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S. Hibben, et al

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CONTENTS

Vol. 1

March, 1975

No. 3

Optical Attenuation in Water.....	1
Bioluminescence Studies in the Black Sea.....	1
Evaluation of Bioluminescent Signals.....	1
Radar Sounding in Fresh Water.....	2
Summer Tests Planned for New Undersea Research Vehicle OSA-3-600.....	2
Mishap with Sever-2 Undersea Research Vehicle.....	3
New Underwater Drone to be Exhibited in Moscow.....	4
Device for Reducing Vessel Drag.....	4
Tyumen Shipyard to Build Ocean-Going Severnoye Siyaniye Floating Power Station.....	4
Hydroacoustic Modelling of Radar Signatures.....	5
Recorder Patent for Side-Look Radar.....	5
Review of Aperture Synthesis.....	5
Photoacoustic Cavitation in Water.....	6
Laser Separation of Nitrogen Isotopes.....	6
Laser Separation of BCl_3 Isotopes.....	7
Laser Cleanup of Oil Spills?.....	7
Dielectric-to-Conductor Transition Under High Pressure.....	8

CONTENTS

Ultrastrong Magnetic Field Generation.....	8
Solenoid for Strong Pulsed Field.....	9
Plasma-Target Study.....	9
Plasma-Fiber Interaction.....	10
Heat-Resistant Coating.....	10
Functional Equations for Ablation Materials.....	10
E-Beam-Plasma Interaction.....	11
E-Beam Deformation of Metal.....	11
Ball Lighting Theory.....	12
Recent Publications.....	13

INTRODUCTION

This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. The intent is to supply a quick look at items of possible interest, including topics not necessarily named in the DARPA interest profile, as a supplement to our reportage on specified topics.

It is intended to publish this collection on a monthly basis, to continue to provide prompt coverage of numerous aspects of Soviet R&D. As an added feature, all recently acquired books will be listed as they are received. A list of source abbreviations is appended.

For further information the reader is invited to call Stuart Hibben or Lee Boylan at Informatics on (301)-770-3000.

Optical Attenuation in Water (abstract)

A method for contactless measurement of optical attenuation factor ϵ in water is introduced and a relatively simple instrumental method is described. The method consists of photometrically determining the ratio of two light fluxes backscattered from two regions within the propagation range of a narrow light beam in water, then calculating ϵ as a function of the ratio and the optical base line.

The optical circuit of the instrument shows a 2 mm dia. LG-56 laser beam backscattered from two regions and directed through two diaphragmed apertures to a photomultiplier. Double modulation of a backscattered light beam produces a signal proportional to ϵ , which is amplified and measured by a voltmeter. Comparative measurements were made with the new instrument and a laboratory transparency meter in waters of different turbidity. Comparative data show that ϵ values measured from backscattering tend to become somewhat lower than ϵ_t values obtained with the transparency meter, as the photon life-time increases. This fact is explained by deviation from the Bouguer law of the light flux backscattered by the more distant region. The relative error of the instrument $\Delta\epsilon/\epsilon$ is no worse than 6%. [Kozlov, V. D., and N. M. Samson. Measuring optical attenuation factor in water by backscatter. FAiO, no. 10, 1974, 1093-1096.]

Bioluminescence Studies in the Black Sea (verbatim)

[Bioluminescence] investigations were conducted during the summer of 1972 and the spring of 1973 in the eastern, central and southwestern part of the Black Sea. Typical vertical profiles of bioluminescent potential (BP) for each region, and the 43° N horizontal profile for the eastern region, are given. It was found that bioluminescence considerably affects the optical field structure in the nocturnal sea, by sharply decreasing the coefficient of skew of brightness indicatrices in the layer with maximum BP. From data on amplitude spectra measured by a sensor suspended at fixed depths, numerical characteristics of the probability distributions of intensity values for different levels of astronomical backgrounds were calculated. [Vladimirov, V. L., V. A. Urdenko, G. G. Neuymin, and L. A. Zemlyanaya. Bioluminescent field study in the Black Sea. IN: Sb. Mor. gidrofiz. issled., no. 4 (63), Sevastopol', 1973, 148-156. (RZhGeofiz, 10/74, #10V109). (Translation)].

Evaluation of Bioluminescent Signals (verbatim)

Measurements of amplitude spectra of bioluminescent signals by a sensor suspended or towed near the vessel bottom were conducted in the equatorial zone of the Pacific Ocean and in the Black Sea. Weight functions $f(\tau)$ (τ = optical density), which indicate the contribution to the total signal of bioluminescent displays at various distances from the sensor were calculated

on the assumption of identical and uniformly distributed sources. It was found that $f(\tau)$ has a sharp maximum at $\tau = 0.05-0.1$. Remote sources are characterized by small specific contributions; however their total contribution is considerable. This contribution is greater for a towed detector than for a suspended detector. [Urdenko, V. A., L. A. Zemlyanaya, and V. L. Vladimirov. Discrete contribution to recorded signals of bioluminescent displays at various distances from a sensor. IN: Sb. Mor. gidrofiz. issled., no. 4(63), Sevastopol', 1973, 157-162. (RZhGeofiz, 10/74, #10V34). (Translation)].

Radar Sounding in Fresh Water (abstract)

Radar bottom soundings are reported being made in 1971 in Petrozavodskaya Bay of Lake Onega, and earlier in Lake Gladishevskoye, from a vessel cruising at 10 km/hr. The transmitting and receiving antennas were located just under the water surface; transmitter carrier signal was 60 MHz. The depth H of the basin and the propagation rate C_v of the radar signal in water were determined from measurements of the time lag of the bottom reflected signal. Simultaneous control measurements were made by bottom sounding with a lead line. The comparative evaluation of C_v data gave an rms value of 33 m/ μ s, in agreement with theory.

Tests show that variations in the average signal levels over different paths are due to differences in water pollution, bottom ground type, and some local interferences. The dielectric loss tangent $\text{tg}\delta$ values calculated from the radar sounding data were found to be in satisfactory agreement with the $\text{tg}\delta$ laboratory measurement data of the water samples taken out of different bay or lake regions. It is concluded from $\text{tg}\delta$ versus frequency dependence that signal frequency for bottom soundings should be in a range where specific absorption is constant. At 1.5 to 2 db/m absorption, an equipment with 140 db range can be used for bottom soundings to $H = 50$ m. The cited data show the feasibility of H measurement, underwater object detection, and determination of water electrical properties from radar probing in fresh water. [Bogorodskiy, V. V., G. V. Trepov, B. A. Fedorov, and G. P. Khokhlov. Radar probing of fresh-water lakes. Vodnyye resursy, no. 5, 1974, 178-184.]

Summer Tests Planned for New Undersea Research Vehicle OSA-3-600 (abstract)

Developed by the Moscow Branch of Giprotybflot Institute, OSA-3-600 is a three-man URV with an endurance of 8 hrs and a speed of 3 knots. Although not stated, the "600" designation in the name may indicate her depth capability. OSA-3-600 is to be equipped with at least two manipulators, one for geological and the other for biological sampling. The vehicle will be equipped with passive sonar, active sonar, an acoustic depth correction system, a hydroacoustic comm link, TV, an automatic control system, an attitude control system, etc. In the event of a mishap, the manipulator can

be dropped, followed by 500 kg of outboard scientific equipment and other gear, if required. In a very dangerous situation, a completely automatic emergency surfacing system actuates on its own and performs all necessary surfacing operations.

The first OSA-3-600 vehicle was ordered by the All-Union Scientific Research Institute of Fisheries and Oceanography (VNIRO) in Moscow and a second OSA vehicle, already in construction, has been ordered by the Far East Science Center of the USSR Academy of Sciences. It is mentioned that more orders for OSA vehicles have been received than can be presently filled. Another vehicle mentioned in the article as being on the drawing boards is an amphibious URV called Triton. This type of vehicle is considered to be extremely useful for off-shore and shelf engineering projects. According to V. P. Shmatok, Director of the Moscow Branch of Giprorybflot Institute, many of OSA's systems were adapted from existing aerospace hardware. Shmatok also adds that it is time that Soviet URV development assumed an industrial production scale. [Reut, V. "OSA" readies for an underwater flight, Pravda, 5 Apr 75, p. 3, cols. 5-8].

Mishap with Sever-2 Undersea Research Vehicle (abstract)

During a series of dives near Yalta, the Soviet Sever-2 URV recently ran into trouble and had to make an emergency surfacing. Upon completing its mission somewhere below 1000 m, Sever-2 was making a routine ascent when the vertical-lift motors began to strain, the ascent rate decreased, and excess water in the variable-ballast tanks was noted. When the ballast pump was started, the static converter went out and the vertical-lift motors stopped. The engineer replaced the converter, pressed a button, and the converter failed to operate. Sever-2 shortly began to sink slowly and after five minutes had dropped by 200 meters. A solid ballast package was jettisoned using explosive bolts, and Sever-2 began to rise very slowly. Small amounts of air were fed into the stern ballast tanks, since the depth was still too great for ballast blowing. Near the surface, the tanks were finally blown and Sever-2 surfaced about three miles away from the support ship Odissey.

On the surface it was learned that the swing-out arms on which the vertical-lift motors are mounted would not swing back over the hull (this is necessary for the URV's recovery). Inspection of the arms revealed a ruptured outboard connection which resulted in flooding of the variable-ballast tank. By this time, the engineer had adjusted the static converter. After several short pulses, the crew was able to tuck the lift-motor arms in over the hull, and Sever-2 was ready for recovery. Twelve hours had elapsed from the start of the dive to the final recovery of Sever-2. It is reported that, shortly after this incident, the R/V Odissey left the Black Sea for operations in the North Atlantic. [Belov, V. Test, Izvestiya, 23 March 1975, p. 4, cols. 3-6.]

New Underwater Drone to be Exhibited in Moscow (abstract)

The drone, called "Gidroplan," was developed by the Kasan' Aviation Institute and was tested by the Institute of Oceanology in early 1974 during the 11th cruise of the R/V Dmitriy Mendeleyev in the western Pacific Ocean. "Gidroplan" is said to resemble an airplane and weighs about one ton. It is instrumented to measure current speed, salinity, temperature, conductance, and turbulence, with data recording on strip chart and mag tape. "Gidroplan" also samples microelements in the water to facilitate the determination of what types of deposits may be found on the bottom in a given area. It is mentioned that the turbulence measurements provide information on eddies, from which it is possible to determine when and where a school of fish has travelled.

In operation, the "Gidroplan" is towed up to a speed which will allow the drone to "glide" effectively. The towing line is released and the free-gliding drone's movements are then remotely controlled (probably acoustically) from the towing ship. At 300 meters, ballast is jettisoned and "Gidroplan" begins to rise. A homing beacon antenna is released and the ship then locates and recovers the drone. In April 1975, "Gidroplan" will be displayed at the Exhibition of the Achievements of the National Economy in Moscow, and subsequently at EXPO-75 in Japan. [Izergin, V. "Gidroplan" on a course to Moscow. Nedelya, no. 9, 1975, p. 3, cols. 1-2].

Device for Reducing Vessel Drag (abstract)

A Soviet patent has been issued for a vessel drag-reducing system consisting of an elastic shell mounted around the hull. The shell forms a cavity which is divided by flexible portions and is filled with a damping fluid. To effectively reduce drag, an inductor mounted on the hull is connected to an electrical power source. The elastic shell is ferromagnetic and it interacts with the electromagnetic field of the inductor winding. This excites a travelling mechanical wave in the ferromagnetic shell. In addition, ferromagnetic particles are suspended in the damping fluid between the hull and the elastic shell. [Kim, K. I., A. A. Afonin, and V. I. Bondarenko. Device for reducing the frictional drag of an object moving in water. Otkr, izobr, no. 3, 1975, 45, Author Certificate 457629].

Tyumen' Shipyard to Build Ocean-Going "Severnoye Siyaniye" Floating Power Station (abstract)

This year, the Tyumen' Shipyard will build an ocean-going version of the "Severnoye Siyaniye" floating power station. The station will be capable of operation in temperatures down to -65° C. [Shipbuilders. Vechernyaya Moskva, 3 March 1975, p. 2, col. 7].

Hydroacoustic Modelling of Radar Signatures (verbatim)

An instrumental array is described for investigation of radar characteristics of various objects, using a hydroacoustic simulation method for range and azimuth resolution. Measurement techniques and some test results are given. [Shaperin, I. L., L. A. Tupitsyn, and Yu. V. Tsuvarev. Experimental study of radar characteristics of complex objects, using a hydroacoustic simulation method for range- and azimuth resolution. IN: Tr. Sev-Zap. zauch. politekhn. in-ta, no. 25, 1974, 16-19. (RZhRadiot, 11/74, no. 11G16)].

Recorder Patent for Side-look Radar (verbatim)

A photographic recording device for a side-looking radar is introduced. The device is composed of an optical data sensor and a photographic film pull-down unit connected to a ground-speed signal amplifier. An electronic commutator of the radar signal is connected to the input of the data sensor to eliminate geometric distortion of the recorded image and minimize weight and dimensions of the apparatus. An interrogation pulse shaper driven by a sweep trigger pulse is connected to the control input of the commutator. The pulse shaper and the signal amplifier receive the altitude and "scale" signals. The optical data sensor is composed of discrete electroluminescent emitters aligned with spacings which vary as the first derivative of a hyperbola. [Groshev, A. A., and P. K. Pavlov. Photographic recording device. Author's certificate USSR, no. 404182, published March 26, 1974. (RZhRadiot, 1/75, no. 1G54 P)].

Review of Aperture Synthesis (abstract)

This is an up-to-date review of Western and Soviet (about 14% of the total) open sources on methods of aperture synthesis, using both noncoherent and coherent illumination of the observed object. It is noted that application of the principle of aperture synthesis, introduced in the USSR by Khaykin and Pariyskiy, to radar ranging has permitted a significant increase in the resolving power of scanning radar systems. Descriptions are given of the interferometric system with two separated apertures (mobile mirrors); systems using optical mechanical aperture synthesis (feedback system) consisting of a large mirror comprising a continuous array of small mirrors; and systems of spaced small apertures with either simultaneous (spatial synthesis) or time sequential (temporal synthesis) recording of images. Different realizations of "active" synthesis with coherent illumination of the observed object are cited.

Methods of information processing by means of a synthesized multielement annular aperture is discussed in connection with the informational paradox of Gabor. A few Soviet contributions to development of the cited systems are noted. Advantages and deficiencies of synthetic apertures as

compared to continuous apertures are outlined. Photographic and spectroscopic studies from space stations and lunar observatories are suggested to be the most important future fields of application of synthetic aperture optical systems. [Sintsov, V. N., and A. F. Zapryagayev. Optical aperture synthesis. UFN, v. 114, no. 4, 1974, 655-676].

Photoacoustic Cavitation in Water (abstract)

Observation is reported of a new physical effect-photoacoustic cavitation in water. The phenomenon was first observed in 1969 and later reported at the 7th All-Union Conference on nonlinear and Coherent Optics in Tashkent. The effect consists of generating a cavitation region of 0.3 to 0.5 mm bubbles by focusing a pulsed laser beam in distilled water. Tests described used a millisecond, 10^2 to 10^3 j pulsed beam from a Nd-glass laser operating in a spike mode. The incident beam is intensively scattered by the cavitation. The cavitation region was 10^{-3} to 4×10^{-3} cm³ in extent and power density within this volume varied from 0.3×10^8 to 3×10^8 w/cm². Additional experiments are described with water heated to 80-90° C and with transillumination of the cavitation by an auxiliary He-Ne laser beam.

The experiments revealed that the cavitation region is the product of a simultaneous action of heat and sound pressure generated by radiation absorption in the water. The minimum sound pressure generated in the focal region within one microsecond is estimated to be 30 atm, which is significantly higher than the acoustic strength of distilled water. The authors discuss the cavitation threshold as well as the physical mechanism of cavitation formation and propagation. [Bunkin, F. V., V. I. Konov, A. M. Prokhorov, V. V. Savranskiy, and V. B. Fedorov. Photoacoustic cavitation in water. ZhETF, v. 67, no. 6, 1974, 2087-2091].

Laser Separation of Nitrogen Isotopes (abstract)

A theoretical basis for isotope separation under laser excitation was given earlier by Belenov et al (Recent Trends in Soviet Research, June 1974, 9). Basov et al verify this in the present study, in which nitrogen isotopes N¹⁴ and N¹⁵ were separated by the laser-stimulated reaction $N_2 + O_2 \rightarrow 2NO$. Hot N₂ molecules were obtained by simultaneous focusing of a ruby laser radiation at fundamental frequency and its Stokes component on an air-containing cell at liquid nitrogen temperature and 300 torr pressure. The Stokes component was initially separated out by stimulated Raman scattering of the ruby laser radiation by focusing it in liquid nitrogen. The mass spectrum of the reaction product showed that the N¹⁴O/N¹⁵O ratio was ~2.5. Since the natural fraction of N¹⁵ in nitrogen is 1/250, the isotope separation factor obtained was on the order of 100. [Basov, N. G., E. M. Belenov, L. K. Gavrilina, V. A. Tsakov, Ye. P. Markin, A. N. Orayevskiy, V. I. Romanenko, and N. B. Ferapontov. Isotope separation by laser-stimulated chemical reactions. ZhETF P, v. 20, no. 9, 1974, 607-608].

Laser Separation of BCl₃ Isotopes (abstract)

The first successful isotope separation from a natural mixture exposed to a pulsed CO₂ laser is described. The separation method is based on an isotope-selective chemical reaction via instant collisionless molecular photodissociation. This mechanism of dissociation was discovered by Letokhov et al (ZhETF, v. 63, no. 6, 1972, 2025).

In the experiment, 0.5 j, 100 nsec pulses from a CO₂ laser at atmospheric pressure were focused on a cell with a gaseous B¹⁰Cl₃ and B¹¹Cl₃ mixture (B¹⁰/B¹¹ = 1/4.32) either pure (type I) or with an added O₂/4N₂ mixture (type II). Luminescence spectra of radicals and molecules produced by dissociation and subsequent chemical reactions were analyzed. In the case of type II mixtures the luminescence spectral region corresponding to instant luminescence of pure BCl₃ was recorded by tuning the laser to the absorption bands of B¹¹Cl₃ or B¹⁰Cl₃. It is shown that in the former case, B¹¹O and in the later case B¹⁰O was predominant. Hence a collisionless molecular dissociation in a high-power IR field is a selective process, at least in the case of BCl₃, when the isotopic shift between absorption bands of two different molecules is greater than 40 cm⁻¹.

The cited data indicate one more possible method of laser-induced isotope separation, in addition to the earlier introduced two-step photodissociation of Ambartsumyan et al (Recent Trends in Soviet Research, June 1974, 8) and photopredissociation (e.g. Letokhov in Chem. Phys. Lett, v. 15, 1972, 221). [Ambartsumyan, R. V., V. S. Letokhov, Ye. A. Ryabov, and N. V. Chekalin. Isotope-selective chemical reaction of BCl₃ molecules in a intensive infrared laser radiation field. ZhETF P, v. 20, no. 9, 1974, 597-600].

Laser Cleanup of Oil Spills? (abstract)

Askar'yan et al. have earlier reported on successful laser burnoff of oil films on water (Effects of High Power Lasers, no. 3, 1974, 31). More data on these experiments is presented to show that this method has practical possibilities. Tests were done with a CO₂ laser in both c-w and pulsed modes, focused and unfocused, on films of oil, kerosene, benzine etc. on water in a laboratory test vessel. Power of the c-w beam was 50 w; in the pulsed regime power was 1 Mw at 1 μs with a 2 Hz pulse rate.

Depending on the laser mode and thickness of the film, various combinations of burning and evaporation were observed, accompanied by a spraying of the film as high as 30 cm above the target surface. Best results were in the pulsed mode; figures given for a 3 mm focused spot on a kerosene layer showed an evaporation rate of 0.05 g per 30 minutes, or an energy outlay of 2400 j/g, which is four times more efficient than with the c-w beam. The process was enhanced by any dust particles or foreign matter suspended in the film, which tended to concentrate heat in the surface layer.

An interesting sidelight to the test was that by strobing the beam over the film area it was inhibited from spreading. This combination of factors suggests a practical application of lasers in arresting or clean up oil spills; CO₂ lasers, such as the gasdynamic type, are particularly suitable because of high surface absorptivity in the IR range, plus the fact that sufficient power is now available in this type of laser. [Askar'yan, G. A., Ye. K. Karlova, R. P. Petrov, and V. B. Studenov. Evaporation, burnoff and localization of petroleum and other films on a water surface by high power laser beam. UFN, v. 113, no. 4, 1974, 709-710].

Dielectric-to-Conductor Transition Under High Pressure (abstract)

A series of recent tests by Vereshchagin et al. reportedly have achieved a metastable metallic state in several nonconductive materials under pressures on the order of a megabar. Specimens were loaded in Bridgman anvils of carbonado at 4.2 K and their resistance measured as functions of force and temperature. In the first cited experiment, SiO_2 specimens dropped from 10^8 to 10^2 ohms resistance at 1 Mbar, and reverted to the original state with pressure removal or heatup. A pronounced hysteresis is seen in the complete pressure-relaxation cycle.

Similar results were later obtained with Al_2O_3 , NaCl and sulfur specimens under the same test procedure. Results showed that the metastable conductive phase can be "defrosted" by a slight increase in temperature at fixed compression force, which confirms that specimens did not decompose under pressure. Transition pressure was highest for Al_2O_3 and lowest for sulfur.

A third test reports analogous results with hydrogen. Layers of varying thickness were deposited on the carbonado anvils at 4.2 K and compression increased to 20--30 kg, or approximately 1 Mbar. Resistance again showed a sharp drop in sufficiently thin layers from 10^8 to 10^2 ohm at ~1 Mbar, with typical hysteresis. By releasing pressure to a point where reversion to the dielectric state begins, and then accelerating the process by "defrosting", the authors claim to confirm the existence of a metallic hydrogen phase. They also do not rule out the possibility of metallic hydrogen at lesser pressures. [Vereshchagin, L. F., Ye. N. Yakovlev, B. V. Vinogradov, V. P. Skakun, and G. N. Stepanov. Transition to conductor in SiO_2 . ZhETF P, v. 20, no. 7, 1974, 472-474; Vereshchagin, L. F., Ye. N. Yakovlev, B. V. Vinogradov, and V. P. Skakun. Transition to conductor in Al_2O_3 , NaCl, and S. Op. cit., no. 8, 1974, 540-544; Vereshchagin, L. F., Ye. N. Yakovlev, and Yu. A. Timofeyev. Possible transition of hydrogen to the metallic state. Op. cit., v. 21, no. 3, 1975, 190-193].

Ultrastrong Magnetic Field Generation (abstract)

Loss mechanisms are considered in the case of powerful magnetic field generation by the exploding conductor method. The specific case is examined for a shell configuration, in which flux losses in the process of explosive field generation are formulated by two equations, on the assumption that the flux-compressing shell is made of solid material and that certain shell-dependent parameters are known. In the case of fields below 0.5 Moe, the problem is reduced to solution of one equation only, since thermal effects are negligible and electric conductivity of the shell material can be assumed constant.

A rigorous solution of the simplified problem is obtained for three particular cases of shell compression in a generator system of two parallel plates. In each case, the magnetic field within the shell is formulated

as a function of compression time. Analysis of these formulas indicates that the most advantageous with respect to field gain is system in which the length of the shell loop decreases during compression. [Yurchenko, V. I. Flux losses in the process of ultra-strong field generation by rapid compression of conducting shells. ZhTF, no. 8, 1974, 1650-1655].

Solenoid For Strong Pulsed Field (abstract)

The design and manufacturing process are described for a pulsed solenoid capable of reliably producing magnetic fields of 400 koe and sustaining at least 100 pulses of several milliseconds duration. The double-layer coil is of cold-worked copper wire which has a higher ponderomotive strength than an annealed wire coil. Winding characteristics are tabulated for two solenoids of 10 mm ID and lengths of 45 and 60 mm. The winding consists of two 25 mm coils connected in series and immersed in an isolating compound.

Tests at liquid nitrogen temperature showed that this design of solenoid sustains 100 pulses at 400 koe field intensity with 15 min intervals between pulses. Several solenoids sustained over 100 pulses at 400 koe and failed only at levels of 440-460 koe. Stable magnetic fields of over 400 koe can thus be obtained by adhering to the described manufacturing process for pulsed solenoids. [Katrukhin, Yu. K., L. I. Zelikman, and A. I. Vorokhov. Pulsed solenoid for obtaining magnetic fields having an intensity to 450 koe. PTE, no. 5, 1974, 177-179].

Plasma-Target Study (abstract)

Recent studies have shown the potential damage effects of a supersonic plasma impinging on a solid target. In this study by Sultanov et al. the shock-compressed plasma formed by supersonic plasma jets impinging on a flat metallic target was studied experimentally to evaluate the effect of electrode polarity on plasma parameters. The plasma jets were produced by high-power pulsed discharge in a specially designed chamber under experimental conditions described earlier by Ageyev and Sultanov (TVT, no. 3, 1973, 498). In the present experiments a Cu or Al plate was connected to an electric discharge circuit as anode or cathode, or else was left floating on an insulating support in the discharge gap.

The experiments showed that compression shocks change their position between the plasma nozzle exit and the plate whenever the plate polarity is reversed or the plate material is changed. Also, compression shock position depends on the polarity of the discharge chamber electrodes when the plate is kept neutral. Spectroscopic characteristics of the compression shock are also affected by polarity inversion. The distribution of temperature and spectral line intensity over the discharge gap and the nozzle exit-to-target

distance shows the maximum temperature to be at the nozzle exit section, where the two plasma jets interact. Further analysis of the test data confirmed that compression shock formation is related to the propagation rate of the supersonic plasma jet. [Sultanov, M. A., and V. I. Kuchеров. The role of electrode polarity in formation of compression shock on a target surface. ZhPS, v. 21, no. 1, 1974, 35-40].

Plasma-Fiber Interaction (abstract)

The effect of a free argon plasma jet on boron, silicon carbide, and B₄C or SiC-coated boron fibers was observed experimentally. Experimental curves of relative strength of the fibers versus their distance L from the plasma nozzle exit and duration t of exposure show a 20 to 30% decrease in strength of B and B₄C-coated B fibers at L = 50 mm and t = 8 to 10 sec. By contrast, the strength of SiC and SiC-coated B fibers remained unchanged or even somewhat increased after a similar treatment. At L = 100 mm, analogous variations of fiber strength versus t were observed.

It is concluded that the decrease in strength of the boron fibers is the result of surface oxidation by chemically reactive gas in the plasma jet. The slight strengthening of the SiC and SiC-coated B fibers is attributed to a purely thermal effect of the plasma jet. Fiber weakening can thus be minimized or completely eliminated by controlling the plasma effect or by using a protective coating, e. g., a 2-3 mm thick SiC layer. [Shorshorov, M. Kh., V. V. Kudinov, V. I. Antipov, and L. V. Katinova. Effect of a plasma jet on boron and silicon carbide fibers. FizKhOM, no. 5, 1974, 59-61].

Heat-Resistant Coating (verbatim)

Research data are given on various physico-chemical and technical characteristics of multicomponent manganese glasses and coatings. A microcrystalline glass coating has been developed which protects a metal against gas corrosion at 1000° C. [Grechanova, S. B., and L. A. Lysenko. Preparation of manganese multicomponent heat-resistant coatings. IN: Sb. Stekloemal' i emalirovaniye metallov. Novocherkassk, no. 1, 1974, 140-143. (RZhKh 19 M, 1/75, no. 1M193)].

Functional Equations for Ablation Materials (abstract)

A set of simplified equations of mass, momentum, and energy conservation is derived for practical application to problems of heat and mass transfer during an intensive (10 to 100°/sec) heating of decomposing heat shield materials, e. g., polymers and glass-asbestos or carbon-reinforced plastics. Simplification of the standard equations is achieved by introducing the functionals Φ , F, and Q of temperature T(x, τ) (τ = time) under the assumption of equal internal and surface porosity. The functionals Φ , F, and Q are the

characteristics of a partial differential equation which describes the process in the absence of heat transfer in the gas phase.

Practical application of the derived equation requires determination of the functionals, which is described as a problem of process optimization. The mathematical method of optimization is illustrated by two numerical examples of Φ and F computation assuming $Q[T(x, \tau)] = 0$, i.e., a small thermal effect of decomposition reaction. The cited numerical experiments thus indicate the practical feasibility of determining the functional thermophysical characteristics of decomposing heat-shield materials. [Omel'chenko, K. G., M. V. Savelov, and V. P. Timoshenko. Study of heat and mass transfer in decomposing porous materials. TVT, no. 4, 1974, 761-768].

E-Beam-Plasma Interaction (abstract)

A study is described which was designed to evaluate the interaction of an e-beam with a plasma whose density was varied from 10^{15} to $10^{17}/\text{cm}^3$. The experimental apparatus included a conventional linac generating a 1 amp, 2 Mev pulsed e-beam of 1 cm diameter, and a coaxial plasma gun. Characteristics of the electron beam and plasma focal formation are given. Plasma electron density was measured with a laser interferometer at $\lambda = 6300 \text{ \AA}$ and by Stark effect on the $H\beta$ and $H\gamma$ spectral lines.

Beam energy loss was approximately 15% at densities $n_p \leq 10^{16}/\text{cm}^3$, increasing sharply to 90% at densities of $6-7 \times 10^{16}/\text{cm}^3$. E-m radiation at $\sim 1 \text{ mm}$ wavelength was also observed from the plasma at $n_p \leq 10^{16} \text{ cm}^{-3}$; this radiation decreased as n_p was increased above $10^{16}/\text{cm}^3$. In addition, at $n_p = 6 \times 10^{16}/\text{cm}^3$, soft x-rays were detected in the plasma emission from e-beam exposure. The data are cited as proof of the collective interaction of a relativistic electron beam with a dense plasma. [Kiselev, V. A., Ya. B. Faynberg, and A. K. Berezin. Collective interaction of a relativistic electron beam with dense plasma. ZhETF P, v. 20, no. 9, 1974, 603-606].

E-Beam Deformation of Metal (abstract)

An experimental study is reported on plastic deformation of annealed copper discs by an electron beam of 10 to 100 nsec duration. Tests were conducted in a vacuum diode with a needle cathode under conditions of explosive emission. Rate of energy input to the target was controlled within two orders of magnitude by varying the interelectrode gap from 0.4 to 2 mm and diode voltage from 7 to 20 kv. Micrographs of the target surface after a single shot showed slip bands which increased in number with beam power density. The plastically deformed subsurface layer was up to 50μ thick, depending on beam intensity. The minimum exposure conditions for microscopically detectable plastic deformation are tabulated.

Calculations of deformation time led to the conclusion that surface deformation under the cited conditions occurs after irradiation of the specimens. An increase in dislocations density and appearance of deformation twinning were observed in the specimen areas exposed to a $\sim 10^7$ w/cm² electron power density. [Shubin, A. F., V. P. Rotshteyn, and D. I. Proskurovskiy. Plastic deformation of metal by a 10^{-7} to 10^{-8} sec high-power electron beam. IVUZ Fiz., no. 7, 1974, 50-53].

Ball Lightning Theory (abstract)

A theory of ball lightning has been advanced which claims to account for all its pertinent phenomena, i.e. formation, motion and final explosion. The formation of spherical eddies of electrostatic charge owing to nonuniform charge distribution is seen as the fundamental mechanism for forming ball lightning. An analog cited is that of the motion of a dye droplet descending by gravity through a liquid of differing specific weight.

The theory relates ball velocity to electric field gradient in the ball trajectory (values up to 30 kv/cm), air density, and effective eddy resistance in the ball. Assumed parameters give a peak velocity of 20 m/sec; propagation tends to be vertical rather than horizontal, which agrees with observations. The cited theory would also account for pearl lightning. [Voytsekhovskiy, B. V., and B. B. Voytsekhovskiy. The nature of ball lightning. DAN SSSR, v. 218, no. 1, 1974, 77-80].

Recent Publications

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Aronov, S. A., L. S. Bogdankevich, and A. A. Rukhadze. Ob'emnyye i poverkhnostnyye elektromagnitnyye volny v prostranstvenno ogranichennoy plazme i ikh возбуждениye relyativistskimi elektronnyimi puchkami (Internal and surface e-m waves in a spatially confined plasma, and their excitation by relativistic electron beams). FIAN, preprint no. 37, 1974. (KLDV, 12/74).

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SOURCE IDENTIFICATION

DAN SSSR	-	Akademiya nauk SSSR. Doklady
FAiO	-	Akademiya nauk SSSR. Izvestiya. Fizika atmosfery i okeana.
FiKhOM	-	Fizika i khimiya obrabotki materialov
IVUZ Fiz	-	Izvestiya vysshykh uchebnykh zavedeniy. Fizika
KL	-	Knizhnaya letopis'
KLDV	-	Knizhnaya letopis', doponitel'nyy vypusk
LC	-	Library of Congress acquisition
Mor. gidrofiz. issl.	-	Morskoye gidrofizicheskiye issledovaniya
Otkr izobr	-	Otkrytiya, izobreteniya, promyshlennyye obraztsy, tovarnyye znaki
PTE	-	Pribory i tekhnika eksperimenta
RBL	-	Russian Book List entry
RZhGeofiz	-	Referativnyy zhurnal. Geofizika
RZhKh	-	Referativnyy zhurnal. Khimiya
RZhRadiot	-	Referativnyy zhurnal. Radiotekhnika
TVT	-	Teplofizika vysokikh temperatur
UFN	-	Uspekhi fizicheskikh nauk
ZhETF	-	Zhurnal eksperimental'noy i teoreticheskoy fiziki
ZhETF P	-	Pis'ma v Zhurnal eksperimental'noy i teoreticheskoy fiziki
ZhPS	-	Zhurnal prikladnoy spektroskopii
ZhTF	-	Zhurnal tekhnicheskoy fiziki