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A Digest of Recent Soviet R & D Articles

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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.

Soviet-bloc Seminar on Semiconductor Optoelectronics (abstract)

Proceedings of the First Seminar on Semiconductor Optoelectronics are reported. The meeting was held October 13-19, 1975 in Vladislavovo, Poland, under the auspices of the Polish Academy of Sciences. Over 150 specialists from the seven European bloc countries attended the presentation of 22 papers on research, development and manufacture of semiconductor sources of radiation. The papers dealt in particular with physical phenomena in materials for electroluminescent diodes, measurement techniques, conventional optoelectronic materials and their applications, new semiconductor materials and structures in sources of e-m radiation, heterolasers, and trends in development of optoelectronics.

S. V. Svechnikov devoted two lectures to development of fiber and integral optics, tunable optical media for spatial and temporal modulation of radiation, radiation sources and photoelectric receivers. D. Z. Garbuzov and P. G. Yelisseyev discussed new heterolaser developments. The lecture by Ya. M. Popov is noted for its discussion of high-speed holographic memory systems based on injection lasers, and a system of image display on a large screen, using a scanning electron beam-pumped semiconductor laser. The possibility of using a laser projector in TV was discussed. Most of the papers, however, were devoted to engineering and manufacture of semiconductor optoelectronic devices. The seminar proceedings will be published in English in 1976 under the title "Semiconductor Sources of Electromagnetic Radiation" by Polish Scientific Publishers in Warsaw. [Yelisseyev, P. G. and M. A. Herman. "Centniewo-1975:" Autumn International School on Semiconductor Optoelectronics. Kvant. elektronika, no. 3, 1976, 672-674].

CdSb Junction Infrared Detector (abstract)

A p-n junction photodiode prepared by surface treatment of n-type CdSb:Te single crystal is introduced as a potential IR radiation detector. The novel method of preparing the junction consists of melting a surface layer by 5 msec. pulses from an Nd laser and a rapid cooling with recrystallization. Thus the n-type conductivity of the surface layer is converted to p-type and a p-n junction is formed at the interface. The forward and inverse currents across the junction decrease as energy density of laser pulse is increased from a threshold of 0.1 j/mm^2 to a maximum of 0.33 j/mm^2 . Simultaneously, photosensitivity of the junction increases.

Good reproducibility and stability of junction characteristics have been observed. Sensitivity of the detector operating in the photodiode mode is higher than in the photovoltaic mode, and depends on bias current. In the photovoltaic mode at 77°C , sensitivity peaks at 0.48 eV energy of incident radiation, i. e., equal to the forbidden gap of the CdSb:Te crystal. In the photodiode mode at 77°C , there is a second, less intensive response peak at 0.12 eV (10μ) due to deep Te levels. [Tovstyuk, K. D., G. V. Plyatsko, O. I. Danilevich, S. G. Kiyak and Ya. V. Bohitskiy. Photosensitive p-n junction, based on CdSb lightly doped with tellurium. UFZh, no. 3, 1976, 496-499].

Holographic Method for Passive Radar (abstract)

A process for generating a hologram in a partially coherent field is analyzed. The effects of spatial and time characteristics of the radiating object are determined, as well as the parameters of the registering device as they affect the quality of the reconstructed image. Necessary conditions are formulated for obtaining a satisfactory image reconstruction from holography in a partially coherent field. Relationships are derived which apply to both passive and active r-f holography. [Kremer, I. Ya., and V. A. Pon'kin. Passive radioholography and analysis of the holographic process in a partially coherent field. RiE, no. 4, 1976, 715-722].

Optical Frequency Converters (verbatim)

Normalized optical excitation spectra in the 0.3 to 2.2μ range are shown and relative excitation efficiencies for 700 to 2.200nm wavelengths are tabulated for $\text{Zn}_2\text{SiO}_4\text{:Mn}$, $\text{Y}_2\text{Al}_5\text{O}_{12}\text{:Ce}$, $\text{Y}_2\text{SiO}_5\text{:Ce}$ and $\text{Y}_2\text{BO}_3\text{:Ce}$ phosphors. Presumably, the phosphors based on Ce-activated yttrium compounds might find use in IR-to-visible radiation converters. [Merzhyakov, A. T. Excitation spectra of phosphors, based on oxygenated yttrium compounds. IN: VNII lyuminoforov i osobo chistyykh veshchestv. Sbornik nauchnykh trudov, no. 12, 1975, 94-97. (RZhKh 19AB, 4/76, no. 4B202)].

R-f Imaging on a Metal + Semiconductor Structure (verbatim)

Theoretical and experimental studies are reported on the feasibility of using a semiconductor + metal structure, based on Ge, as a means of converting an r-f image to the visible. A Fresnel zone plate is selected for r-f image generation. The recording structure comprises a layer of Ge single crystal and a metal grid, opaque to microwave frequencies. Readout is obtained by means of local electron nonuniformity, induced in the Ge layer by a focused optical beam, which scans the image area by means of an electromechanical raster device. The signal reflected by local nonuniformities is fed to a horn antenna, detected, video-amplified and fed to a high-persistence cathode ray tube. [Artemov, K. S., V. N. Ivanov, N. V. Kotosonov, and I. I. Shchukin. Visualizing microwave images of objects formed by Fresnel zone plate and a photocontrolled semiconductor-metal structure. IN: Sb. Vopr. issled, fiz. svoystv. tverd. tel i obrabotki inform. v diapazone radiochastot. Yaroslavl, 1975, 113-119 (RZh Radiot, 5/76, no. 5 Ye303)].

High Power E-Beam-Target study (abstract)

An experimental clarification of the laws governing interaction of 35 to 70 keV electron beams with Al, Cu and Au thin films was undertaken.

Results are reported of simultaneous measurements of the transmission, reflection and absorption coefficients of electrons, applying 10 to 300 μ sec pulses with 10 to 500 Hz repetition rates and up to 3a/cm² current densities. The experimental coefficients were found independent of the beam frequency, but varied with thickness x of a given metallic film. The x -dependence of the coefficients is illustrated by families of curves for gold films at varying initial beam energy.

It is concluded that interaction of high-power electron beams obeys the same law over the 10 to 70 kev range of initial energies, and at current densities to 3a/cm². The electrons are reflected mainly from the subsurface layer, as shown by the free path distribution curves of absorbed and reflected electrons. The mean free path x -dependence on initial energy E_0 can be approximated by exponential laws, in which the value of the exponent k is somewhat higher for $E_0=35$ to 75 kev than for $E_0=10-35$ kev. [Vyatskin, A. Ya., A. N. Kabanov, B. N. Smirnov and V. V. Trunev. Study on the laws governing the interaction of high-power electron beams to 70 kev energy with solid thin films. RiE, no. 4, 1976, 895-898].

E-Beam Interaction With Liquid Metals (abstract)

A theoretical and experimental study is summarized of the processes on a liquid metal surface interacting with a high-power electron beam focused on the surface. The theoretical evaluation shows that in the process of metal vaporization, an electron beam with a high kinetic energy and a low electron momentum converts into an atomic beam with a low kinetic energy and a high momentum. This high recoil momentum of vaporized atoms produces a crater on the liquid surface, and periodic shifting of the crater position or periodic changes in its depth generate surface capillary waves.

Capillary waves were thus generated on the surface of liquid copper by a focused 1cm diam. electron beam in a 10^{-5} torr vacuum. Strobe photography was used to obtain images of the standing waves whose frequency was calculated to be 50 Hz. It is concluded tentatively that capillary waves are caused by modulation of emission current from the electron gun as well as by pulsations of accelerating voltage and currents in the magnetic system of the gun. Analogous waves were also observed from vaporization of other metals (Al, Sn, Ni, etc.) Circulation currents observed on the molten surface contribute to intensification of vaporization by removing refractory film from the surface. [Borisenko, V. V., Yu. D. Klebanov and V. I. Sumarokov. Electron beam generation of capillary waves on a liquid metal surface. ZhTF P, v. 2, no. 8, 1976, 371-375].

E-Beam Destruction of Glass (abstract)

A brief statistical analysis is given of the destruction threshold of glass targets exposed to a pulsed electron beam in vacuum. The source used was a linac generating electron pulses at energies up to 0.3 Mev and duration of 17 nsec, striking glass targets ranging from 140-160 μ thickness. While the incident beam density was gradually increased the target area was observed for evidence of breakdown.

Statistical results are presented from tests of 80 targets, showing a mean threshold density of approximately 10^{14} electrons/cm², and a normal distribution of the density curve. In addition the authors suggest that the destruction may generate from within the target volume, rather than at the surface as usually assumed. In support of this they note that a preliminary degrading of the surface quality (not specified) had no significant effect on the damage threshold of the specimen. [Vaysburd, D. I., G. I. Gering, and V. N. Kondrashov. Brittle failure of glass from irradiation by high density pulsed e-beams. ZhTF, no. 5, 1976, 1071-1072].

Explosive Emission Studies (abstract)

The study of explosive field emission from metallic needle cathodes has occupied several Soviet research teams for a number of years, and recent publications indicate that interest in this technique is still substantial. Laboratories active in explosive emission include those at Moscow State University and the Institute for Atmospheric Optics at the Academy's Siberian Branch in Tomsk. In generalized form the method uses a diode configuration with one or more needle-shaped cathodes, separated a few centimeters from a planar anode. Application of a fast-rise voltage pulse across the diode, on the order of tens of kilovolts, generates kiloampere currents typically on the order of nanoseconds duration.

Two studies on explosive emission phenomena give an indication of recent efforts by the group under Mesyats and Bugayev at Tomsk. One of these addresses the problem of increasing the current pulse duration without unduly degrading the explosive nature of the emission. This is accomplished by applying a two-step voltage to the diode, with an initially high (30 kv) for about 100 nanoseconds, then stepping down to a few kilovolts for the balance of the current pulse. In this way pulses have been stretched to 10^{-4} seconds using copper needle cathodes; similar results are indicated for mercury capillary and lanthanum boride cathodes. The current levels reported here are in the range of tens of amperes, relatively low for this process.

A second recent study by Mesyats et al. reports fresh data on the micro-relief of the needle undergoing explosive emission, in tests using a scanning electron microscope to observe formation of "microneedle" emission areas on the cathode surface. Among other findings this test establishes criteria for maximum regeneration of microneedle regions, in order to obtain maximum useful life of a cathode. It was determined in this case that a copper needle exposed to pulses on the order of a few nanoseconds can sustain some 10^5 shots before effectively wearing out. [Bazhenov, G. P., S. P. Bugayev, G. A. Mesyats, and S. M. Chesnokov. Using explosive emission to generate current pulses of 10^{-4} second or more. ZhTFP, no. 10, 1976, 462-465].

Electron-Induced IR Photoconduction in Crystals (abstract)

A new effect from electron bombardment of ZnSe single crystals is reported. Conversion of IR quenching to IR stimulation of photoconductivity has been observed in ZnSe:Mg single crystals after

irradiation with 86 Mev electrons at 10^9 to 10^{17} e/cm² doses. Common IR quenching of photoconductivity, observed in all irradiated specimens at a 20^3 v/cm applied field, was converted into IR-stimulated conductivity at a 10^3 v/cm applied field and a lowered excitation intensity. The spectra of IR quenching and stimulation of photocurrent illustrate the observed phenomena. The authors surmise that quenching-to-stimulation conversion is due to an increase in the height of potential barriers concurrently with a decrease in carrier recombination rate and an increase in hole lifetime. The existence of potential barriers and the IR stimulated hole photoconductivity was confirmed by the experiments with electron-irradiated crystals. [Gavrikova, I. G., V. P. Migal', T. S. Mikhaylovskaya and A. L. Rvachev. Conversion of IR quenching to IR stimulation of photoconductivity. IVUZ Fiz, no. 4, 1976, 148-149].

Patent on Laser Heating of Crystals (verbatim)

A crystal heating device is introduced in which the specimen is mounted on the goniometer head of a precision X-ray camera, and heated by a CO₂ laser. A uniform and controlled heating to 3300° is achieved, using a special focusing device. Photographic recording of X-ray diffraction lines on separate segments of the X-ray film is provided for obtaining a series of reflections at different temperatures on a single film. An optical fiber micro-pyrometer records temperature. One or two lasers may be used to heat the specimen. [Hanic, F. and J. Straselsky. A method and apparatus for heating poly- or single crystalline specimens to 3300° for high-temperature phase and structural analysis. Czechoslovak Patent No. 149538, published 15 July 1973. (RZh Metal 15I, 1/76, #11867P)].

Predicting Plasma Stabilization in a Tokamak (abstract)

Experiments with dynamic stabilization of a plasma column by r.f. modulation of the discharge current are reported in a large-scale TT-3 Tokamak unit. The object was to determine the relation of modulation level to longitudinal magnetic field strength, for which a level of stability could be predicted in the plasma torus. Tests were done under the following conditions: Maximum discharge current = 50 ka at 1 millisecond pulses, r-f current = 20 ka, 0.5 millisecond pulses at a 6×10^5 Hz frequency; overall torus diameter = 40 cm; plasma filament diameter = 10 cm; axial field strength was up to 3 koe; working medium was hydrogen at 10^{-3} torr.

Results are shown graphically and agree with previously calculated values. The tests show that the modulating frequency must be chosen to allow for the destabilizing effect of radial oscillations. The results suggest that the technique should be able to be scaled up to systems of a thermonuclear scale. [Royfe, I. M., M. A. Vasilevskiy, V. A. Kubasov, B. V. Lyublin and Ye. V. Seredenko. Experiments with dynamic stabilization of a plasma column in the TT-3 Tokamak. ZhTFP, v. 2, no. 7, 1976, 309-311].

MHD Model of Nonlinear Wave Propagation (abstract)

A theory of MHD simulation of nonlinear wave propagation in various dispersive media is described, and a sample hydraulic model of nonlinear wave propagation in an electrolyte solution is discussed. The authors show that application of MHD effects to aqueous electrolytes makes control of the initial turbulence and the characteristic parameter of wave propagation more accurate than in the case of application of mechanical devices. Characteristic wave profiles were observed in experiments with waves generated by exponential or symmetrical electric pulses. The experimentally observed evolution of capillary gravitational waves of finite amplitude is in a good agreement with the theoretical concept for a weakly dispersive media. [Gak, M. Z. and N. F. Bondarenko. Application of MHD effect in electrolytes for simulation of nonlinear wave processes. ZhTF, no. 3, 1976, 634-637].

Improved Unipolar Generator (abstract)

Various designs of unipolar generators have appeared in recent times as a means of generating high currents for pulsed magnetic fields. Researchers at the Academy's Ural Scientific Center in Perm now propose a design in which the magnetic load is built integrally with the generator, thus avoiding the coupling problems usually found in this type of generator.

The proposed design uses a tapered steel disk rotor with a copper rim, and concentric with an external copper torus which is separated from the disk by a small gap. With the disk rotating at speed, liquid metal is applied to its outer portion, spinning off from centrifugal force to shorten the gap and delivering the generated current pulse to the copper torus.

The authors provide basic design equations for optimizing switching conditions and maximizing the generated field. They list calculated specifications for a system designed to generate 60 tesla pulses of nominal 0.12 sec duration, using a 13 m diameter, 265 kg steel disk rotating at 6000 rpm. A dense liquid metal, such as a lead alloy, as well as dense disk material, is required for optimum performance. [Kirko, I. M., and G. Ye. Kirko. Inertial accumulator with liquid metal contact as a source for energizing strong magnetic fields. DAN, v. 227, no. 4, 1976, 833-835].

Strengthening Laser Glass (abstract)

A common problem in high power laser usage is the breakdown limit posed by the optical glass used, whether it's the active lasing element or the associated optics. In view of the fact that long term use of a high power laser array depends on this factor, it is understandable that a great deal of effort is under way in seeking ways to increase the optical strength of laser glass elements.

A Soviet team has been publishing research papers on this problem for several years. This group (Aleshin, Alexandrova, Bonch-Bruyevich and others) has recently published another study on optical "hardening" of glass, which is further indication of their progress level in the field.

Experience shows that the entrance (or exit) face of an element passing the laser beam is the typical weak spot, evidently because in forming these surfaces, even with refined polishing techniques, there still remains a residue of discontinuities, inclusions and the like which become the focal point of laser breakdown. The problem reduces to seeking increasingly sophisticated methods of surface treatment so that the breakdown threshold can be raised to a useful limit.

Among the methods studied by the Russian team, in addition to deep grinding and polishing, have been chemical etching, ion polishing, and most recently a chemical processing of the glass face to add a surface film. In the latest reported tests the film was of porous silicon dioxide with a sulfur hexafluoride filler to provide maximum surface smoothness. Specimens of barium silicate and aluminum borosilicate glasses thus treated were exposed to varying numbers of shots from an Nd glass laser, focused at random points over the specimen faces. The pulse energy level was held within a range of 90-95% of breakdown threshold, the criterion for breakdown being evidence of plasma generation at the target face.

The results are given as probability functions, rather than in absolute terms. Thus in barium silicate glass the probability of breakdown in 4000 shots, using laser energies at 95% of threshold, drops to a value of 0.69 in coated specimens, as opposed to an 0.9 breakdown probability for uncoated mechanically polished specimens. The $\text{SiO}_2 + \text{SF}_6$ coating method is hence credited with raising both absolute breakdown threshold as well as substantially increasing the life expectancy of the laser-exposed glass. [Yeroniko, S. B., G. T. Petrovskiy, A. V. Shatilov, A. K. Yakhkind, and L. V. Aleksandrova. Strengthening of glass surfaces under repeated optical loading. OMP, no. 1, 1976, 35-38].

Monograph on Chemical Lasers (abstract)

A new summary on theory and practice of chemical lasers has been issued by four Soviet authors active in the field: Bashkin, Igoshin, Nikitin and Orayevskiy. The work is presented as an overview of chemical laser progress through 1973, covering mostly Soviet and U. S. publications.

The book is written in four main sections, each well documented. The breakdown is as follows:

1. Basic Theory of Chemical Lasers
 - 1.1 Simplified analysis of the function of chemical lasers.
 - 1.2 Nonequilibrium excitation in chemical reactions.
 - 1.3 Population inversion and radiation amplification in rotational-vibrational transitions.
 - 1.4 Elementary processes in vibrational relaxation.

- 1.5 Basic equations
- 1.6 Vibrational kinetics.
- 1.7 Analysis of lasing mode in a multilevel chemical laser.
- 1.8 Kinetics of chemical lasers based on hydrogen + halide mixtures.
2. Pulsed Chemical Lasers
 - 2.1 Basic operating principles of pulsed chemical lasers.
 - 2.2 Pulsed lasers based on HCl and HBr.
 - 2.3 Pulsed lasers based on H and F mixtures.
 - 2.4 Chain reaction pulsed lasers.
 - 2.5 Pulsed lasers with energy transfer from products of multiatomic molecular reactions.
 - 2.6 Using chemical lasers to study details in the kinetics of chemical reactions.
 - 2.7 Pulsed lasers based on molecular CO₂.
3. C-w Chemical Lasers
 - 3.1 The purely chemical (DF-CO₂) laser.
 - 3.2 C-w lasers with thermally triggered reactions.
 - 3.3 Other types of c-w chemical lasers.
4. Photorecombination Lasers
 - 4.1 Problems in developing photorecombination lasers.
 - 4.2 Physical description of photorecombination processes.
 - 4.3 Kinetics of photorecombination reactions.
 - 4.4 Gain in the active medium of photorecombination lasers.
 - 4.5 Emission dynamics of photorecombination lasers.

While somewhat out of date, this book appears to be a useful review of the experience of some leading Soviet chemical laser proponents, together with their views on future promise of chemical lasers. For reasons not specified, photodissociative lasers have been omitted from this work, while a substantial treatment is given to the so-far theoretical photorecombination laser, for which the authors see great promise. The section on photorecombination is essentially a re-run of the review article by Bashkin and Orayevskiy on the subject, appearing in the January 1973 issue of Kvantovaya elektronika. [Bashkin, A. S., V. I. Igoshin, A. I. Nikitin, and A. N. Orayevskiy. Khimicheskiye lazery (Chemical lasers). Itogi nauki i tekhniki. Radiotekhniki, no. 8. Moskva, VINITI, 1975, 384p.].

Atomic Reactor-Laser (verbatim)

The feasibility is investigated of stable operation of an atomic reactor-laser based on $\text{UF}_6 + \text{TlF} + \text{F}_2$ gas. It is shown that the demands for a sufficiently high reactor energy density, to get high population of the upper level, and for a limited temperature of the active medium in order to achieve population inversion, are not contradictory requirements. [Gudzenko, L. I., and S. I. Yakovlenko. On an atomic reactor-laser using a $\text{UF}_6 + \text{TlF} + \text{F}_2$ mixture. KSpF, no. 12, 1975, 13-16 (RZhRadiot, 5/76, no. 5Ye284)].

Gamma Laser Theory (abstract)

A number of theoretical papers on possible mechanisms for developing a gamma laser have been published by Soviet physicists in recent times. One technique which is being touted is based on use of narrow Mossbauer lines in a three-level scheme of nuclear excitation, starting with pumping of a long-lived isomer. A theoretical model for achieving this so-called Mossbauer laser was advanced by Baklanov and Chebotayev last year at the Institute for Semiconductors in Novosibirsk. Their idea basically is that pumping to an initial long-lived level is accompanied by Raman scattering which excites a second but short-lived transition, from which gamma lasing occurs.

In the March 1976 issue of Kvantovaya elektronika Baklanov enlarged on this scheme and proposed some concrete parameters for such a gamma laser. This postulates an isomer gas pumped by x-radiation at 10^{-7} cm wavelength, and lasing at 10^{-9} cm. Figures are given showing an increase in pump efficiency by the order of 10^{15} over that of the two-level scheme suggested earlier. Transverse x-ray laser pumping of a one-centimeter long host volume is assumed, with a gas flow rate of 10^5 cm/sec, yielding a gamma laser beam-width of 10^{-5} cm, normal to pump and gas

flow directions. In this case the x-ray pumping laser would require a power density of 10^9 watts/cm². Summarizing his requirements, Baklanov lists development of an x-ray laser as one of them, but rather casually passes over this as "a problem of quantum electronics which is now being solved", without any further explanations. Candidates among possible long-lived isomers are given as Pt¹⁹⁹, Ta¹⁸², Cs¹³⁴, and Te¹²⁵, with lifetimes ranging from seconds up to days.

The following issue of Kvantovaya elektronika carries a review of factors governing x- and gamma laser action by Chapline and Wood of Livermore, in which they express doubts on the feasibility of the Mossbauer laser; an earlier paper by these authors was skeptical of a proposed nuclear-pumped Mossbauer variant, and proposed a non-Mossbauer gamma laser with fast neutron pumping. Gol'danskiy and Namiot, responding to this, in return criticize Chapline's non-Mossbauer model as unrealistic, and also suggest that Chapline's skepticism on the Mossbauer type is not justified.

The net impression seems to be that the Russian researchers most prominent in gamma laser studies are putting their money on the Mossbauer type described above, even though no concrete results along this line are in sight. [Baklanov, Ye. V., and V. P. Cheboteyev. On the possibility of developing a gamma laser. KE, no. 3, 1976, 634-636. Gol'danskiy, V.I., and V. A. Namiot. A note on the non-Mossbauer gamma laser. KE, no. 4, 1976, 835-837].

Wind Deflection of a Laser Beam (verbatim)

Regular stationary wind deflection of a laser beam is analyzed, for the case of c-w propagation through an illuminated region formed by water droplets. Based on an approximation for the radiation field, expressions are obtained for the angular and lateral deflection of the beam in the illuminated area. Deflection characteristics are analyzed as functions of the dispersive medium, parameters of the illumination process, and of lateral wind velocity. A qualitative difference is noted between these deflection characteristics and those for analogous configurations using gas or liquid media. [Nerushev, A. F. Wind deflection of a laser beam in an illuminated region. IN: Tr. In-t eksperiment. meteorol. Gl. upr. gidrometeorol. sluzhby pri Sov. Min, SSSR, no. 11, 1975, 41-49 (RZhGeofiz, 3/76, no. 3B166)].

New Organic Superconductors (abstract)

Preparation and properties are described of metal polymers which become superconductors at a higher critical temperature T_c and a higher critical magnetic field than their corresponding metals. The metal polymers were prepared by electrolysis of aqueous solutions of Pb and Bi salts in a two-layer cell with a toluene solution of poly (diphenyl butadiene) (PDBB) in the upper layer. The material thus obtained contained highly dispersed (0.5 to 5 μ) Pb-Bi alloy particles joined together by thin films of a π -conjugated cyclic polymer. The IR spectra show Me-O-C and Me-C bonds formed by polymer interaction with the metal particle surface.

Typical superconducting transition curves of the prepared materials with 21 to 23% PDPB indicate $T_c = 7.4$ to 8.1°K , or significantly higher than T_c of the corresponding alloys. Also, the fact that a material with up to $100\text{ohm} \times \text{cm}$ resistivity at 293°K becomes superconducting is significant. The upper critical field vs. temperature variation is linear, with a 4 to 11 kOe/deg. slope. Dispersed metal-conjugated polymer systems thus appear to be interesting new subjects for superconductivity study. [Berlin, A. A., Yu. I. Khimchenko, V. M. Pan, T. I. Gil, and A. G. Popov. Superconducting metal polymers. DAN SSSR, v. 227, no. 4, 1976].

Monograph on Superconductivity (verbatim)

Issue no. 86 of the Lebedev Institute's Trudy reviews theoretical and experimental studies on superconductivity. Theoretical works analyze the relation between both electron and structural transitions and superconductivity; nonequilibrium superconductivity; and the effect of crystal defects on thermodynamic properties of superconductors. The status of high-temperature superconductivity is reviewed, including prospects for improving the critical parameters of existing systems.

The experimental coverage includes results of tunneling studies with Nb_3Sn ; electron and phonon characteristics are obtained and possibilities are discussed of various critical superconductive parameters with use of an A-15 lattice. [Nekotoryye voprosy sverkhprovodimosti (Problems of superconductivity). Tr. Fiz. in-ta AN SSSR, no. 86. Moskva, Nauka, 1975, 162p. (RZhRadiot, 5/76, no. 5Ye383K)].

Superconducting Cable (verbatim)

A patent disclosure has been issued for a superconducting cable comprising a superconducting wire, insulating layer of porous material, a channel for refrigerant circulation, an overall hermetic seal, and thermal insulation. To improve cooling and conductive performance, the conductor is made of porous material, such as braided wire, and the cooling channel is made of perforated metal tubing coaxial with the conductor and with an annular gap. [Vasil'yev, L. L., V. A. Margun, I. S. Desyukovich, and V. V. Senin. Superconducting cable. Author's Certificate, USSR, no. 439 874, issued 4 October 1975. (RZh Radiotekh, 5/76, no. 5Ye 406P)].

Fireproof Coating (verbatim)

A fireproof, heat-insulating protective coating is introduced for metallic, wood and other structures, e. g., buildings, ships and aircraft. The new coating is more adhesive to materials and less heat conductive than the known coatings (cementing, plaster, insulating board or fireproof cover). The coating contains 60 to 90% inorganic mineral fibers, 4 to 14 % powder-like water-soluble binder and 0.5 to 3% poly (vinyl acetate). The coating is sprayed by two mixing nozzles (for thinned fibers and suspension

of poly (vinyl acetate) and binder, and allowed to harden and dry. [Vlk, V. and P. Tesarik. Fireproof insulation material. Czechoslovak Patent No. 149952 (RZhKh 19 M, 4/76, no. 4M82 P)].

Refining a Doppler Sonar System (abstract)

A brief analysis of the operation of a Doppler sonar suggests a method for improved signal reception. The model assumes a rectangular transmitted pulse with monochromatic carrier frequency, and a similar Doppler shifted received pulse applied to ideal narrowband comb filters. Noise at the filter inputs is assumed to be random, stationary and to be a combination of reverberation plus white acoustic noise.

Graphical solutions are given for sonar performance in terms of noise rejection, both for moving and stationary targets. Results show that for small Doppler shifts, the detected echo signal will vary inversely as the bandpass of the filters, while at large Doppler shifts the signal is effectively independent of either Doppler frequency or filter bandpass. In any case the signal will vary directly as the ratio of reverberation to noise varies.

The author concludes that for conditions of the assumed model the filter bandpasses could be made a function of the Doppler frequency, rather than kept at fixed identical values as in the usual comb filter. This would enhance reception at small Doppler frequencies without sacrificing overall noise rejection of the system. [Kondrashov, V. I. A feature of Doppler sonar systems. IVUZ Radioelektr, no. 4, 1976, 97-99].

Light Polarization vs. Scattering in Sea Water (abstract)

The degree of monochromatic light beam polarization as a function of attenuation index γ is defined here as the ratio of the attenuation index of extreme scattering to the Bouguer index. The experimental assembly of the underwater photometer/polarimeter used is described in detail.

Results of P and γ measurements are plotted for various simulated conditions beyond a reference depth. They show a general increase in γ with increased P , varying from a linear to a square law relationship depending on scattering angle. This type of study on polarization characteristics of a radiation field beyond a threshold depth is concluded to be an efficient method of determining structure and property of light-scattering laboratory models and natural water basins. [Guminetskiy, S. G. and Ya. P. Marchuk. Study of radiation polarization in a scattering medium beyond a threshold depth. FaiO, no. 3, 1976, 332-336].

Magnetic Field Induced by Sea Waves (verbatim)

New experimental data is reported showing that a cause for variation in the ocean magnetic field, in the period range of 30-50 seconds,

is long-period sea waves analogous to surf beats. [Bychkov, V. S., A. E. Leybo, and V. Yu. Semonov. Magnetic field induced by long sea waves. In: Sb. Analiz prostranstvenno-vremenn. struktury geomagnit. polya. Moskva, Nauka, 1975, 178-182 (RZhGeofiz, 5/76, no. 5A376)].

Shipboard Laser Study of Sea Waves (verbatim)

Shipboard tests were made during the fourth voyage of the R/V Mendeleyev to determine optical absorption index and relative change in scattering index from sea surface waves. Shape and amplitude of surface-reflected optical pulses were recorded using a Q-switched YAG:Nd laser in a special ship installation. Laser frequency was doubled in an LiNbO_3 crystal to yield a 530nm wavelength and 7 nanosecond pulses, with an initial divergence of 7°. Receiver aperture angle was 20°, and the input lens was 44 mm in diameter. The receiver was a wideband fast-response system based on an FEU-59 photomultiplier. Overall receiver bandwidth was 100 MHz or above. Experiments in the Indian Ocean have shown the feasibility of using this system for large-scale collection of optical data. [Gol'din, Yu. A., V. V. Bacherikov, V. I. Voytov, M. I. Vortman, V. E. Kagayn, Yu. A. Makarov, V. N. Pelevin, and Ye. M. Shvom. Results of shipboard laser probing of surface waves. In: Sb. Gidrofiz. i optich. issled. v Indiyisk. okeane. Moskva, Nauka, 1975, 160-163. (RZh Geofiz, 5/76, no. 5V17)].

Indian Ocean Research

An extensive collection of articles covering the 1973 cruise of the R/V Mendeleyev in the Indian Ocean has been published. The primary purpose of the expedition was to study optical characteristics of the ocean and factors affecting them. The papers are grouped in five sections:

- o hydrophysical studies
- o optical properties of Indian Ocean waters
- o optical fields in the Indian Ocean
- o atmospheric optical and radiation studies
- o suspensions in water and the boundary air layer; organic matter; biological studies; relief.

The papers were mostly written by scientists taking part in the voyage. [Gidrofizicheskiye i opticheskiye issledovaniya v Indiyiskom okeane. 10-y reys NIS Dimitriy Mendeleyev. (Hydrophysical and optical studies of the Indian Ocean. Tenth cruise of the R/V Dimitriy Mendeleyev). Moskva, Nauka, 1975.]

Monograph on Turbulent Flow

A new look on turbulent flow has appeared by S. Kutateladze and coworkers at the Institute of Thermophysics in the Academy's Siberian branch. This is an extensive monograph recording experimental results on processes of turbulent exchange under complex gas dynamic and thermal conditions.

Topics covered include transverse flow, gas shielding, non-isothermal conditions, compressibility, longitudinal pressure gradient, chemical reactions, and addition of polymer molecules. Emphasis is on the study of wall turbulence, using stroboscopic, electrochemical, thermal anemometry and other diagnostic techniques. [Kutaleladze, S. S., B. P. Mironov, V. Ye. Nakoryakov, and Ye. M. Khabakhpasheva. Eksperimental'noye issledovaniye pristennykh turbulentnykh techeniy (Experimental studies of wall turbulent flows) Novosibirsk, Izd-vo Nauka, Sib. otd-ye, 1975, 168 p.].

Soviet Conference on Robotics (abstract)

The Sixth All-Union Symposium on the Theory and Design Principles of Robots and Manipulators was held recently in Tol'yatti (USSR). Over 150 papers were read, with most interest expressed in existing systems and applications in technology. In the article, Academician I. Artobolevskiy generalizes on the future of robotics, with emphasis on automation of industrial and dangerous processes. Brief mention is made of the applications to space and undersea research, and of the existence of robotic systems with artificial intellect elements [Cheprasov, A. The robot-an intelligent machine. Izvestiya, 14 May 1976, p. 4, col. 1].

Theory of Ultrasound Self-Focusing (abstract)

The condition for nonstationary self-focusing of a pulsed or a frequency-modulated hyper-or ultrasonic beam propagating in a nonlinear medium is formulated. Only the most practically important case is considered, namely when $1/\lambda\nu \ll \tau$, where l and τ are the characteristic length and time of wave amplitude fluctuations normal to the beam propagation direction, and λ and ν are wavelength and frequency. In the case where pulse duration τ_p is of the same order as the relaxation time τ_r , the equations of nonstationary self-focusing yield the condition $W_0 = W_{cr}$; that is, the beam energy is the critical parameter of self-focusing. W_{cr} is in the range of 5×10^4 to 10^3 joules for various metals. It is shown that under the condition of nonstationary self-focusing, several focuses exist, which shift their position during the applied pulse period. The coordinates of focal point positions are determined as functions of t for a rectangular pulse [Sardaryan, V. A. and A. V. Shekoyan. Nonstationary self-focusing of ultrasound in a nonlinear medium. Akust. zhurnal, no. 2, 1976, 313-315].

Semisubmerged Drilling Platform for Caspian Sea Planned (abstract)

Gipromorneft' Institute and other Soviet oil interests have designed a twin-hull semisubmerged drilling platform capable of drilling a 6-km deep well in 200 meters of water. Three 25-m high towers will support a 4200 square meter main platform. An 8-point moor will hold the rig in place after towing to the drill site. This system will apparently be backed up by a computer-assisted dynamic positioning system used during drilling and bad weather. Following preliminary operations, the drill rig will descend about 20 meters prior to installation of the steel well casing. TV will monitor

the underwater operations, and a diving station capable of supporting 200-meter dives is planned. Justification for the project is the existence of 150 identified prospective oil and mineral formations in water too deep for present technology. The rig will be built in Astrakhan' during the present Five-Year Plan. [_____]. Beneath the keel-200 meters. Vyshka, 8 May 1976, p. 4, cols. 2-6].

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Bokin, M. N. Novyye armirovannyye polimernyye materialy dlya mashinostroyeniya. (New reinforced polymer materials for machine construction). Leningrad, LDNTP, 1975, 21 p. (KL, 13/17, no. 10818).

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Kompozitsionnyye polimernyye materialy (Composite polymer materials). Seminar lectures. An UkrSSR, In-t khimii vysokomolek. soyedineniy. Kiyev, Naukova dumka, 1975, 190 p. (KL, 4/76, no. 2969).

Kutaleladze, S. S., B. P. Mironov, V. Ye. Naboryabkov, and Ye. M. Khabakhpashova. Eksperimental'noye issledovaniye pristennykh turbulentnykh techeniy (Experimental studies of wall turbulent flows). Novosibirsk, Izd-vo Nauka, Sib. otd-ye, 1975, 168 p.

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SOURCE ABBREVIATIONS

DAN	-	Akademiya nauk SSSR. Doklady
FAiO	-	Akademiya nauk SSSR. Izvestiya. Fizika atmosfery i okeana
IVUZ Fiz	-	Izvestiya vysshikh uchebnykh zavedeniy. Fizika
IVUZ Radioelektr	-	Izvestiya vysshikh uchebnykh zavedeniy. Radioelektronika
KE	-	Kvantovaya elektronika
KL	-	Knizhnaya letopis'
KSpF	-	Kratkiye soobshcheniya po fizike
OMP	-	Optiko-mekhanicheskaya promyshlennost'
RiE	-	Radiotekhnika i elektronika
RZhF	-	Referativnyy zhurnal. Fizika
RZhGeofiz	-	Referativnyy zhurnal. Geofizika
RZhKh	-	Referativnyy zhurnal. Khimiya
RZhMetal	-	Referativnyy zhurnal. Metallurgiya
RZhRadiot	-	Referativnyy zhurnal. Radiotekhnika
ZhTF	-	Zhurnal tekhnicheskoy fiziki
ZhTF P	-	Pis'ma v Zhurnal tekhnicheskoy fiziki.