOACTIVE DISTRIBUTION OF SIZE PARTICLES FOR SIMULATION OF SOME ANTROPOGENIC ACTIVITIES

GARGER E.K., KASHPUR V.

Institute of Radioecology UAAS

Tolstoy St. 14, 252033 Kiev, Ukraine

PARETZKEH.G., TSCHIERSCH J.

Institute of Radiation Protection GSF-National Research Center for Environment and Health D-85764 Neuherberg, Germany

(First received 5 February 1998)

Results for the antropogenic activities conducted in the frame of the Project ECP 1 "Contamination of surfaces by resuspended material" is presented. The accent is made on the

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describing of the radioactive distribution of size particles for the emission and transport processes simulated in the real field conditions into 30 km exclusive zone.

For tractor and truck experiments the character of the radioactivity distributions of size particles had the similar form with two maximums for the 2-4 μm range and the 12-20μm one. In all agricultural experiments it was a considerable part of activity distributed at the particles of 0.1 μm to 2.0 μm that is at the inhaleable range of size distribution. This part was equal 33% ± 6%.

From vertical profiles of Cs-137, Sr-90, Pu-239+240, Pu- 238 and Am-241 concentrations in two emission experiments with the high values of the emission rates and assuming that ratios between Cs-137 and other nuclides did not change with different ranges of size particles it was carried out the radioactivity size particle distributions for these nuclides by Cs-137 size distributions. The air concentrations of the plutonium sum was made up 36-40% from the total concentration for the inhaleable (0.1 - 2.0 μm) range and for giant particles (12.0 - 20.0 μm) - ~ 20%.

Ratios of the settling and friction velocities w_g / u* were calculated for the estimation of the transport ability the large and giant particles. These ratios were 0.026-0.070 for different experiments . It means that particles with d = 12 - 20 μm may consider as light particles that is to neglect their settling velocity during the windy and unstable conditions preservation. So this supports a necessity to take into consideration this fact for the different tasks of dose assessments and radioactivity redistribution in the underlying layer of ground.

Measurement of the number concentrations to shown that the mean number concentration for large particles (3-10 μm and 10-30 μm) six times more the mean number concentration of fine particles (0.6-1.0 μm). The variation factor is more for giant particles (10-30 μm) and the ratio (N_{max} / N_{min}) has three order of magnitude for this range of particles compare with 7 times for the fine particles range.

Measuring were allowed to estimate the radioactive loading of size particles and to show the enrichment of resuspended particles compare with soil particles for the inhalation, respireable and large ranges of particles. The enhancement factor is increased from 4 to 29 times for (d < 2 μm) and (7 - 16 μm) ranges respectively.

1037.
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SIZE DISTRIBUTION OF RADIOACTIVE PARTICLES RESUSPENDED IN THE CHERNOBYL AREA

GARGER E.K.*, TSCHIERSCH J.**

* Jnsi e of Radioecology UAAS, Tols oy S., 14252033 Kie , Ukraine,

** Jnsi e of Radia ion Pro ec ion GSF-Na ional Research Cen er for En ironmen and Heal h D-85764 Ne herberg, Germany

(First received 4 November 1997; accepted for presentation during IAS-4)

Size distribution measurements of particulate radionuclides were performed at two sites in the Chernobyl 30 km zone using several cascade impactors. The results obtained in the period September 1986 till June 1993 were discussed in regard to the general assumption in inhalation dose assessment of a log-normal activity size distribution. At Zapolie (a site 14 km far from the Chernobyl reactor) in 91 % of all measured distributions a bimodal distribution was observed. In most cases the medians were in the ranges 4 μm and 20 μm - 30 μm. According to soil granulometric data this finding was explained by superimposing two processes: local resuspension and advective transport of radioactive aerosol from highly contaminated territories. The mean air concentration showed an increasing part of inhalable particles with the years since the accident. In 1993 the inhalable fraction was about 48 % of the total concentration. At Pripyat, a site

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situated within a highly contaminated area, unimodal types of size distributions were predominant with the median diameters in the range 5 μm - 10 μm for ^{137}Cs. For the three nuclides ^{137}Cs, ^{144}Ce and ^{106}Ru very similar types of distributions were observed. Apparently the radioactive aerosol was of fuel origin. During a forest fire at a distance of 17 km, the main part of radioactivity was measured to be associated with to submicrometer particles with median diameters in the range 0.28 μm - 0.50 μm.

1291.
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MODELLING OF GAS PHASE REACTIONS IN POLLUTED AIR, INITIATED BY IONIZING IRRADIATION

GURBANOV.M.A.

Sec or of Radia ion Research of Sciences , Azerbaijan , Bak

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The comparative simulation and experimental kinetic stydy of products forming was carried out under the impact of ionizing irradiation on air (System 1) and air containing admixtires SO_2 , H_2 , CO_2 , NO_x , CH_4 , C_2H_2 (System 2). The kinetic scheme including 124 elementary reactions was taken into consideration.

- It's established that in the kinetic curves of azone and nitrogen oxide maximums are observed , their yields make up - 1 mol.\100 ev. In presence of humidity (-2%) the formation of nitrogen acid takes plase with yield of 0,5 mol.\100 ev (System 1).
- The comparison of kinetic ozone formation curves indicate maximum gliding of O_3 conrentrations in presence of admixed molecules and decrease of radiation yield of O_3 formation in this case (System 2).
- Nitrogen and sulpur acid yields are defined by presence and content of humidity , as well as oyher admixed molecules in irradiated mixtures.

The presented scheme includes variety of reactions ability of nitroge atoms N , N (D) and N (P) in relation to the molecules of components and molecular interactions of end products - N0x , O_3 , SO_2 , as well as clusterization of ions N_2 + , H_2O + , O_2 + and others.

The role of irradiated gas phase reaction on the formation of aerosols in atmosphere is discussed.



1428.
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PLUTONIUM RELEASE FRACTIONS FROM ACCIDENTAL FIRES

VLADIMIR KOGAN AND PHIL M. SCHUMACHER

Ba elle Memorial Ins i e Col mb s, Ohio, USA

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Open literature and technical reports covering airborne releases of plutonium and plutonium-simulating contaminants during combustion of radioactive metals themselves and during fires in processing and waste storage facilities were reviewed.

Examination of the literature has identified three major sources of contamination which may be released during a severe accident at nuclear facilities:

1) Release by oxidation of plutonium metal,
2) Release by combustion of contaminated solid waste materials stored in the facility, and

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3) Release by combustion of contaminated flammable process liquids, or evaporation of contaminated non-flammable liquids.

Based on the information gathered in this study, airborne releases from oxidation of metallic plutonium were grouped into three general categories. These categories include plutonium oxidation at a range of temperatures not exceeding plutonium ignition point, exothermic combustion of plutonium leading to its melting, and an explosive-like dissemination of plutonium resulting in formation of airborne plutonium particles and their subsequent violent combustion.

Combustion of contaminated solid waste materials appears to present a significant contamination hazard, because of the quantity of contaminated wastes stored in nuclear facilities, and because of the large fraction of contamination that can be released during a solid waste fire. Experiments have shown that up to 50 percent of the radioactive contamination can become airborne during combustion of a typical waste material, if the material is burning in the convective plume of the fire. A large fire may also cause bursting of waste storage drums exposed to direct flames.

Airborne release parameters are presented in terms of airborne release fractions (ARF) and respirable fractions (RF) for various contaminated combustible solid materials involved in a fire:

1) Rubber (polychloroprene or latex)
2) Polystyrene resin
3) Polymethylmethacrylate
4) Paper (cellulose) and mixed waste
5) Mixed waste in 55-gal drums

All releases from burning contaminated solid materials are conservatively assumed to be in the respirable size range. However, since plutonium oxide contaminant is a refractory material unaffected by fire, its original RF, if known, should be used.

Potential releases from flammable liquids are less significant, because of the lower releases expected. Nevertheless, the risk of contaminant releases associated with combustion of kerosene-like flammable liquids, such as during a jet-fuel fire caused by a crash of an airplane, will continue to be of significant concern.

With the potential for high release fractions, uncertainties associated with any release parameter needed for the environmental impact calculations become also extremely important. It is shown that major uncertainties are associated with the considerable amount of scatter among the reported ARF and RF data. Much of this scatter is due to the experimenters' desire to investigate a variety of test conditions in a limited-scope study. These variables include use of plutonium or a simulant, chemical form of the contaminant, its size distribution, its amount and application procedure, type of combustible material, flow conditions, and many others. Even when experimenters took great care to achieve reproducible fire conditions, order of magnitude variations in contaminant release were observed. The physical arrangement of the contamination and combustible material can also affect test results.

The health effects of the released contamination are strongly dependent on the size distribution and composition of the aerosol. Respirable contaminated particles present the greatest hazard to the surrounding population. Aerosol from solution tends to be mostly respirable, and a conservative estimate requires a relatively large respirable fraction for this contamination form. In many experiments involving combustible materials, the total mass distribution of the released aerosol was measured, which may not provide correct information regarding the size distribution of the contaminant aerosol.



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1512. УДК 541.18

STRATOSPHERIC INTRUSIONS AS TRANSFERRING RADIOACTIVE AEROSOL TO THE ATMOSPHERIC SURFACE LAYER

I. N. KUZNETSOVA, N. P. CHAKINA

Hydrometeorological Research Center of the Russian Federation, Moscow, Russia E-mail anatmo@mskw.mecom.ru

The Russian radiometric network registers episodes of sharp increase in the surface air radioactivity to the levels of 5-10, in some cases of 20-40 background values. At the radiometric stations, total beta-activity (TBA) concentrations and densities of their fallouts are measured, as well as, in certain cases, contents of particular isotopes, among which the cosmogenic Be-7 is of a special interest as a marker of stratospheric air.

Frequency of the increased TBA levels occurence has no pronounced annual cycle and varies largely from year to year: in 1993 to 1997, there were registered 88, 205, 123, 124, and 82 episodes/year, respectively; in two first months of 1998, about 80 episodes are already observed. In the cases of simultaneous increase in TBA and Be-7 concentrations, one can believe that the radioactive aerosol is of stratospheric origin. The radiometric network data allow one to document a limited number of such episodes (<10 for 1996-1997). In the cases when the Be-7 concentration is not measured, stratospheric origin of the aerosol can be but hypothesized.

It is known that the stratospheric air intrudes tropospheric levels when deep vertical circulations arise in the tropospheric frontal zones. The intrusions manifest themselves through folding of the tropopause - an interface between the troposphere and the stratosphere.

The tropopause routinely defined through the air temperature lapse rate - so called thermal tropopause - usually exhibits discontinuities in the areas of intense stratospheric intrusions. Stratospheric origin of the air can be determined, apart from direct measurements of chemical composition, by evaluation of potential vorticity - a Lagrangian invariant of diabatic motion. In the stratosphere, potential vorticity is one order of magnitude larger than in the troposphere. A level at which the potential vorticity sharply increases from tropospheric to stratospheric values is called dynamic tropopause. Outside the zones of strong vertical motions, the dynamic tropopause is close to the thermal one. Due to the potential vorticity conservation properties, the dynamic tropopause is not destroyed by stratospheric intrusion, but forms a fold or a funnel.

The dynamic tropopause can be calculated on the basis of objective analysis (or numerical forecasting) data on pressure (height), temperature, and wind. Accuracy of the calculation depends on horizontal resolution of the data under use. By comparing the air circulation conditions in the lower troposphere and the dynamic tropopause topography, one can identify, in the tropospheric frontal zones, "tongues" of stratospheric air sinking into the troposphere and sometimes reaching the surface layer.

For an episode of extraordinary sharp (15 to 20-fold) increases in TBA and Be-7 concentrations in Novosibirsk and Barnaul and the next day in Krasnoyarsk in March 1996, we have shown that the air radioactivity peak observation time is in a good agreement (within the data time resolution) with the time of a deep funnel passage over the three stations. For other documented episodes of increase in both TBA and Be-7 concentrations (Turukhansk, January 1997; Salekhard, June 1997; Krasnoyarsk, October 1997; Syktyvkar, January 1998), analysis of the tropopause topography evolution reveals analogous processes of the tropopause funnel fast motion. For the high TBA episodes with no available data on Be-7 concentrations, in a number of cases, stratospheric intrusions are also revealed.

The life time, depth, and dimensions of the stratospheric intrusions vary largely. The rawinsonde network being sparse, especially in Asian Russia, small funnels and folds can hardly be resolved. However, sufficiently large and deep intrusions can be successfully traced in rawinsonde data and described by numerical forecasting models of the atmosphere.

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ACTIVITY SIZE DISTRIBUTION OF RADIOACTIVE AEROSOLS IN THE ATMOSPHERE

C. PAPASTEFANOY, A. IOANNLDOU

N clear Physics Depar men , Aris o le Uni ersi y of Thessa1oniki Thessa1oniki 54006, Greece, e-mail: papas efano @physics.a h.gr fax3031 998058

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KEYWORDS Activity Size Distribution, Radioactive Aerosols, Atmospheric Aerosols, Radon Decay Products

The aerodynamic size distribution of radioactive aerosols was determined by using low-pressure as well as conventional low-voluine and high-volume impactors. The activity distribution of short-lived Rn decay products ^{214}Pb and ^{212}Pb measured by a-spectroscopy, was largely associated with submicron aerosols in the accumulation mode (0.08 to 2 μm). The activity median aerodynamic diameter (AMAD) ranged from 0.09 to 0.37 μm (mean 0.16 μm) for ^{214}Pb and from 0.07 to 0.25 μm (mean 0.13 μm) for ^{212}Pb. The mean values of the geometric standard deviation (σ_g) were 2.97 and 2.86, respectively. The activity size distribution of Be measured by γ-spectroscopy (E_γ=477 keV), was largely associated with submicron aerosols in the accumulation mode (0.4 to 2.0 μm). The activity median aerodynamic diameter (AMAD) ranged from 0.76 to 1.18 μm (average 0.90 μm), indicating post-condensation growth either in the upper atmosphere or after mixing into the boundary layer. The geometric standard deviation, σ_g ranged from 1.86 to 2.77 (average 2.24). In estimating lifetimes of radioactive aerosols, in ambient air, a mean residence time of about 8 days averaged for tropospheric aerosols.

Representative plots for 46 low-pressure impactor measurements illustrating aerodynamic size (D_p) distributions of ^{212}Pb and ^{214}Pb (R=radioactivity) are presented in Fig.1.(a) Type results occurred 46% of the time, (b) 39% of (he time, (c) 8.7% of the time, and (d) 6.5% of the time. Lower D_p limits are arbitrary (Papastefanou and Bondietti 1987). A typical plot of tlute activity size distribution of 7Be versus aerodynamic diameter (Dp) is represented in Fig.2 for 11 measurements carried out by I-ACFM impactors (Papastefanou and Ioannidou, 1995).

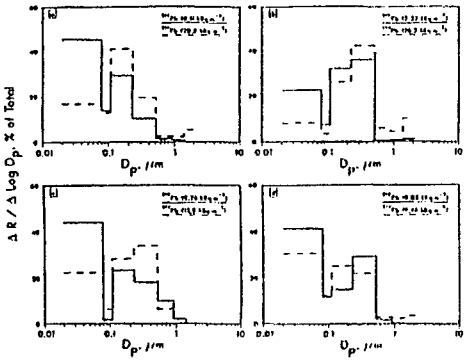


Fig.1. Representative plots from 46-low-pressure impactor measurements illustrating aerodynamic size (Dp) distributions of ^{212}Pb and ^{214}Pb

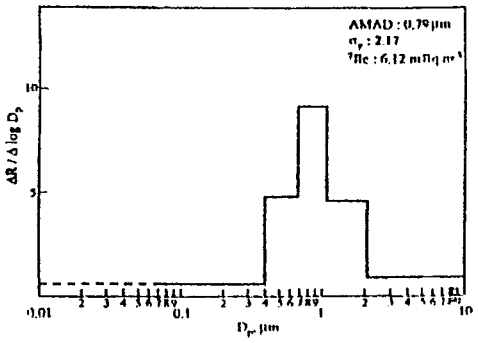


Fig.2. Typical plot of aerodynamic size distribution of 7Be aerosols.

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1253.
УДК 541.18

NATURAL AND COSMOGENIC RADIONUCLIDES AT MT. CIMONE-ITALY

TOSITTI L., TUBERTINI O., BETTOLI M.G. , BONASONI P.

En ironmen al Radiochemis ry Lab., Dep . Chemis ry, Uni . Bologna, V. Selmi 2, 40126 Bologna, Italy

Ins i e of Physics & Chemis ry of he Lower and Upper A mosphere wi h CNR - FISBAT, Bologna, Italy

(First received 25 February 1998; accepted for presentation during IAS-4)

In this work, an overview of radioactivity measurements at a mountain site (2165 m a.s.l.) representative of the free troposphere of Mediterranean basin located in the Italian northern Apennines, together with some preliminary results are presented. This area is of great interest for at least two main reasons: 1) high frequency of cyclogenetic phenomena in connection with intense stratosphere-to troposphere exchange processes; 2) the location is not directly affected by anthropic emissions, providing the opportunity of observing and identifying the drift of air masses both of European and Saharan origin. Current work includes high-volume aerosol samplings followed by gamma spectrometry of particled radionuclides, mainly Pb-210 at 47 keV and of Be-7 at 478 keV. Stratospheric intrusions have been at times detected and diagnosed by cross-check of activity values of both radionuclides and of their activity ratio with ozone and meteorological parameters which are simultaneously measured at Mt. Cimone observatory. In addition, the setup of a radiochemical procedure for the determination of cosmogenic P-32 in the same samples is in progress in order to better distinguishing between transports from the upper troposphere from those from the lower stratosphere when compared to corresponding Be-7 activity. Noble gas Rn-222 is continuously measured on a hourly basis by means of a modified lucas cell. Time series of radon activity are presented and discussed in the light of local climatology including the occurrence and description of some peculiar events observed.



1125.

HOT PARTICLES OF CHERNOBYL ORIGIN IN ENVIRONMENTAL SAMPLES

Tschiersch J., Wagenpfeil F.

Ins i e of Radia ion Pro ec ion GSF-Na ional Research Cen er for En ironmen and Heal h

D-85764 Ne herberg Germany

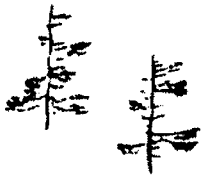
(First received 31 January 1998; accepted for presentation during IAS-4)

Pure nuclear fuel particles were released into the atmosphere during the reactor accident in Chernobyl. These particles are connected with high concentrations of radionuclides and are called "hot particles". During resuspension experiments in the 30-km exclusion zone of Chernobyl,

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(digital) autoradiography and gamma-spectrometry. In the size range larger 3 μm aerodynamic diameter approximately 36 hot particles per 1000 m^3 were measured during anthropogenic enhanced resuspension.

Hot particles in the environment cause samples which are not uniformly contaminated, especially if there are only few hot particles in the sample. Because of the inhomogene distribution of radionuclides in environmental samples a significant measurement uncertainty may result. In laboratory experiments the analytical uncertainty for various sample media (filter, soil) and measurement geometry were investigated. A single hot particle was analysed for instance in a sample without any other contamination in a frequently used 1000 cm^3 bottle by gamma-spectrometry. The measured ^{137}Cs activity may range between a factor 10 too high or a factor of 20 to low (related to the actual activity of the hot particle) depending on the position of the single hot particle in the sample. For most measurement geometries it was possible to formulate a procedure by which the relation between the measured and the actual activity concentration can be calculated in dependence on the position of the hot particle.



1014.
УДК 541.18

ON SECONDARY RESUSPENSION RADIONUCLIDES INCOME INTO ATMOSPHERE AFTER

VASILYEVA K.I., VOSZHENNIKOV O.I., NIKONOV S.A., FOSTER K. (*), BURKOV A.I., MOROZKO E.A.

Tayif n (*), LLNL

(First received 16 December 1997; accepted for IAS-4)

The parametrizations for a resuspension factor and a resuspension rate as functions of the time after an accident, wind velocity and roughness parameter are developed based on existing experimental and theoretical data. For taking into account the dependence of resuspension process on moisture content of soil and on anthropogenic activity it is introduced the empirical factors. The comparison of resuspension factor and resuspension rate calculated with use parametrizations shows good coincidence with experimental data. The correlation coefficient for them is equal 0.9.



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1276
УДК 541.18

COMPLEX MODEL FOR EVALUATION OF ECOLOGICAL SITUATION IN THE VICINITY OF NUCLEAR FACILITY

VOZSZENNIKOV O.I.*, MOROZ'KO E.N.*, SEMYONOVA E.V.**

*Scientific Production Association "Typhoon", Obninsk

**Moscow State University, Moscow

(First received 08 February 1998; accepted for presentation during IAS-4)

Evaluation of the influence of Nuclear Power PlantTs (NPP) releases including accidental ones is the important part of projecting organizationT work. In Russian practice, such an evaluation are performed by the different organizations, on the base of their own techniques and methodologies. As results, the non comparable estimation of NPP environmental impact appear.

The distinguishing feature of a model described is using of the whole complex of data available for the territory around nuclear facility(data on relief vegetation, land use, orography demographic data , etc.,),. A set of physico-mathematical submodels is proposed to perform the evaluation of the radioecological situation.

The present version of the complex model:

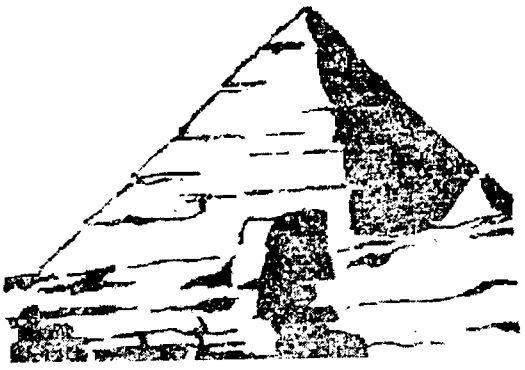
- is based on GIS technologies to operate with distributed data on territory;
- includes the atmospheric dispersion model capable to take into account deposition onto various surfaces;
- includes the runoff model to take into account the radionuclides washoff from the watersheds;
- is able to simulate wind resuspension of pollutants for different accidental stages.

All model parameters based on demographic , land and contamination data distribution are used average values for each cell of a rectangular grid. Diffusion fluxes between the adjacent cells could depend on the grid resolution.

RadionuclidesT transport by is described by with system of ordinary differential equations for each cell.

The complex model described was applied in the 30-km zone Novovoronezhskaya NPP to evaluate the possible environmental consequences of the accidental releases .

The evaluation results and model analysis are submitted in the paper.



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List of participants of IAS-4 with presentations during 8 July 98



Ackermann Ingmar J *(1967-06-24)*
Ford Forschungszentrum Aachen
Phone: (49)-241-9421205
fax (49)-241-9421301
email: iackerma@ford.com
Aachen
Germany

Andronova Natalia G.
University of Illinois at Urbana-Champaign
email: Natasha@uiatma.atmos.uiuc.edu
Urbana
USA

Aristova Elena Nikolaevna *(1961-03-22)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@kiam.ru
Moscow
Russia

Arking Albert *(1932-11-05)*
Johns Hopkins University
Phone: (1)-301-2992478
fax (1)-301-2992479
email: arking@aa.gsfc.nasa.gov
Baltimore
USA

Barthelmie Rebecca *(1963-06-22)*
Indiana University
Phone: (1)-812-8554083
fax (1)-812-8551661
rbarthel@othello.ucs.indiana.edu
[illegible] USA

Belov Nikolay Nikolaevich *(1947-05-04)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Belov Pavel Nikolaevich *(1977-05-02)* AEROSOL TECHNOLOGY LTD
Phone/fax: (7)-095-1474362
email: pnbelov@orc.ru
Moscow Russia

Degtyarev Alcksandr Iosifovich *(1947-09-13)*
Institute of Geography RAN
Phone: (7)-095-9503919
fax (7)-095-2879826
anaumov@mskw.mccom.ru
Moscow
Russia

Garger Evgeniyi Konstantinovich *(1937-02-06)*
Institute of Radioccology (Ukraine Sci.Academy)
Phone: (7)-044-2205313
fax (7)-044-2209346
email: garger@garger.pp.kiev.ua
Kiev
Ukraine

Goldin Vladimir Yakovlevich *(1924-06-25)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@KIAM.RU
Moscow
Russia



Hamill Patrick *(1936-04-29)*
San Jose State University
Phone: (1)-408-9245241
fax (1)-408-9242917
email: hamill@light.arc.nasa.gov
San Jose
USA

Ivlev Lev Semenovich *(1936-05-21)*
Sankt-Petersburgh State University
Phone: (7)-812-4287349
email: vlas@aero.phys.pu.ru
St.-Petersburg
Russia

Kashkin Valentin Borisovich
Phone: (7)-3912-494987
fax (7)-3912-433918
email: root@kashkin.krasnoyarsk.su
Krasnoyarsk
Russia

Kiseleva Margarita Sergeevna *(1928-12-01)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189900
fax (7)-812-2183720
St.-Petersburg
Russia

Kogan Vladimir *(1948-07-05)*
Battelle Memorial Institute Columbus
Phone: (1)-614-4247970
fax (1)-614-4244185
email: koganv@battelle.org
Columbus USA

Kuznetsova Irina Nikolaevna *(1954-01-20)*
Phone: (7)-095-2559804
fax (7)-095-2556301
Moscow
Russia

LI ZHANQING *(1963-09-17)*
CANADA CENTRE FOR REMOTE SENSING
Phone: (1)-613-9471311
fax (1)-613-9471406
email: li@ccrs.emr.ca
Ottava Canada



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Lobanova Galina Ivanovna *(1936-11-20)*
Russian Scientific Optical Center named by Vavilov
Phone: (7)-812-2189946
fax (7)-812-2188179
St.-Petersburg
Russia

Naumov Aleksandr Dmitrievich *(1949-12-13)*
Phone: (7)-095-9446246
Moscow
Russia

Nguyen Ba Cuong
CENTRE DES FAIBLES RADIOACTIVITES
Phone: (33)-1-69088503
fax (33)-1-69087716
PARIS
France

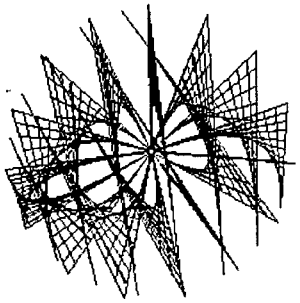
Pryor Sara *(1967-10-19)*
Indiana University
Phone: (1)-812-8555155
fax (1)-812-8551661
email: spryor@indiana.edu
Bloomington
USA

Rublev Alekseyi Nikolaevich *(1953-12-24)*
RNC of Nuclear Energy KURCHATOVASKY INSTITUTE
Phone: (7)-095-1967687
fax (7)-095-1941994
email: rublev@imp.kiae.ru
Moscow
Russia

Rusina Elena Nikolaevna *(1946-02-18)*
The Arctic and Antarctic Research Institute
Phone: (7)-812-3523081
fax (7)-812-3522688
email: aaricoop@aari.nw.ru
St.-Petersburg
Russia

Schlesinger Michael E.
University of Illinois at Urbana-Champaign
email:
schlesin@uiatma.atmos.uiuc.edu
Urbana
USA

Shakina Natalya Pavlovna *(1937-10-14)*
Phone: (7)-095-2555101
fax (7)-095-2556301
anaumov@mskw.mecom.ru
Moscow
Russia



Shevchenko Vladimir Petrovich
Institute of Oceanology of RAS
Phone: (7)-095-1247737
fax (7)-095-1245983
email: vshevch@geo.sio.rssi.ru
Moscow
Russia

Shilkov Aleksandr Viktorovich *(1958-03-20)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: SergePol@KIAM.RU
Moscow
Russia

Shilkova *(1958-02-04)*
Institute for Matematical Modeling of Russian Ac. Sci.
Phone: (7)-095-2509803
fax (7)-095-9720723
email: mageiko@kiam.ru
Moscow
Russia

Stenchikov Georgiy L.
University of Maryland
Phone: (1)-310-4055370
fax (1)-310-3149482
email: gera@metosrv2.umd.edu
College Park



USA

Suhinin Anatoliyi Ivanovich
Forest Institute Sibirian Branch of Acad. of Sci.
Phone: (7)-3912-494092
fax (7)-3912-433686
email: fire@ifor.krasnoyarsk.su
Krasnoyarsk
Russia

Zaharenko Valeriyi Semenovich
Institute of Catalysis of RAS
Phone: (7)-3832-355764
fax (7)-3832-355756.
email: SOLAR@catalysis.nsk.su
Novosibirsk
Russia



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1625
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TOTAL OZONECONCENTRATION INVESTIGATIONS USING NOAA SATELLITE INFRA-RED DATA

V.B.KASHKIN, V.U. ROMASIKO, A.I. SUKHININ

Krasnoyarsk State University

79 Svobodny av., 660041 Krasnoyarsk

(First received 20 June 1998; accepted for presentation during IAS-4)

Institute of Forest, Russian Academy of Sciences, Krasnoyarsk Akademgorodok, 660036 Krasnoyarsk Russia

Maps and surfases of total ozone concentration were plotted using NOAA satellite infra-red radiomemer data (wavelenth 9.59 mkm). NDAA-12 total ozone concentration (TOC) data at 1995-1997 were processed with TOVS software. The resemblance of ground and satellite data in Krasnoyarsk is revealled (correlation factor is about 0.85, the systematic divergence is 6%), it agrees with data from literature.

It was found that the divergence increased (up to 9-10%) during large forest fires in Eastern Siberia. There are extra aerosols in atmosphere this period, ground ultraviolet TOC data are more sensitive to aerosols then NOAA infra-red data.

Areas with lack of TOC {up to 15-20%) were detected over large forest fires. For inst'.e, there were forest fires of 5000 km in Irkutsk region and more large fires in

Mongolia at May 13, 1997. Hole of 100000 km^2 was found, minimum Toc Was 296 Dobson units at 45'N 106 E but TOC was 340-410 D.U. to the North (latitude more then 53 N).

Spring stratosphere ozone dynamics was studied at 1997, waves and couples of ozone waves were detected at March. Direction of movement of waves and rates were found. Using independent satellite data we have estimated rate and direction of wind at levels 10-15 km. It was found that rates of the waves (levels 15-30 km) and of the wind are approximately equal.



1628
УДК 541.18

VOLGOGRAD PM-10 SATURATION STUDY

J. SCHWEISS [1], E. BEZUGLAYA [2], I. SMIRNOVA [2], S. CHICHERIN [2], L. KURDINA [3], L .FOKINA [4]

[1] *EPA USA,*

[2] *Main Geophysical Observatory, St. Petersburg,*

[3] *Volgograd Center for Hydrometeorology and Environmental Monitoring,*

[4] *Volgograd Committee for Environmental Protection*

(First received 06 June 1998; accepted for presentation during IAS-4)

Fine particulate is more harmful for human health than coarse particulate as it was established by many scientific researches. In accordance with RAMP program in Volgograd from 29 July through 26 August 1997 the second stage of saturation study was carried out on the distribution of small suspended particles PM10 over the city area. During the experiment there were made 500 measurements of PM-10 concentrations at 25 sites located in the north and south areas of the city over the vast territory (the city extent is almost 100 km). Three organizations conducted jointly studies during the given experiment: Volgograd Center for Hydrometeorology and Environmental Monitoring (VCHEM), Volgograd Committee for Environmental Protection (VCEP) and Main Geophysical Observatory (MGO). MGO collected, processed, made statistical

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analysis of information obtained as a result of experiment.

The principal aim of Volgograd experiment was determination of spatial temporal changes in PM10 concentrations and contribution of basic enterprises of the north industrial area to the total air pollution, obtaining the ratios between the concentrations of fine dust (PM10) and total suspended particulate, comparison of the concentrations of metals measured from PM10 filters and at the fixed monitoring network in Volgograd.

Studies were carried out in the area of industrial enterprises in the north Volgograd limited by triangle formed by Red October plant, Aluminum plant and Silicate plant, and in the south city part in the area of Foundry and Mechanical plant. Two pairs of stations functioned during the experiment for estimating the correctness and accuracy of instruments for PM-10. The data have shown a good compatibility, correlation factors are equal to 0.97 and 0.99..The presented materials show that the repeatability with parallel measurements is rather satisfactory.

The mean over the experiment period concentrations of PM-10 at different stations range from 131.8 to 36.9 μg/m³. The highest daily mean concentration at the north Stations is equal to 385.4 μg/m³, at the South stations 406.0 μg/m³, the lowest respectively 19.1 and 2.8 μg/m³. During the experiment two stations were taken as background . The background in the south part of the city was 28% lower than in the north. The results allow us to describe thoroughly enough the field of PM-10 concentrations in the north and south parts of the city where the basic sources of air pollution by PM-10 are located. The data of instruments located on the territory of north industrial area near the roadway reflect the motor transport effect. The maximum mean over the observation period concentrations are observed in the area of Volgograd Aluminum Plant (104-132 μg/m³). In this area PM-10 concentrations above 100 μg/m³ are observed during 16 days. The lowest mean PM-10 concentrations are observed in the south part of the city, in arboretum where the mean is 36.9 μg/m³. Due to the detailed picture of PM-10 concentration distribution on the city territory an approximate contribution of each plant to the total city air pollution can be estimated. In the north part of the city the VAP contribution is 23%, "Red October" Plant - 16%, SMP - 13%< including brick production - 20%.

Analysis of the experiment results enables one to recommend it for extending to other areas in Russia to estimate the fields of fine particles (PM-10) concentrations on the city territory. The Volgograd PM-10 study is of important significance for possible future steps in developing the monitoring system and air protection activity in Russia.



1565.
УДК 541.18

CREATING LOCAL ZONES OF REDUCED ATMOSPHERIC VISIBILITY BY LIFTING COMBUSTION PRODUCTS WITH VORTEX RING

A.I. STROUTCHAYEV, N.KH. KOPYT

Odessa State University, Department of Physics, Research Laboratory for Aerosol Systems

(First received 29 March 1998; accepted for presentation during IAS-4)

Aerosols emission due to motion and decay of polluted clouds has been of interest because causes serious problem in visual air quality. Numerous soot or smoke particles with wide spectra of the size generated during industrial processes remain suspend in the air and lead to unacceptable concentration of the aerosol in the atmosphere. These processes have been

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recognized one of the main source airborne pollution and surface visibility reduction.

This study suggested that buoyant vortex rings may be exploited to transport aerosols by lifting the particles to high altitudes. This can be performed for two purposes:

1) lifting the polluted particles to high altitudes, where they will be dispersed by the atmospheric diffusion, resulting in the visibility length increase;

2) creation of nontransparent aerosol zones in the atmosphere for masking.

The visibility length reducing down to limiting value can be realize experimentally at masking by specially injected aerosol into atmosphere due to the strongly selective absorption inherent to particles with complex refractive index (for the soot particles formed at combustion of heavy hydrocarbons $m \sim 3(1\text{-}0{,}15i)$, $k=0.3$).

Full-scale experiments reported here were carried out on same fuel species (e.g. black oil and Diesel fuel F-5) under variety operating and environment conditions (actual vapour pressure, temperatures of superheated fluids, reservoir imputing time) in the ambient atmosphere (Kopyt and Stroutchayev, 1993).. With a view to prepare of large fuel-spray clouds we used a superheated liquid aerosol-generator (SLAG) which based on the rapid expansion of superheated solutions (RESS) - thermohydrodynamical atomization (THDA) phenomenon. Initial turbulence and buoyancy, created by impulsive outlet of superheated fuel from the nozzle of SLAG joint led to form spherical aerosol cloud. The aerosol particles absorpting were obtained at combustion of previously spraying hydrocarbon fuel (25 to 40 kg of black oil or Diesel fuel F-5, volume of formed air-droplets mixture 850 - 1200 cubic *m*, fuel droplets mean diameter *is* 40 $mkm < d <$ 56 *mkm*, size variation coefficient $2.03 < \text{var} < 3.84$, environment relative humidity $76\% < h <$ 94 *%*). At the time when the hot volume of combustion products begins to rise by its buoyancy, the vorticity producing by density gradients has transformed into a complete circular vortex ring. It consists of toroidal-shape core of very fine scale turbulence surrounded by co-travelling aerosol "atmosphere". Because in the early stage of the rising vortex ring the circulatory force is very strong that causes large amounts combustion products to be sucked up. As the vortex ring moved higher the circulatory force becomes weaker, the upwards soot and smoke pollutants will be replaced by the fallout ones from "atmosphere" of vortex ring. In this way a zone of lowered visibility is created along the trace of vortex ring. Vortex rings diameters were varied in the range 5,0 - 12,0 *m* dependently on the mass and origin of the fuel spray. Its thickness in the horizontal direction was identified with the diameter of the vortex ring, and in the vertical direction - by the altitude of its rising.

Experiments carried out were demonstrated that the results obtained may be applied to predict the behaviour of airborne pollutants rising with buoyant vortex ring and further atmospheric emission leading to change of air visibility. Comparison to corresponding experimental data shows fairly well agreement with reported in the literature.

1. Kopyt, N.Kh., Struchayev, A.I. (1993) // J. Aerosol Sci.,1993.- Vol.24, Suppl.1. - P. 249 -250.



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MONITORING PB(II) IN THE VEHICLES AEROSOL POLLUTIONS BY SPECTROPHOTOMETER TECHNIQUE

G. SAVENKO, N. MALAKHOVA, N. KOPYT, A. STROUTCHAYEV

Odessa S a e Uni ersi y, 2 D oryanskaya S ., 2, UA-270000 Odessa, UKRAINE

(First received 29/4/98; accepted for presentation during IAS-4)

In the megapoles, large cities and centers a substantial role in aerosol pollutions containing metals and their compounds is played by exhausts from vehicles. Special danger for biosphere is highly toxic Pb compositions, their large amount is polluted from benzene engines using anti-detonation additives (tetraethyllead, or tetramethyllead) and so-called "carriers-out"(brometyl, 1,2-dibrom-propan or dibrometan).

The presence in combustion products of aerosol particles containing lead compounds is explained by the intensive oxidation at working engine of heated to temperatures over 450 K vapours of antidetonators or "carriers-out" with formation of lead particles and Pb(II) oxide.

По имеющимся оценкам с выхлопными газами автомобилей в атмосферу ежегодно выбрасывается различных соединений свинца порядка 1% массы использованного топлива. Их концентрация на оживленных перекрестках часто превышает предельнодопустимые нормы и требует постоянного контроля как за ней, так и за динамикой накопления.

Для серийных определений микроколичеств свинцаи его соединений предлагается сорбционно(спектро)-фотометрический метод, отличающийся простотой и скоростью выполнения измерений, обеспечивающего к тому же достаточно высокую точность и высокую чувствительностью.

In the paper there are considered results of application of sorbtion extraction of Pb(II) from water solutions to the pollutions from engines with subsequent photometric determination using 1-(2-piridylazo)-rezorzin (PAR).

The sampled polluted gaseous mixtures containing aerosol particles with Pb compounds were transformed into a solution using mixtures of фтористоводородной and sulphuric acid with subsequent concentration]. As sorbents with optimal sorbtional properties respectively to Pb the silicagels were used with various dispersity (СГ 100/250, СГ 40/100, СГ 5/40).

For the desorbtion of Pb(II) the solutions of acids with various concentration were used and the quantity of desorbed ions was found directly in the eluate by photometric method. The optical density of the sorbent separated from the solution after 60 min shaking followed by 5 min centrifuging was determined by spectrophotoneter sp-16 in the cuvette l=0.2 cm a the wavelength 540 nm respectively to the standard solution.

The lower limit of Pb(II) concentration with PAR was 0.01 mg/liter corresponding to sampling from working in idle regime engine during 15-20 seconds.

The reliability of used technique has been proved by atom-emission analysis of both natural objects (silt curative muds in Krimea, bottom layers, natural waters and model samples with known Pb(II) content).

The proposed technique differs by its simplicity, expressivity and sensitivity, that can be used not only in stationary laboratories, but in the mobile ones as well, controlling the environment quality.



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CREATING LOCAL ZONES OF REDUCED ATMOSPHERIC VISIBILITY BY LIFTING COMBUSTION PRODUCTS WITH VORTEX RING

A.I. STROUTCHAYEV AND N.KH. KOPYT

Odessa State University, Department of Physics, Research Laboratory for Aerosol Systems

(First received 29 April 1998; accepted for presentation during IAS-4)

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This study suggested that buoyant vortex rings may be exploited to transport aerosols by lifting the particles to high altitudes. This can be performed for two purposes:

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2) creation of nontransparent aerosol zones in the atmosphere for masking.

The visibility length reducing down to limiting value can be realize experimentally at masking by specially injected aerosol into atmosphere due to the strongly selective absorption inherent to particles with complex refractive index (for the soot particles formed at combustion of heavy hydrocarbons m~3(1-0,15i), k=0.3).

Full-scale experiments reported here were carried out on same fuel species (e.g. black oil and Diesel fuel F-5) under variety operating and environment conditions (actual vapour pressure, temperatures of superheated fluids, reservoir imputing time) in the ambient atmosphere (Kopyt and Stroutchayev, 1993).. With a view to prepare of large fuel-spray clouds we used a superheated liquid aerosol-generator (SLAG) which based on the rapid expansion of superheated solutions (RESS) - thermohydrodynamical atomization (THDA) phenomenon. Initial turbulence and buoyancy, created by impulsive outlet of superheated fuel from the nozzle of SLAG joint led to form spherical aerosol cloud. The aerosol particles absorpting were obtained at combustion of previously spraying hydrocarbon fuel (25 to 40 kg of black oil or Diesel fuel F-5, volume of formed air-droplets mixture 850 - 1200 cubic m, fuel droplets mean diameter is 40 mkm < d < 56 mkm, size variation coefficient 2.03 < var < 3.84, environment relative humidity 76% < h < 94%). At the time when the hot volume of combustion products begins to rise by its buoyancy, the vorticity producing by density gradients has transformed into a complete circular vortex ring. It consists of toroidal-shape core of very fine scale turbulence surrounded by co-travelling aerosol "atmosphere". Because in the early stage of the rising vortex ring the circulatory force is very strong that causes large amounts combustion products to be sucked up. As the vortex ring moved higher the circulatory force becomes weaker, the upwards soot and smoke pollutants will be replaced by the fallout ones from "atmosphere" of vortex ring. In this way a zone of lowered visibility is created along the trace of vortex ring. Vortex rings diameters were varied in the range 5,0 - 12,0 m dependently on the mass and origin of the fuel spray. Its thickness in the horizontal direction was identified with the diameter of the vortex ring, and in the vertical direction - by the altitude of its rising.

Experiments carried out were demonstrated that the results obtained may be applied to predict the behaviour of airborne pollutants rising with buoyant vortex ring and further atmospheric emission leading to change of air visibility. Comparison to corresponding experimental data shows fairly well agreement with reported in the literature.

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INVESTIGATION OF THE BURNING AND COMBUSTION OF THE AEROSOLS INSIDE OF PIPELINES

V.A. PUHLIYI, V.I. VODYANIK, N.P. KOZHUSHKOV V.N. LITVINENKO

(Moskva - Severodonetsk)

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This abstract contains results of experimental investigations of the localisation of the flame moving inside of the long size tube line with diameter 500 mm by automatical system of inhibition of the combustion. Experimental set-up includes combustion chamber V = 10^3 m with long size tube line L = 22 m and diameter 500 mm. Induction sensors DD-10 was used for registration of the gas pressure inside of the combustion chamber and long size tube line. Photosensors was used for measurement of the moving of the flame front inside of tube line.

These investigations held with propan gas / air mixture and dust particles / air mixtures.

Analysis of results of the combustion of the gas/air mixture shows following.

The maximum speed of the flame moving in pipeline and maximum pressure in chamber registered for initiation of the combustion in the upper part of chamber.

Speed of moving of the flame inside of tube line for L=1 - 2 m from chamber is 250 m/c, for L= 3-4 m is 300 m/c, for L- 6-7 m is 400 m/c. For L>7 m speed has not dependence from length.

Front of flame paths through first photosensor after 0.45 c. Maximum pressure inside of chamber was 0,19 MPa. The speed of transfer of flame inside of tube line depends from place of initiation of burning. This time is reduced in three times if flame was initialised in lower part of chamber with comparison of initiation in upper part of chamber.

Maximum pressure inside of chamber is 0.13 MPa, time of registration of the flame front by photosensor is 1.1 c.

High level of turbulence inside of tube line leads to burning down of gas/air mixture.

Difference in speeds of moving of pressure wave and wave of products of burning leads to increasing of the

Results of the investigations of the combustion of the bensol - air mixture with localisation for the flame inside of tube line by powder dispergation shows that distance of moving flame front is only 3-3.5 m from the point of injection of powder.

These results show that mixture burning from the point of dispergation of the aerosol powder has localised behaviour by length of tube line.

Dynamics of the combustion of the aerosols inside of tube line by dispergation of the powder shows that distance of localisation of the flame by powder is very small - less than 0.5 m. Using of the powders for localisation of the flame is reducing of the maximum pressure inside of chamber to value 0,03 MPa (more than three times against of analogous value without powder dispergation).

These experimental measurements shows possibility of localisation of the flame inside of tube lines by dispergation of the powder composites.



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SOOT PARTICLES RESTRUCTURING IN FLOW CONDENSATION CHAMBER

MIKHAILOV E.F., VLASENKO S.S., KISELEV A.A.

S. Petersburg State Academy University, Institute of Physics, Department of Atmospheric Physics 198904 Petrodvorez, Ulianovskaya 1, Russia tel: [+7] 812-428-7240; fax: +7 812-428-7240 las@phys.niif.spb.su

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In most cases, carbon black particles resulting from burning of hydrocarbon raw materials are structures of complex organization composed of a large number of primary nuclei (monomers) of nanometer size. The internal structure of such aggregates complies with the known fractal scaling relationship between the number of monomers and aggregate size, that is why such particles are often referred to as fractal clusters. The main distinction of these aerosols particles is their physics properties dependence on their internal geometric structure. The specifity of soot particles in relation to other similar objects is determined by a relatively low bond energy of the interparticle contacts in the aggregates that account for the strong structural changeability of the aggregates under the effect of external factors. From the viewpoint of the applied studies, especially those concerning the effect of soot aerosols on atmospheric processes, investigation of the restructuring processes of carbon black aggregates in an environment of condensing water vapor is of particular importance. Under conditions of higher humidity, carbon black particles become compact, thus increasing their fractal dimension and simultaneously decreasing their sizes [1]. Despite the importance of this mechanism of aerosols transformation, the process of interaction between soot particle and water vapor was studied rather unsufficiently. The study is complicated by the fact that condensing ability of soot agglomerates varies with their hygroscopicity and surface structure which in turn strongly depends upon conditions of clusters formation. So while exploring aggregates restructuring under the effect of condensation it is necessary to monitor humidity of water vapor condensing on the soot particles surface. That is why we applied the special modification of flow diffusion nucleation chamber [2] designed for measuring of condensation activity of large aggregates. To study the structural changes of soot aggregates resulting from water vapor condensation the soot aerosol mixed with water vapor in certain proportion and passed first through the preheater and then through tube cooler where condensation took place. Water vapor was produced by clean air bubbling through water maintained at certain temperature. Varying the water temperature one was able to regulate the vapor concentration. On entering the condensation chamber after preheater, the relatively warm vapor diffused to the cooler walls of chamber where it condensed. Energy was transported to the walls too thus cooling the flowing aerosol stream and resulting in supersaturation of vapor (up to 200%) in a region downstream from the entrance to chamber. When passing through the region soot particles appeared to be centers of vapor condensation that accompanied by restructuring of aggregates.

The result of condensation effect was estimated by means of electronmicroscopic analysis of the particles sampled on formvar film using the thermoprecipitator. The structural and disperse parameters (cluster size distribution, average size of monomers, fractal dimension) were determined using specific image processing technique. The soot

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particles size distribution was found to change significantly upon vapor condensation, which is indicated primarily by a decrease in characteristic size of clusters. The changes observed in particle size distribution appeared to be accounted for by the compaction of large aggregates. Note that nearly spherical globules of closely packed primary particles were formed on the clusters. These globules can cover the cluster either partially or completely and form compact aggregates. The formation of these structures can be accounted for by the effect of surface tension of condensed water on particles in aggregates.

It is of interest to note that the structural change of soot aggregates took place even in slightly undersaturated vapor (more than 95%). In the case restructuring increased the fractal dimension of aggregates but they retained their branched character (there were no compact globules on aggregates). This effect appeared to be bound up with capillary condensation on the interparticle contacts in aggregates. This process gave rise to association of adjacent branches of cluster and formation of multiply-connected chains of primary particles. As a result, the cluster structure retained its rarefied character only at large scales (comparable with the cluster size), while the branches themselves are no longer the chains of monomers, but formations of closely packed particles. When the partial vapor pressure increased, the deformation involves larger and larger cluster branches that yield more and more compact aggregates.

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REGIONAL AEROSOL MODELLING WITH A EULERIAN MODEL

INGMAR J ACKERMANN, HEINZ HASS

FORD RESEARCH CENTRE AACHEN DENNEWARTSTR.25 D-52068 AACHEN GERMANY

ph.:49 241 9421 205 e-mail: iackerma@ford.com

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The particulate matter suspended in the troposphere is strongly linked to numerous air pollution problems. Aerosol particles serve as cloud condensation nuclei and therefore influence the chemistry and spatial distribution of precipitation. In case of evaporating clouds the cycling of aerosol particles through clouds leads to a physically and chemically modified aerosol system. Heterogeneous processes within as well as on the surface of particles have the potential to modify the concentration levels and the spatial distribution of most acidic and photochemical air pollutants found in the atmosphere. Due to their light scattering properties aerosol particles have a strong impact on the radiative budget of the atmosphere. This in turn might effect the photochemistry by changing the photolysis rates of important reactions. Additionally submicrometer particles can be inhaled and therefore might be a cause for adverse health effects.

Hence, a more accurate modelling of air pollution has to consider atmospheric aerosol processes. In contrast to gas phase substances it is not sufficient for an aerosol to predict the chemistry of the system to capture the effects mentioned above, since these are additionally influenced by the physical characteristics of the particle population, e.g. number and size of the particles or mixing degree and phase state. Therefore this paper describes an approach to model particle formation, transport and deposition with respect to aerosol chemistry as well as aerosol

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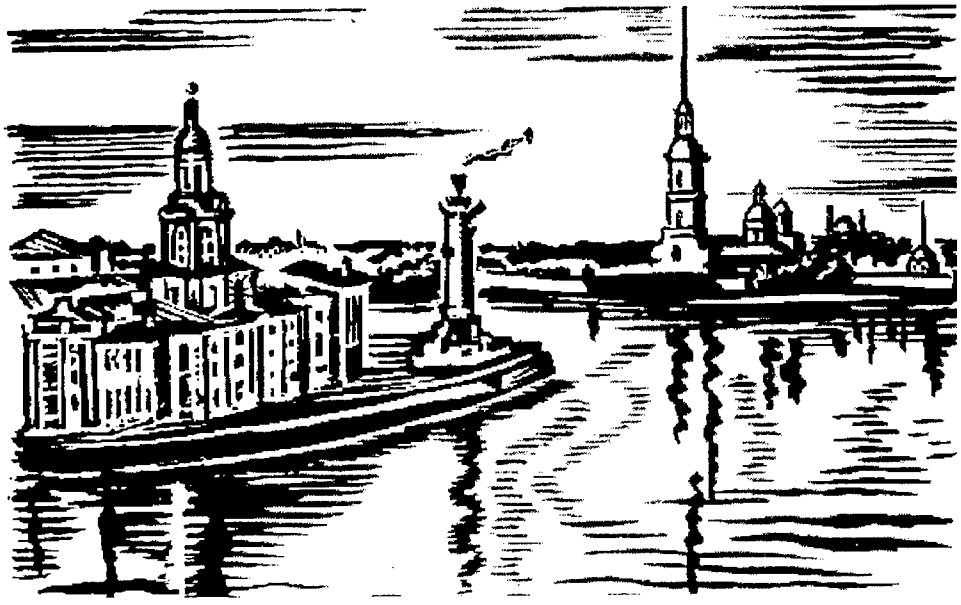
dynamics for the use in regional chemistry transport models.

The Modal Aerosol Dynamics Model MADE for Europe has been developed from the Regional Particulate Model (RPM. Binkowski and Shankar. 1995), adapted for European conditions and implemented into the Eulerian chemistry transport model EURAD (EURopean Air pollution Dispersion model, Hass et al., 1995; Ackermann et al., 1995). The size distribution of the submicrometer aerosol is represented by two overlapping intervalls (modes) assuming a lognormal distribution within each mode. Coagulation is treated within each mode as well as between the modes. Aerosol mass can be increased by direct emission of particles, the formation of new particles from the gas phase (nucleation) and by growth due to condensation.

In previous versions aerosol chemistry was restricted to the sulfate-nitrateammonia and water system. Since secondary organics comprise a major portion of the atmospheric aerosol we will describe the extension of MADE to organic substances in the aerosol phase. This allows to study the formation of secondary organic particles, their impact on the size distribution of the aerosol population and the response of the gas phase chemistry to the formation of particles on a regional scale over Europe.

Addtionally we will describe the extension of the model towards a more complete coverage of particle chemistry -by adding elemental carbon, primary organics and PM2.5- and particle size range -by adding the coarse mode aerosol particles. New developments to incorporate aerosol-cloud interactions in the model will also be presented.

The simulations will be performed with a prototype version of the aerosol code from the USEPA-Models3 system, thus providing a test case for this new community model platform. Results will be presented for an episode in July 1994 for an European domain and subdomains nested into this grid with a finer resolution.



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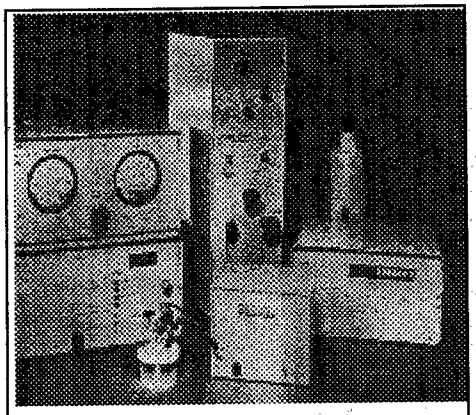
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