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13. ABSTRACT

This report includes abstracts and bibliographic lists on major contractual subjects that were completed in June, 1972. The major topics are: laser technology, effects of strong explosions, geosciences, and particle beams. A section on material science has been included as the optional fifth topic, as well as a section on items of miscellaneous interest.

To avoid duplication in reporting, only laser entries concerning high-power effects have been included, since all current laser material will appear routinely in the quarterly bibliographies.

An index identifying source abbreviations and an author index to the abstracts are appended.

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INTRODUCTION

This report includes abstracts and bibliographic lists on major contractual subjects that were completed in June, 1972. The major topics are: laser technology, effects of strong explosions, geosciences, and particle beams. A section on material science has been included as the optional fifth topic, as well as a section on items of miscellaneous interest.

To avoid duplication in reporting, only laser entries concerning high-power effects have been included, since all current laser material will appear routinely in the quarterly bibliographies.

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TABLE OF CONTENTS

1. Laser Technology

A. Abstracts

Bozhkov, A. I., and F. V. Bunkin. Optical excitation of surface waves in transparent condensed media. ZhETF, v. 61, no. 6, 1971, 2279-2286.

The excitation of surface waves in condensed media by two mutually interfering plane monochromatic waves is discussed. Optical excitation of surface waves in such a case proceeds by a striction mechanism which involves a ponderomotive force jump from the normal to the surface component. The mechanism is not related to radiation absorption and hence is primarily applicable to transparent media. The proposed method of surface wave excitation is examined for two coherent monochromatic waves incident on a liquid surface. Mathematical treatment of an equation of motion of the liquid-atmosphere interface, with allowance for ponderomotive forces, produced general formulas of the velocity component V_z and the function $\zeta(x, y, t)$ describing surface deviation from the $z = 0$ plane. These formulas led to the conclusion that two plane electromagnetic waves stimulate vibrations of the liquid surface with amplitude $|\zeta_o|$, a wave vector $q = k_{t1} - k_{t2}$, and a beat frequency $\Omega = \omega_1 - \omega_2$. In these expressions, k_{t1} and k_{t2} are the wave vector projections on the liquid surface, and ω_1, ω_2 are the frequencies of the two optical beams. A formula was derived for $|\zeta_o|^2$ as a function of q, Ω, which is applicable also to a total Fresnel reflection, when the liquid occupies a space $z > \zeta(x, y, t)$. Analysis of frequency characteristic $|\Delta|^{-2}$ variations as a function of Ω in the regions of low and high Ω revealed that $|\Delta|^{-2}$ for viscous liquids decreases continuously with increases in Ω, and the $|\Delta|^{-2}$ characteristic for low viscosity liquids is a resonance frequency in the region of high Ω. For $\Omega = 0$, the $|\zeta_o|$ of the static surface wave is independent of viscosity γ and in the cases of $\Omega = \Omega_o(q)$ and $\geq \Omega_o^2 / \nu_q^2$ the surface wave travels with $|\zeta_o|$ dependent on ν, surface tension and α, dielectric constant of the liquid, and independent of ν and α, respectively. Conditions are given for the application of the $|\zeta_o|$ formulas to a laser excitation source. Examples of numerical evaluations of the optical beam intensities required to stimulate surface waves in a high or a low viscosity liquid show that striction can stimulate these waves with an amplitude much higher than thermal excitation, and in certain cases may determine the radiation resistance of transparent laser materials.

Askar'yan, G. A., E. Ya. Gol'ts, and T. G. Rakhmanina. Alteration of the propagation and reflection of ultrasound under the effect of an intense light on the surface of a body in liquid. ZhETF, v. 62, no. 3, 1972, 1072-1074.

A new effect was investigated experimentally in which the propagation of sound is changed due to intense light acting on the medium. A flash of an unfocused and unmodulated neodymium laser beam sharply reduced the reflection and transmission of ultrasound through the surface of a steel plate immersed in water. Strong change is found when the surface temperature T is high enough to form vapor or gas. An expression was derived for determining this temperature. In the experimental arrangement (Fig. 1), a laser beam

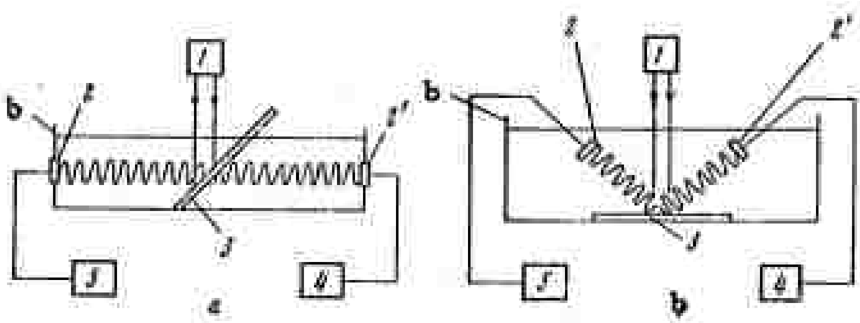


Fig. 1. Experimental sketch for investigating alterations of (a) propagation and (b) reflection of sound due to an unfocused laser beam on the surface.

from 1 falls on the surface of a steel plate 3, immersed in water in vessel 6. An ultrasonic transmitter 2, a piezoelectric element of 1 cm radius, transmits a directional ultrasonic wave at a frequency of 2 MHz from generator 5, in such a way that the sound wave passes through the surface region, illuminated by the laser pulse. The piezoelectric receiver 2' records the ultrasound radiation, passing through (Fig. 1a) or reflected by the plate (Fig. 1b). Two series of experiments were conducted: a) using a free-running laser with a maximum energy ~10 joules, pulse duration ≈0.5 msec, and beam radius 1 cm; and b) using an unfocused, Q-switched laser with a pulse width of 30-40 nsec. Seven oscillographs obtained during the experiments are given to show the effects of light on the reflection of sound. The build-up time of the interaction effect, connected with the formation of vapor-gas bubbles or of a non-uniform film, was commensurate with the energy release time.

Duration of interaction increases with an increase of flux density and at a light flux density of ~10kw/cm^2 lasts for ~200 msec, which significantly exceeds the laser pulse duration (~1 msec). At high laser powers with Q- switching a rapid film formation was observed, which eliminated propagation and changed the sound reflection. Possible applications include: the interruption and elimination of reflection and propagation of sound, and ultrarapid modulation of sound, when short laser pulses are used.

Zakharov, V. P., V. N. Chugayev, V. I. Zaliva, and Yu. G. Poltavtsev. Study of the graphitization process of thin carbon films from the effect of powerful light pulses. UFZh, no. 2, 1972, 279-283.

An experiment in optical graphitization of a carbon film is described, which complements the work of Zakharov reported previously (March 1972 monthly report, p. 9 and April report, p. 130). Instead of a laser a type IFP flashlamp was chosen in the present case, having a spectral peak at 0.4 micron, and used to irradiate a 10^{-5} cm pure carbon film at various distances and flash intensities. The bulk of the experiment was devoted to recording change in optical transmission of the film, giving an index of the induced graphitization process. A typical result is shown in Fig. 1.

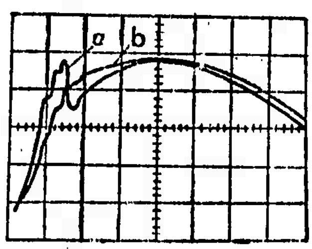


Fig. 1. Change in transmitted flux of irradiated carbon film.
a- after first pulse;
b- after second pulse
major division = 10^{-4}sec.

For this case a film area of 1 cm^2 was determined to be raised to the order of 1000°C per pulse. Curve (a) in the figure shows the inflection interval where graphitization occurs; the reduced response of curve (b) then held true for subsequent pulses. In this case graphitization occurred in about 10^{-5} sec.; correspondingly increased times were required for reduced film treating rates. The authors suggest a two-step process occurring, beginning with a rapid formation of crystallites, and followed by a more extended period of crystallite reorientation and grouping into the graphite structure. Additional tests on r-f transmissibility of the exposed film confirmed the assumed process.

Mirkin, L. I. Dynamic deformation of low-carbon steel from the effect of a laser beam. IN: Sbornik. Vysokoskorostnaya deformatsiya. Moskva, Izd-vo Nauka, 1971, 109-112. (RZhMekh, 3/72, #3V1469)

Structural effects are studied in low-carbon steel exposed in vacuums to focused laser pulses in the 1 millisecond range, at energies up to 35 j. The amount and distribution of resultant twinning was measured. A physical model of the beam action is postulated to explain the simultaneous presence of a thermal and mechanical interaction zone.

Gurevich, V. I. Pulse forms of a periodic point source of heat on the surface of a large body. FiKhOM, no. 2, 1972, 19-22.

A study on the effect of pulse shape on laser interaction with metals was mentioned by Baranov, Gurevich, and Heinrichs in a previous report (April Monthly Report, p. 4). In the present paper Gurevich gives a more extended analysis of pulse shape effect. The model assumes a periodic pulse from either a stationary or moving source, and is used to calculate a limiting temperature field in the impact region at the conclusion of the laser pulse; for convenience a dimensionless temperature θ_i is introduced. Analytical expressions for θ_i' (fixed) and θ_i'' (moving source) are then obtained in terms of beam parameters and the Fourier (Fo) and Peclet (Pe) criteria. A comparison of pulse shape effect on θ_i' is seen in Fig. 1 for the fixed source case, showing the maximum effect of a sawtooth pulse

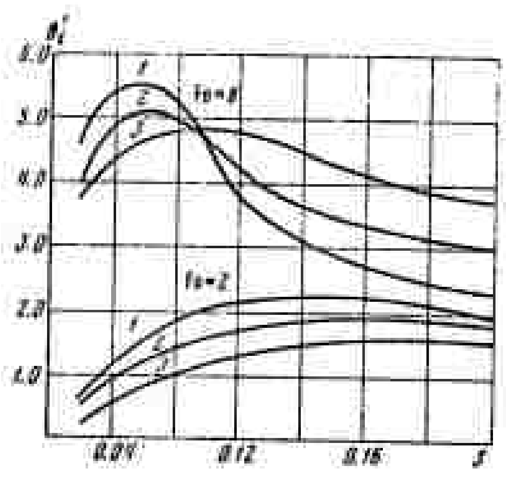


Fig. 1. Temperature θ_i' vs. duty factor S
1- sawtooth pulse, vertical leading edge;
2- rectangular pulse;
3- sawtooth, vertical trailing edge

with vertical leading edge, at the higher Fo levels. It follows that this form would be preferable for fast local heating of a limited surface area, despite the fact that a $\sin^2$ pulse generally gives most efficient energy transfer in a given pulse width. Tabulated results are also included comparing the limit temperatures for a moving beam in terms of the cited pulse shapes, again showing the superiority of the vertical-rise sawtooth.

Kapel'yan, S. N., and A. M. Yudovin. Duration of vaporization after termination of a powerful thermal flux. DAN BSSR, no. 3, 1972, 214-216.

Theoretical expressions are developed which define post-pulse vaporization duration, as well as depth of the vaporization layer, for the case of laser irradiated metals. The work is based on heating concepts reported by Anisimov (Effects of High Power Lasers, Dec. 1971, p. 24) and uses his thermophysical model. This asserts that the thermal field at the conclusion of a rectangular pulse can be given by

$$T(x) = T_0^* \exp(-\beta x) \tag{1}$$

where $1/\beta = a/v_0$ is a characteristic dimension of the heated region, and T_0^* is the temperature at the vaporization front. Following the laser pulse the vaporization front will continue to expand until T^* drops to vaporization threshold. This interval can be found from a transcendental equation expressing vapor kinematics and target thermal parameters; the authors obtained solutions by simple iteration using a Minsk-22 computer. Results for several metals are seen in Fig. 1, showing that at a given laser flux

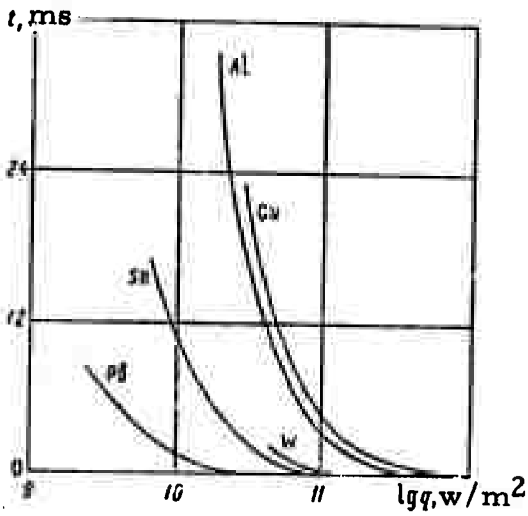


Fig. 1. Post-pulse vaporization duration vs. laser intensity

the longest post-vaporization will occur in Cu and Al, and the shortest in Pb. The sharp decrease in post-pulse vaporization with rise in pulse intensity is shown to be consistent with the thermal storage mechanisms in the impact region.

Pustovalov, V. K. Self-similar gas motion behind a shock wave front sustained by radiation. DAN BSSR, no. 12, 1971, 1079-1081.

The author analyzes a simple model which relates to the optical plasmatron described by Rayzer and others (see for example the February 1972 Monthly Report, p. 11), i.e. a continuous local plasma sustained by a laser beam. The present model assumes a half-space $x > 0$, filled with a cold ideal gas of constant density ρ, where the surface $x = 0$ is the boundary between the gas and vacuum. At time $t = 0$ a strong shock wave begins to propagate from the boundary in to the gas, impelling the gas to expand into the vacuum. Energy from an optical flux q is absorbed by the gas and uniquely determines the propagation of the shock wave; gas expansion is assumed to be adiabatic. Using this model, the author develops self-similar equations in Euler coordinates defining gas pressure, density, velocity in terms of adiabatic index γ and the self-similar index ξ. It is shown that for the sustained shock condition γ must lie between 1 and 1.5. The case of $q < 0$, i.e. energy radiating from the shock wavefront, is also briefly considered.

Korotin, A. V., and L. P. Semenov. Vaporization of crystals under the effect of external excitation. IN: Institut eksperimental'noy meteorologii. Trudy, vyp. 30. Fizika aerodispersnykh sistem. Moskovskoye otdeleniye gidrometeoizdata, Moskva, 1972, 65-71.

The authors present a straightforward thermodynamic analysis of the interaction of a concentrated heat flux with a crystal surface, for the case in which an appreciable melt zone appears prior to evaporation. The analysis assumes a constant-intensity beam normal to a semiinfinite crystal face, and arrives at expressions for melt zone boundaries, growth rate and limit conditions, and time to melt, in terms of target and beam parameters. It is shown that in the general case the maximum temperature will occur at the outer melt surface, and also that an optimum beam intensity exists for which the melt area will be maximum, decreasing at higher or lower intensities. It is interesting to note that the numerical examples given assume an ice target; results on the ice-water parameters are given for beam densities ranging from 25 to 200 w/cm^2. In ice, for example, the depth of the melt zone is only weakly dependent on beam intensity.

Basov, N. G., Yu. S. Ivanov, O. N. Krokhin, Yu. A. Mikhaylov, G. V. Sklizkov, and S. I. Fedotov. Generation of neutrons from spherical irradiation of a target by powerful laser radiation. ZhETF P, v. 15, no. 10, 1972, 589-591.

The authors note some limitations to neutron production from laser heating of a target for fusion purposes. Specifically, the effect of an increasingly powerful focused laser becomes offset by diffusion of the high temperature region owing to thermoconductive and gasdynamic energy loss. An alternative approach suggested recently by Basov et al is to heat a spherical target simultaneously with multiple beams; in the present case this was done with a deuterated polyethylene target exposed to nine equal beams, as indicated in Fig. 1, using an Nd glass laser in the giant pulse

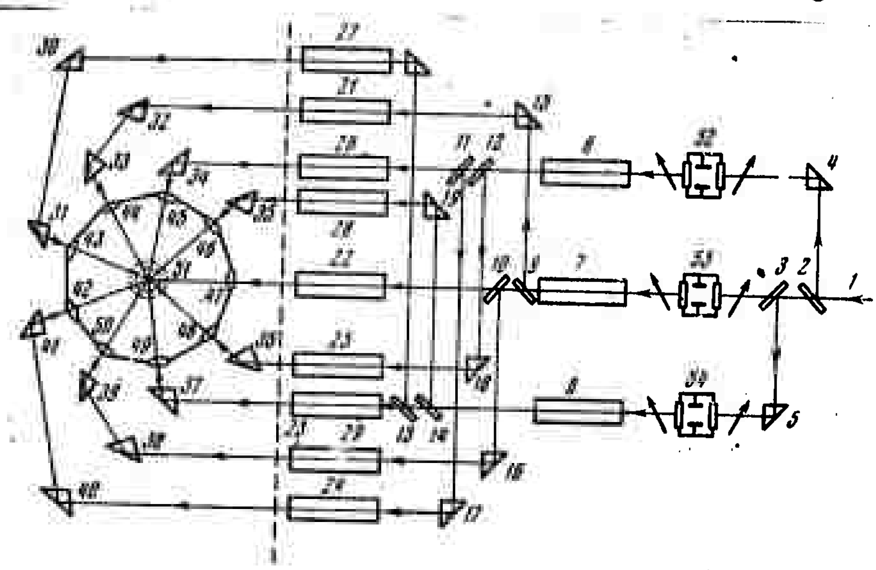


Fig. 1. Multibeam array for CTR target.
1- preamplified beam
6-8- second amplifier
21-29- third amplifier
42-50- focus lenses
Compensating delays for differing path lengths not shown.

mode. This array attained a mean power density of 10^{16} w/cm^2 on the target surface, at 2--16 ns duration. The focusing objectives were placed to obtain a focal plane 200μ from the target, for minimum reflection and uniform heating.

Some results are shown in Table I for various target sizes and beam energies; the measured value was obtained from three scintillation counters. The $n\tau$ values, calculated independently for thermoconductive and gas dynamic regimes, were 2.4×10^{12} and 2×10^{11} respectively. The effect of cumulation in the cited experiments is concluded to be a minor one.

Target radius, cm	Laser energy, j	Mean temp., ev	Neutron output per pulse	
			exp.	calc.
$2{,}50\cdot10^{-2}$	600	40	–	–
$1{,}25\cdot10^{-2}$	202	120	–	10^2
$5{,}50\cdot10^{-3}$	214	840	$3\cdot10^6$	$8\cdot10^7$
$3{,}00\cdot10^{-3}$	232	$4\cdot10^3$	–	$1\cdot10^{10}$

Table I. Neutron generation with multiple laser beam

Novikov, N. P., and A. A. Kholodilov. Destruction of thermoplastics by the combined action of gas and powerful thermal flux. I-FZh, v. 22, no. 4, 1972, 618-626.

This paper is a repeated treatment of an experiment reported by the authors previously (Effects of High Power Lasers, Dec. 1971, 48), in which the destruction characteristics of several polymers are compared under combined laser and hot gas impact. In the present case only PMMA and polystyrene specimens were used; surface heating was provided by a CO_2 laser plus a coaxial high-speed flow of heated nitrogen over the specimen. The gas jet diameter was more than double the specimen diameter so that the process could be treated as one-dimensional and stationary. The resulting liquefaction, cavity formation and ejection rate of material are discussed as functions of beam power density and jet velocity; the conclusions are as stated in the cited earlier work. The main emphasis is on the differences in destruction characteristics which depend on the chemical structure of the target material. Thus polystyrene shows a monotonic rise in destruction rate with beam intensity and gas velocity, whereas PMMA may show a definite peak in destruction rate for the same heating, as seen in Fig. 1. This is evidently caused by a temporary shielding effect by ejecta in PMMA for two of the four curves in Fig. 1(a), which dissipates at higher gas velocities; no similar effect was found for polystyrene. Rough calculations were also made of the amount of ablated material for the polystyrene target, as a function of beam intensity and flow rate. An extensive theoretical analysis of the observed destruction mechanisms is included.

(Fig. 1 on page following)

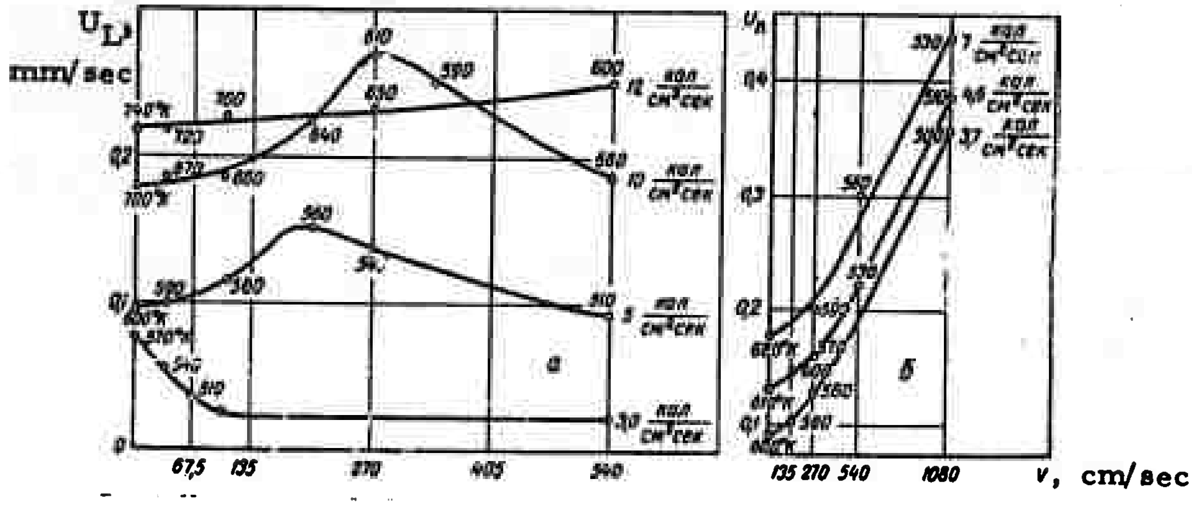


Fig. 1. Linear destruction rate U_L as a function of laser intensity and gas velocity.
a- PMMA
b- polystyrene
Surface temperatures are shown on each curve.

Krasyuk, I. K., and P. P. Pashinin. Breakdown in argon and nitrogen from a picosecond laser pulse at 0.35 micron wavelength. ZhETF P, v. 15, no. 8, 1972, 471-473.

Optical breakdown triggered in Ar and N_2 by the second harmonic emission from a ruby laser was studied to ascertain the breakdown mechanism from 30-50 psec. pulses at 0.35μ wavelength. Breakdown threshold I_{th} was measured in the gases at a pressure in the 400-4500 torr range in an experimental arrangement analogous to one described by the authors and A. M. Prokhorov (ZhETF P, v. 9, 1969, 581). The power of the filtered second harmonic emission was measured with a resolution equal to or better than 20 psec. The emission peak corresponding to the limit of visibility was assumed to be I_{th}. The experimental plots (Fig. 1) indicate that breakdown is triggered by multi-photon ionization of gas atoms or molecules. This mechanism is confirmed by experimental data obtained by the authors and A. M. Prokhorov (ZhETF, v. 58, 1970, 1606) at 0.69μ wavelength. Analysis of the cited data and that of other authors reveals that the quasiclassic formula derived by Keldysh adequately describes the relative decrease in I_{th}, i.e., the increased probability of photoionization, with the increases in frequency of optical emission. In contrast, no theory exists to explain the fact that I_{th} in Ar and Xe also decreases when the breakdown is triggered by a 20 nsec laser pulse at the 0.35μ wavelength; accepted avalanching theory predicts instead a monotonic rise in I_{th} with laser frequency in the nanosecond case. Hence different breakdown mechanisms must be considered in the picosecond and nanosecond pulse cases.

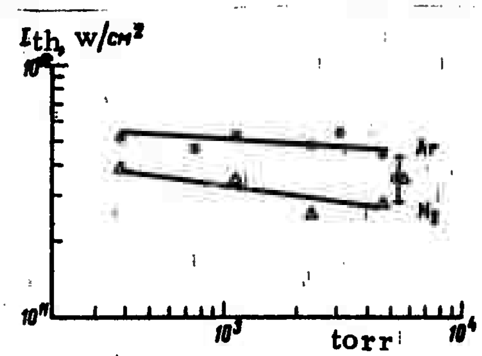


Fig. 1. Experimental plots of I_{th} vs. pressure: o- in argon, Δ - in nitrogen

Kostylev, V. M., and N. V. Komarovskaya. Energy transfer in a medium of low optical density. I-FZh, v. 22, no. 5, 1972, 907-912.

An experimental study was made of the radiative energy transfer in optically thin loose fibrous layers bound by diffusely radiant and reflecting surfaces. Allowance was made for the effects of induced radiation and scattering from the medium in approximation of local thermodynamic equilibrium. The fibrous layers were made of a superthin (1-2μ) fiberglass or ~30μ thick caprone fibers bound by oxidized aluminum and copper or polished aluminum surfaces. The effective thermal conductivity λ_τ of the plane-parallel optically thin layers was measured in an electric calorimeter with a special heat-insulating shield in high vacuum. The maximum λ_τ error was 5%. The experimental λ_τ data are plotted in Fig. 1 in comparison with the theoretical $\lambda_\tau(\tau)$ dependence calculated from

$$\lambda_\tau = \frac{1}{\frac{1}{\lambda} + \frac{1}{4\epsilon_r \sigma T^3 L}} \quad (1)$$

where λ is the radiative thermal conductivity of an optically dense layer, σ is the Stefan-Boltzmann constant, T is the arithmetic mean of the layer temperature, L is the geometric thickness of the layer, and ϵ_r is the reduced emissivity of the boundary surfaces, which was experimentally measured in the absence of the loose fibrous layer. Allowance was made, when calculating λ_τ, for the coefficient $\overline{\mu} = 3/2$ of angular distribution of radiation flux intensity incident on the boundaries. The experimental and theoretical λ_τ/λ versus τ plots for two different ϵ_r values were similar. The data indicates that λ_τ dependence on L and τ of the layers with diffusely reflecting surfaces is described with a good approximation by (1) and similar formulas. In contrast, the experiments with a polished aluminum boundary (cold) surface

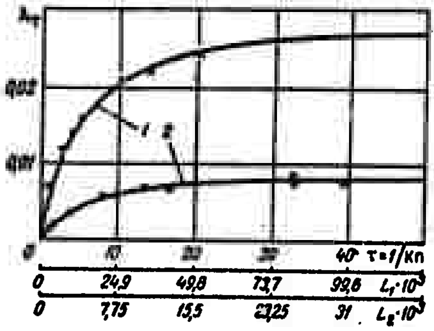


Fig. 1. λ_τ in W/m/degree vs. optical thickness τ and L(m m) of a loose fibrous layer of 30 kg/m^3 volume density, $\epsilon_r = 0.27$. Solid lines are calculated by (1).
1- caprone fiber, 2- super-thin glass fiber

revealed a significant discrepancy with the theoretical data calculated by (1). It was concluded that the $\overline{\mu} = 3/2$ value is acceptable only for gray, diffusing boundary surfaces of thin layers of any τ, i.e. the boundary boundary has the effect of increasing τ by a constant value.

Burakov, V. S., P. A. Naumenkov, V. P. Ivanov, and G. A. Kolosovskiy. Study of the passage of powerful laser radiation through an optically dense plasma. ZhPS, v. 16, no. 2, 1972, 239-242.

Some nonlinear absorption characteristics of laser propagation through a plasma are described. The plasma used was optically dense (4--7/ cm) and at ~4ev in a textolite capillary 2.9 mm in diameter. Transmissibility was measured with a passively Q-switched ruby laser generating a 30 ns pulse at 10^6--10^8 w/cm^2. A pronounced bleaching peak was found at about 10^7 w/cm^2. as seen in Fig. 1. The left-most point of the extrapolated

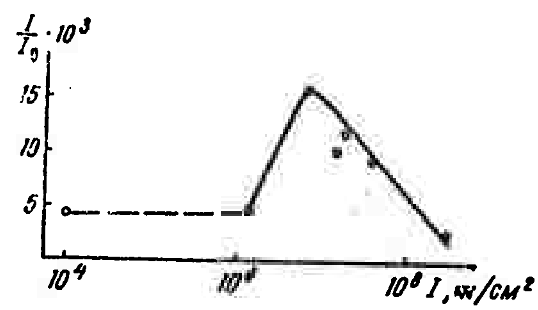


Fig. 1. Plasma transmissibility vs. laser intensity

portion was obtained with a free-running ruby; it was not possible to excite the plasma in the Q-switched mode below 10^6 w/cm^2. The absorption characteristic vs. temperature are given for the HI, CI, OI and CII components. Results indicate the ion and electron temperatures vary almost in synchronism. A general conclusion is that in a multicomponent, highly ionized plasma of the type tested, deviation from equilibrium concentration of electrons can be caused by individual hard-ionizing elements; in the present case this was due to the C II component. It follows that care must be taken to allow for nonlinear absorption when using a powerful laser for certain plasma diagnostics.

B. Recent Selections

i. Beam Target Effects

Aseyev, G. I., and M. L. Kats. Destruction mechanisms of alkali-halide crystals and multiphoton ionization of impurity centers. FTT, no. 5, 1972, 1303-1307.

Aseyev, G. I., and M. L. Kats. Multiphoton excitation and ionization of Tl+ impurity centers in alkali-halide crystals. FTT, no. 5, 1972, 1365-1368.

Basov. N. G., Yu. S. Ivanov, O. N. Krokhin, Yu. A. Mikhaylov, G. V. Sklizkov, and S. I. Fedotov. Generation of neutrons from spherical irradiation of a target by powerful laser radiation. ZhETF P, v. 15, no. 10, 1972, 589-591.

Geguzin, Ya. Ye., A. K. Yemets, and Yu. I. Boyko. Lowered optical strength of transparent solids with microscopic defects. FTT, no. 5, 1972, 1565-1566.

Mezokh, Z. I., L. I. Ivanov, and V. A. Yanushkevich. Change in electrical properties of Ge under the effect of a Q- switched pulsed laser at 77° K. IN: Nauchnyye trudy Kubanskogo universiteta, no. 141, 1971, 102-109. (LZhSt, 20/72, #63510)

Nikolayev, G. I., and V. I. Podgornaya. Application of graphite cells for atomic absorption analysis of laser probes. ZhPS, v. 16, no. 5, 1972, 911-913.

Sivers, V. N., V. Ye. Shemshura, and B. S. Yugas. Determination of excitation state density in a three-level medium with allowance for multiple light scattering. ZhPS, v. 16, no. 5, 1972, 929.

Strekalov, V. N. Electromagnetic field effect on shock ionization. FTT, no. 5, 1972, 1563-1565.

ii. Beam-Plasma Interaction

Aliyev, Yu. M., O. M. Gradov, and A. Yu.Kiriy. Electromagnetic wave field excitation of internal ion-acoustic oscillations in a nonuniform dense plasma. ZhETF P, v. 15, no. 11, 1972, 694-696.

Batanov, V. A., V. K. Goncharov, and L. Ya. Min'ko. Powerful optical erosion plasmatron. ZhPS, v. 16, no. 5 1972, 931-934.

Buechl, K., K. Eidmann, H. Salzmann, and R. Sigel. Evidence of nonthermonuclear neutron production in laser-generated deuterium plasma. IPP-Berichte, v. 28, no. 4, 1971, 9p. (RZhF, 5/72, #5G307)

Grigor'yeva, L. I., A. V. Longinov, A. I. Pyatak, V. L. Sizonenko, B. I. Smerdov, K. N. Stepanov, and V. V. Chechkin. Investigation of high-frequency plasma heating. IN: Plasma Physics and Controlled Nuclear Fusion Research. 1971. Proceedings 4th International Conference, Madison, Wis., U.S.A., 1971, v. 3. Vienna, 573-595. (RZhF, 5/72, #5G294)

Kaliski, S. Generalized equations for laser heating of a dual-temperature plasma with allowance for heat of thermonuclear synthesis. Biul. WAT J. Dabrowskiego, v. 20, no. 12, 1971, 25-30. (RZhF, 5/72, #5G299)

Kormilets, V. M., and I. P. Yakomenko. Nonlinear interaction of waves in a magnetoactive plasma cylindrical column. IVUZ Radiofiz, no. 5, 1972, 652-659.

Omel'chenko, A. Ya., V. I. Panchenko, and K. N. Stepanov. Absorption of an extraordinary electromagnetic wave in a linear layer of plasma in the vicinity of a hybrid resonance. IVUZ Radiofiz, no. 5, 1972, 660-664.

Semenova, V. I. Electromagnetic wave reflection during oblique incidence on a moving ionization front. IVUZ Radiofiz, no. 5, 1972, 665-674.

2. Effects of Strong Explosions

A. Abstracts

Buravova, S. N., and A. N. Dremin. Calculation of detonation initiation by a shock wave with negative pressure gradient in liquid explosives. FGiV, no. 1, 1971, 117-121.

Formulas for heat build-up Θ in a homogeneous liquid explosive and the induction period τ_{ind} behind a shock wave were derived in an approximation of gas dynamics, with allowance for the cooling effect of the expansion wave. A necessary but insufficient condition for explosion initiation was formulated in the case $\Theta > 0$. The accuracy of the formula of τ_{ind} was estimated to be within 20 - 30 % for $\tau_{ind} \leq \delta$, the wave effect duration, and a reaction depth $\eta \leq 1$. At near critical δ, heat conductivity and reaction kinetics must be accounted for in exact formulations of explosion initiation. Near "threshold initiation", the error in a τ_{ind} evaluation may be greater than 100%, if allowance is not made for the expansion wave effect.

Dubnov, L. V., V. A. Sukhikh, and I. I. Tomashevich. Nature of decomposition microlocuses created by mechanical action in condensed explosives. FGiV, no. 1, 1971, 147-149.

Hypotheses on the nature of the sensitivity of condensed explosives to mechanical effects are discussed. Kinetic energy calculations of the free surface molecules of a compressed cavity in a liquid explosive indicate that a thermal explosion may originate in a cavity with the formation of a gas phase. Analogous calculations for polycrystalline explosives reveal the possible role of dislocations in a local heat build-up. The hypothesis was formulated that structural imperfections (dislocations, cavities, gas occlusions) as carriers of free energy, can account for the formation of local centers of heat build-up by mechanical action.

Myshenkov, V. I. and Yu. P. Rayzer.
Ionization wave propagating as a result of resonance quanta diffusion and sustained by shf radiation. ZhETF, v. 61, no. 5, 1971, 1882-1890.

Sustained propagation of an ionization wave in noble gases in an shf electric field E was analyzed. The wave propagates at a power density far below the threshold density of gas breakdown. The simplified scheme of steady-state propagation involves: energy transfer from the shf field to electrons, atom excitation to a single resonance state, and ionization of the excited atoms by electron shock and diffusion of plasma resonance radiation into undisturbed layers. In the one-dimensional model of the reference coordinate system (Fig. 1) the ionization wave is at rest in the system. The

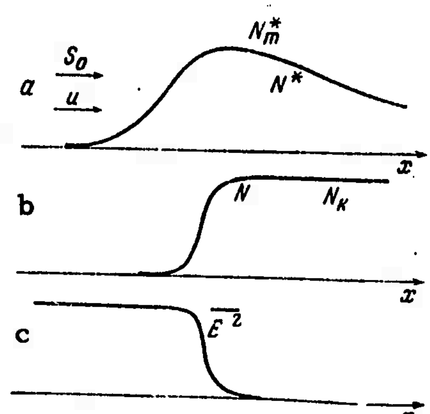


Fig. 1. Schematic parameters distribution in a two-dimensional steady-state ionization wave: a - density N* of excited atoms; b - electron density N; c - mean square shf field $\overline{E}^2$. Arrows indicate directions of propagation velocity u of nonionized gas in the wave and energy flux S_o of the incident electromagnetic wave.

wave propagation is described by the simplified equations:

$$u dN / dx = \alpha N N^*, \quad \alpha = \overline{v\sigma_i^*(v)}, \tag{1}$$

where α is the ionization rate constant, V is the electron velocity, and σ_i^* is the ionization cross-section of an excited atom;

$$u\frac{dN^*}{dx} = D\frac{d^2N^*}{dx^2} + \frac{\sigma E^2}{I^*} - \frac{N^*}{T} \tag{2}$$

where D is the diffusion coefficient, T is the average lifetime of the excited state, and I* is the excitation potential; and

$$\frac{d^2E}{dx^2} + \frac{\omega^2}{c^2}\left(\varepsilon' + i\frac{4\pi\sigma}{\omega}\right)E = 0, \tag{3}$$

where ω is the electric field frequency, and ϵ' is the dielectric constant.

Approximate solution of (1), (2), and (3), with allowance for boundary conditions, gives the unknown functions

$$N(x) = N_0 e^{\gamma(x)}, \quad \gamma = \frac{\alpha}{u}\int_{-\infty}^{x} N^* dx, \tag{4}$$

where

$$\gamma(x) = \frac{\alpha S_1}{u I^* \sqrt{u^2 + u^{*2}}} \cdot \begin{cases} \Delta_1 e^{x/\Delta_1}, & x \leqslant 0 \\ \Delta_1 + \Delta_2(1 - e^{-x/\Delta_2}), & x \geqslant 0 \end{cases} \tag{5}$$

$$N^*(x) = \frac{S_1}{I^* \sqrt{u^2 + u^{*2}}} \cdot \begin{cases} e^{x/\Delta_1}, & x \leqslant 0 \\ e^{-x/\Delta_2}, & x \geqslant 0 \end{cases}, \tag{6}$$

where

$$\frac{1}{\Delta_{1,2}} = \frac{u}{2D}\left[\sqrt{1 + (u^*/u)^2} \pm 1\right], \quad u^* = \sqrt{4D/T}. \tag{7}$$

and

$$\frac{dS}{dx} = -\mu S, \quad \sigma\overline{E^2} = \mu S, \tag{8}$$

where

$$S = S_1 e^{-\tau(x)}, \quad \tau(x) = \int_{-\infty}^{x} (\mu - \mu_0)\, dx, \tag{9}$$

S and $S_1 = S_0(1 - \rho)$ are the total and dissipative electromagnetic energy fluxes, ρ and μ are the coefficients of reflection and absorption, τ is the relative lifetime of an excited atom, and u* is the characteristic velocity.

Using (4), (5), and (7), formula (10) is derived,

$$N_k = \left[\frac{\alpha S_1 \ln(S_1/S_k)}{\beta\, bu\, I^* \sqrt{u^2 + u^{*2}}} \right]^{\beta}, \quad S_1 = S_0[1 - \rho(N_k)] \qquad (10)$$

where β and b are constants. The maximum electron density N_k in the plasma is consequently related directly to u. Using (4), (5), and (8) and approximating S(x) by the step function $S = S_1$ at $x < 0$, $S = 0$ at $x > 0$, an equation was also derived which correlates u with S_1. N_k (S_1) can then be calculated from (10) and finally, $u(S_o)$ and $N_k(S_o)$. The wave propagation velocity is given by

$$u = \frac{\alpha T}{2\gamma_c I^*} S_1. \qquad (11)$$

where γ_c = const, if $u < u^*$. The formula for maximum density of excited atoms

$$N^*_{max} = S_1 / I^* u^* \qquad (12)$$

is derived from (6).

The formulas (4) - (12) and experimental and theoretical data from the literature were used to calculate u, N_k, N^*_m, S_o, and S_1 for Xe at p = 3 torr, under the experimental conditions described by Bethke and Ruess [Phys. Fluids 12, 1969, 822]. The tabulated data show that the calculated u values increase with an increase in shf power, in agreement with the experiment, but are 4--7 times lower than the experimental u. This discrepancy is possibly connected with the low α value used in calculations. The existence threshold of the ionization wave $S = cE^2/4\pi$ was calculated as 0.4 w/cm^2 for Xe and 1.2 w/cm^2 for Ar, which is in reasonable agreement with the experiment.

Shifrin, E. G. Study of a "hanging" shock wave near the point of origin. MZhiG, no. 6, 1971, 30-37.

Mapping of a "hanging" compression shock into a hodograph plane is described for a two-dimensional, nonuniform supersonic flow in a perfect gas. A general analytical solution of the shock at its point of origin is obtained in the hodograph plane by the method of asymptotic expansions in first and second order approximations. Shock formation conditions are formulated at a supersonic point of flow. It is shown that a quadratic parabolic form of the boundary line in the hodograph plane is a necessary condition of shock formation at a supersonic point in a physical plane in which convolution is present.

Aleksandrov, V. V. Phase plane method for solution of one-dimensional problems in radiative gas dynamics. MZhiG, no. 1, 1972, 144-155.

The phase plane method is used to solve the problem of one-dimensional equilibrium flow of an inviscid, radiating, absorbing, and scattering gas. For gas propagation with strong radiation interference, the usual numerical solution to this problem, based on Peierls equation of radiant emission W as a function of optical depth τ, becomes complicated because of boundary layer formation behind a shock wave. For that reason the problem is formulated in different material coordinates; namely, dimensionless gas velocity V and W, in the (V, W) or "phase plane". In the presence of scattering and strong radiation interference with gas propagation, such an approach is preferable to using the Peierls equation, because the V of one-dimensional gas flow is a measure of both kinetic and internal gas energies. The phase plane thus represents an energetic space with the energy characteristics of the substance and radiation as coordinates. The function W(V) for gray body radiation is determined by the nonlinear integral equation

$$w(v) = \frac{B}{2}\int_{v_1}^{1} \{[1-\lambda(\xi)]\theta^4(\xi) + \lambda(\xi)w(\xi)\}K[\xi, w(\xi)] \times$$
$$\times E_1\left\{B\left|\int_{\xi}^{v} K[\eta, w(\eta)]d\eta\right|\right\} d\xi \qquad (1)$$

where B = Bo/4 is the Boltzmann constant, Θ is the dimensionless gas temperature, K is the absorption coefficient, ξ, E_1, and η are values from Peierls equation in neutron transport theory. Solution of (1) gives W(V). The phase plane (V, W) for selective radiation has an infinite dimension, and the problem for a nonscattering gas is therefore formulated by the equation of energy

$$q(v) = -\frac{\pi^3 k_P(v)}{15}\theta^4(v) + \frac{\pi B_s}{2}\int_{v_1} \frac{d\xi}{q(\xi)}\left(\frac{dh}{d\xi} + \xi\right) \times \qquad (2)$$
$$\times \int_0 dy k(v, y) k(\xi, y) P(\xi, y) E_1\left\{B_s\left|\int_{\xi} \frac{k(\eta, y)}{q(\eta)}\left(\frac{dh}{d\eta} + \eta\right) d\eta\right|\right\}$$

where q is the volumetric rate of gas energy increase due to radiation, $B_s = \frac{\pi^5}{60}$ Bo, Kp, K, h, y, and P are the dimensionless Planck absorption coefficient, optical constant, enthalpy, frequency, and Planck function, respectively.

Application of formulas (1) and (2) is illustrated by examples of a strong shock wave propagating in a cold, transparent, nonscattering gas and a shock wave propagating in a radiating, absorbing, and scattering gas with strong radiation interference. In the first example, a formula derived from (1) for the Θ of a gray body shows that the gas is strongly cooled by radiation. The discontinuity of shock wave velocity is formulated in the second example for a perfect gas in a diffusion approximation of the radiation transport equation in the phase plane. It is shown that discontinuity exists at $\gamma < 2$ and $M_1 > 1.5$ or > 2.05 in the incident flow.

Nevskiy, L. B. Application of interferometer mirror shift for gas dynamic investigations. OMP, no. 2, 1972, 9-11.

A quantitative analysis is presented of the shift of supersonic gas flow interferograms, which were obtained with a dual beam shift interferometer with a spherical mirror in a reflected divergent optical beam. In contrast to a polarization shift interferometer, this interferometer allows a smooth and uncomplicated shift of the wavefront. Integral equations were derived for flow densities $\rho_\nu{}^* = \rho_\lambda / \rho_\infty$, where ρ_∞ is the density of incident flow; and $\rho_s{}^*$, where the ν and s subscripts indicate, the points of an interferogram along the section under study and the points between which ρ * is to be determined. The equations for $\rho_\nu{}^*$ and $\rho_s{}^*$ can be used for small and large shifts of wavefront, respectively, if the shift interferometer is used as a shadow instrument attachment for the study of axisymmetrical inhomogeneities. It is assumed that shift interferograms with large and small shifts in wavefronts are obtained simultaneously and successively for a steady flow.

Experimental data obtained from the shift interferograms are compared with theoretical aerodynamic data and experimental data obtained from Mach-Zender interferograms. Theoretical and interferometric $\rho^*(\xi)$ plots (where ξ is a coordinate) for a $M_\infty = 2$ flow around a sharp-nosed cone with a 15° apex half-angle exhibit an ~8% discrepancy at the edge of inhomogeneity. For a $M_\infty = 2$ flow around a hemisphere cylinder, the $\rho^*(\xi)$ plots obtained for three sections from the shift interferograms, using either the $\rho_\nu{}^*$ or $\rho_s{}^*$ formula, deviated by 8-10% from plots obtained with the Mach-Zender interferometer for the same sections.

Gorelov, V. A., and L. A. Kil'dyushova. An experimental study of parameters of ionized air in front of a strong shock wave. MZhiG, no. 6, 1971, 17-22.

Electron density n_e and elctron diffusion velocity in ionized air ahead of a strong shock wave (V_s = 10-12.5 km/sec) were measured in an electric discharge shock tube at an initial pressure p_0 = 0.2 torr. A resonance shf probe was used for the n_e measurements to verify earlier data obtained by the authors with a standard probe (MZhiG, no. 2, 1971, 147). A conductor wire shortcircuited at both ends was used as a resonance system. The wire was placed along the shock tube diameter and connected to the feed system and a measuring line; the feed system was connected to the shf-generator (f = 5.8-6.7 GHz). Resonance of the shorted wire appeared at the instant when effective length l was 1/2 N λ, where N is the number of half-waves on the wire. The instant was recorded as a characteristic spike on an oscilloscope trace. The corresponding n_e was calculated to be 2.8×10^{11} cm^{-3} as compared to the 2.2×10^{11} cm^{-3} value measured with a double probe (at V_s = 11.2 km/sec). The n_e values obtained by the two methods differ by ~ 30%, as shown on an $n_e = f(x)$ plot, where x is the distance to the shock wavefront. Ba atoms were injected into the tube near the measuring probe but did not affect the n_e level.

The electron mass velocity U_e // in the direction of shock wave propagation was measured to determine the effect of free-electron diffusion into the region of precursor ionization. An electromagnetic induction method was used, based on measurement of the potential difference at the boundary of the plasma flow through a transverse magnetic field. The experimental U_e versus x plots show that the measured U_e // values near the shock front are in satisfactory agreement with those calculated for a free diffusion, but they decrease rapidly with increases in distance from the front approaching values corresponding to ambipolar diffusion.

Ivanov, A. A., L. L. Kozorovitskiy, V. D. Rusanov, R. Z. Sagdeyev, and D. P. Sobolenko. Experimental observation of electron shock waves in a collisionless plasma. ZhETF P, v. 14, 1971, 593-596.

Experiments are described which establish the existence of a stationary thermal discontinuity, or electron shock wave, in a collisionless plasma. Tests were done in hydrogen, argon, and xenon, using a plasma generated in a glass tube by two shf generators and an axial magnetic field in the 0.5--5 koe range. Local heating of the plasma to electron temperatures of some 300 ev was induced by a single-turn high current coil generating a large magnetoacoustic wave whose energy was absorbed by the plasma in the coil region. Probe data of nT vs. axial position then show a drop in nT and pressure characteristic of a shock wave. Variation in wavefront parameters were investigated under different test conditions; these showed that the length and velocity of the wavefront were independent of initial electron temperature. Tolerably good agreement was found between theory and experiment for the argon and hydrogen

Vul'fson, N. I., and L. M. Levin. Explosive breakup of developing cumulus clouds. FAiO, no. 2, 1972, 156-166.

Upward and downward spontaneous convective jets initiated by explosions at various heights in developing cumulus clouds were investigated. Relationships are found among the parameters of jets formed in different sectors of an unstable layer (a conventional developing cumulus) to determine those zones in which explosions create significantly more intensive downward rather than upward movements. Mathematical expressions are derived and results are tabulated. Comparison of the calculated jet velocities shows that explosions in the upper sectors of developing cumulus produce a system of spontaneous jets, with a destructive capacity (caused by the downward jets) considerably exceeding the intensity of cloud development, due to upward jets. The more favorable the condition of cloud development, the greater the intensity of cloud destruction. Experiments were conducted under natural conditions in the Fergansk valley during May 1970, using explosive shells in dense convective clouds. The shooting of two cumulus, 5500 and 6600 m thick, by antiaircraft mine shells lowered their thickness by 3 to 4 times and the clouds gradually vanished. The explosion effectiveness can be further increased by blasting with a special type of cumulative shell, which generates downward jets during explosion.

Alimov, V. A. Frequency correlation of fluctuations in radiowaves reflected from the ionosphere. Geomagnetizm i aeronomiya, no. 3, 1972, 548-551.

The author considers the question of frequency correlation in the received fluctuations of dual frequency waves reflected from the ionosphere, as a means of interpreting some inhomogeneous characteristics of the ionosphere. As noted previously, the correlation function $R(f_{\omega_1} f_{\omega_2}^*)$ may vary both within the ionosphere and beyond it; also vertical refraction effects must be allowed for. Alimov analyzes the general case of inclined incidence of the transmitted beam, and determines expressions for $R(f_{\omega_1} f_{\omega_2}^*)$ at varying conditions of ionospheric anisotropy. Analysis of this case generally requires calculation of the trajectories of wave normals when a substantial effect of vertical refraction on $R(f_{\omega_1} f_{\omega_2}^*)$ is to be expected.

Avduyevskiy, V. S., V. K. Gretsov, and K. I. Medvedev. Flow stability with leading edge stall zones. MZhiG, no. 1, 1972, 74-81.

Two-dimensional and axisymmetric leading-edge stall zone instability was investigated in both laminar and turbulent gas flow past a semifinite plate with a fixed flat step (Fig. 1a) and around a cone with a fixed shield (Fig. 1b). The free-stream M varied from 2.9 to 6. The combination of a periodically alternating strong expansion and complete

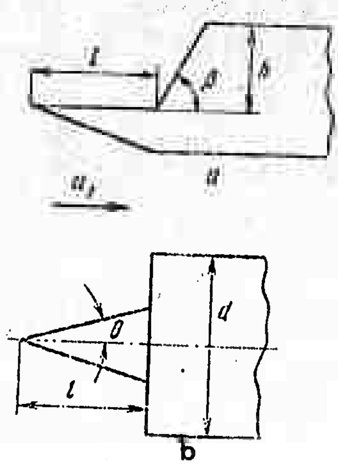


Fig. 1. a - semifinite plate with fixed step of height h and width b; b - cone with a fixed shield of diameter d.

disappearance of stall zones was considered as instability. The geometry effects of the streamline bodies on flow characteristics were studied, i.e., the parameters ℓ, b/h, and β of the plate and ℓ/d and Θ of the cone. Shadow photography and high speed motion pictures were used to record gas flow phases. An unsteady regime with pulsations of compression shock was observed in the flow past the plate when the boundary layer in front of the separation point was either laminar or turbulent. The pulsations disappear at $b \cong h$, $\beta = 70^{\circ}$ or at $\ell < \Delta$, the shock wave separation value in a perfect gas. The flow stabilizes when b/h is decreased.

The flow around the shielded cone, with a surface laminar boundary layer, is steady at a sufficient ℓ, but becomes unsteady when ℓ/d is decreased below a certain value. The flow restabilizes when ℓ is decreased to a value $< \Delta$. Four distinct phases of pulsations were detected in the unsteady flow. The flow is steady at $\Theta > \Theta_*$; Θ_* depends on M of free-stream flow (Fig. 2). Flow stability in region I depends on ℓ/d. In region II, the

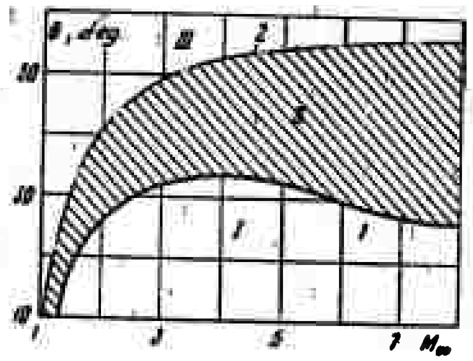


Fig. 2. Angle Θ versus Mach number in free-stream flow. Curve 1 - theoretical Θ_*, 2 - Θ limits of separation.

flow is steady without separation of the turbulent boundary layer, and in region III the shock wave is separated. The value of the angle γ between the plate or cone surfaces and a line connecting the leading edge or cone tip with the upper edge of the step or shield is established as a flow stability criterion. The flow is steady if $\gamma < \gamma_*$, the critical value. The effect of three-dimensional flow transition on pulsations was also evaluated using experimental data.

Mikhaylov, V. N., and V. S. Tamilov. Supersonic flow over an edge formed by intersecting plates. MZhiG, no. 2, 1972, 162-166.

A mathematical method is introduced for the numerical solution of a supersonic flow problem on the edge formed by two perpendicular plates of zero thickness. In a Cartesian coordinate system, the plates are made to coincide with the y = 0 and z = 0 planes, and the velocity vector V_∞ is defined by the angle of attack α and the angle θ between the y-axis and the projection of V_∞ on the x = 0 plane (Fig. 1). Pressure p, density ρ, and the velocity components u, v, w must satisfy a set of differential equations with plate boundary conditions. Solution of the equations is obtained in the region bounded by the y = 1, z = 1, and $x \geq 0$ planes using the method of adjustment. Formulas are given for the flow parameters u, v, w, ρ, and p and the stability condition of the calculation scheme.

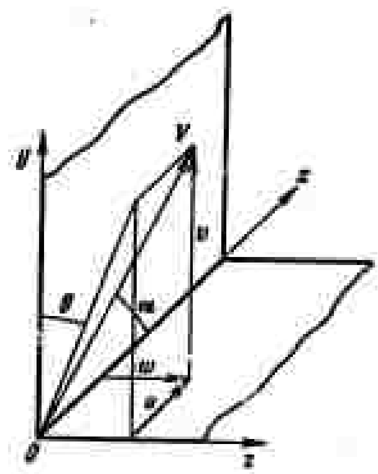


Fig. 1. Flow diagram over the edge in perpendicular plates

Plots of the calculated parameters along the half-lines y/x = const ("conical" variable) show that the parameters become constant at high x values (Fig. 2). A qualitative theoretical flow pattern plotted for a perfect gas presents shock wave traces as flow region boundaries with sharply different parameters. It is concluded that the perfect gas model is inadequate to describe the flow type studied, because of a discrepancy between the pattern and an earlier experimental pattern of interference flow over an edge in intersecting wedges. The method of calculation was also applied to the expansion flow between two perpendicular plates. Calculations at $M_\infty = 6$, $\theta = 45^\circ$, $\alpha = 10^\circ$ show that flow ahead of the interference region is directed from the edge with a subsequent significant decrease in p in the interference region.

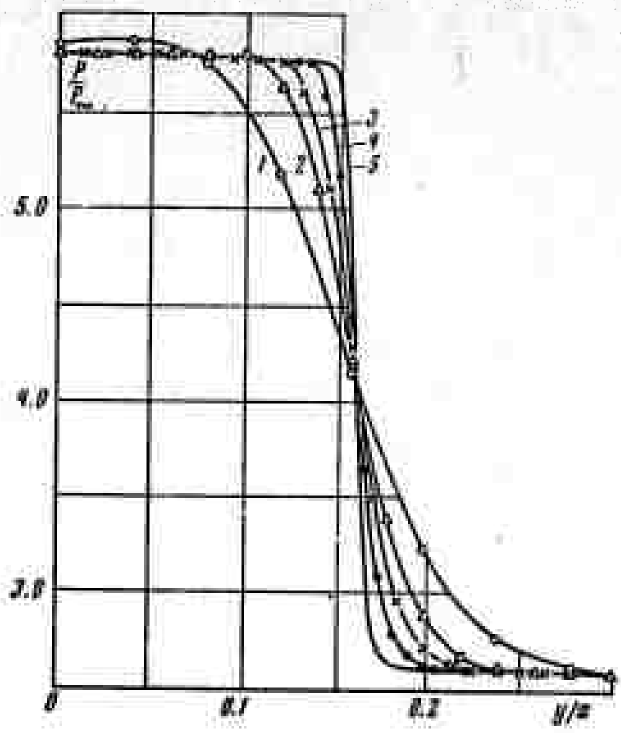


Fig. 2. Typical plot of p distribution along the y axis for the parameters $M_\infty = 6$, $\theta = 45^o$, $\alpha = -10^o$ of the incoming flow. The curves 1, 2, 3, 4, 5 correspond to increasing x values

Stulov, V. P. Strong blowoff on a blunt body surface in supersonic flow. MZhG, no. 2, 1972, 89-97.

A theoretical analysis is made of the supersonic axisymmetrical flow of a perfect gas around a blunt body, with simultaneous injection of another gas through the body surface according to a specified formula. The incoming gas passes through shock wave S and spreads along the contact surface C with the injected gas (Fig. 1). The two-layer flow is described by a set of gas dynamic equations with boundary conditions in the shock wave, at the C and body surfaces. The equations are formulated in a system of spherical coordinates ξ, θ centered on the flow axis, and are solved separately for each layer assuming that the pressure on the C outer side is given by the Newton formula

$$p_{1c} = p_1{}^* \sin^2 \sigma \tag{1}$$

where σ is the angle of the flow axis with C. A complete numerical solution of the boundary problem by the method of successive approximation is given for injection according to the formula

$$u_w = u_{w_0} \cos^n \theta \qquad (2)$$

which describes the distribution of the radial component of injection velocity over the front surface in a hypersonic flow, e. g., $M_\infty = 10$, around a spherical body with r_c radius (Fig. 1). The discrepancy between the approximate

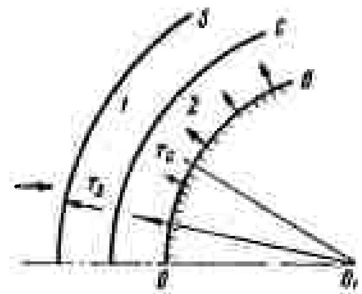


Fig. 1. Flow diagram around a blunt body B with injection:
1- shock layer, 2- injected gas layer

and exact numerical solution for layer 2 is shown to be insignificant. Two approximate analytical solution variants for layer 2 are presented. One variant is based on an assumption of constant but different densities of the 1 and 2 layers. In this case, two equations are solved for r_s and r_c. The solution for layer 1 approximates well the numerical data calculated earlier by the author for a flow around different bodies. The solution for layer 2 near or far from the symmetry axis agrees with the approximate numerical solution. The other solution variant for layer 2 was obtained within the framework of boundary layer approximation and local flow self-similarity. The solution in this case agrees with the first variant near the flow axis and at small values of the ratio K of specific kinetic energy of injection and incoming flows. But the discrepancy with numerical solution becomes significant at a distance from the axis, e. g. ~20%.

Iskakbayev, A. Crack propagation in the curve of a linear viscoelastic fold. VAN KazSSR, no. 12, 1971, 54-57.

Brittle fracture of a viscoelastic layer (rectangular band) compressed at the ends by a force p within a fold of a rock mass is analyzed. The fracture is examined as a jointing process with a creep deformation background. The material of the rock mass is described by the standard linear body model. The time required for fracture initiation is determined from a formula of tensile stress in the curved section of a fold subjected to a bending force (p-q), where q is the weight of the rock mass. Solution of a transcendental equation gives the time $t > t_1$ necessary for fracture propagation through a 2δ thick layer cross section from a given point of the surface fiber. Determination of the time of layer fracture is similarly arrived at when the layers are described by a Maxwellian model.

Rodionov, V. N., V. V. Adushkin, V. N. Kostyuchenko, V. N. Nikolayevskiy, A. N. Romashov, and V. M. Tsvetkov. The mechanical effect of an underground explosion. Moskva, Izd-vo Nedra, 1971, 224 p.

A comprehensive review is given of all fundamental characteristics relating to mechanical effects of underground explosions. A simplified method is set forth for calculating explosion-produced mechanical motion, which enables prediction of explosion cavity dimensions, destruction range, fissurability of rock, parameters of cratering explosions, and intensity of seismic waves. Theoretical results are compared with experimental laboratory and field data from Soviet and non-Soviet sources. Engineering applications of strong underground explosions are discussed; examples given include the creep dam against mud-debris flows formed in Medeo, near Alma-Ata, in 1966-67, and the Baypazinsk explosion of 1968 which generated a rock slide to dam the Vakhsh River. Theoretical solutions to analogous problems are included, using basic physical properties of soil and rock, and possible future developments in the techniques are suggested.

Stesik, L. N. Calculation of detonation parameters of explosive mixtures with metals using an equation of state for perfect gases. FGiV, no. 1, 1971, 111-117.

Detonation parameters and composition of detonation products are computed, using formulas derived for a system satisfying an equation of state for perfect gases. Detonation velocity D is determined mainly by the relationship of two opposing factors: the heat Q released in a detonation wave and the fraction of a condensed phase in the products. Tabulated theoretical data and plots of D and Q versus metal percentages led to the conclusion that the D of the metal mixtures (Al, Be, B) in explosives having a negative oxygen balance (TEN, pyroxylin, RDX, TNT) increases by only 2-5% with an increase in metal content, while D in mixtures of Al with oxydants (hexanitroethane, ammonium nitrate or perchlorate) may increase by 10-30%.

B. Recent Selections

i. Shock Wave Effects

Adadurov, G. A., O. N. Breusov, A. N. Dremin, V. N. Drobyshev, and S. V. Pershin. Shock compression phase transitions of T--Nb_2O_5 and H--Nb_2O_5. FGiV, no. 4, 1972, 589-594.

Aleksandrov, V. V., and V. N. Koterov. Classification of shock waves in a radiating gas. ZhVMMF, no. 3, 1972, 700-713.

Artamonova, T. A., and V. A. Baskakov. Irrotational shock wave reflection from an elastoplastic half-space boundary. Results of numerical analysis. IN: Trudy NII matematiki. Voronezhskiy universitet, no. 4, 1971, 96-100. (RZhMekh, 5/72, No. 5V390)

Baskakov, V. A. Irrotational shock wave reflection from an elastoplastic half-space boundary. IN: Sbornik nauchnykh trudov fakultet prikladnoy matematiki i mekhaniki VGU (Voroneszhskiy universitet), no. 1, 1971, 39-49. (LZhS, 19/72, No. 60087)

Bezrukova, T. V., V. M. Volchkov, P. O. Pashkov, and R. I. Tsoy. Plastic deformation in a plane shock wave. IN: Sbornik. Metallovedeniye i prochnost' metallov. V. 3. Volgograd, 1971, 197-203. (RZhMekh, 5/72, No. 5V395)

Bocharov, Yu. A., A. A. Bocherov, and T. Ya. Nedopovz. Shtampovochnoye oborudovaniye udarnogo deystviya. (Obzor). (Shock-activated stamping equipment (review). IN: NIIMash Seriya S-III, Moskva, 1971, 83p. (KL, 8/72, No. 6629)

Brazhnev, V. V., and Z. M. Gelunova. General relationships for property changes in metals and alloys under shock wave loads of pressures to 1.2 Mbar. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov. Moskva, 1971, 19. (RZhMekh, 5/72, No. 5V984)

Chigarev, A. V. Shock wave propagation in a stochastic heterogeneous elastic medium. PM, no. 5, 1972, 69-74.

Drozd, M. S., G. V. Gur'yev, and A. V. Fedorov. Contact deformation method for evaulating steel resistance to compressive or tensile deformation under shock loads. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov, Moskva, 1971, 4. (RZhMekh, 5/72, No. 5V977)

Galiyev, Sh. U., and N. N. Shikhranov. Excitation of periodic shock waves in a dissipative medium by the small parameters method. IN: Trudy Seminara po teorii obolochek. Kazanskiy fiz-tekhnicheskiy institut AN SSR, no. 2, 1971, 214-239. (RZhMekh, 5/72, No. 5B255)

Gorbovskiy, S. V., and V. G. Samoylovich. Shock wave during discharge in an ozonizer. VMU. Seriya khimiya, no. 2, 1972, 231. 231.

Grigolyuk, E. I., and A. G. Gorshkov. Vzaimodeystviye slabykh udarnykh voln s uprugimi konstruktsiyami. (Izd. 2-e) (Interaction of weak shock waves with elastic structures.) Trudy. MGU imenno M.V. Lomonosova, Institut mekhaniki, Moskva, 1971, 198p. (KL, 12/72, No. 9812)

Gurgenyan, A. A. Applying the Legras method to motion in a liquid half-space. IAN Arm. Mekhanika, no. [illegible], 1971, 25-36. (RZhMekh, 5/72, No. 5B319)

Guz', I. S., and L. I. Neizvestnykh. Investigation of stress wave interaction with a macrocrack system. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov, Moskva, 1971, 14. (RZhMekh, 5/72, No. 5V983)

Kalimov, A. I., V. V. Malyatin, and Ye. K. Pochtennyy. Destruction kinetics of steel under shock loads. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov, Moskva, 1971, 8-9. (RZhMekh, 5/72, No. 5V978)

Khristoforov, B. D. Shock wave parameters for explosion of a spherical charge in porous NaCl. FGiV, no. 4, 1971, 594-599.

Khristoforov, B. D., Ye. E. Goller, A. Ya. Sidorin, and L. D. Livshits. Manganin sensor for measuring shock wave pressure in solids. FGiV, no. 4, 1971, 613-615.

Kiyko, I. A. Longitudinal shock along a thin cylindrical shell. VMU, no. 3, 1972, 118-121.

Malyy, V. I., and A. B. Yefimov. Buckling of an elastic cylindrical shell during longitudinal impact against a barrier. VMU, no. 3, 1972, 122-125.

Mantaroshin, A. P., P. O. Pashkov, and V. D. Rogozin. Structure and properties of materials manufactured by shock loading of metal powders. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov, Moskva, 1971, 20. (RZhMekh, 5/72, No. 5V985)

Maykapar, G. I. Calculation of body drag based on the shape of a bow shock wave. IN: Uchenyye zapiski TsAGI, v.2, no. 6, 1971, 23-31. (LZhS, 19/72, No. 60100)

Nagornov, G. M. Characteristics of tangential stress relaxation under multiple shock compression at pressures to 200 kbar. IN: Sbornik. Metallovedeniye i prochnost' materialov, v. 3. Volgograd, 1971, 203-209. (RZhMekh, 5/72, No. 5V991)

Nagornov, G. M., and P. O. Pashkov. Transient creep and structure of Armco iron hardened by shock waves and static deformation. IN: Sbornik. Metallovedeniye i prochnost' materialov, v. 3. Volgograd, 1971, 214-222. (RZhMekh, 5/72, No. 5V1084)

Pashkov, P. O., and I. I. Polyakova. Surface properties during high-speed metal collisions. DAN SSSR, v. 204, no. 2, 1972, 332-334.

Pavlov, A. I. Prevention of destruction and out-of-tolerance deformation under high speed shock effects. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov, Moskva, 1971, 1-2. (RZhMekh, 5/72, No. 5V975)

Pelunova, Z. M., and D. P. Cheprasov. Strengthening of tempered steel by plane and oblique shock waves. IN: Sbornik. Metallovedeniye i prochnost' materialov, v. 3. Volgograd, 1971, 222-225. (RZhMekh, 5/72, No. 5V974)

Polyanskiy, O. Yu. Structural properties of weak shock waves in a relaxing gas. IN: Uchenyye zapiski TsAGI, v. 2, no. 6, 1971, 55-61. (LZhS, 19/72, No. 60105)

Rakhmatulin, Kh. A., and G. D. Tkacheva. Source-and-sink method for solution to the problem of impact of an elastic body against a rigid barrier. ZhVMMF, no. 3, 1972, 814-819.

Tupchiyev, V. A. Asymptotic solution to unit value problem for the equation $\varepsilon^2 t u_{xx} = u_t + [\varphi(u)]_x$, where $\varepsilon \to 0$, in a problem on the decay of an arbitrary discontinuity for a rarefied wave. ZhVMMF, no. 3, 1972, 770-775.

Verveyko, N. D., and N. M. Zinov'yev. Reflection of a plastic limited irrotational wave from the boundary of a viscoelastic plastic half-space. IN: Sbornik nauchnykh trudov fakulteta prikladnoy matematiki i mekhaniki VGU (Voronezhskiy universitet), no. 1, 1971, 50-54. (LZhS, 19/72, No. 60090)

Volchov, V. M., I. A. Kulakov, and P. O. Pashkov. Viscous mechanisms of deformation in strong shock waves. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov, Moskva, 1971, 19-20. (RZhMekh, 5/72, No. 5V406)

Vompe, G. A. Mass spectrometry measurement of rate constants for high temperature gas reactions. Zhurnal fizicheskoy khimii, no. 5, 1972, 1334-1335.

Zlatin, N. A., A. A. Kozhushko, V. A. Lagunov, and V. A. Stepanov. Method for studying the destruction process in the microsecond range in solids from a high voltage electric pulse breakdown. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov, Moskva, 1971, 3-4. (RZhMekh, 5/72, No. 5V976)

ii. Hypersonic Flow

Antonova, A. M. High speed gas flow around a slender three-dimensional body. IN: Trudy II Respublikanskoy konferentsii po aerogidomekhanicheskomu teploobmenu i massoobmenu, Kiyev, 1971, 99-102. (RZhMekh, 5/72, No. 5B340)

Babenko, K. I., V. N. Ivanova, E. P. Kazandzhan, M. A. Kukarkina, and Yu. B. Radvogin. Nonstationary flow around the leading section of a blunt body. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu. Kiyev, 1971, 29-43. (RZhMekh, 5/72, No. 5B325)

Balakin, V. B., and V. V. Bulanov. Numerical solution to a problem on shock wave interaction with a cylinder in supersonic flow. IFZh, no. 6, 1971, 1033-1039. (RZhMekh, 5/72, No. 5B327)

Biberman, L. M., S. Ya. Bronin, and A. N. Lagar'kov. Heating and flow around blunt bodies during atmospheric entry. IN: Trudy Sektsii po chislennym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969, v. 3. Moskva, 1971, 134-153. (RZhMekh, 5/72, No. 5B424)

Bulakh, B. M. Vortex interaction of a three-dimensional laminar boundary layer on a circular cone with external nonviscous supersonic flow. IN: Sbornik. Materialy nauchno-tekhnicheskoy konferentsii Leningradskogo elektrotekhnicheskogo instituta svyazi. Leningrad, no. 4, 1971, 146-147. (RZhMekh, 5/72, No. 5B329)

Davlet-Kil'deyev, R. Z. Heat transfer and flow characteristics of a body of revolution in supersonic gas flow. IN: Uchenyye zapiski TsAGI, no. 6, 1971, 103-107. (RZhMekh, 5/72, No. 5B556)

Fedotov, B. N., and G. G. Skiba. Nonstationary three-dimensional supersonic motion of bodies of revolution in an ideal gas. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu, Kiyev, 1971, 44-49. (RZhMekh, 5/72, No. 5B326)

Gilinskiy, S. M., T. S. Novikova, and V. P. Shkadova. Numerical solution to two-dimensional problems on external aerodynamics in the presence of combustion. IN: Trudy Sektsii po chislennym metodam v gazovoy dinanike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969, v. 3. Moskva, 1971, 29-49. (RZhMekh, 5/72, No. 5B331)

Ivanov, M. Ya., and A. N. Krayko. Direct calculation method for two-and three-dimensional supersonic flow. II. ZhVMMF, no. 3, 1972, 805-813.

Katskova, O. N., and P. I. Chushkin. Three-dimensional supersonic gas flow around bodies with nonequilibrium physico-chemical transformations. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu, Kiyev, 1971, 63-69. (RZhMekh, 5/72, No. 5B332)

Kosorukov, A. L. Supersonic flow around smooth bodies with relaxation. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu, Kiyev, 1971, 70-74. (RZhMekh, 5/72,No. 5B337)

Kryukova, S. G., and V. S. Nikolayev. Experimental investigation of optimally balanced profiles in viscous hypersonic flow. IN: Uchenyye zapiski TsAGI, no. 5, 1971, 94-98. (RZhMekh, 5/72, No. 5B377)

Kukarkina, M. A., and Yu. B. Radvogin. Application of divergent scheme for solution of flow problems. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu, Kiyev, 1971, 56-62. (RZhMekh, 5/72, No. 5B334)

Kyrurkchiyev, R. Flutter of two coaxial elastically-coupled cylindrical shells in supersonic gas flow. Teor. i pril. mekh., v. 2, no. 2, 1971, 7-11. (RZhMekh, 5/72, No. 5V289)

Leonov, B. P., S. V. Shteynman, and A. V. Kulikov. Methods for calculating burn-up in supersonic flow. FGiV, no. 4, 1971, 572-577.

Lerman, M. I. Hypersonic flow around a body of revolution subjected to fan jet blowing. VLU, no. 7, 1972, 96-101.

Lobanov, V. F., and Yu. I. Fadeyenko. Calculation of stress in an elastic sphere in hypersonic flow. IN: Sbornik. Dinamika sploshnoy sredy. Novosibirsk, no. 7, 1971, 226-232. (RZhMekh, 5/72, No. 5V285)

Mevlyudov, S. I. Linear theory of supersonic flow around a slender body in a two-phase mixture. IN: Sbornik. Voprosy vychislitel'noy i prikladnoy matematiki. Tashkent, no. 9, 1971, 156-165. (RZhMekh, 5/72, No. 5B1203)

Molodtsov, V. K., and A. N. Tolstykh. Calculation of supersonic viscous flow around blunt bodies. IN: Trudy Sektsii po chislovym metodam gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969, v. 1. Moskva, 1971, 37-54. (RZhMekh, 5/72, No. 5B335)

Myshenkov, V. I. Investigation of the initiation of flow discontinuity behind a plate using a numerical solution to the Navier-Stokes equations. IN: Trudy Sektsii po chislovym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969, V. 1. Moskva, 1971, 67-82. (RZhMekh, 5/72, No. 5B890)

Pavlov, B. M. Solutions to complete Navier-Stokes equations in problems on flow around blunt bodies. IN: Trudy Sektsii po chislovym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969, v. 1. Moskva, 1971, 55-66. (RZhMekh, 5/72, No. 5B887)

Perminov, V. D. and Ye. Ye. Solodkin. Axisymmetric body with minimum resistance at a specific heat flow to the surface. IN: Uchenyye zapiski TsAGI, no. 6, 1971, 32-40. (RZhMekh, 5/72, No. 5B345)

Popov, F. D., and I. M. Breyev. Finite difference calculation of flow around blunt bodies. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu. Kiyev, 1971, 50-55. (RZhMekh, 5/72, No. 5B336)

Rakhmatulin, Kh. A., and S. I. Mevlyudov. Supersonic flow around a slender body in a two-phase mixture. IN: Sbornik. Voprosy vychislitel'noy i prikladnoy matematiki, no. 9, Tashkent, 1971, 166-175. (RZhMekh, 5/72, No. 5B1204)

Saltanov, G. A. Sverkhzvukovyye dvukhfaznyye techeniya. (Two-phase supersonic flow.) Minsk. Izd-vo Vysheyshaya shkola, 1972, 480p. (LZhS, 23/72, No. 19483)

Sil'vestrov, V. V., and V. P. Urushkin. Method for determining density of high speed gas jets. IN: Sbornik. Dinamika sploshnoy sredy, no. 7, Novosibirsk, 1971, 125-129. (RZhMekh, 5/72, No. 5B477)

Senkovenko, S. A. Structure of underexpanded supersonic jets of CO_2. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu. Kiyev, 1971, 154-159. (RZhMekh, 5/72, No. 5B486)

Sokolov, B. A., and Yu. V. Troyankin. Gas flow and separated particles effect on melt film motion in a cyclone chamber. IVUZ Ener, no. 1, 1972, 144-147. (RZhMekh, 5/72, No. 5B504)

Stulov, V. P., G. F. Telenin, and L. I. Turchak. Supersonic flow around blunt bodies by various gas mixtures with high-speed chemical reactions. IN: Trudy Sektsii po chislennym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, v. 3, 1969. Moskva, 1971, 3-28. (RZhMekh, 5/72, No. 5B1114)

Timoshenko, V. I. Study of axisymmetric gas flow. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu. Kiyev, 1971, 94-98. (RZhMekh, 5/72, No. 5B346)

Tsvetkova, M. V. Characteristics of supersonic flow around blunt bodies under conditions of intensive injection. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu. Kiyev, 1971, 112-115. (RZhMekh, 5/72, No. 5B415)

Turanov, Ye. N. Heat transfer at a concave surface in supersonic flow. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu. Kiyev, 1971, 168-172. (RZhMekh, 5/72, No. 5B998)

Vasil'yev, M. M. Supersonic flow around a cone at an angle of attack. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu. Kiyev, 1971, 75-58. (RZhMekh, 5/72, No. 5B338)

Vlasov, V. I. Calculation of aerodynamic characteristics of an infinite flat plate in hypersonic rarefied gas flow. IN: Uchenyye zapiski TsAGI, no. 6, 1971, 116-118. (LZhS, 19/72, No. 61028)

Voytenko, D. M., A. I. Zubkov, and Yu. A. Panov. Flow regimes around three-dimensional obstacles with varying sweptback structure. IN: Trudy II Respublikanskoy konferentsii po aerogidromekhanicheskomu teploobmenu i massoobmenu. Kiyev, 1971, 116-121. (RZhMekh, 5/72, No. 5B343)

Yermak, Yu.N., and V. Ya. Neyland. Viscosity effect on shock wave separation in hypersonic flow around a cylinder. IN: Uchenyye zapiski TsAGI, no. 2, 1971, 41-47. (RZhMekh, 5/72, No. 5B315)

iii. Soil Mechanics

Baladinskiy, V. L. Dinamicheskoye razrusheniye gruntov. (Dynamic destruction of soils.) Izd-vo Kiyevskogo universiteta, 1971, 226p. (KL, 2/72, No. 1279)

Baryshnikov, G. P., M. I. Gol'tsev, B. L. Lerner, and G. S. Sokolov. Device for simultaneous recording and processing of seismic data. Otkr izobr, no. 16, 1972, No. 338870.

Bergman, E. D., and G. N. Pokrovskiy. Termicheskoye razrusheniye gornykh porod plazmoburami. (Thermal destruction of rocks by plasma storms.) Alma-Ata, Izd-vo Nauka, 1971, 175p. (KL, 13/72, No. 10891)

Drukovanyy, M. F., V. M. Komir, and V. M. Kuznetsov. Deystviye vzryva v gornykh porodakh. (Effects of explosions in rocks.) Izd-vo Naukova dumka (for publication in 1973). (NK, 23/72, No. 87)

Fadeyev, A. B. Drobyashcheye i seysmicheskoye deystviye vzryvov na kar'yerakh. (Crushing and seismic effects of explosions on pits.) Moskva. Izd-vo Nedra, 1972, 135p. (KL, 13/72, No. 10919)

Gavryushin, V. B., Ye. V. Zavalko, Sun'-Shun'-I, Yu. V. Brulev, I. A. Mikulin, V. A. Grodzenskiy, Ye. P. Vishnyakov, and I. S. Lev. Seismic signal analyzer. Otkr izobr, no. 16, 1972, No. 338872.

Gogonenkov, G. N. Raschet i primeneniye sinteticheskikh seysmogramm. (Calculation and application of synthetic seismograms.) Moskva. Izd-vo Nedra, 1972, 141p. (KL, 17/72, No. 14336)

Inzhenernyye metody upravleniya deystviyem vzryva na otkrytykh i podzemnykh rudnikakh. (Engineering methods for control of explosion effects in open and underground mines.) Magnitogorsk, 1971, 89p. (KL, 10/72, No. 8267)

Kucheryavyy, F. I., and Yu. M. Kozhushko. Razrusheniye gornykh porod. Uchebnoye posobiye dlya gornykh spetsial'nostey vuzov. (Destruction of rocks. Textbook for mining specialists at higher education institutions.) Moskva. Izd-vo Nedra, 1972, 240p. (KL, 16/72, No. 13498)

Kucheryavyy, F. I., and Yu. F. Khodakovskiy. Investigation of the destruction process in an elastic medium by explosions on transparent material models. Fiziko-tekhnicheskiye problemy razrabotki poleznykh iskopayemykh, no. 2, 1971, 81-90. (RZhMekh, 5/72, No. 5V620)

Mosinets, V. N. Deformatsiya gornykh porod vzryvom. (Deformation of rocks by explosions.) Frunze. Izd-vo Ilim, 1971, 188p. (KL, 15/72, No. 12620)

Motsonelidze, N. S. Ustoychivost' i seysmostoykost' kontrforsnykh plotin. (Stability and earthquakeproof quality of buttressed dams.) Moskva. Izd-vo Energiya, 1971, 295p.

Nematov, L. V. Propagation of one-dimensional spherical shock waves in soils. (Direct case.) IN: Sbornik. Voprosy vychislitel'noy i prikladnoy matematiki. Tashkent, no. 7, 1971, 115-119. (RZhMekh, 5/72, No. 5V501)

Padukov, V. A., V. A. Antonenko, and D. S. Podozerskiy. Razrusheniye gornykh porod pri udare i vzryve. (Destruction of rock from shock and explosion.) Leningrad, Izd-vo Nauka, 1971, 161p.

Plaksiy, V. O. Propagation of elastoplastic cylindrical blast wave in cohesive ground. DAN UkrSSR, Seriya A, no. 5, 1972, 460-465.

Rodionov, V. N. Mekhanicheskiy effekt podzemnogo vzryva. (Mechanical effects of an underground explosion.) Moskva. Izd-vo Nedra, 1971, 221p.

Savityuk, V. I., P. I. Plakhotnyy, and I. P. Sadovoy. Stress distribution in an anisotropic mountain mass from an explosive discharge. IN: Razrabotka rudnikovykh mestorozhdeniy, no. 13, 1972, 77-79. (RZhMekh, 5/72, No. 5V618)

Seysmicheskoye dvizheniye grunta. Voprosy inzhenernoy seysmologii. (Seismic movements in soils. Problems of seismological engineering.) Moskva. Izd-vo Nauka, no. 13, 1970, 203p.

Timoshin, Yu. V. Technique for determining seismic wave propagation rate using combined seismograms. Otkr izobr, no. 16, 1972, No. 338871.

Trofimov, V. D., and Yu. A. Yurmanov. Changes in stress deformation state in a coal bed in a critical zone due to explosive charges. IN: Nauchnyye trudy Leningradskiy gornyy institut, no. 4, 1971, 36-40. (RZhMekh, 5/72, No. 5V619)

Yefremov, E. I. Vzryvaniye s vnutriskvazhinnymi zamedleniyami. (Explosion with intra-borehole delay.) Kiyev. Izd-vo Naukova dumka, 1971, 170p. (KL, 15/72, No. 12617)

iv. Equations of State

Freydank, H., and M. Raetzsch. Second virial coefficients of binary gas mixtures with association taken into account. 1. Investigation using Stockmayer potential (12-6-3). Z. phys. Chemie v. 248, no. 1-2, 1971, 83-102. (RZhKh, 19 ABV, 11/72, No. 11B721)

Freydank, H., and M. Raetzsch. Second virial coefficients of binary gas mixtures with association taken into account. 2. Studies with a modified Kihara potential (12-6). Z. phys. Chemie, v. 249, no. 1-2, 1972, 33-40.

Zhdanov, V. A., and V. F. Konusov. On the theory of an equation of state for solids. IN: Sbornik. Itogi issledovaniy po fizike 1917-1967. Tomsk. Izd-vo Tomskiy universitet, 1971, 87-102. (RZhKh, 19ABV, 10/72, No. 10B577)

V. Atmospheric Physics

Alimov, V. A. Frequency correlation of fluctuations in radiowaves reflected from the ionosphere. Geomagnetizm i aeronomiya, no. 3, 1972, 548-551.

Benediktov, Ye. A., L. V. Grishkevich, and V. A. Ivanov. Simultaneous measurement of electron concentration and collision frequency in the ionospheric D-region using a partial reflections method. IVUZ Radiofiz, no. 5, 1972, 695-702.

Bukin, G. V., and Yu. K. Perekhatov. Properties of plane asymmetric plasma waveguides applied to shortwave propagation in inhomogeneities of the upper ionosphere. Geomagnetizm i aeronomiya, no. 3, 1972, 421-426.

Fizika ionosfery i rasprostraneniye radiovoln. (Ionospheric physics and radiowave propagation. Collection of articles.) Alma-Ata. Izd-vo Nauka, 1971, 174p. (KL, 8/72, No. 6527)

Gurvich, A. S., and A. P. Naumov. Principal possibilities of investigating atmospheric moisture content based on thermal radiation in the submillimeter wave range. FAiO, no. 5, 1972, 543-546.

Kallistratova, M. A., and V. V. Pokasov. Correlation measurement of "wandering" optical centers of gravity of spatially-limited beams in the atmosphere. IVUZ Radiofiz, no. 5, 1972, 725-731.

Kaplan, S. A., V. V. Kulinich, and S. F. Morozov. Calculation of excitation wave propagation from a light flash in a gas medium. FAiO, no. 5, 1972, 557-561.

Katasev, L. A., and V. F. Chepura. Investigation of movement of artificially ionized clouds in the upper atmosphere. Geomagnetizm i aeronomiya, no. 3, 1972, 473-476.

Kozyrev, B. P., and V. A. Bazhenov. Measurement of atmospheric vertical transparency in the infrared region using an artificial source. FAiO, no. 5, 1972, 552-556.

Kuz'micheva, A. Ye., L. I. Dorman, and N. S. Kaminer. Determination of shock wave velocity in an interplanetary medium. Geomagnetizm i aeronomiya, no. 3, 1972, 534-535.

Minullin, R. G. Signal path length during single-shock wave reflection from the E_s layer. IN: Trudy Sibirskiy NII metrologii, no. 11, 1971, 89-97. (LZhS, 19/72, No. 61387)

Mironov, V. L., and S. S. Khmelevtsov. Laser beam divergence during propagation in a turbulent atmosphere along an oblique path. IVUZ Radiofiz, no. 5, 1972, 743-750.

Naumov, A. P. Radiowave absorption by gas impurities in the atmosphere. IVUZ Radiofiz, no. 5, 1972, 682-694.

Protsessy v vysokikh sloyakh atmosfery. (Processes in upper atmospheric layers. Collection of articles.) Irkutsk, 1971, 171p. (KL, 2/72, No. 1202)

Starobinets, I. A. Average illumination and fluctuation intensity of a light beam focus in a turbulent atmosphere. IVUZ Radiofiz, no. 5, 1972, 738-742.

S''yedin, V. Ya., S. S. Khmelevtsov, and R. Sh. Tsvyk. Fluctuation intensity in a focused light beam passing through turbulent atmospheric strata. IVUZ Radiofiz, no. 5, 1972, 798-800.

Tsaplin, V. S., and L. V. Zubareva. Transient and spatial intensity distribution of excess radiation in the vicinity of the equator. Geomagnetizm i aeronomiya, no. 3, 1972, 536-537.

Voprosy chislennykh metodov analiza atmosfernykh protsessov. (Numerical methods for analysis of atmospheric processes. Collection of articles.) Leningrad. Izd-vo Gidrometeoizdat, 1971, 127p. (KL, 2/72, No. 1171)

vi. Miscellaneous Explosion Effects

Andriankin, E. I., V. K. Bobolev, and A. V. Dubovik. Collapse of an elliptic cavity and explosive initiation in a liquid layer under shock effect. ZhPMTF, no. 5, 1971, 78-85. (RZhMekh, 5/72, No. 5B665)

Barzykin, V. V., V. A. Veretennikov, Yu. M. Grigor'yev, and A. S. Rozenberg. Results of Third All-Union Symposium on combustion and explosions. FGiV, no. 4, 1971, 616-618.

Bezmenov, V. Ya., and P. I. Gorenbukh. Application of a nonstationary analog to an investigation of explosive wave effects on an obstacle in a hypersonic tunnel. IN: Uchenyye zapiski TsAGI, no. 6, 1971, 48-54. (RZhMekh, 5/72, No. 5V282)

Bobolev, V. K., I. A. Karpukhin, and V. A. Teselkin. Mechanism of shock explosive initiation in ammonium perchlorate mixtures with fuel additives. FGiV, no. 2, 1971, 261-264. (RZhMekh, 5/72, No. 5B272)

Borisenko, K. S. Vzryvy v kompressornykh ustanovkakh. (Explosions in compressor assemblies.) Izd-vo Naukova dumka. (For publication in 1973) (NK, 23/72, No. 85)

Deribas, A. A. Fizika uprochneniya i svarki vzryvom. (Physics of hardening and welding by explosions.) Novosibirsk. Izd-vo Nauka, 1972, 188p. (KL, 15/72, No. 12640)

Glazkova, A. P. Positive and negative catalyses and their safety factors during combustion of ammonium nitrate and its explosive derivatives. FGiV, no. 4, 1971, 528-536.

V. V. Gorbunov, A. A. Shidlovskiy, and L. F. Shmagin. Combustion of ammine perchlorates and nitrates of copper (II), nickel (II) and cobalt (III). FGiV, no. 4, 1971.

Gordiyenko, V. G., and Ye. G. Baranov. Primeneniye lineynogo mekhanicheskogo uskoritelya dlya resheniya nekotorykh zadach modelirovaniya vzryva. (Application of a linear mechanical accelerator for solution of problems in modeling explosions.) Frunze. Izd-vo Ilim, 1971, 75p. (KL, 2/72, No. 1285)

Ivanov, A., et al. Raketno-yadernoye oruzhiye i yego porazhayushcheye deystviye. (Nuclear missile weaponry and its destructive effect.) Moskva. Izd-vo Voyenizdat, 1971, 224p.

Kestenboym, Kh. S., F. D. Turetskaya, L. A. Chudov, and Yu. D. Shevelev. Euler and Lagrange methods for calculations of point explosions in a heterogeneous atmosphere. IN: Trudy Sektsii po chislennym metodam v gazovoy dinamike 2-go Mezhdunarodnogo kollokviuma po gazodinamike vzryva i reagiruyushchikh sistem, 1969, v. 3. Moskva, 1971, 85-100. (RZhMekh, 5/72, No. 5B238)

Khaffner, D. Yadernoye izlucheniye i zashchita v kosmose. (Nuclear radiation and protection in outer space.) Moskva. Izd-vo Atomizdat, 1971, 318p.

Krishtal, M. A., A. D. Lyuchkov, S. N. Verkhovskiy, and I. A. Goncharenko. Investigation of temperature and velocity conditions of plastic deformation during explosive extrusion. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov. Moskva, 1971, no. 3, (RZhMekh, 5/72, No. 5V378)

Krivokhatskiy, A. S., and V. I. Katsapov. Radiatsionnaya bezopasnost' pri tekhnicheskikh yadernykh vzryvakh. (Radiation danger during industrial nuclear explosions.) Moskva, 1971, 48p.

Mezhdunarodnyy kollokvium po gazodinamike vzryva i reagirushchikh sistem, 2-y Novosibirsk. 1969. Trudy sektsii po chislennym metodam v gazovoy dinamike. (Second international colloquium on gas dynamics of explosions and reactive systems, Novosibirsk, 1969. Transactions of the section on numerical methods in gas dynamics.) Moskva, v. 2, 1971, 419p. (KL, 8/72, No. 6480)

Moroz, E. M., S. V. Ketchik, and S. S. Batsanov. Formation of solid solutions of alkali halides from explosive effects. ZhNKh, v. 17, no. 6, 1972, 1775-1776.

Rusin, A. D. Explosive method determination of transition probabilities in the $A^1\Pi - X^1\Sigma$ system of an SiO molecule (bands 0-0, 0-2, 0-3, 2-3). VMU, no. 2, 1972, 196-200.

Safonov, L. V., et al. Veroyatnostnyy metod otsenki seysmicheskogo effekta promyshlennykh vzryvov. (Probability method of assessing the seismic effect of industrial explosions.) Moskva, Izd-vo Nauka, 1970, 64p.

Sanasaryan, N. S. Viscoplastic deformation of a pipe by an explosion, as a function of properties of the surrounding medium. FGiV, no. 4, 1971, 600-604.

Stolin, A. M., and A. G. Merzhanov. Critical conditions for a thermal explosion in the presence of chemical and mechanical heat sources. FGiV, no. 4, 1971, 502-510.

Strunin, V. A., and G. B. Manelis. Stability of a stationary combustion process in explosives limited by k-phase reaction. FGiV, no. 4, 1971, 498-501.

Trofimov, N. I. Explosion effects in an elastoplastic space. Linear form of the problem. IN: Sbornik nauchnykh trudov fakultet prikladnoy matematiki i mekhaniki VGU (Voronezhskiy universitet), no. 1, 1971, 21-38. (LZhS, 19/72, No. 61063)

Trofimov, N. I. Explosion effects in an elastoplastic space. Comment on a single loading of a special type. IN: Sbornik nauchnykh trudov prikladnoy matematiki i mekhaniki VGU (Voronezhskiy universitet), no. 1, 1971, 60-61. (LZhS, 19/72, No. 61062)

Trufakin, N. Ye., and V. M. Borovikov. Explosive pressure sensor. Otkr izobr, no. 15, 1972, No. 337667.

3. Geosciences

A. Abstracts

Chamo, S. S., N. S. Yefimkin, T. G. Borisova, G. M. Ayzenberg, V. Ye. Zin'kovskiy, and V. N. Belokopytov. Deep structure of the crust and upper mantle of the Voronezh anteclise. Moskovskoye obshchestvo ispytateley prirody. Otdel geologicheskiy. Byulleten', v. 46, no. 5, 1971, 27-33.

Results of the study of the deep structure of the crust and upper mantle of the Voronezh anteclise are presented. Continuous deep seismic sounding (DSS) was conducted along the 316-km-long Kupyansk - Voronezh - Lipetsk profile and point deep seismic sounding (PDSS) at 30 points in a 300-km-wide strip along the profile (Fig. 1).

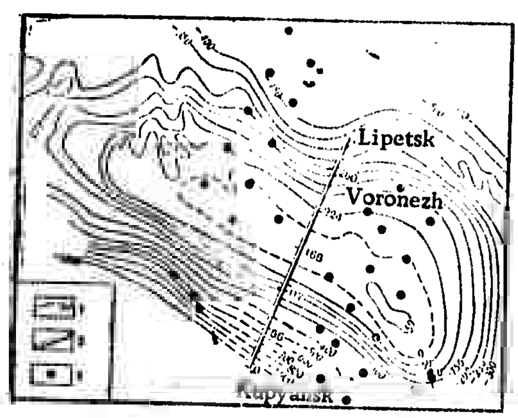


Fig. 1. Map showing DSS and PDSS profiles
1- Isolines of the crystalline basement
2- Kupyansk - Lipetsk DSS profile
3- PDSS points

In the inferred seismic section shown in Figure 2, the crust and upper mantle are finely layered. The thin layers are separated by crustal interfaces designated as d_o^o (crystalline basement surface), d_1^o, d_2^o, $d_1^* - d_6^*$, M (Mohorovicic discontinuity), and upper mantle interfaces $d_1 - d_4$.

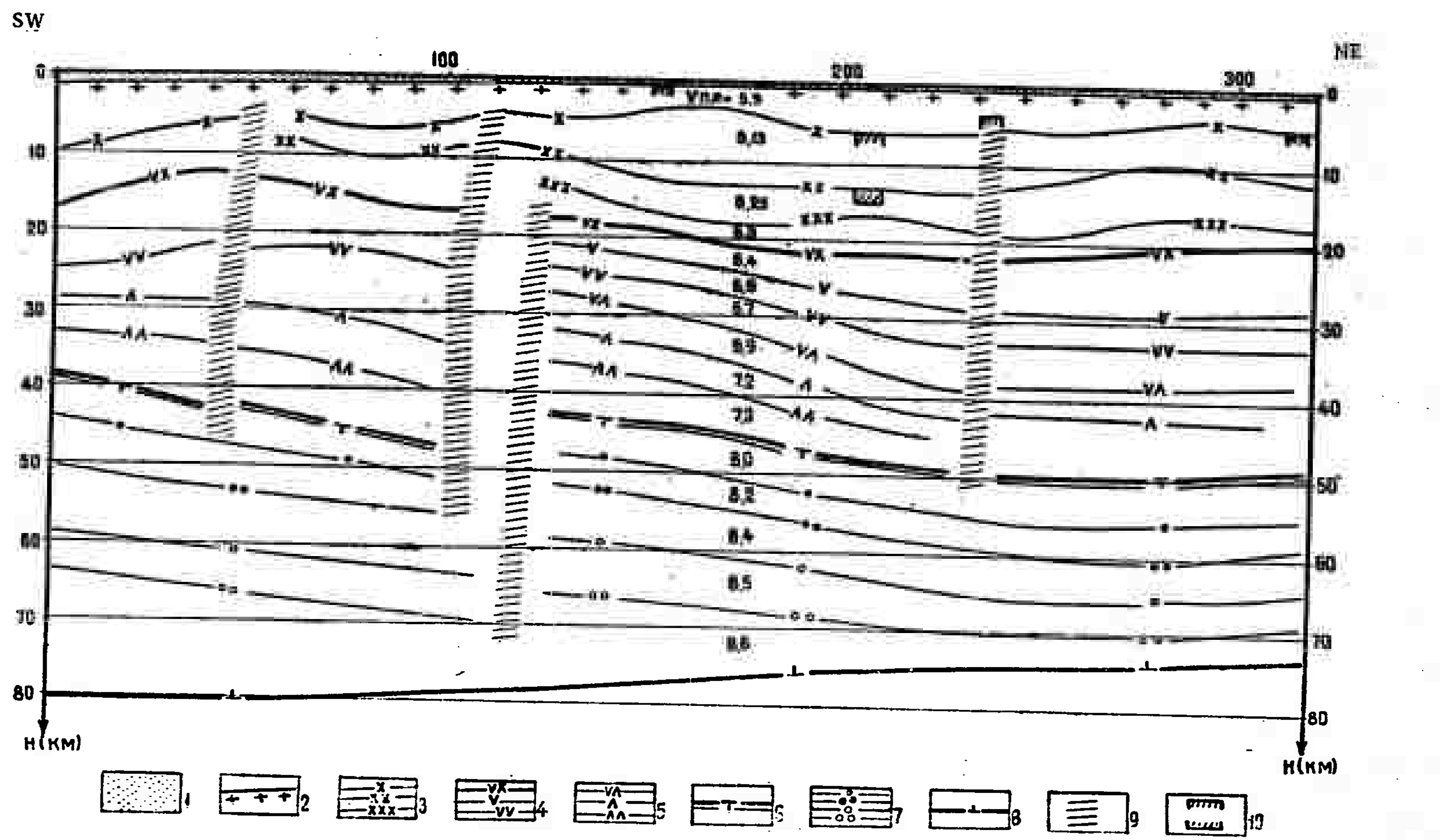


Fig. 2. Seismogeological section of the crust and upper mantle along the Kupyansk - Lipetsk profile

1- Sedimentary layer; 2- crystalline basement surface; 3- interface within the consolidated crustal complex; 4- interfaces within the upper granitic-metamorphic complex; 5- interfaces within the lower granitic-metamorphic complex; 6- Mohorovicic discontinuity; 7- upper mantle interfaces; 8- upper mantle interface identified by dynamic characteristics; 9- zones of deep-seated faults; 10- upper and lower edges of magnetic anomalies.

The crystalline crust is divided into consolidated (below the d^o interface) and granitic-metamorphic (below the d_1^* interface) complexes. The thickness of the consolidated complex varies from 10-11 km in the southwest to 20-22 km in the northeast portions of the section. Three interfaces, d_1^o, d_2^o, and d_3^o, are identified within the consolidated complex: the first two can be traced along the entire profile, while the third is limited to the central and northeastern portions of the profile. These interfaces are displaced and nonconformal with each other, as well as with the top of the complex.

The thickness of the granitic-metamorphic complex varies within broad limits. In the southwestern portion of the profile, the thickness sharply increases from 20 to 30 km, while in the central portion of the profile (arched part of the Voronezh anteclise) it decreases to 22 km, and in the northeastern portion of the profile it again increases to 28-30 km. The top of the granitic-metamorphic complex occurs at a depth of 12-13 km in the southwestern portion of the profile and plunges to the northeastern reaching a depth of about 20 km. Interfaces d_1^* - d_6^* are attributed to this complex. In the southwestern portion of the profile, only four of the interfaces (d_1^*, d_3^*, d_5^*, and d_6^*) are confidently identified. The structure of the complex is relatively simple, with a ridge-like uplift in the southwestern portion of the profile, revealed especially in the d_1^* and d_3^* interfaces. Other interfaces gradually plunge toward the northeast.

The Mohorovicic discontinuity plunges from a depth of 38 km in the southwest to a depth of 48-50 km in the northeast. In the arched part of the Voronezh anteclise, an uplift of about 4 km occurs in the Mohorovicic discontinuity.

Upper mantle interfaces (d_1 - d_4) conform with the Mohorovicic discontinuity, while the deepest of them (d_3) is nonconformal. This interface rises from 80 to 70 - 71 km toward the northeast.

The crust and upper mantle are divided into blocks by several zones of deep-seated faults. All of these faults extend from the upper part of the consolidated complex (interface d_1^o) to the upper mantle. Some of them are characterized by complex slippage. Along the Belgorod - Ol'khov zone, at interfaces within the consolidated complex and at the Mohorovicic discontinuity, the northeastern walls are upheaved, while at the interfaces of the granitic-metamorphic complex, the southeastern walls are downthrust. Along the Novooskol'sk zone, all northeastern walls are upheaved. The magnitude of slippage increases with depth, exceeding 4 km at the upper mantle interfaces. Along the Voronezh zone, a significant slippage occurs only at the Mohorovicic discontinuity.

The results are compared with results of seismic (DSS along the Bliznetsy - Shevchenkovo profile), magnetometric, gravimetric, and seismological studies of the region. It was found that: there is relatively good agreement in depth determinations to interfaces on the overlapping segments of the profiles; there exist intrinsic differences in the crustal structure between the southwestern and northeastern parts of the Voronezh anteclise. Zones of deep-seated faults coincide with the epicenters of weak earthquakes, and with a band of intensive magnetic anomalies, a zone of gravity gradient anomalies, and regional boundaries separating blocks with different characteristics in their gravity and magnetic fields.

It is concluded that:

1. The crystalline crust and upper mantle show thin layering which is typical of sedimentary complexes;

2. the block structure of the crust and upper mantle, though clearly identified, is less distinctive a feature than the fine layering;

3. all waves recorded both as first and later arrivals are reflected phases from different interfaces (excluding P_o^1, P_1^o, and P^M);

4. the lack of a sufficiently high contrast in velocity at the interface between the "granitic" and "basaltic" layers makes such crustal subdivision impossible;

5. according to the dynamic characteristics of the waves, the crystalline crust can be generally divided into a consolidated complex having a structure similar to the overlaying sedimentary complex and a granitic-metamorphic complex, with simpler structure.

Garkalenko, I. A., M. Ya. Komornaya, V. M. Mikhayiov, and A. S. Gurzheyeva. Regional deep seismic investigations of the Sea of Azov. IN: AN UkrSSR. Geofizicheskiy sbornik, no. 41, 1971, 3-15.

Results of deep seismic sounding conducted by the joint Black Sea expedition in the Sea of Azov in 1968 are described. Offshore profile 28 was recorded along a line from Kosa Obitochnaya in the north to Mys Kazantip in the south. The profile crossed different tectonic zones with sedimentary overburden ranging from hundreds of meters in the north to 10-15 km in the south segment. DSS profile 28, as well as onshore DSS profile X and two refracted-wave correlation method (RWCM) profiles run in 1961 are shown in Figure 1.

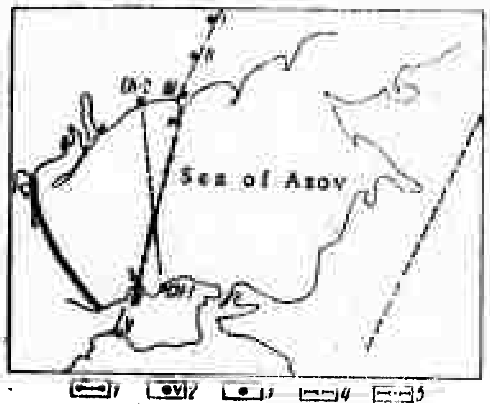


Fig. 1. Location of profiles
1- DSS profile 28 and recording vessels
2- shot points
3- shore stations
4- RWCM profiles
5- DSS profile X

The field procedure involved onshore shooting and offshore recording. Shot points (three in the north and two in the south coasts) were spaced 30 - 40 km apart. Total charge weights of 700 - 1000 kg were detonated in groups of 40, in 12 - 13-m-deep shot holes. Standard low frequency seismic recorders (Institute of the Physics of the Earth) were installed aboard each of the five recording ships, while three ships also were equipped with seismic recording systems developed by the "Dneprgeofizika" Trust. To calculate the depth of the basement surface, the velocity-depth function established from RWCM data was used, while for the depth of intercrustal interfaces, the velocity-depth function obtained for the Azov massif (DSS profile X) was used. The seismic section derived is shown in Figure 2.

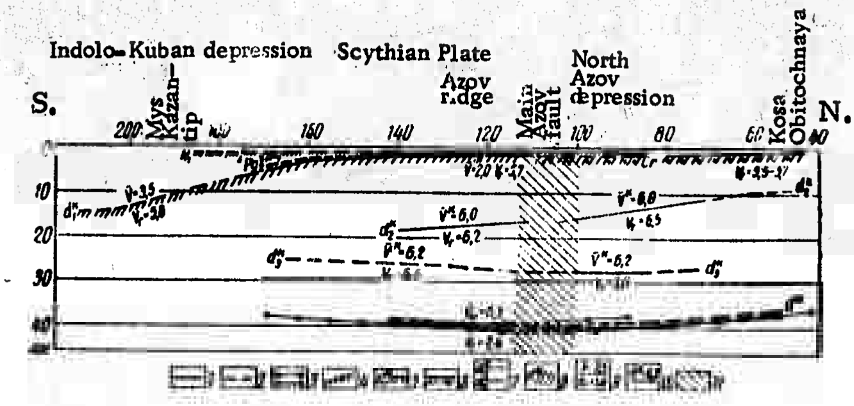


Fig. 2. Seismic section along profile 28.

1- Refracting interfaces determined by reversed time field; 2- refracting interfaces determined from unreversed time field; 3 and 4- reflecting interfaces from reflection measurement data; 5- consolidated crust surface; 6- Precambrian basement surface; 7- interfaces within the consolidated crust; 8- Mohorovicic discontinuity; 9- average and refractor velocities, in km/sec; 10- average velocity from the consolidated crust surface, in km/sec; 11- main Azov fault- a supposed deep seated fault on the boundary between the East European platform and Scythian plate.

A stratigraphic correlation of the interfaces identified is given in the table below.

Crustal interfaces and layers	Interface	Refractor Velocity v_r, km/sec
Sedimentary layers	d^{se}	2.5 - 4.5
Consolidated crust surface ("granitic" layer surface)	d_1^k	5.5 - 5.8
Interface within consolidated crust ("basaltic" layer)	d_2^k	6.2 - 6.4
	d_3^k	6.5 - 7.3
Mohorovicic discontinuity	d^M	7.4

Interface d_1^k (basement surface) underlies sedimentary cover with a thickness that sharply changes from the north to south ends of the profile. From a depth of 1.2 - 1.6 km in the central segment of the profile, d_1^k plunges, first gradually and later more steeply, to a depth of 15 km. The refractor velocity along the basement surface is V_r = 5.7 km/sec. Interface d_2^k in the upper consolidated crust is reliably determined by the time field method, with the average velocity of the overlying rock $\overline{V}$ = 6.0 km/sec. This interface dips sharply by 6^o - 10^o in the south, and its depth of occurrence varies from 9 to 19 km. The velocity along this interface is V_r = 6.5 and 6.2 km/sec north and south of the presumed fault zone, respectively.

Interface d_3^k in the lower consolidated crust is rather unreliably determined with $\overline{V}$ = 6.2 km/sec assumed for the overlying rock. The interface occurs at a depth of 76 - 78 km and is characterized by V_r = 6.5 and 7.0 km/sec south and north fo the presumed deep fault, respectively.

Interface d^M (the Mohorovicic discontinuity) is determined in two ways: as a reflecting and a refracting interface with $\overline{V}$ = 6.5 assumed for the consolidated crust. The refracting (V_r = 7.4 km/sec) and two reflecting interfaces are basically a repetition of each other. The Mohorovicic discontinuity occurs at a depth of 40 km in the central part of the profile and rises to 36 and 38 km in the north and south, respectively. The thickness of the consolidated crust decreases from 40 to 20 km in the south. The division of the consolidated crust into "granitic" and "basaltic" layers is considered only nominally for the sake of comparison with other DSS data. Using this division, d_2^k and d_3^k are proposed to be the top and bottom of a transition zone between the "granitic" and "basaltic" layers. If such a division is accepted, then the thickness of the "granitic" layer increases toward the south, reaching 16 km in the central segment of the profile, while the "basaltic" layer decreases from 15 to 7.5 km. The thickness of the "basaltic" layer is constant and does not exceed 12 km along the entire profile.

In the vicinity of recording point 100 (100^{th} km of the profile), a deep fault (designated as the Main Azov fault) was identified. It divides the consolidated crust into two blocks having different physical properties. The northern crustal block is characterized by higher seismic velocities. The lower seismic velocities of the southern block indicate the presence of an uplift beneath the Indol - Kuban foredeep.

Based on DSS results, it is concluded that the Main Azov fault penetrates the entire consolidated crust. It is probable that the boundary between the East European platform and the Scythian plate lies along this fault. The Mohorovicic discontinuity is obviously the top of the crust-to-mantle transition zone. Thus, the crustal structure beneath the Sea of Azov is more complex than previously assumed, based on DSS studies. Therefore, it is shown that marine DSS techniques, with shore-based shots, are quite feasible. It is pointed out, however, that bottom seismographs are unsuited to this technique, due to high background noise levels in shallow water.

Pavlenkova, N. I., T. V. Smelyanskaya. Characteristics of seismic discontinuities in the Earth's crust in the Ukraine. IN: Priroda seysmicheskikh granits v zemnoy kore, Moskva, Izd-vo Nauka, 1971, 45-54.

On the basis of a study of the dynamic and kinematic characteristics of wave fields recorded by DSS in the Ukraine, crustal seismic discontinuities were modeled and conclusions on their nature reached.

A thin-layered model of crustal discontinuities was found to be best fitted to the observed wave field. Small reflection as well as extensive reflection and refraction surfaces with complex inner layering were identified.

The inner structure of the Mohorovicic discontinuity in the Dnepr - Donets depression and Donets downwarp, which constitute the same tectonic structure but have a different geological evolution, are discussed. Beneath the Dnepr - Donets depression all reflection surfaces form an uplift; but beneath the Donets downwarp the upper reflection surfaces form uplifting and lower downwarping. Reflection surfaces in the latter instance were assumed to correspond to the bottom of the crust in different geological periods.

Vozhzhova, N. N., and S. S. Chamo. Characteristics of seismic discontinuities in the West Turkmen depression. IN: Priroda seysmicheskikh granits v zemnoy kore, Moskva, Izd-vo Nauka, 1971, 63-65.

Seismograms of near-normal (subcritical) reflections generated at intercrustal interfaces obtained by the method of reflected waves were analyzed. The seismograms were recorded with low-, medium- and high-frequency bandpass. The purpose was to study 1) the recording modes, 2) the capabilities of the method for detecting reflections from different crustal interfaces and, 3) the characteristics of crustal layering. Dynamic characteristics of the wave field recorded with filtering in the frequency range from 13 - 15 to 80 - 100 Hz are discussed. Plots of averaged amplitudes of the main reflections in the true ranges 0.5 - 4, 4.5 - 10, and over 10 sec and their dependence on resonant frequency of filtering were constructed.

A model is hypothesized of the crust-mantle transition zone, consisting of an interstratified thin layer (0.06 - 0.1 km) of gabbro-basalt with V = 6.8 - 7.0 km/sec and eclogite-peridotite with V = 8.1 - 8.2 km/sec.

Belyayevskiy, N. A., I. S. Vol'vovskiy, and V. Z. Ryaboy. Seismic layering of the Earth's crust and upper mantle. IN: Priroda seysmicheskikh granits v zemnoy kore, Moskva, Izd-vo Nauka, 1971, 6-31.

The authors give a comprehensive review of seismic data on the structure of the Earth's crust and upper mantle. The nature of seismic discontinuities and layers is discussed.

A multilayered model of the Earth's crust and upper mantle characterized by lateral velocity anisotropy and subhorizontal interfaces was developed using DSS data. Although a decrease of velocity in the lower part of granitic and basaltic layers has been established, a reliable method for identification of low velocity layers was not developed. The characteristics of variation of refractor, layer, and average velocity in the crust and upper mantle are discussed. Possible causes of crustal layering are examined, such as primary heterogeneity of composition, thermodynamic conditions, tectonics and regional metamorphism with applications to the regions given. The nature of the Mohorovicic discontinuity and upper mantle as interpreted by different authors is reviewed. Data on the main complexes of the continental and oceanic crust and the upper mantle are tabulated.

It is concluded that the DSS method does not yield persuasive evidence to support the absence of steep-sloping interfaces in the continental crust. Interfaces identified by DSS are averaged levels reflecting structural and other nonconformities and interfaces between petrographic complexes of rocks. Seismic discontinuities in the lower layers are caused by the process of regional metamorphism. Seismic discontinuities confined to the bottom of the granitic layer are due to chemical alteration while lower ones are the result of metamorphic phase transitions. Differences in physical properties and composition between granitic and basaltic layers are apparently connected with both primary crustal characteristics and superimposed processes of regional metamorphism. The Mohorovicic discontinuity in the continental and oceanic crust corresponds to a zone of regional eclogitization ("eclogite threshold") and to the interface dividing the peridotite complex of the upper mantle from the basaltic layer, respectively.

Rezanov, I. A. On the geological nature of crustal seismic discontinuities. IN: Priroda seysmicheskikh granits v zemnoy kore, Moskva, Izd-vo Nauka, 1971, 124-132.

The author develops the idea that intercrustal interfaces identified by DSS have a structural or lithologic-stratigraphic nature and that the Mohorovicic discontinuity represents an uplifting front of metamorphism superimposed on these interfaces.

The sections are described along the DSS profiles across the Greater Caucasus (Alpine, Hercynian, and Baikalian folded complexes), Northeastern USSR (Permian-Mesozoic, Lower - Middle Paleozoic and Baikalian folded complexes), and Central Kazakhstan (Lower Paleozoic folded complex) which support the idea that intercrustal interfaces correspond to the boundaries between large folded complexes. The formation of each new folded complex is followed by a plunging of the older ones and results in a gradual plunging of the crust into the mantle and an upward movement of the Mohorovicic discontinuity. Examples are given of nonconformities to intercrustal interfaces of the Mohorovicic discontinuity relief, and the heterogeneous structure of the upper mantle representing relict crustal structure, which also support the idea. The Conrad discontinuity corresponds to structural boundaries except in some downwarps (the South Caspian depression) where it represents a superimposed front of basification.

Zhdanov, V. V. On the nature of the Conrad discontinuity. IN: Priroda seysmicheskikh granits v zemnoy kore, Moskva, Izd-vo Nauka, 1971, 102-106.

The hypothesis that the Conrad discontinuity is of a metamorphic nature is assumed and the section of exposed basaltic layer of the Lapland block of the Baltic shield supporting it is described.

A gradual transition was observed along the 200 m section from hypersthene diorite (V = 6.4 -6.8 km/sec) into acid granulite and gneiss of amphibolite facies of metamorphism (V = 5.5 - 6.0 km/sec). This difference between velocities measured at 1000 atm is in agreement with the increase of velocity at the Conrad discontinuity observed by DSS in the same region.

An explanation for the seismic heterogeneity of the Conrad discontinuity and basaltic layer is given. Frequently observed increased seismic velocity in relatively uplifted blocks is associated with a frontal zone of consolidation occurring in the process of penetration of the basaltic layer (Young's modulus $9 - 10 \times 10^{-5}$ kg/cm^2) into the granitic layer (Young's modulus $5 - 6 \times 10^{-5}$ kg/cm^2) (analogous to a rigid punch penetration into plastic matter). The consolidated zone consists of garnet amorthosite, garnet amphibolites and eclogites. A refractor velocity higher than the velocity of the underlaying layers occurs possibly due to the small thickness of the consolidated zone. Lower velocities on the Conrad discontinuity are associated with the process of granitization due to vertical flow of juvenile matter into the basaltic layer.

Lutts, B. G., I. S. Tomashevskaya, A. P. Akimov, and N. Ye. Galdin. Paragenetic analysis of mineral associations of deep-seated rocks, and velocity of elastic waves in them at high pressures. IN: Priroda seysmicheskikh granits v zemnoy kore, Moskva, Izd-vo Nauka, 1971, 66-77.

On the basis of a paragenetic analysis of mineral associations, metamorphic rocks of eclogite and granulite facies were divided into groups corresponding to different facies and T-P conditions during metamorphism. The velocity of compressional waves at a pressure of 10-20 kbar was determined for each group of rocks. The purpose was to determine if metamorphic rocks at different depths in the Earth's crust and mantle are characterized by different velocities.

Laboratory data on velocity at various pressures, as well as the mineral composition and density of rocks are shown in tables. Results are summarized in Table 1 below.

Type of rock	Density at atm. conditions (gr/cm^3)	Pressure of metamorphism P_M (kbar)	Velocity at P_M (km/sec)	Temp. of metamorphism (^oC)
1. Crustal eclogites	2.98-3.40	8-10	7.30-7.70	650-750
2. Rocks of granulite facies:				
Quartziferous	2.60-2.90	~10	6.45-6.93	800-900
Quartzless	3.00-3.15	~10	6.80-8.00	800-900
3. Eclogite-like inclusions from pipes	3.10-3.30	15-20	7.70-8.20	1000-1300
4. Pyrope peridotite	3.10-3.15	> 20	7.70-8.50	1000-1400
5. Mantle eclogites from kimberlite pipes	3.30-3.56	>20	8.40-9.10	1000-1400

Table 1. Average velocity of compressional wave propagation for groups of metamorphic rocks.

The velocity of compressional waves in rocks was measured in samples and agreed with seismic wave propagation velocities through the crust and mantle. The velocity in mantle eclogites is 8.5-9.1 km/sec, and in the subcrustal part of the upper mantle it is 8.0-8.5 km/sec. Rocks of granulite facies are characterized by the same velocity at 6.7-7.8 km/sec as the "basaltic" layer. Crustal and mantle eclogites differ greatly in their chemical and mineralogical composition as well as in the density and velocity of compressional waves.

Rezanov, I. A., and V. I. Shevchenko. <u>Structure and origin of "basaltic" layer of the Caucasus and South Caspian.</u> IN: Priroda seysmicheskikh granits v zemnoy kore, Moskva, Izd-vo Nauka, 1971, 107-111.

A geological interpretation is given for the structure along the profiles crossing the Caucasus neck, Caspian Sea, and Transcaspian lowland.

As seen in Fig. 1, the submeridional strike of structures pre-

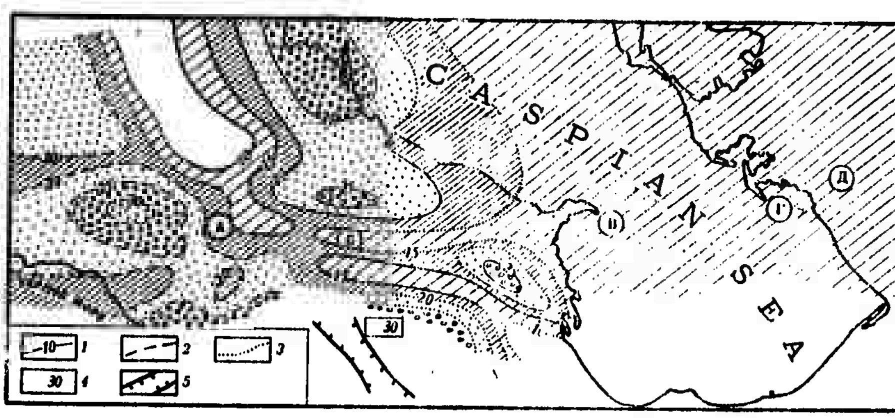


Fig. 1. Diagram of the "Basaltic" Layer Thickness.
1- depth isopleths by DSS data
2- by gravimetric data
3- hypothesized
4- thickness of the "basaltic" layer
5- transverse downwarp on the Lesser Caucasus

vails, which is transverse to the Caucasian structure. The band of large thickness (20-30 km) on the west adjoins a band of low thickness (10-15 km) on the east. Further to the east, the "basaltic" layer thickness increases to 20-25 km.

Two types of "basaltic" layer, designated as relict and newly-formed, were established. The first type represents the metamorphosed basement of the Archeozoic - Palezoic platform with preserved relicts of the old structure of the continental crust (submeridional strike) and extends over a large part of the region. The second type, formed in the process of basification of the crust, after which its lower parts acquire characteristics of the mantle, is confined to a narrow, very deep geosynclinal downwarp (the South Caucasian downwarp). In the case of the relict "basaltic" layer, the Conrad discontinuity can be regarded as an interface between different structural formations, and in the newly formed "basaltic" layer as a front of metamorphic transformation fo the crust.

Kulagina, M. V. Features of the Mohorovicic discontinuity relief within the Afghan - Tadzhik depression, Pamir, and South Tien Shan. DAN TadSSR, v. 14, no. 8, 1971, 18-21.

The Mohorovicic discontinuity relief was mapped using observational data from 30 earthquakes with energies of 10^{10} - 10^{13}. Observations were made at about 60 seismograph stations located in the Pamir, the Afghan - Tadzhik depression, South Tien Shan, the Fergana Valley, and Tashkent regions. The data were interpreted by a system of opposed and overtaking time-distance curves along five profiles. The Mohorovicic discontinuity relief is mapped in Fig. 1. A refractor velocity of 8, 0 ± 0. 1 km/sec and an average crustal velocity of 6, 1 ± 0. 1 km/sec were determined.

The structure of the Mohorovicic discontinuity relief corresponds pronouncedly to the three tectonic structures- the Afghan - Tadzhik depression, Pamir, and South Tien Shan. A minimum depth of 30-40 mm occurs in the Afghan - Tadzhik depression and a maximum of 62-72 mm between the Zaalay and South Alichur mountain ridges. Abrupt changes of the crustal thickness are associated with joint zones between different tectonic structures.

Within the boundaries of the Afghan - Tadzhik depression the crustal thickness increases toward its marginal parts, reaching 45-50 km toward South Tien Shan and 55-60 km toward Pamir. A sharp scarp on the Mohorovicic discontinuity is associated with the Ilyak fault separating the uplifted block of the Gissar Valley.

The Pamir block is characterized by a generally increased depth to the Mohorovicic discontinuity, 50 m on its west and 70 mm in the eastern parts. A disparity between the configuration of the Mohorovicic discontinuity relief and the Pamir tectonic structure was observed. The contour lines of the Mohorovicic discontinuity beneath the central part of Pamir are transverse to the structural element of the Pamir region.

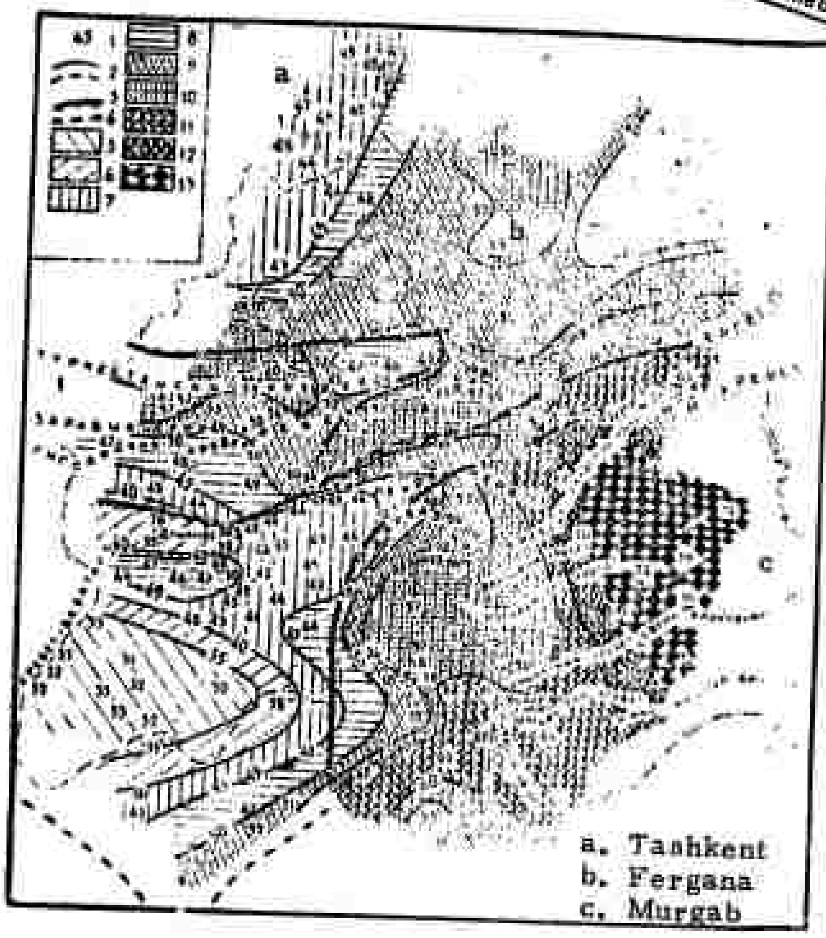


Fig. 1. Mohorovicic discontinuity relief
1- thickness of the Moho discontinuity
2- structure contours of the Moho discontinuity relief
3- zones of deep-seated faults
4- southern boundary of the Afghan-Tadzhik depression
Depth intervals in km
5- 30-35
6- 35-40
7- 40-45
8- 45-50
9- 50-55
10- 55-60
11- 60-65
12- 65-70
13- over 70

In the South Tien Shan region there is a conformity in the trend of surface structures and the isobathic lines of the Mohorovicic discontinuity. The depth of the Mohorovicic discontinuity increases from the west towards the east from 45 to 60 km. The maximum depth is associated with the southern parts of the Alay mountain ridge and the minimum with the southern slopes of the Gissar ridge. Within the intermontane depression, the depth to the Mohorovicic discontinuity is 50-55 km. An uplift of the Mohorovicic discontinuity to 45 km was observed beneath the Kuraminsk mountain.

Avdeyenko, N. S., V. G. Kolmogorov, and V. I. Shcherbik. Use of lasers in studying recent crustal movements. Geologiya i geofizika, no. 9, 1971, 79-83.

Electromagnetic methods for distance measurement are applied to the study of recent movements of the Earth's surface. Modern geodetic methods for base-line measurement using the travel times of radio and optical waves with amplitude and polarization modulation are most widely used. Although methods based on radio-wave travel time are less dependent on weather conditions, those using optical waves are more accurate and thus more suitable for the study of the Earth's deformations. With the introduction of the gas laser as a light source, distance-measurement accuracy has been improved. Further improvement is attributed to laser interferometers set up in a vacuum or gas lightguides.

Sources of errors such as low beam intensity and variation of the optical properties of the air along the beam path are discussed.

The use of laser interferometers in distance measurement makes it possible to solve problems such as: 1) measurement of the seasonal and diurnal deformations of the upper ground layers to adjust precision leveling results; 2) determination of variation and rate of deformation of the Earth's surface to assist in earthquake prediction; and 3) measurement of horizontal movement over large seismically active areas, with high accuracy and efficiency.

Tregub, F. S. Amplitude structure of first arrivals in DSS. Razvedochnaya geofizika, no. 40, 1970, 24-34.

Opposed amplitude-distance curves for first arrivals were sudied using DSS data obtained by continuous profiling along a 217 km long profile.

Based on the assumption that spatial distributions of seismic parameters can be approximated by the sum of a deterministic and a random field, amplitude-distance curves were expressed by

$$A(x) = \bar{A}(x) + \delta A(x). \qquad (1)$$

where $\bar{A}(x)$ is spatially well correlated, and $\delta A(x)$ is a random component.

The deterministic component $\bar{A}(x)$ was separated from experimental amplitude-distance curves by a "moving window" analysis with weighting function

$$f(t) = e^{-(x-x')/2\sigma^2} \qquad (2)$$

for $\sigma = 2.5$; 5.0; 10.0 km. The random component is calculated as

$$\delta \ln A = \ln A - \ln \bar{A}. \qquad (3)$$

It was found to consist of two portions: the first was well correlated and due to surface inhomogeneities in the vicinity of detection points; the second was due to inhomogeneities along the ray paths. They were divided and histograms of the latter component were plotted and compared with theoretical normal distribution curves. Amplitude-distance curves obtained by spatial filtering with various σ were considered.

Results show that the reciprocity principle holds true for the deterministic component of dynamic similarity as well as for kinematic parameters. The variation of the deterministic component is clearly connected with conditions in the vicinity of detection points, with an increase in the segment of the profile where the sedimentary cover is developed and a decrease in the segment of outcropping crystalline rocks. The random component consists of two parts: $\delta \ln(A) > 0.3$ well correlated, and $\delta \ln(A) < 0.3$ with normal distribution. The random component distribution of the amplitude-distance curve is a valid criterion for selection of σ.

Mikhaylova, R. S. Statistical similarity of groups of weak and microearthquakes. DAN TadSSR, v. 13, no. 1, 1970, 22-25.

Space-time distributions of earthquakes of different energy classes were analyzed for possibilities of similarity.

Observational data on microearthquakes (K = 3-6), weak earthquakes (K = 7-9), and strong earthquakes (K = 10) with focal depths up to 10 km obtained at the Chusal seismological observatory (Tadzhik SSR) were used.

Empirical distributions of true intervals between successive events of an earthquake group of various energy classes were compared using the Smirnov criterion. The hypothesis of the similarity of distribution curves according to this criterion should be rejected if

$$D_{k_ik_j} \quad D_{\beta}, \tag{1}$$

where

$$D_{k_ik_j} = |\varphi(x)_{k_i} - \varphi(x)_{k_j}| \tag{2}$$

is the maximum difference between distribution curves for i-th and j-th energy classes and

$$D_{\beta} = \sqrt{-\frac{1}{2}\ln\beta}\,\sqrt{\frac{1}{n_i}+\frac{1}{n_j}} \tag{3}$$

is the theoretical permissible maximum divergence. For $\beta = 5\%$ and $n_i = n_j = 300$,

$$D_{0.05} = 1.22\sqrt{\frac{1}{n_i}+\frac{1}{n_j}} \approx 0.099. \tag{4}$$

Calculated maximum differences between empirical distribution curves for 8 earthquake groups (K = 3 to K = 10) are tabulated. All calculated $D_{k_ik_j}$ are smaller than 0.099.

The spatial distribution for micro- and weak earthquakes was compared by correlating earthquake distributions with respect to S-P. Distribution curves were constructed for earthquake totalities characterized by $0 \leq$ S-P ≤ 4 sec, K = 5-10; $0 \leq$ S-P ≤ 6 sec, K = 6-10; and $0 \leq$ S-P ≤ 10 sec, K = 7-10.

Findings reveal that a similarity exists between empirical distributions of time intervals between successive events of an earthquake group within the large energy class range (K = 3-10). There is a high similarity of spatial distributions in the vicinity of the observation station between microearthquakes K = 5-6 and weak earthquakes K = 7-10.

Kovalevskiy, G. L. Kinematic and some dynamic characteristics of diffracted seismic waves. Geologiya i geofizika, no. 7, 1971, 101-110.

Equations of time-distance curves for waves diffracted at the edge bordering a sloping reflection surface in an arbitrary direction were developed. Time-distance curves calculated using the equations were compared to experimental curves obtained from models.

Equations were derived for different cases in terms of: φ - angle of dip of reflection interface, φ^*- angle between edge and observation surface, β - angle between direction of dip of reflection interface and projection of the edge onto the observation surface, and α- angle beween the observation profile and the edge projection as follows:

1. $\varphi^* = \varphi$	Edge in the direction of interface dip
2. $\varphi^* \neq \varphi$	Edge in an arbitrary direction
3. $\beta = 0^o$	The same as (1)
4. $\beta = 90^o$	Edge in the direction of strike of interface (equal to the case $\varphi = 0^o$)
5. $\alpha = 90^o$	Profile perpendicular to edge
6. $\alpha = 0^o$	Profile parallel to edge (equal to the case of reflected waves)

An ultrasonic three-dimensional modeling study of kinematic and dynamic characteristics of diffracted waves was made. Observations were along profiles with $\alpha \leq 90^o$. Experimental time-distance and amplitude-distance curves of diffracted and sum waves were compared to theoretical curves. The diffracted wave amplitudes reach the maximum at the point of contact of time-distance curves of diffracted and reflected waves. This amounts to 1/2 of reflected wave amplitude regardless of α. With a decrease of α, the diffracted wave amplitude increases and the time-distance curve flattens out. At $\alpha = 0^o$, the time-distance curve of diffracted waves coincides with that of reflected waves, their amplitudes amount to 1/2 or less than reflected wave amplitudes, and attenuate according to the same law.

Theoretical time-distance and amplitude-distance curves for the waves reflected by a flexure were compared with theoretical curves for waves diffracted at an edge. Waves diffracted from the edge were found to be difficult to discriminate from those reflected by a convex or concave segment of an interface. Reflected wave amplitudes were significantly higher then diffracted wave amplitudes.

B. Recent Selections

Aliyev, A. M. Spectral function of P waves for a space divided into a three-layer medium. IN: AN Azer SSSR. Izvestiya. Seriya nauk o Zemle, nos. 5-6, 1971, 33-37.

Aranovich, Z. I., et al. Basic trends in the development of seismic instrumentation. IN: AN SSSR. Izvestiya. Fizika Zemli, no. 5, 1972, 21-27.

Belokurov, V. S. Field of compressional-wave velocities in the crust of the Black Sea region. IN: AN Ukr SSR. Geofizicheskiy sbornik, no. 44, 1971, 10-18.

Berzon, I. S. Accounting for attenuation in computing theoretical seismograms for discontinuous media. IN: AN Ukr SSR. Geofizicheskiy sbornik, no. 44, 1971, 36-46.

Bondarenko, A. T., and N. Ye. Galdin. The physicomechanical and electrical properties of basalts under high pressures and temperatures. IN: AN SSSR. Izvestiya. Fizika Zemli, no. 5, 1972, 28-40.

Davtyan, Kh. H. An algorithm for velocity determination in seismic research. IN: AN Ukr SSR. Dopovidi. Seriya B. Heolohiya, heofizika, khimiya ta biolohiya, no. 5, 1972, 429-432.

Drumya, A. V., and N. Ya Stepanenko. Effect of errors in the initial parameters on the final result of earthquake susceptibility computations. IN: AN SSSR. Izvestiya. Fizika Zemli, no. 5, 1972, 60-64.

Eyyubov, F. D. Distribution of karst caves in the vicinity of the Shushinskoye Plateau. IN: AN Azer SSR. Izvestiya. Seriya nauk o Zemle, nos. 5-6, 1971, 56-61.

Fomenko, K. Ye., et al. Structure of the Precambrian crystalline basement in the eastern part of the Caspian depression, based on seismic data. Geologiya nefti i gaza, no. 5, 1972, 67-72.

Glogovskiy, V. M., et al. Selection of a wave equation for computing synthetic seismograms for attenuating media. IN: IVUZ. Geologiya i razvedka, no. 6, 1972, 111-119.

Gontova, L. I. Kinematic aspects of refracted waves in media having sharply sloping interfaces. IN: AN Ukr SSR. Dopovidi. Seriya B. Heolohiya, heofizika, khimiya ta biolohiya, no. 5, 1972, 425-428.

Kapitanova, S. A. Dispersion of the phase velocities of Rayleigh waves in Crimea. IN: AN SSSR. Izvestiya. Fizika Zemli, no. 5, 1972, 72-76.

Khalevin, N. I. Seismic studies of the crust in the Ural area. IN: AN SSSR. Ural'skiy nauchnyy tsentr. Sostoyaniye i perspektivy razvitiya geofizicheskikh metodov na Urale (Status of and prospects for the development of geophysical research methods in the Ural area). Sverdlovsk, 1971, 105-124.

Khalevin, N. I., et al. Shear waves recorded during deep seismic sounding in the Ural area. IN: AN SSSR. Ural'skiy nauchnyy tsentr. Sostoyaniye i perspektivy razvitiya geofizicheskikh metodov na Urale (Status of and prospects for the development of geophysical research methods in the Ural area). Sverdlovsk, 1971, 125-133.

Kharitonov, O. M. Application of the ray method in computing theoretical seismograms of reflected waves in a medium with spectral properties. IN: AN Ukr SSR. Dopovidi. Seriya B. Heolohiya, heofizika, khimiya ta biolohiya, no. 5, 1972, 438-440.

Klyushin, I. G. The nature of a series of seismic interfaces in the lower zone of the lithosphere. IN: AN Ukr SSR. Geofizicheskiy sbornik, no. 44, 1971, 3-9.

Lukk, A. A., and V. S. Ponomarev. Tendency of seismic noise to vary with time. IN: AN SSSR. Izvestiya. Fizika Zemli, no. 5, 1972, 3-11.

Pavlenkova, N. I., et al. Basic types of multiple waves for observations at great distances from the source. IN: AN Ukr SSR. Geofizicheskiy sbornik, no. 44, 66-75.

Rudnitskiy, V. P. Polarization properties of body waves. IN: AN Ukr SSR. Geofizicheskiy sbornik, no. 44, 1971, 57-65.

Rykunov, L. N., and Fam Van Tkhukh. Study of the effect of local discontinuities on the field of Rayleigh waves. IN: AN SSSR. Izvestiya. Fizika Zemli, no. 5, 1972, 65-71.

Tomashevskaya, I. S., and Ya. N. Khamideullin. Burst precursors for rock samples. IN: AN SSSR. Izvestiya. Fizika Zemli, no. 5, 1972, 12-20.

4. Particle Beams

A. Abstracts

Balkarey, Yu. I. and E. M. Epshteyn.
Coulomb shielding in a strong electromagnetic field. FTT, no. 3, 1972, 741-745.

The effect is analyzed of a strong electromagnetic field on the shielding of a static charge by an electron cloud in the electron plasma of a crystal. A dipole approximation is introduced on the assumption that the e-m wave amplitude varies over a distance greater than the charge dimension, the Debye shielding radius, and the electron oscillatory amplitude. In a collisionless plasma, the condition $\omega_p \tau \geq 1$ must be satisfied, where ω_p is the plasma electron frequency and τ is the electron relaxation lifetime. An integral equation of the scalar potential function $\varphi(q, t)$ was derived in an approximation of chaotic phases from the wave equation using Poisson's equation. The potential φ describes the static charge field. Using the known expansion of the Bessel function $J_s(z)$, the constant component of φ is expressed by

$$\varphi_0(\mathbf{r}) = \int \varphi_0(\mathbf{q}) e^{-i\mathbf{qr}} \frac{d\mathbf{q}}{(2\pi)^3} = \int \frac{d\mathbf{q}}{(2\pi)^3} e^{i\mathbf{qr}} \frac{4\pi\rho(\mathbf{q})}{q^2} \sum_{s=-\infty}^{+\infty} \frac{J_s^2(\mathbf{aq})}{\varepsilon(\mathbf{q}, s\Omega)} \quad (1)$$

where r is the distance from the shielded charge to the observation point, q is a coordinate in the Hamiltonian of the analyzed system, $\rho(q)$ is the Fourier component of a static charge, a is the oscillatory amplitude of electrons in the wave field, $\epsilon(q)$ is the static dielectric constant, and Ω is the electromagnetic field frequency. By introducing

$$\frac{1}{\varepsilon_{eff}(\mathbf{q})} = \sum_{s=-\infty}^{+\infty} \frac{J_s^2(\mathbf{aq})}{\varepsilon(\mathbf{q}, s\Omega)} \quad (2)$$

in (1), a formula for the effective static dielectric constant $\epsilon_{eff}(q)$ is obtained. The formula (1) together with (2) describe the effect of an electromagnetic wave on static distribution of φ.

The component $\varphi_0(r)$ of φ is calculated on the assumptions that the shielded charge is a point charge ($\rho(q) = Ze$), $\Omega \geq \omega_p$, and r satisfies inequalities $r \geq \lambda$ and $\chi r \geq 1$, where λ is the characteristic electron wavelength and $\varkappa$ is the Debye radius reciprocal. Under these assumptions, (1) becomes

$$\varphi_0(\mathbf{r}) = \frac{4\pi Ze}{\epsilon_0}\int \frac{dq}{(2\pi)^3}\frac{e^{iqr}}{q^2}\left[1 - \frac{\varkappa^2}{q^2+\varkappa^2}J_0^2(aq)\right] \quad (3)$$

When a is much smaller than the Debye radius ($\varkappa a = F \leq 1$), the formula (3) is approximated by

$$\varphi_0(\mathbf{r}) = \frac{Ze\varkappa}{\epsilon_0}\left\{\frac{e^{-R}}{R}\left[1 + \frac{F^2}{2}\left(\cos^2\alpha + \left(\frac{1}{R}+\frac{1}{R^2}\right)(3\cos^2\alpha - 1)\right)\right] - \right.$$
$$\left. - \frac{F^2}{2R^3}(3\cos^2\alpha - 1)\right\}, \quad (4)$$

where $R = \varkappa r$, and α is the angle between the r and E_o vectors.

In the presence of an electromagnetic field, it follows from (4) that the potential distribution is anisotropic and contains exponentially decreasing terms which predominantly contribute to the φ_o value at long distances. An electromagnetic wave thus induces a "shielding breakdown". At $R \longrightarrow \infty$, $\varphi_o(r)$ acquires a quadrupole instead of a dipole form, because the average dipole moment is zero in a high-frequency field. If $R \geq \max(2F, 1)$ and $\alpha = 0$, it follows from (4) that φ_o acquires the asymptotic form $\varphi_o = -(Ze\varkappa/\epsilon_o)(F^2/R^3)$, regardless of the F value.

Analogous mathematical operations, using linearized equations of motion and continuity, led to the conclusion that formulas (1) and (2) are also applicable for frequent collisions in an electronic gas, when $\omega_p \tau \leq 1$. Formulas (3) and (4) are also satisfied if the condition $\Omega \geq \omega_c$ (where $\omega_c = D\varkappa^2$ is the reciprocal of the Maxwellian relaxation lifetime and D is the diffusion coefficient) is substituted for $r \geq \lambda$ and $\varkappa r \geq 1$. In contrast to the collisionless plasma, the formulas of a and $\epsilon(q, \omega)$ are explicit.

In summary, "breakdown" of shielding occurs at a sufficiently high e-m field frequency regardless of the status of collisions in the electron gas. Numerical calculations show for example that the condition $\Omega \geq \omega_p$ is satisfied for n - InSb with an average electron concentration $N_o \cong 10^{16}$ cm^{-3} at $\Omega \cong 10^{14}$ sec^{-1}. At low temperatures, $E_o \cong 10^5$ V/cm is required to achieve $F \cong 1$. The condition $\Omega \geq \omega_c$ is satisfied for n-Si with $\rho \sim 10^3$ ohm x cm at $\Omega \cong 10^{10}$ sec^{-1} and room temperature; $E_o \cong 10^3$ V/cm is sufficient to achieve $F \cong 1$. The examples demonstrate that the "breakdown" of shielding can occur at reasonably attainable field values in the i-r and shf ranges.

Yegorov, N. V., G. N. Fursey, and S. P. Manokhin. Common characteristics in the laws of field emission from n- and p-type semiconductors. FTT, no. 10, 1971, 3110-3112.

The authors point out that the occurrence of a saturation region in the Fowler-Nordheim curves is an inherent feature of the p- and n-type semiconductors. A study on this effect was made with a high resistance n-Si specimen (300 ohm•cm); the experimental method was similar to that described by Fursey et al (Phys. Stat. Sol., 22, 39, 1967; Phys. Stat. Sol., 32, 23, 1969; and FTT, 11, 1969, 3672). Results are shown in figures 1 and 2. It was noted that the voltage drop at the emitter does not lead to rectification of the volt-ampere characteristic (Fig. 1). Transition

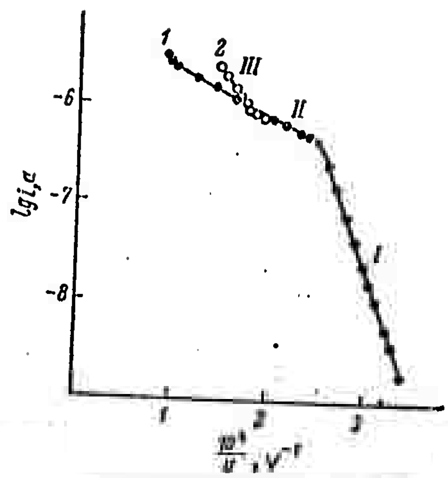


Fig. 1. V-a characteristic of n-Si at room temperature. 1 - general type, 2 - with correction of voltage drop ΔU in a crystal.

from the saturation region is followed by the appearance of photosensitivity and compression of the emission image. Compression of the emission image sharply slows down with the beginning of avalanche multiplication of carriers in region III of the v-a characteristic (Fig. 2, curve 2, point A). For n-type as opposed to p-type semiconductors, the saturation current is quite high and depends on the doping level of the material. Emission current in region II of the v-a characteristic depends only slightly on vacuum conditions up to a pressure of 1×10^{-5} torr. The results generally confirm the earlier theoretical predictions of Fursey et al, and show the generally common

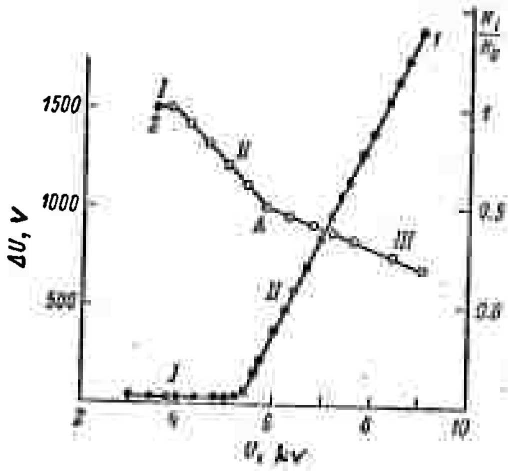


Fig. 2. Relationship $\Delta U = f(U)$ - 1 and Ri/Ro = f(U) - 2. Ro - size of emitted image in region I.

factors governing field emission from both n- and p-type materials.

Kabanov, A. N., and Ye. Ye. Chernova-Stolyarova. <u>Study of processes occurring from the action of intense electron beams in liquids.</u> FiKhOM, no. 6, 1971, 97-98.

The mechanism of channel formation in liquids due to an intense electron beam was explained in an earlier work of Vol'fson and the authors (Behavior of intense electron beams in liquids, FiKhOM, no. 5, 1971). In the cited test the rate of channel deepening was found to drop sharply from the initial 100 m/sec to an approximately constant value of 10 m/sec. The decrease is connected initially with an increase of vapor density in the channel. The subsequent establishment of a constant rate is explained by the appearance of an equilibrium between vapor formation and its elimination (at a rate of 10^5 cm/sec) from the channel due to a pressure release on the bottom. A mathematical expression is established for the pressure release. For a 100 kev electron beam of 100μ diameter and a maximum electron travel of 100μ, pressure at the bottom of channel was 100 atm. Electron beam passage through dielectric liquids causes micro--breakdowns when the field intensity of the accumulated discharge in the liquids exceeds the breakdown value of field intensity of the given liquid. The vapor formed in the channel is in an ionized form and generates a plasma. Using a Langmuir probe, measurements were made of the ionized vapor state and volt-ampere characteristics were obtained. The electron temperature in the channel was 3.5 x 10^5 °K and the electron density was Ne = 10^{14} cm^{-3}. The cited liquid in these tests was a type VKZh-94 vacuum oil.

Brodskaya, B. Kh. Certain phenomena in liquids under the effect of pulse discharges. EOM, no. 2, 1971, 39-44.

Results are described of an experimental investigation on the development of discharges in strong electrolytes in relation to physico-chemical properties of the medium, the value of pulsed energy, and system characteristics, resulting from the introduction of an organic admixture. Experiments were performed with a high-voltage pulse device, in which discharge parameters could be varied with voltages to 50 kv. and capacitance from 0.0022 to 3 μf. Discharge development was controlled by the synchronous recording of electrical, optical and, as appropriate, spectral effects. Pulsed double-beam oscillographs OK-17, OK-19, a SFR-2 streak camera, and an ISP-51 spectrograph were used. Experiments were conducted in hermetically sealed reactors made of stainless steel and plexiglass. The discharge development process was studied for a symmetric gap with point-point electrodes and an asymmetric point-plane system at different polarity of pulsed voltages and interelectrode gap variation of 3-25 mm. Physico-chemical characteristics of liquid solutions of tested salts, acids and alkalies are given in Table 1. Results show that plasma

Table 1.

Soln.	γ, $ohm^{-1}cm^{-1}$	C, g mol	λ, $ohm\,cm^{-2}$/g eq.	$λ_∞$, $ohm\,cm^{-2}$/g eq.	p, μsec	$\frac{1}{\varepsilon}\cdot 10$ [illegible]	$ΔG_H$, kcal/mole
NaCl	$3,3\cdot 10^{-3}$	0,91	75	126	30,1	0,2	176
	0,133*	1,98	67	"	0,68	3,0	"
	0,188*	1,2***	42	"	0,32	20	"
H_2SO_4	0,133*	0,31	211	330	2,1	7,8	249
	0,165	0,11	202	"	1,72	6,6	"
	0,188*	0,51	184	"	1,24	6,0	"
HCl	0,188*	0,68	263	426	0,95	5,2	79
	0,244	1,9***	212	"	0,61	4,3	"
NH_4Cl	0,188*	1,81	99	"	0,61	3,2	151
	$3,3\cdot 10^{-3}$	0,024	229	150	31,3	0,27	180
	0,13*	0,6	222	253	1,26	5,5	"
KOH	0,22*	2,18	105	"	0,37	3,0	"
	0,32	4,2***	75*	"	0,18	2,0	"
NaOH	0,22*	2,15	98,6	218	0,48	3,0	208
$KNaSO_4$	0,24	3,05	75*	"	0,63	2,5	"
	0,13*	1,0***	63,8	85	0,11	1,2	425

* Equal specific electrical conductivity
** Approximate values of equivalent electrical conductivity
*** Equal molar concentration

breakdown is possible in strong electrolytes up to a specific conductance of 0.3 ohm^{-1} cm^{-1}. The influence of chemical composition of non-organic electrolytes on discharge development is discussed. The main characteristics of pulsed discharge are given for H_2SO_4, KOH and NaCl liquid electrolytes at γ = 0.135 ohm^{-1} cm^{-1}, U = 30 kv and L = 15 mm (Table 2.).

Table 2

Symbol	Units	H_2SO_4			KOH			NaCl		
		C, μf								
		0 6	1,2	2,4	0,6	1,2	2,4	0,6	1,2	2,4
I_m	ka	3,0	4,4	5,8	2,9	4,0	5,2	2,7	3,7	4,9
t	μ sec	8,8	11,2	16,2	8,7	11,2	16	8.7	11,2	15
P_m	kw	63	83	93	62	80	91	55	69	80
R_{min}	ohm	4,0	2,0	0,12	1,0	2,3	1,3	4,0	2,0	1,5
$l_{\cdot}$	mm	4,5	5,0	10	3,0	4,0	5,0	3,0	3,5	4,5
l_{-}	mm	2,5	3,1	5	2,5	3,5	4,5	2,8	3,2	4,0
T	μ sec	15	22	48	33	48	58	44	65	86

At a specific conductance γ = 0.135 ohm^{-1} cm^{-1} and an energy value in the discharge gap from 50 to 1500 joules, a sharp distinction is observed in the character of discharge development, depending on the pH of the medium for H_2SO_4, KOH, and NaCl. Introduction of an organic substance in a strong electrolyte causes a significant change in the discharge development characteristics (increases current in the predischarge period; and evidently contributes to an increase in the dehydration level of ions, decreases their radius, increases mobility, and facilitates electron multiplication). Eight streak camera pictures, five oscillograms and two graphs are given in the article.

Shchepetov, V. N. Characteristics of material dispersion from the action of pulsed electron beams. FiKhOM. no. 6, 1971, 93-96.

Results are described of focused electron beam experiments in piercing of small diameter holes in heat-resistant alloys. For one of the experiments (Fig. 1), electron beam parameters were: E = 65 kv

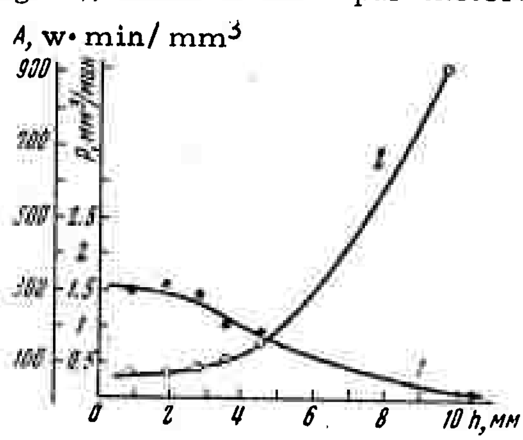


Fig. 1. Relationship of efficiency P, (1), and energy content A, (2), of the dispersion process from the depth of pierced hole.

(accel. voltage), I = 1.5 ma (average beam current), T = 10 msec (repetition interval), and τ = 1 msec (pulse duration). The beam penetrated the alloy VZL-101 as thick as 10.5 mm. By varying parameters of the beam, a very high beam processing rate was obtained together with a high beam power density (10^9 watt/cm^2) at comparatively lower voltages. A formula for the beam processing rate closely approximating the experimental results is discussed.

Study conclusions are:

1. The high speed effect of electron beams can be explained by the explosion-like character of a dispersion substance in solid, liquid, and vapor states. At the beginning of a pulse, a considerable portion of the substance does not undergo phase transition.

2. Processing rate sharply increases with an increase in the relationship of the beam current to its diameter.

3. At a constant power source, the processing rate can be increased, but the energy capacity of the process decreases due not only to the beam diameter decrease, but also to an electron energy decrease.

4. The depth of the hole formed by an electron beam can be increased not only be increasing electron beam power, but also by arranging the cross-over below the initial crater.

5. The relationships derived on the process of forming holes by an electron beam will permit low cost determination of optimum regimes for processing of detail parts.

Gaponov, V. A., and V. S. Nikolayev. <u>Accelerator tube.</u> Author's certificate USSR no. 299989, published March 26, 1971, 2 p.

An accelerator tube with magnetic focusing lenses is introduced. The tube consists of sectionalized insulated segments and electrodes. With the aim of increasing the electric field gradient along the tube, plates are placed on the electrodes near the aperture for charged particle beam transmission. The plates are located on alternate electrodes in a diametrically opposite manner, forming a periodic inclined system. The plates are comb-shaped with teeth equivalent to elementary Faraday cylinders. Details of the accelerator tube are shown in Fig. 1.

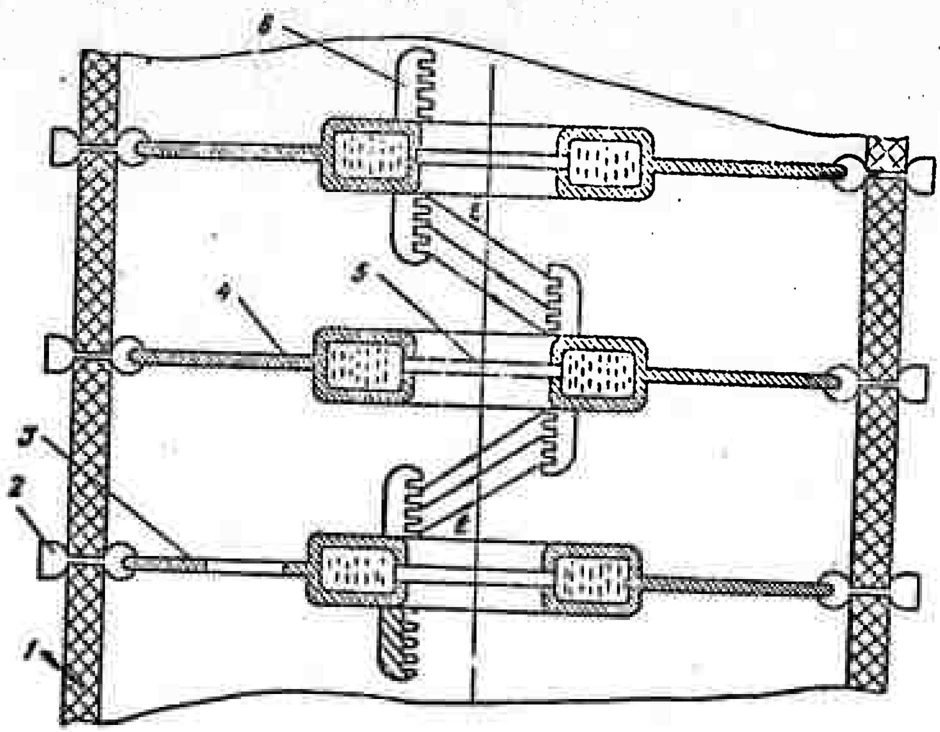


Fig. 1. Section of accelerator tube.
1- accelerator ring
2- split metallic electrodes
3- internal electrodes
4- focusing magnetic lenses
5- apertures
6- flat plates
E- electric field

Kul'man, V. G., E. A. Mirochnik, and V. M. Pirozhenko. Linear charged particle accelerator. Author's certificate USSR no. 279822, published March 26, 1971, 2 p.

A linear charged particle accelerator operating on a $\pi/2$ wave is described. The accelerator consists of H-profile accelerating and coupling elements with coupling windows. To increase the coefficient of cell coupling, the cells are in the form of ring resonators. The connecting windows between the accelerating and coupling cells are placed with a mutual relative offset in azimuth. The design provides for simple welding of sections and ease of evacuation. Details are shown in Fig. 1.

(Fig. 1 on following page)

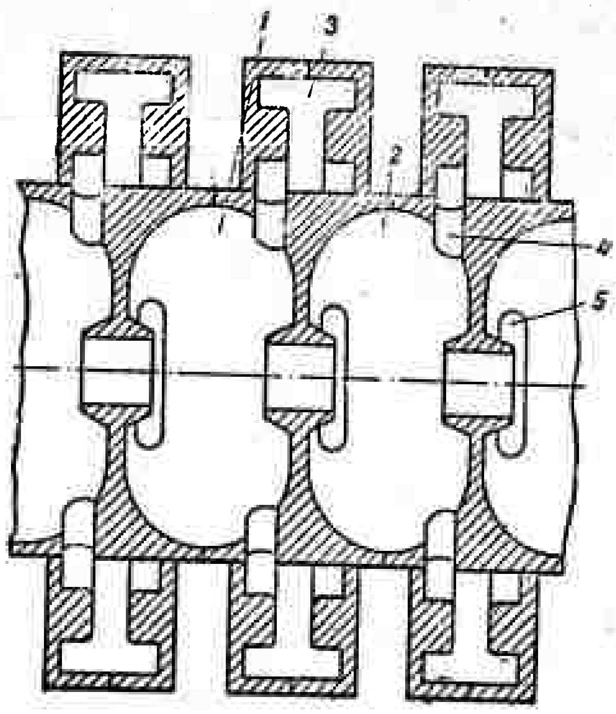
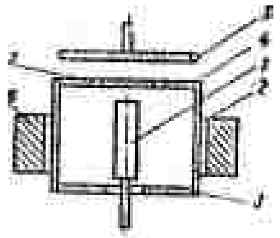


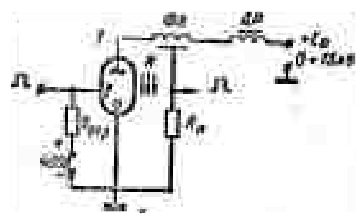
Fig. 1. Section of linear accelerator.
1, 2- Toroidal accelerating cells
3- Coupling cells
4, 5- Coupling windows

Vishnevskiy, A. I., V. I. Krizhanovskiy, A. I. Soldatenko, and A. I. Shendakov. The trio-plasmatron: A new pulse-regulated gas discharge device with crossed fields. IVUZ Radioelektr, no. 1, 1972, 117-118.

The trioplasmatron device with a cold cathode and a permanent magnet is described and results are given for tests in a pulse modulator circuit. The trioplasmatron (Fig. 1a) consists of a cylindrical control electrode 1, around which a cylindrical cold cathode 2 is coaxially placed with disc and plates 3 and 4. An anode 5 is fixed over the upper end plate with an annular slot 7. All electrodes are placed in a vessel (not shown in the figure) filled with H_2 at 10^{-2} torr; the pressure is maintained constant by means of a hydrogen generator. A circular permanent magnet 6 is attached to the device, producing a linear magnetic field. When a high voltage is applied on the anode 5, discharge does not take place between the anode and cathode due to the shielding of the cathode gap by the upper end plate 4. Discharge between the anode and screen 4, under the cathode potential, similarly does not take place since the distance between anode and screen is significantly smaller than the length of the free-path of electrons at 10^{-2} torr. When a voltage of 400-800 v is applied on the control electrode, a glow discharge is established between the electrode and cathode in crossed electric and magnetic fields. This discharge acts as a source for the initial ionization of the anode circuit. Trioplasmatron testing was conducted in a linear pulse modulator circuit as shown in Fig. 1b. The device is triggered by a generator with pulses of 650 V amplitude and 3 μsec duration; the initiating discharge current was 2 ma. At U_a = 10~15 kv, anode pulsed current Ia = 300 - 500 a, and discharge delay and periodic instability did not exceed 0.65μ sec and 6 nsec, respectively. The shape of current pulses is similar to those obtained in a commercial thyratron. Formation time was 70-100 nsec. The possibility of operating the trioplasmatron in a short pulse regime was also studied. The device was stable in the following regime: U_a = 10 kv, I_a = 300 a, f = 1500 Hz, τ_a = 100 nsec, R_H = 15 ohm.



(a)



(b)

Fig. 1. Trioplasmatron
(a) configuration
(b) pulse modulator:
T- commutating hydrogen trioplasmatron
DR- charging choke
FL- shaper line
R_H- load resistance
R_{ogr}- limiting resistance (τ_a = 1 sec, R_H = 15 ohm, f = 250 Hz

Kraft, V. V., and V. M. Stuchenkov. Effect of nonmetallic impurities and coatings in microsections of a cathode on vacuum breakdown. ZhTF, no. 1, 1972, 88-93.

Results are described of experimental studies on the effect of nonmetallic impurities and carbon and oxygen coatings on microsections of an iron cathode surface on the breakdown of small interelectrode gaps at room temperature and a residual gas pressure of 10^{-6} torr. Figure 1 shows the experimental device. A discharge was established between a spherical molybdenum anode of 1 mm diameter and an interchangeable cathode of 7 mm diameter and 2 mm thickness. Cathode specimens tested were: (1) pure electrolytic iron; (2) electrolytic iron with FeS, sizes up to

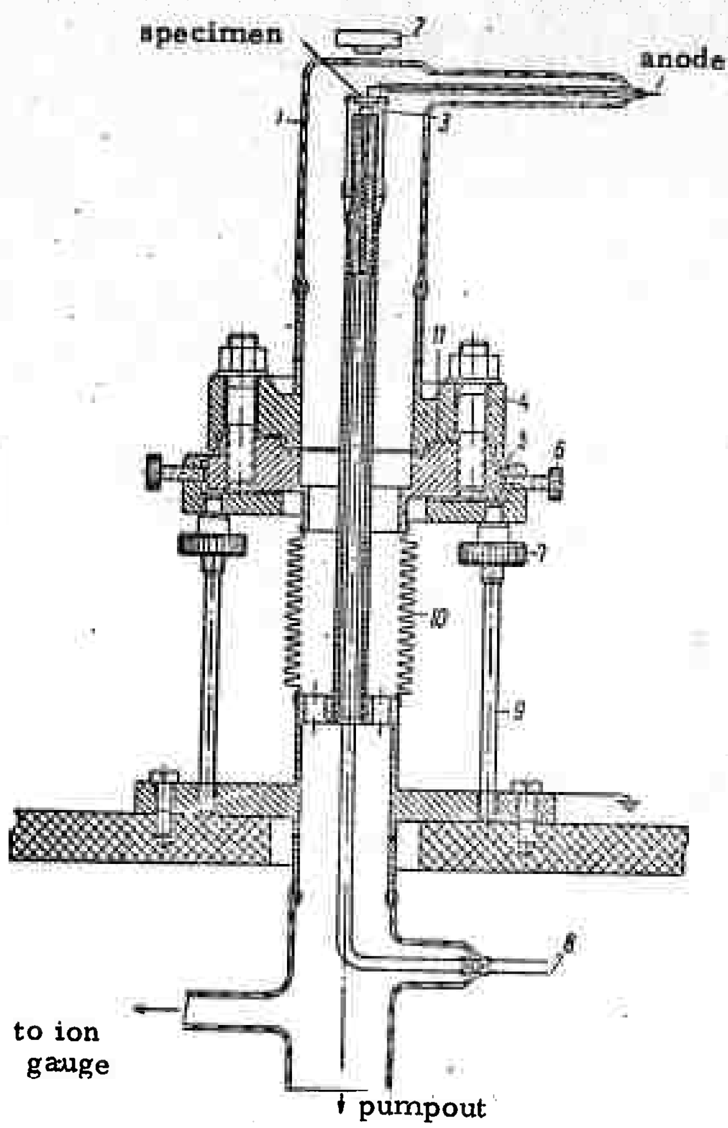


Fig. 1. Experimental device
1- glass chamber
2- microscope objective
3- tungsten heating coil
4- flange
5- sliding flange
6- regulating screw
7- nut
8- molybdenum heater inlet
9- supporting rod
10- steel bellows
11- copper gasket

30 μ; (3) electrolytic iron with SiO_2, sizes 100-500 μ; (4) electrolytic iron with Al_2O_3, sizes 50-500 μ; (5) iron, fused by vacuum smelting and containing FeO, sizes up to 5 μ; (6) fused iron (by direct reduction), with globular SiO_2 content, sizes up to 10 μ; (7) electrolytic iron covered by a carbon coating of ~0.4 mm; and (8) Armco-iron with an oxide coating of ~0.2 μ thickness. Experimental procedures are outlined and electrical stability data on the air gap (0.05 mm) for the cathode impurities and coatings are tabulated. Microphotographs are given, which show discharge traces on various specimens.

Conclusions of the work are:

1. Discharge traces during vacuum breakdown concentrate on nonmetallic impurities.

2. Nonmetallic impurities in in iron and steel, with the exception of large impurities, do not significantly affect vacuum gap stability.

3. Thin carbon coatings on an iron surface lower vacuum gap stability but subsequently restore it to a maximum value after several flashovers.

Rosinskiy, S. Ye., and A. A. Rukhadze. The problem of injecting a relativistic electron beam into a plasma. ZhTF, no. 12, 1971, 2504-2512.

Fields and currents induced in plasma during the injection of relativistic electron beams were studied. Beam density was assumed to be smaller than plasma density; the beam is thus considered as a small perturbation. Mathematical expressions and solutions are obtained which are applicable for analyzing disturbed electric and magnetic fields, and charge and current density starting directly from the moment of injection and to any distance from the injector. The problem is stated in two ways: (1) beam injection with a finite time τ, and (2) beam injection in a finite interval between $z = 0$ and $z = \ell_0$. Findings show that in a time less than the electron plasma collision time the induced fields and currents are a superposition of fields and currents accompanied by a beam (static in a stationary beam system) and transient fields and currents, substantially resulting from the onset of injection and vanishing with a time lapse of a prolonged electron collision duration.

Vagin, Yu. P., G. L. Kabanov, Yu. A. Medvedev, and B. M. Stepanov. Method of visualizing space distribution of dose in a powerful pulsed high-speed electron beam. Atomnaya energiya, v. 32, no. 1, 1972, 73-75.

The scattering field of high-speed electrons, and the luminosity field in air were investigated by photoelectronic and photographic methods; and luminosity field characteristics were compared with results of approximation theory on multidimensional electron scattering. Electron beams of 1 and 4 Mev were used with a pulsed electron current of 0.1 and 3.0 a, a pulse duration of 2 and 1.2 μsec, and a frequency of 400 and 25 Hz, respectively. Electron beams were dispersed in air forming a typical luminous cone. A photoelectronic detector (an FEU and Faraday cylinder) simultaneously recorded the luminous intensity and electron current. Luminescence was observed in a small volume of air ($\sim$1 cm^3), placed in the Faraday cylinder and confined by an inlet diaphragm ($\sim$1 cm). The results are given of measurements of the luminescence intensity and the electron current in a lateral cross-section of an electron beam at a distance of 3 cm from the outlet window of the accelerator (Fig. 1). Measured by three different methods,

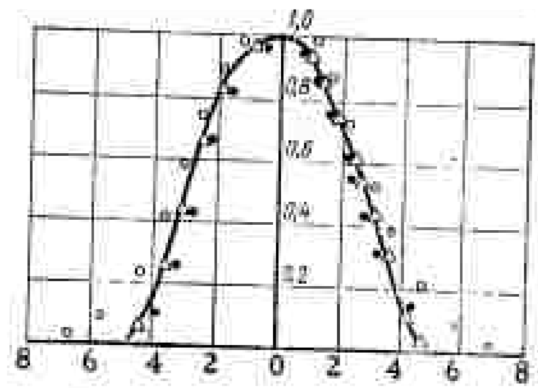


Fig. 1. Lateral distribution of the intensity I of luminous air. (• - photoelectronic method; o- photographic method) and electron current with 1 Mev energy (Δ)

the results are in good agreement and deviate from the mean Gaussian distribution curve by not more than ± 10%. The comparison of experimental results with calculations using approximation theory on multidimensional electron scattering is plotted in Fig. 2. These results agree well for the 4 Mev electron beam; however, for the 1 Mev beam satisfactory agreement began to appear only at a distance of about 10 cm.

(Fig. 2 on page following)

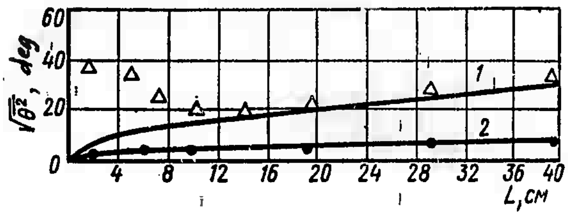


Fig. 2. Relationship of electron scattering angle θ in air to distance L along the beam axis.
1, 2- calculated curves for 1 and 4 Mev electrons
•, Δ- experimental curves for 1 and 4 Mev electrons

Yeliseyev, B. V., and Yu. P. Mordvinov. Distribution of charged and neutral particles along a cross-section of a positive column in a high-current discharge. ZhTF, no. 12, 1971, 2534-2538.

A problem on the distribution of charged and neutral particles over a cross-section of a discharge column is solved by a system of hydrodynamic equations. The system consists of an equation of motion, an equation of particle conservation, and Maxwell's equation for the plasma of a positive isothermic column, taking into account the motion of neutral particles at intermediate pressures. The distribution of charged and neutral particle density along the radius is obtained by assuming ion recombination on the wall and the reflection of neutrals from the wall with a coefficient of accomodation equal to zero. Computer-assisted calculations were made to find the relationship of charged and neutral particle densities for Hg and H_2. The results are plotted in Figures 1 and 2. With an increase of current the limiting value of charged particle density for H_2 falls and the neutral particle density increase is insignificant (less than 1%, not shown in Fig. 2). With an increase of current, the charged particle density for Hg falls slightly (from 0.08 to 0.06), but neutral particle density rises and reaches 1.82 at I = 300 a. The ionization frequencies of $2 \cdot 10^6 sec^{-1}$ calculated for H_2 and $2 \cdot 10^4 sec^{-1}$ for Hg are quite close to experimental values.

The following conclusions are drawn:

1. The charged particle density profile for light gases is mildly sloping and becomes steep with an increase of current; a pinch-effect results in the column. Charged particle density on the wall however is sufficiently high $[n(1) \sim 0.5]$. Neutral particles are essentially uniformly distributed.

2. The charged particle density profile for heavy gases is relatively steep $[n(1) \sim 0.1]$; an increase in current has practically no effect on n(r) due to the small amount of ion and neutral particle motion. Neutral particles are distributed with a positive gradient along r. The gradient and the density limit of the neutrals rise with an increase of current. The ratio

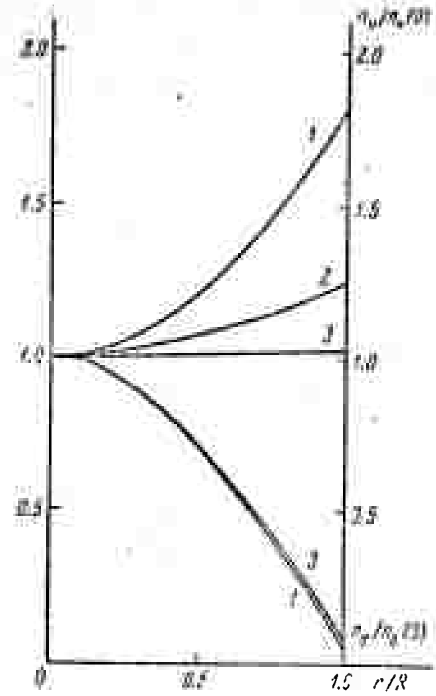


Fig. 1. Distribution of charged and neutral particle density for a discharge in Hg.
1- 300 a
2- 100 a
3- 10 a

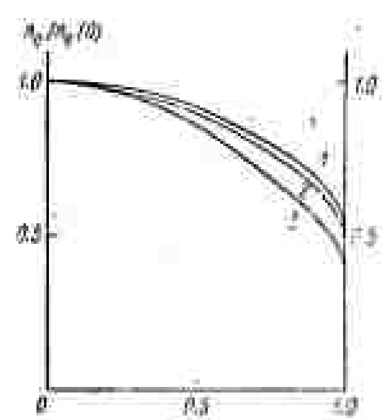


Fig. 2. Distribution of charged particle density for a discharge in H_2.
1- 5 a
2- 15 a
3- 25 a

of the neutral density limit to the axis reaches several units at currents on the order of hundreds of amperes.

Rukhadze, A. A., and V. G. Rukhlin. Injection of a relativistic electron beam into a plasma. ZhETF, v. 61, no. 1, 1971, 177-189.

This article deals with theoretical asymptotic investigations of induced charges, currents, and electromagnetic fields, resulting from the injection of an electron beam into a plasma. The plasma was assumed to be free of other external fields. Only high-speed processes were taken into account; thermal movements of particles were neglected. Mathematical expressions were obtained for induced charges, currents, magnetic fields, and dielectric permeability. The problem is represented by a series of mathematical terms, so that the general formulas obtained can be ap... to systems at any moment of time during the injection of a finite length electron beam into the plasma. At conditions $r_o > c/\omega_p$, where r_o- beam radius and ω_p- plasma frequency, plasma perturbations are localized in the region of the electron beam itself; and currents induced in the plasma tend to compensate the beam magnetic field, facilitating its injection into the plasma. If the beam injection time $\tau > T_o = \gamma^{-1} (r_o \omega_p/c)^2$ (where γ is the plasma electron collision frequency), magnetic field compensation occurs at distances $z < z_o = u\tau_o$ from the beam front, where u is the directed electron velocity. For a high-current electron beam when the magnetic energy of beam current exceeds the kinetic energy of electrons, simplified injection into a dense plasma is possible only for the case where $\omega_p > c/r_o$ and $\tau < \tau_o$.

Krasovitskiy, V. B., and K. K. Namitokov. Feasibility of increasing power density in a focused spot during electron-beam processing of materials. FiKhOM, no. 2, 1972, 15-18.

A method is proposed for increasing beam power density during electron-beam processing of materials by focusing the beam such that radial beam dispersions are decreased and beam current density is increased. The basis of this method lies in the sign-inversion effect of coulomb force of the electron beam interaction, produced during passage of highly modulated beams through a resonator, when the modulated beam frequency is less than the resonator threshold frequency. The modulated beam forms successive bunches moving at a distance ℓ from one another with a velocity V_o in a cylindrical resonator. The problem is represented by a series of equations and an expression is found for the radial beam density distribution; a numerical example is also given.

Zolotykh, B. N., A. I. Marchuk, and M. S. Sen'kina (deceased). Investigation of the surface of tungsten single crystals after treatment by electro-erosion. FiKhOM, no. 1, 1972, 145-150.

Changes in the crystalline structure of surface layers, resulting from the action of electrical erosion, are studied on the basis of tungsten single crystals. The influence of the electrical discharge-pulse parameters and of the crystallographic orientation of the cutting plane of tungsten single crystals upon the value of the erosion and the nature of destruction of the surface layers is shown. The tungsten single crystals were obtained by zone melting with electron beam heating. The desired crystallographic orientation of the cutting plane was derived on the UPS-55 X-ray installation by means of a goniometric head with an accuracy to within 1^{o}. Erosive action was obtained with a pulsed beam of 400--8000 μj and 0.7--2 μsec duration.

The character and value of the changed layer in relation to the pulse parameters was studied on the basis of cutting planes with the crystallographic orientation (100), (110), and (111). Layers 5 - 7 microns thick were successively removed, in order to study the distribution of structural changes by a metallographic method under a microscope, and by the microhardness method on an instrument with a twenty-gram load. The value R_z was adopted as the measure of surface roughness. The measurements failed to show that the value of R_z depended to any essential degree upon the pulse duration and the crystallographic orientation of the cutting plane. The treatment of tungsten single crystals by electrical erosion is accompanied by structural changes of the surface layer to a depth of up to 70 microns. The obtained data confirm the fact that in the erosion process, an essential part is played by thermal stresses developing under the influence of nonuniform and unsteady heating of the zone adjacent to the region of action of the charge.

It was shown from metallographic analysis that besides purely thermal destruction, the electrical erosion of tungsten single crystals is accompanied by brittle destruction; the total value of erosion depends upon the crystallographic orientation of the cutting plane. A microhardness increase of the treated surface in comparison to the initial surface indicates the development of plastic deformation (cold hardening) in the layer, which is of a polycrystalline nature. Greatest strengthening of the defective layer occurred with specimens oriented in the (110) plane. The article includes microhardness characteristic curves and microphotos of eroded specimens.

B. Recent Selections

Aleksakhin, I. S., G. G. Bogachev and Ye. N. Postoy. Features of excitation functions of lithium and sodium atoms above ionization threshold. OiS, v. 32, no. 5, 1972, 1045-1047.

Aleksandrov, V. M., N. N. Karlson, A. A. Nesterov and N. P. Filippova. Dynamic compensation of particle beam motion in accelerators. SOAN SSSR. Avtometriya, no. 1, 1972, 37-46.

Altyntsev, A. T., B. N. Breyzman, A. G. Yes'kov, O. A. Zolotovskiy, V. I. Koroteyev, R. Kh. Kurtmullayev, V. L. Masalov, D. D. Ryutov, and V. N. Semenov. Collisionless relaxation of an ultra-relativistic electron beam in a plasma. IN: Plasma phys. and contr. nucl. fusion res. Proc. 4th int. conf., Madison, Wis., U.S.A., 1971. Vol. 2. Vienna, 1971, 309-324. (RZhF, 5/72, #5G232)

Bagirov, M. A., M. A. Kurbanov and N. E. Nuraliyev. Optical image of an electric discharge in an air gap confined by dielectrics. EOM, no. 2, 1972, 9-12.

Bakay, A. S., A. K. Berezin, G. P. Berezina, L. I. Bolotin, A. M. Yegorov, N. S. Yerokhin, V. P. Zeydlits, V. I. Ivanov, A. N. Izmaylov, A. F. Kivshik, V. A. Kiselev, O. F. Kovpik, Ye. A. Kornilov, Yu. Ye. Kolyada, S. M. Krivoruchko, V. I. Kurilko, Ye. I. Lutsenko, N. S. Pedenko, L. A. Mitin, S. S. Moiseyev, A. P. Tolstoluzhskiy, Ya. B. Faynberg, V. D. Shapiro and V. I. Shevchenko. Experimental study of nonlinear effects during interaction of nonrelativistic and relativistic beams with plasma. IN: Plasma phys and contr. nucl. fusion res. Proc. int. conf. Madison, Wis., U.S.A., 1971. Vol. 2. Vienna, 1971, 113-139. (RZhF, 5/72, #5G231)

Balbekov, V. I., and P. T. Pashkov. Vzaimodeystviye intensivnogo puchka s rezonatorami uskoryayushchikh stantsiy pri kriticheskoy energii (Interaction of an intense beam with resonators of accelerators at critical energy). In-t fiz. vysok. energ. SKU 71-72, Serpukhov, 1971, 17 p. (RZhF, 5/72, # 5A361)

Bel'kov, Ye. P. Rabota iskrovykh upravlyayemykh razryadnikov pri bol'shoy chastoti povtoreniya moshchnykh impul'sov toka (Operation of arc-regulated spark gaps at a high repetition rate of powerful current pulses). AN SSSR, Moskva, 1971, 16 p. (RZhF, 5/72, #5G324 DEP)

Bondarenko, B. F. Problem of determining evaporation temperatures of powder specimens in an arc discharge. ZhPS, v. 16, no. 5, 1972, 774-779.

Borodin, V. S., V. D. Gebekov, and Yu. M. Kagan. Plasma diagnostics of a pulsed discharge in mixtures containing hydrogen. OiS, v. 32, no. 5, 1972, 1033-1035.

Collective methods of accelerating particles in plasma and heavy-current electron beams. VAN, no. 4, 1972, 12-19.

Czernichowskiy, A. Interferometric determination of temperature in a laminar jet of argon or neon plasma. Acta phys. pol., A40, no. 3, 1971, 283-294.

Dashuk, P. N., S. L. Zayyents, V. S. Komel'kov, G. S. Kuchinskiy, N. N. Nikolayevskaya, P. I. Shkuropat, and G. A. Shneyerson. Tekhnika bol'shikh impul'snykh tokov i magnitnykh poley (Techniques of powerful pulse currents and magnetic fields). Moskva, Atomizdat, 1970, 471 p.

Godyak, V. A., A. V. Ivlez, and L. A. Shirochin. Analysis of current dynamics in a drift space with an inductive load. RiE, no. 6, 1972, 1295-1296.

Gorbenko, V. G., Yu. V. Zhevrovskiy, L. Ya. Kolesnikov, and A. L. Rubashkin. Measurement of coherent bremsstrahlung spectrum in a linear electron accelerator. UFZh, no. 5, 1972, 757-760.

Gritsyus, A. A., A. I. Grigonis, L. I. Pranyavichyus and A. A. Statkyavichyus. Field emission as a criterion of the surface state of silicon. Litovskiy fizicheskiy sbornik, v. 12, no. 1, 1972, 167-171.

Karchevskiy, A. I. and Yu. I. Strakhov. Energetic balance and dynamics of heating a plasma by an electron beam accelerated in a high-current direct discharge. IN: Plasma phys and contr. nucl. fusion res. Proc. 4th int conf. Madison, Wis., U.S.A., 1971. Vol. 2. Vienna, 1971, 325-344. (RZhF, 5/72, # 5G258)

Katsaurov, L. N. Possibility of using fog particles as a target or acceleration medium. KSpF, no. 10, 1971, 56-63. (RZhF, 5/72, # 5A408)

Kolesnikov, P. M. Elektrodinamicheskoye uskoreniye plazmy (Electrodynamic acceleration of plasma). Moskva, Atomizdat, 1971, 389 p. (KL, 1/72, #179)

Komar, A. P., S. P. Kruglov, and I. V. Lopatin. Izmereniye polnoy energii puchkov tormoznogo izlucheniya ot elektronnykh uskoriteley (Measurement of peak bremsstrahlung from electron accelerators). Leningrad, Nauka, Leningr. otd-niye, 1972, 43 p. (KL, 1/72, #18696)

Koval', A. G., V. T. Koppe, N. P. Danilevskiy, and L. I. Popova. Effective cross-section and excitation function of spectral bands of CO_2^+ ions under excitation by (0.4-20) kev electrons. OiS, v. 32, no. 5, 1972, 1037-1038.

Krishtal, M. A., L. I. Ivanov, and V. V. Ryazantseva. Effect of electron irradiation on the temper of steel. MiTOM, no. 5, 1972, 52-53.

Kvartskhava, I. F., Yu. V. Matveyev, and N. G. Reshetnyak. The mechanism of charged particle acceleration in a dynamic zeta-pinch. ZhETF P, v. 15, no. 10, 1972, 619-622.

Lazarenko, B. R., A. Ye. Gitlevich, and V. N. Tkachenko. Features of electrode erosion and material displacement by an erosive plasma during an arc discharge. EOM, no. 2, 1972, 34-37.

Laziyev, E. M., G. G. Oksuzyan, and V. L. Serov. Parametric radiation from relativistic electron bunches in a wave-guide with laminated dielectric filling. RiE, no. 6, 1972, 1335-1336.

Levchuk, L. V., A. P. Galushka, and I. D. Konozenko. Effect of irradiation by 1.2 Mev electrons on electrophysical properties of p-Si monocrystals growing in a hydrogen atmosphere. UFZh, no. 5, 1972, 851-854.

Levin, M. B., M. G. Lyubarskiy, I. N. Onishchenko, V. D. Shapiro, and V. I. Shevchenko. Nonlinear theory of kinetic instability of an electron beam in plasma. ZhETF, v. 62, no. 5, 1972, 1725-1732.

Mal'tsev, I. G. Sistema teleupravleniya ionnym istochnikom forinzhektora lineynogo uskoritelya I-100 (Remote control ion source system for foreinjection in the I-100 linear accelerator). Serpukhov, 1971, 10 p. (RZhF, 5/72, # 5A334)

Melkumyan, L. G., and A. R. Tumanyan. Dosing of accelerated beam intensity in an electron synchrotron. IAN Arm, no. 7, 1972, 73-76.

Mishakov, V. G., and A. M. Shukhtin. Application of the Rozhdestvenskiy hook method for observing metal evaporation from discharge tube walls. OiS, v. 32, no. 5, 1972, 1006-1009.

Nekotoryye voprosy issledovaniya gazorazryadnoy plazmy i sozdaniya sil'nykh poley (Questions on the investigation of a gas discharge plasma and the generation of powerful magnetic fields). Leningrad, Nauka, 1970, 172 p. (Russian book list, 3/71, #811)

Roginskiy, L. A. Problems of discrete autocompensation of closed orbits and parametric excitation of beam dimensions. IN: Trudy Radiotekhnicheskogo instituta, AN SSSR, no. 7, 1971, 107-123. (RZhF, 5/72, #5A388)

Suladze, K. V. Process of intensive charged particle beam formation in a current-carrying plasma. ZhETF P, v. 15, no. 11, 1972, 648-652.

Teoriya uskoriteley (Theory of accelerators). IN: Trudy Radiotekhnicheskogo instituta. AN SSSR, no. 7, Moskva, 1971, 140 p. (RZhF, 5/72, # 5A383)

Tsveyman, Ye. V., V. V. Zashkvara, M. I. Korsunskiy, V. S. Red'kin, S. Tazhibayeva, and S. S. Kiseleva. Ionization loss in spectra of inelastic electron reflection from rare-earth metal surfaces. FTT, no. 5, 1972, 1549-1551.

Tsytovich, V. N., and A. S. Chikhachev. Structure of power-law spectra of relativistic electrons in a turbulent plasma. IN: Sbornik. Fiziki plazmy, no. 3, Moskva, Atomizdat, 1971, 97-103. (RZhF, 5/72, #5G156)

Ushakov, V. Ya., O. P. Semkina, V. V. Ryumin, and V. V. Lopatin. The nature of pulsed electric flash-over in aqueous electrolytes. EOM, no. 2, 1972, 48-54.

Yakobashvili, S. B., V. F. Khorunov, V. S. Nesmikh, and N. N. Sinitsa. Device for measuring surface tension of refractory materials. IN: Sbornik. Fiz. khimiya noverkhnostn. yavleniy v rasplavakh. Kiyev, Naukova dumka, 1971, 129-131. (RZhF, 4/72, #4Ye668)

Yerokhin, N. S., V. I. Kurilko, M. B. Levin, M. G. Lyubarskiy, N. G. Matsiborko, S. S. Moiseyev, I. N. Onishchenko, A. P. Tolstoluzhskiy, Ya. B. Faynberg, V. D. Shapiro, and V. I. Shevchenko. Nonlinear theory of the interaction of relativistic and nonrelativistic beams with a plasma. Nonlinear theory of wave transformation. IN: Plasma phys. and contr. nucl. fusion res. Proc. 4th int conf. Madison, Wis., U.S.A., 1971. Vol. 2. Vienna, 1971, 195-217. (RZhF, 5/72, #5G230)

Zakharova, L. R., R. A. Meshcherov, and Ye. S. Mironov. Computer methods for calculating magnetic fields of nonferrous magnets of circular accelerators and storage rings. IN: Trudy Radiotekhnicheskogo instituta, AN SSSR, no. 6, 1971, 151-163. (LZhS, 20/72, # 63468)

Zavadovskaya, Ye. K., A. T. Ovcharov, M. I. Kalinin, and V. M. Lisitsyn. Mechanism of self-formation of radiation defects in potassium fluoride crystals. IVUZ Fiz, no. 5, 1972, 129-131.

Zavoyskiy, Ye. K., B. A. Demidov, Yu. G. Kalinin, A. G. Plakhov, L. I. Rudakov, V. D. Rusanov, V. A. Skoryupin, G. Ye. Smolkin, A. V. Titov, S. D. Fanchenko, V. V. Shapkin, and G. V. Sholin. Progress in the study of turbulent heating of plasma. IN: Plasma phys. and contr. nucl. fusion res. Proc. 4th int conf. Madison, Wis., U.S.A., 1971. Vol. 2. Vienna, 1971, 3-24. (RZhF, 5/72, #5G257)

Zhukov, I. G., I. P. Zapesochnyy, and P. V. Fel'tsan. Excitation of $3p^54sArI$ and $3s3p^6ArII$ states by electron shock. OiS, v. 32, no. 5, 1972, 1049-1051.

5. Material Science

A. Abstracts

Nitskevich, V. P., and A. L. Tsykalo. All-Union Conference on High-Temperature Thermophysical Properties of Materials. TVT, no. 5, 1971, 1099-1100.

This is a summary of 122 papers presented at the Conference held from 10 through 14 May 1971 in Odessa under sponsorship of the Scientific Council on High-Temperature Thermophysics, AS USSR. Scientific-Research organizations and universities (vuz) active in thermophysical research, and design and manufacturing organizations supplying the research data, were represented at the conference.

The papers were devoted to theoretical and experimental research on thermophysical properties of heat-resistant materials, refractory compounds, metals, and alloys, composite and structural materials, high-temperature melts and liquid metals; thermodynamic and transfer properties of gases; equations of state, conductivity, radiative and other properties; and diagnostics of low-temperature plasma and plasma jets. A substantial progress was noted in research on heat conductivity of semitransparent solids. The volume of high-pressure experimental studies on transfer coefficients and radiation of gases, and experimental determination of plasma viscosity and heat conductivity, has not been sufficient, in the reporters' opinion. A round-table discussion led by I. I. Novikov dealt with the problem of critical state of matter. The conference issued recommendations on directions of future research expansion; four collections of the proceedings will be published. The next conference is slated for 1974.

Bogachev, I. N., I. L. Kupriyanov, and V. S. Litvinov. Investigation of heat-resistant coatings on type ZhS6K alloy. FKhMM, no. 1, 1972, 106-108.

Effects of aluminizing on surface temperature resistance are described. The high temperature coatings investigated were obtained by thermal diffusion of Al, and Al and Ta in type ZhS6K alloy. Introduction of Ta in the coating also changes its endurance properties. Microhardness of the surface layer of non-alloyed coatings, as measured in the IMASh-9-66 device at a load of 100 g is higher at room temperature than that of coatings with Ta, and decreases less markedly with a rise in temperature (Fig. 1). Tests at 1100°C reveal that prolonged high temperature effects produce changes in the structural and phase components of coatings. X-ray photographs of the non-alloyed coating specimens after 100 hrs contained spots on interference lines of the NiAl phase; after 300 hrs only separate reflexes of this phase were noted, which indicates the consolidation of its crystallites. Prolongation of high temperature leads to a growth in the number of Ni_3Al phases. For alloyed coatings, a similar mechanism prevails, but the increase of NiAl crystallites is slower and the lines of this phase are continuous after 100 hrs. Diffusion of Al increases the thickness of non-alloyed coatings by 4 to 5 times, and of coatings with Ta by 2.5 times. Structural and phase transitions at 1100°C lower the hardness of coatings (measurements were done using the "Superokvell" device). After 300 hrs, the hardness of non-alloyed and alloyed coatings dropped to 390 kg/mm^2 and 380 kg/mm^2 from the initial values of 600 kg/mm^2 and 400 kg/mm^2, respectively. The addition of Ta to coatings in the process of aluminizing does not significantly change the phase component of coatings, but does increase the plasticity of the main phase component- NiAl. By slowing the diffusion process, Ta also retards coating growth at high temperatures.

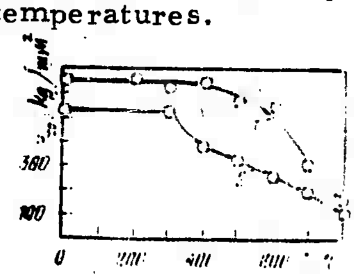


Fig. 1. Relationship of microhardness to temperature
1- non-alloyed coating
2- coating with Ta

Baron, V. V., M. I. Bychkova, and Ye. M. Savitskiy. Thermal treatment effect on superconductive properties of niobium alloys. FiKhOM, no. 2, 1972, 85-90.

Binary Nb-Ti, Nb-Zr, and Nb-Hf systems, ternary Nb-Ti-W systems, and alloys of a $Nb_{25}Ti_{75}$-$Nb_{25}Me_{75}$ partial phase diagram (Me = Zr, Hf, V, Ta, Mo, W, Re up to 25 at %) were studied. The aim was to establish a relationship between the structure of alloys and their fundamental superconducting characteristics, to enable development of alloys with predetermined characteristics. From microstructural and X-ray analyses, superconducting transition temperature T_c, critical current density J_c, and specific electron heat capacity γ were determined with 0.25 mm diam. wire specimens. T_c of Nb-Ti and Nb-Zr alloys was correlated directly with γ. J_c of the Nb-50-80 at. % Ti alloys heat-treated at 350-450° for one hr and water-quenched, substantially increased up to a maximum ~10^5 a/cm^2, because of separation of the α-phase from a β solid solution of the b.c.c. type. Maximum J_c was observed in the Nb-75% Ti after heat-treatment at 450°. Studies of the kinetics of α-phase separation and the effect of cold working on J_c reveals that J_c of the Nb-75 at. % Ti alloy recrystallized by heat-treatment, increased more slowly and to a lower maximum value than the J_c of the cold-worked, then heat-treated alloy. The effect of cold working on the microstructure was also observed. It was concluded that the maximum J_c corresponds to a two-phase structure: a strongly deformed β-with b.c.c. structure and an α-phase of h.c.p. type.

The optimum particle size of the α-phase is 10^{-5} - 10^{-6} cm. and the optimum α-particle density is $10^{11}/cm^2$. The beneficial effect of forming on J_c was also observed in the Nb-25 at. % Zr alloy. In Nb-Zr alloys, very high J_c values were recorded owing to decomposition of the β-phase into two b.c.c. solid solutions of different composition. A similar increase in J_c was noted in the heat-treated at 350-450° ternary Nb-Ti-Zr (VTa) alloys by $\beta \rightleftarrows \beta_2 + \alpha$ transformation in the solid state. T_c of the Nb-65-75 at. % alloys was also shown to increase by heat-treatment at 450° because of $\beta \rightarrow \alpha$ transformation. J_c and T_c data for Nb-Ti alloys developed at the Institute of Metallurgy are tabulated.

Zhidkova, Z. V. Photochromic properties of films dyed by peri-naphthothio-indigo and 2-(peri-benzothionaphthene)-2' - (5' -methylthionaphthene) - thioindigo. ZhPS, v. 16, no. 2, 1972, 325-330.

Absorption spectra of indigoid-dyed polystyrene and polymethylmethacrylate films were measured, to explore the possibility of using the photochromic properties of the dyes in memory and other devices. The two dyes studied were selected from 18 indigoid dyes because their photochromy was the strongest. Testing of photochromic properties of the dyes in solution was secondary to the main purpose of testing the dyed films. The cis-trans isomeric transition in the indigoid dyes is the basis of their photochromy. The absorption spectra of both dyes studied in 0.3-0.4 mm thick polystyrene films exhibited two peaks corresponding to trans- and cis-isomers, which were separated at 130 and 115 nm distances. The maximum photochromic effect (difference D_c - D_c' of optical densities of the spectral line at the maximum of trans- form at the start (D_c) and the end (D_c') of trans-cis transformation) was ≈1.0 for the second dye. This effect increased with an increase in dye concentration. Study of kinetics of the photochromic process revealed that the time required for a complete trans- to cis-transformation was 3 min, 15 sec and that for completion of the reverse transformation was 20 sec for the first and 10 sec for the second dye. The coefficient of dark thermal cis-trans transformation (the measure of thermal stability of the stored information) was 4×10^{-5} and 10^{-3} min^{-1}, respectively for the two dyes. Study of the aging of the dyed polystyrene films indicated that reproducibility of the photochromic effect (D_c - D_c') somewhat decreased after 1 month storage in the dark, and decreased by half after 60 days storage for the first and second dyes. The illumination time of the first dye film after one month storage had to be doubled to obtain a D_c - D_c' equal to that of the fresh film. On illumination, a variable number of dye molecules in the film were transformed from one isomeric form to another, depending on the illuminating flux and chemical nature of the dye and the film.

Osipov, V. G. Deformation and fracture of superplastic materials. FiKhOM, no. 2, 1972, 91-96.

Superplasticity of certain metals and single crystals subjected to tensile loads is discussed as a particular case of a perfectly plastic or visco-plastic state. In contrast to strain-hardening, superplastic materials are distinguished by the absence of necking during tensile deformation, in addition to an extremely high elongation ϵ (> 150%) and a low resistance to deformation. These characteristics of superplastic and, generally, visco-plastic materials are explained by the "travelling neck" effect, microheterogeneous behavior analysis, and strain-rate plots. The occurrence of the perfectly plastic or visco-plastic behavior of materials depends on phase composition, and the mechanism and conditions of deformation. Experimental data are cited to illustrate the occurrence of superplasticity exclusively in viscoplastic materials, e.g. in type EI435 alloy at 1200°. Analysis of stress distribution around a stress concentrator such as a circular hole shows that stress in a viscoplastic material remains constant during tensile deformation. Consequently, in the absence of strain hardening, microcracks do not act as stress concentrators or increase in size according to the Griffith rule. The fracture of viscoplastic material follows the accumulation of microdefects and formation of a macrocavity extending over the entire cross-section of the sample (Fig. 1). The cited fracture

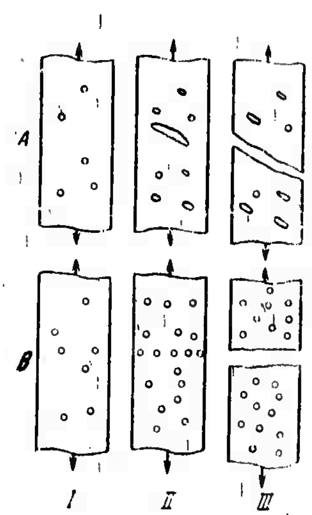


Fig. 1. Fracture process in a strain-hardening (A) and a viscoplastic (B) material: I, II, III- tensile deformation phases

mechanism was confirmed by an experiment with a superplastic Ni + 49% Cr alloy at 1,000°. The author subscribes to the predominant role of diffusion, along with slip, in plastic deformation in viscoplastic alloys and single crystals.

Abramyan, E. A., L. I. Ivanov, Ye. Ye. Kazilin, and N. S. Kudryavtsev. Method of investigating the effect of rarefied gas flows on metal creep. FKhMM, no. 1, 1972, 96-97.

A simplified method was used for studying the effect of rarefied gas flow on the high temperature creep of refractory metals. Permitting the establishment of molecular gas flow on the surface of a specimen for control of the composition and density, the method involves the gas blowing of the specimen through a nozzle placed close to the specimen. Torsion tests were conducted on metals in this type of device; the mode of gas feed to the test specimen is shown in Fig. 1. Nozzle length was selected from

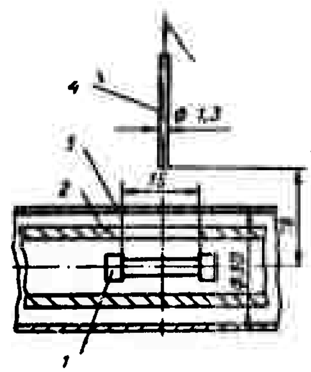


Fig. 1. Sketch of gas feed to the specimen.
1- specimen
2- heater
3- screen
4- nozzle

the condition $l/d > 10$, where l is the length and d the diameter of the nozzle. At an initial vacuum of 10^{-6} torr, this system provided a molecular flow of 10^{16} mol. /cm^2/sec on the specimen surface. The system vacuum was maintained with an accuracy of 10% at a 10^{-4} torr level. The specimen was 15 mm long and made of molybdenum. The gas flow density distribution along the specimen length was statistically modeled on a computer by the Monte-Carlo method. The coefficient of gas molecule reflection from nozzle and heater walls was considered as unity, and the reflections were assumed to follow a cosine law. The modelling was done for various nozzle distances from the specimen surface. At separation distances up to 20 mm, the distribution of molecular flow density along the 15 mm specimen was practically uniform. Experimental results at 1800 and 1850°C are plotted in Fig. 2. To attain a steady creep stage in 10^{-5} torr vacuum, a molecular oxygen flow of 10^{17} mol/cm^2/sec was directed at the specimen surface. (Blowing started at the arrow points shown in Fig. 2.) At the moment of blowing, the steady creep rate decreases due to the formation in the specimen of metastable oxide occlusions; the creep rate increases with further blowing due to a decrease in specimen diameter because of evaporation of easily sublimated molybdenum oxides on the surface.

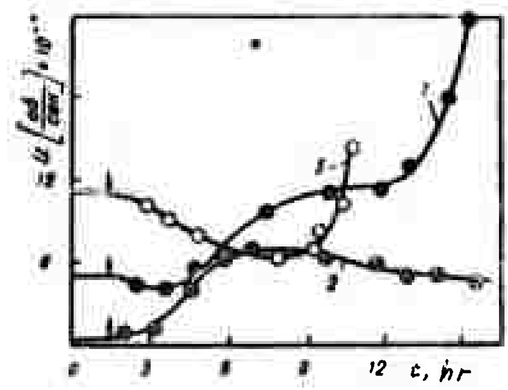


Fig. 2. Effect of oxygen flow (10^{17} mol. /cm^2/sec) on steady creep of molybdenum.
1- two-way at τ = 61 kg/cm^2 in atmospheric medium, 1800°C
2- one-way at τ = 116 kg/cm^2 in atmospheric medium, 1850°C
3- two-way at τ = 75 kg/cm^2 in N_2, 1800°C.

Voloshin, V. A., and L. K. Mashkov. <u>Pressure-induced changes in energy levels of 4f6 electrons.</u> OiS, v. 32, no. 3, 1972, 567-569.

An experimental study was made of the effect of hydrostatic pressure to 18 kbar on absorption and luminescence spectra of europium tetrakis- (benzoylacetone) piperidinium EuB4HP powder, europium (III) chloride hexahydrate $EuCl_3 \cdot 6H_2O$, and europium (III) sulfate octahydrate $Eu_2(SO_4)_3 \cdot 8H_2O$ single crystals. The position of spectral line peaks was determined from spectro-photographic recordings with an accuracy better than 1 cm^{-1}.

At about 10 kbar pressure, the two sublevels of the $^7F_1$ level of EuB4HP merge, which indicates an increase in symmetry of the environment around the Eu^{3+} ion. In the first order approximation, splitting of the $^7F_2$ energy is analyzed in terms of crystal field theory. Calculations of the crystal field parameters at different pressures revealed crystal anisotropy in both EuB4HP and $EuCl_3 \cdot 6H_2O$ with respect to deformation of their coordination spheres. The crystal anisotropy causes changes in symmetry. In all three compounds studied, the gravity center of energy levels shifted towards long waves with an increase in pressure (Fig. 1). The shift of

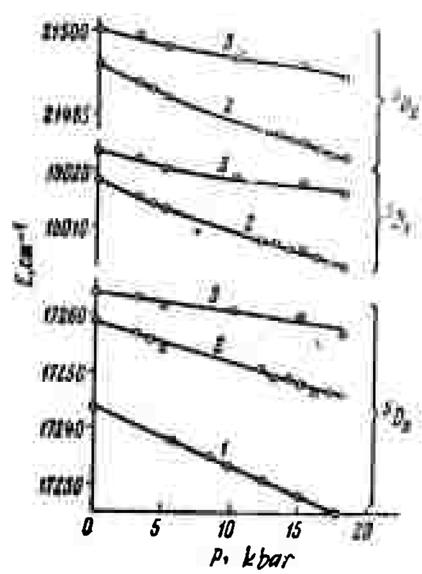


Fig. 1. Position of energy levels of Eu^{3+} versus pressure.
1- EuB_4HP
2- $EuCl_3 \cdot 6H_2O$
3- $Eu_2(SO_4)_3 \cdot 8H_2O$

the ^5D levels also proceeds faster than that of the ^7F levels, as shown in Fig. 1 and Fig. 2 for EuB_4HP.

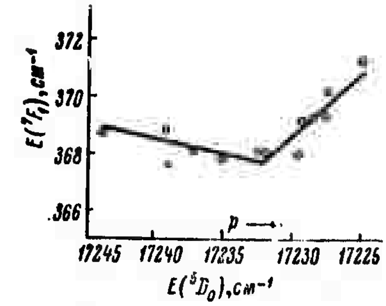


Fig. 2. Change in the $^7F_0$ - $^7F_1$ transition distance versus shift of the $^5D_0$ - $^7F_0$ transition line of EuB_4HP.

The spin-orbit interaction parameter of $^7F_0$ - $^7F_1$ transition distance in EuB_4HP and $EuCl_3 \cdot 6H_2O$ hardly changed at pressures to 10 and 18 kbar, respectively, but increased, after the symmetry of the electron shell of the central ion increased. Changes in fine structure and shift of energy levels in $Eu_2(SO_4)_3 \cdot 8H_2O$ were insignificant due to its stronger crystal lattice.

Nikitenko, A. F., O. V. Sosnin, N. G. Torshenov, and I. K. Shokalo. Creep of reinforceable materials with different tensile and compressive characteristics. ZhPMTF, no. 2, 1971, 118-122.

Experimental room temperature creep measurements of a titanium alloy sheet are described. It is shown that creep of reinforceable material with different elongation and compression creep characteristics can be described by two different functions Φ_1 and Φ_2, depending on the sign of the linear invariant strain tensor σ_{ii}. For the case of $\sigma_{ii} > 0$, the creep rate η_{ij} is expressed as

$$\Phi_1 = \left(\frac{\sqrt{S}}{N}\right)^{\alpha} T_1^{1/2(n+1)}, \qquad \eta_{ij} = \frac{\partial \Phi_1}{\partial \sigma_{ij}} \tag{1}$$

and for $\sigma_{ii} < 0$, η_{ij} is given by

$$\Phi_2 = \left(\frac{\sqrt{S}}{N}\right)^{\alpha^*} T_2^{1/2(n^*+1)}, \qquad \eta_{ij} = \frac{\partial \Phi_2}{\partial \sigma_{ij}} \tag{2}$$

Experimental creep curves show that the material is anisotropic with respect to creep and has different elongation and compression creep characteristics. The initial anisotropy of the material remained unchanged even after 1000 hr. of experimental time. The experimental data were in satisfactory agreement with the log ϵ - log σ and log ϵ - log t plots calculated from the approximate formula

$$\varepsilon^{x} d\varepsilon \quad B\sigma^{n} dt \qquad (3)$$

The validity of (1) was confirmed by comparison of calculated plots of axial ϵ versus t and shear deformation γ versus t with experimental data on the creep of tubular samples to which a tensile force and torque were applied simultaneously. The creep description method is not applicable in the $\sigma_{ii} \approx 0$ region of strains.

B. Recent Selections

i. Crack Propagation

Basheyev, S. M., and L. V. Pervitskiy. Formation and growth of pre-pitting cracks on gear wheels. VAN BSSR, no. 2, 1972, 17-20.

Berezhnitskiy, L. T., V. V. Panasyuk, and G. P. Cherepanov. Strength of composite bodies weakened by cracks. IN: Kontsentratsiya napryazheniy, no. 3, 1971, 10-15. (LZhS, 15/72, #47748)

Finkel', V. M., I. S. Guz', I. A. Kutkin, Sh. G. Volodarskaya, and Yu. M. Korobov. Experimental results on stress wave mutual interaction with a crack. IN: Sbornik. Vysokoskorostnoy deformatsiya. Moskva. Izd-vo Nauka, 1971, 37-42. (RZhMekh, 4/72, #4V701)

Gol'dman, A. Ya., V. V. Matveyev, and V. V. Shcherbak. Crack growth in polymers under creep conditions in air and liquid. F-KhMM, no. 2, 1972, 28-33.

Gold'shteyn, R. V., and L. N. Savova. Extent and coefficients of stress intensity for smooth curvilinear cracks in a plastic surface. MTT, no. 2, 1972, 69-78.

Kachanov, M. L. On a continuity theory for crack media. MTT, no. 2, 1972, 54-59.

Kirenko, O. F., V. A. Marikhin, and L. P. Myasnikova. Fractographic analysis of macrocrack propagation in oriented Capron. Mekhanika polimerov, no. 4, 1971, 645-648. (RZhMekh, 5/72, #5V1169)

Kit, G. S., and O. V. Poberezhnyy. Equilibrium limit in a brittle solid with a disk-shaped crack under stress and temperature effects. F-KhMM, no. 2, 1972, 63-69.

Krestin, G. S., L. L. Libatskiy, and S. Ya. Yarema. Stress state of a disk with a diametric crack. F-KhMM, no. 2, 1972, 69-74.

Libatskiy, L. L. Equilibrium limit for a circular disk with external radial cracks. IN: Kontsentratsiya napryazheniy, no. 3, 1971, 76-81. (LZhS, 15/72, #47772)

Molchanov, A. Ye., and L. V. Nikitin. Crack dynamics of longitudinal shift following stability loss. MTT, no. 2, 1972, 60-68.

Panasyuk, V. V., S. Ye. Kovchik, and N. S. Kogut. Method for formation of axisymmetric surface cracks in cylindrical forms. F-KhMM, no. 2, 1972, 95-97.

Poberezhnyy, O. V. Thermoelastic state of a medium with a thermally isolated circular crack. PM, no. 11, 1970, 59-66.

Prokhorenko, V. M., I. M. Zhdanov, I. M. Chertov, and B. V. Medko. Stress state in vicinity of the terminus of a moving crack under quasi-brittle destruction. IN: Vestnik Kiyevskogo politekhicheskogo instituta. Seriya machinostroyeniya, no. 7, 1970, 88-92. (LZhS, 18/72, #57763)

Rakhmanov, A. S., V. S. D'yakonova, and L. S. Livshits. Evaluation of studies on crack growth in steel specimens. Zavodskaya laboratoriya, no. 10, 1971, 1253-1254. (RZhMekh, 4/72, #4V697)

Regel', V. R., A. M. Leksovskiy, and U. Bolibekov. Kinetics of crack growth in polymers under repeated loads with a small number of cycles. Mekhanika polimerov, no. 2, 1972, 247-251.

Sholtmir, L. G. An electroresistivity method to determine crack propagation rate for low cycle fatigue. IN: Trudy Severo-Zapadnogo zaochnogo politekhnicheskogo instituta, no. 16, 1971, 68-76. (RZhMekh, 5/72, #5V1053)

Summ, B. D., Ya. Mukhammed, N. V. Pertsov, T. P. Malygina, and P. V. Kozlov. Crack propagation in stressed polyethlene terephthalate in the presence of organic liquids. F-KhMM, no. 2, 1972, 33-37.

Sysoyev, E. P., Ye. S. Lukin, and D. N. Poluboyarinov. Creep and long term strength of magnesium oxide ceramics. Ogneupory, no. 6, 1972, 38-43.

Verchuk, V. M. Crack branching in a brittle plate. IN: Sbornik. Gidrodinamika, tverdoye telo, Dnepropetrovsk, 1971, 31-47. (RZhMekh, 4/72, #4V689)

Volokushin, V. F., and V. V. Savitskiy. Technological parameters effect on crack formation during hardening of pellets. MiTOM, no. 5, 1972, 57-58.

ii. High Pressure Research

Al'tshuler, L. V., M. I. Brazhnik, and G. S. Telegin. Strength and elasticity of iron and copper under high pressures of shock compression. ZhPMTF, no. 6, 1971, 159-166. (RZhMekh, 4/72, #4V1188)

Amirkhanov, Kh. I., A. P. Adamov, and G. D. Gasanov. Experimental investigation of low temperature thermal conductivity of argon. I-FZh, v. 22, no. 5, 1972, 835-842.

Badalyan, A. L., and N. F. Otpushchennikov. Thermodynamic properties of hexene-1 liquid phase at high pressures. IN: Uchenyye zapiski Kurskogo GPI, 1971, 215-225. (RZhF, 3/72, #3Ye200)

Badalyan, A. L., and N. F. Otpushchennikov. Calculation of n-hexane thermodynamic properties at pressures to 1200 kg/cm^2. IN: Uchenyye zapiski Kurskogo GPI, 1971, 27-36. (RZhF, 3/72, #3Ye189)

Bobrovnichiy, G. S. Apparaty sverkhvysokikh davleniy. (Super high pressure equipment.) Izd-vo Znaniye, no. 5, 1972, 31p.

Boyko, A. A., V. F. Degtyareva, Ye. G. Ponyatovskiy, and A. G. Rabin'kin. BiSn alloy structure under high pressure. FTT, no. 5, 1972, 1484-1488.

Exploded benzole ring. Khimiya i zhizn', no. 6, 1972, 27.

Kalinina, A. A., M. I. Sokhor, F. I. Shamray, and A. F. Kovalena. High pressure effects on phase composition of SiC alloys with boron. NM, no. 5, 1972, 839-842.

Karpenko, I. V., G. A. Marinin, and V. P. Saak'yants. High pressure time delay effect on physical and mechanical properties of copper. F-KhMM, no. 2, 1972, 104-105.

Kir'yakov, B. S., and Yu. S. Shoytov. Thermodynamic properties of n-hexane and n-heptane at temperatures of 30 and 40°C. IN: Uchenyye zapiski Kurskogo GPI, 1971, 209-214. (RZhF, 3/72, 3Ye199)

Kislykh, V. V., and Kh. A. Rakhmatulin. Dual-chamber adiabatic compression assembly. TVT, no. 2, 1972, 400-404.

Kondratenko, P. I., K. P. Rodionov, G. A. Matveyev, M. I. Oleynik, and F. G. Khaime. Hydrostatic pressure effect on plasticity of steels. IN: Sbornik. Bureniye glubokikh skvazhin v oslozhennykh usloviyakh. Moskva. Izd-vo Nedra, 1971, 217-223. (RZhMekh, 4/72, #4V1154)

Korchin, V. A., V. A. Ruban, V. V. Danilov, and V. V. Zaporozhets. Residual effect of high pressure on width of the ferromagnetic resonance line in $Y_3Fe_{5-x}Ga_xO_{12}$ single crystals. FTT, no. 5, 1972, 1545-1546.

Kurdyumov, A. V. X-ray analysis of packing defects in layers of graphite structures. Kristallografiya, no. 3, 1972, 620-625.

Malyushitskaya, E. V., S. S. Kabalkina, and L. F. Vereshchagin. Maintenance of high pressure metastable phases of CdS, Mg_2Sn, SnTe, and SnTe-GeTe alloys. FTT, no. 4, 1972, 1219-1224.

Mirinskiy, D. S., and Ya. I. Shurin. Check valve for pressure to 20 kbar. PTE, no. 2, 1972, 193-194.

Mirinskiy, D. S., and Ya. I. Shurin. High pressure liquid separator. PTE, no. 2, 1972, 190-191.

Otpushchennikov, N. F., and A. L. Badalyan. Ultrasonic velocity in n-paraffin liquids as a function of pressure and temperature. IN: Uchennye zapiski Kurskogo GPI, 1971, 260-268. (RZhF, 3/72, #3Ye202)

Panin, P. P., N. F. Otpushchennikov, and G. M. Pan'kevich. Sound velocity and thermodynamic properties of n-undecane at pressures to 1200 bar. IN: Uchenyye zapiski Kurskogo GPI, 1971, 124-134. (RZhF, 3/72, #3Ye195)

Pardavine, H. M. High pressure effects on magnetic properties of materials. Magy. fiz. folyoirat, v. 19, no. 4, 1971, 343-359. (RZhF, 4/72, #4Ye1554)

Pryanishnikov, V. P., V. G. Chistoserdov, T. I. Prokhorova, R. N. Lebedeva, and T. P. Ledneva. Phase transformations in a pure silica system. IN: Sbornik. Steklobraznoye sostoyaniye. Leningrad. Izd-vo Nauka, 1971, 107-109. (RZhKh, 11/72, #11B1012)

Rabinovich, L. B., and G. P. Sechenov. Heat transfer conditions from a surface to a fluidized layer under pressure. I-FZh, v. 22, no. 5, 1072, 789-794.

Shepot'ko, D. I., P. P. Ryazantsev, and L. M. Shcherbakov. Device for measuring contact angles at high pressures. IN: Sbornik. Fizicheskaya khimiya poverkhnostnykh yavleniy v rasplavakh. Kiyev. Izd-vo Naukova dumka, 1971, 136-137. (RZhF, 3/72, #3Ye150)

iii. High Temperature Research

Buzovkina, T. B., T. V. Sokolova, A. P. Obukhov, R. I. Uspenskaya, and M. G. Degen. Structural parameters and temperature effect on effective thermal conductivity of plasma-deposited aluminum oxides. TVT, no. 2, 1972, 395-399.

Chechel'nitskiy, A. Z. Thermal conductivity of fused quartz in the 350 to 1100° K temperature interval. TVT, no. 2, 1972, 285-289.

Fridlender, B. A., and V. S. Neshpot. Directional dependence of high temperature conductivity of crystal-oriented pyrolytic graphite. TVT, no. 2, 1972, 313-317.

Gindin, I. A., I. M. Neklyudov, I. I. Soloshenko, and S. A. Khizhkovaya. Preliminary deformation effect on plastic properties of germanium single crystals. DAN SSSR, v. 204, no. 1, 1972, 74-76.

Golovina, Ye. S., and L. L. Kotova. Carbon sublimation in a flow. TVT, no. 2, 1972, 368-380.

Gur'yev, A. V., and N. V. Shishkin. Deformation mechanism of commercial iron at high temperatures. IN: Sbornik. Metallovedeniye i prochnost' materialov. Volgograd, v. 3, 1971, 17-24. (RZhMekh, 5/72, #5V1085)

Institut vysokikh temperatur. Moskva. Vazhneyshiye rezul'taty nauchno-issledovatel'skikh rabot 1971 goda. (Significant results of work completed in 1971 by members of the Institute of High Temperature, Moscow.) Moskva. Izd-vo Nauka, 1972, 80p. (KL, 22/72, #18689)

Kalinnikov, L. D. Boundary conditions for experimental investigations of nonstationary heat exchange. TVT, no. 2, 1972, 381-388.

Kashalyan, Yu. A. Kharakteristiki uprugosti materialov pri vysokikh temperaturakh. (Elasticity characteristics of materials at high temperatures.) Kiyev. Izd-vo Naukova dumka, 1970, 112p.

Kogan, Yu. N., and V. M. Markovskiy. Mechanical strength of ceramic-metal bonds at high temperatures. Zavodskaya laboratoriya, no. 5, 1972, 596-598.

Kon'kov, A. A., and A. V. Vorontsov. Experimental investigation of infrared radiation from nitrogen. OiS, v. 32, no. 4, 1972, 655-660.

Levin, Ye. S., and I. V. Gel'd. Thermal expansion and energy formation in holes in liquid metals and alloys. IVUZ Tsvetnaya metallurgiya, no. 2, 1972, 105-110.

Lisin, V. N., O. A. Kolotov, D. I. Shetulov, and L. D. Sokolov. Recording hardening of a metal during fatigue tests at high temperatures. Zavodskaya laboratoriya, no. 5, 1972, 594-596.

Lutkov, A. I., B. K. Dymov, and V. I. Volga. Relationship between thermal and electrical conductivity in graphite. I-FZh, no. 5, 1972, 932.

Merzhanov, A. G., and I. I. Borovinskaya. Self-propagating high temperature synthesis of refractory inorganic compounds. DAN SSSR, v. 204, no. 2, 1972, 366-369.

Mirzoyeva, V. A. Dependence of creep rate of pure copper on preliminary thermal treatment. IAN Tadzh, no. 4, 1971, 31-37.

Moyzhes, B. Ya., and V. A. Nemchinskiy. Theory of a high pressure arc using a refractory cathode. ZhTF, no. 5, 1972, 1001-1009.

Muradyan, L. M. Two-dimensional problem of thermal creep at high temperatures. DAN ArmSSR, v. 54, no. 1, 1972, 33-42.

Mustafayev, R. A. Dynamic method for measuring thermal conductivity of gases at high temperatures. I-FZh, v. 22, no. 5, 1972, 850-858.

Nepershin, R. I. Calculation of a temperature field for high speed plastic flow processes at high temperatures IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov. Moskva, 1971, 2. (RZhMekh, 5/72, #5V376)

Pakhomov, Ye. P., and V. V. Sautkin. Study of the viscosity of nitrogen and air plasma. TVT, no. 2, 1972, 221-226.

Panov, A. S., and M. M. Rysina. Kinetics of solid phase reactions in Ta-Be-Zr and Nb-Be-Zr systems. IAN Metally, no. 3, 1972, 219-223.

Petrov, M. D., and V. A. Sepp. Two-layer calorimetric probe for measuring temperature and total pressure in high temperature flow. IT, no. 4, 1972, 49-50.

Petrov, V. A., and V. Yu. Reznik. New method for determining integral emissivity of partially transparent materials at high temperatures. TVT, no. 2, 1972, 405-411.

Severdenko, V. P., and R. M. Kal'nitskiy. Strength and plasticity of molybdenum under short-period testing. DAN BSSR, v. 16, no. 4, 1972, 321-323.

Shatinskiy, V. F., R. N. Garlinskiy, and O. I. Kravchuk. Apparatus for tensile tests of metals and alloys at elevated temperatures and extra-high vacuum. F-KhMM, no. 5, 1971, 66-68.

Sveshnikova, G. A., and A. M. Borzdyka. Effect of molybdenum and tungsten on Ni-Cr-Nb alloy properties. IAN Metally, no. 3, 1972, 215-218.

Tolmacheva, Z. I., and V. I. Kornilova. Phase distribution boundaries in a W-Ta-Ti system at 1600°C. IAN Metally, no. 3, 1972, 211-214.

Umanskiy, E. S., I. Ye. Debrivnyy, and V. V. Kryuchkov. Strength and deformability of thin composite materials of the magnetic carrier type. 1. Strength and deformability at high temperatures. Problemy prochnosti, no. 5, 1972, 40-45.

Vitorskiy, Ya. M., L. S. Igolkina, I. S. Malashenko, G. N. Nadezhdin, and V. G. Tkachenko. Study of Young's modulus for sheet molybdenum. Problemy prochnosti, no. 11, 1971, 119-121. (RZhMekh, 4/72, #4V1357)

Zhdanov, G. S. Electron microscopy analysis of kinetics of high temperature phase transformations. OMP, no. 4, 1972, 59-60.

Zinov'yev, V. Ye., S. I. Masharov, L. I. Chupina, and P. V. Gel'd. Kinetic properties and scattering mechanisms of Ti, Zr and Hf electrons at high temperatures. FTT, no. 4, 1972, 1053-1057.

iv. Miscellaneous Strength of Materials

Abramov, S. K. All-Union symposium on engineering evaluation of polymer materials and structures. Mekhanika polimerov, no. 2, 1972, 380-381.

Alentov, B. P., A. A. Kotomin, L. G. Rukin, and V. G. Stepanov. Hardening capacity of steel under effect of high speed impulse loads. IN: Trudy instituta (TsNII tekhnologii sudostroyeniya), no. 118, 1971, 43-48. (LZhS, 18/72, #58135)

Bakuma, S. F., V. P. Belousov, V. S. Sedykh, and Yu. P. Trykov. Sheet composites manufacture by explosive welding and intermediate rolling. Tsvetnyye metally, no. 5, 1972, 58-62.

Baskin, E. M., and M. V. Entin. Vliyaniye poverkhnosti na elektronfononnoye vzaimodeystviye v plenkakh. (Surface effect on electron-phonon interactions in films) Institut fiziki poluprovodnikov SOAN SSSR. Novosibirsk, 1970, 14p. (RZhF, 4/72, #4Ye970 DEP)

Baydov, V. V., L. L. Kunin, and L. N. Sokolov. Surface tension and compressibility of oxide melts within the limits of surface sphere models. IN: Sbornik. Fizicheskaya khimiya poverknostnykh yavleniy v rasplavavakh. Kiyev. Izd-vo Naukova dumka, 1971, 40-44. (RZhF, 4/72, #4Ye189)

Brovkin, L. A., and S. I. Devochkina. Radiation heating of bodies with variable coefficients. IVUZ Chernaya metallurgiya, no. 5, 1972, 167-170.

Burylev, B. P., and V. V. Vasil'yev. Isotherms for surface tension in scandium, yttrium and rare earth element liquid alloys. IN: Sbornik. Fizicheskaya khimiya poverkhnostykh yavleniy v rasplavakh. Kiyev. Izd-vo Naukova dumka, 1971, 144-149. (RZhF, 4/72, #4Ye181)

Dekhtyar, I. Ya., and V. I. Silantev. New method of investigation of electron structure in metal surfaces with the aid of positron annihilation. PSS (a), no. 10, 657-666.

Deystviye radioaktivnykh izlucheniy na veshchestva. (Effects of radioactivity on matter.) Tashkent, 1970, 202p.

Dorfman, A. Sh. Calculation of thermal flow and surface temperature during heat exchange between liquid flow past plates. TVT, no. 2, 1972, 335-341.

Epshteyn, G. N. Vysokoskorostnaya deformatsiya i struktura metallov. (High speed deformation and metal structure.) Izd-vo Metallurgiya, 1971, 198p.

Filatov, G. F. Stability of strong discontinuities in nonlinear theory of elasticity. IN: Sbornik nauchnykh trudov. Fakultet prikladnoy matematiki i mekhaniki Voronezhskogo universiteta, no. 1, 1971, 62-64. (RZhMekh, 4/72, #4V104)

Fizika tverdogo tela, novyye idei i metody. (Solid state physics: new ideas and methods. Collection of articles.) Moskva. Izd-vo Znaniye, 1972, 64p. (KL, 22/72, #18704)

Gashchenko, A. G. Statistical aspects of thermal stability of refractory materials. Problemy prochnosti, no. 5, 1972, 79-82.

Georg, E. B., Yu. K. Rulev, G. F. Sipachev, and M. I. Yakushin. Experimental investigation of the boundary layer on a destructive specimen under combined effects of convective and radiant heat flow. MZhiG, no. 2, 1972, 25-29.

Gogeshvili, A. A., B. M. Tsogoyev, and A. G. Sorochishin. Strength and deformability of polyethylene film reinforced by a bonded grid. AN LatvSSR. Riga, 1971, 12p. (RZhMekh, 4/72, #4V1455 DEP)

Golger, Yu. Ya., V. I. Klassen, and A. I. Rusanov. Energetics of surface processes. IN: Sbornik. Fizicheskaya khimiya poverkhnostnykh yavleniy v rasplavakh. Kiyev. Izd-vo Naukova dumka, 1971, 9-14. (RZhF, 4/72, #4Ye488)

Grinchenko, I. G. Uprochneniye detaley iz zharoprochnykh i titanovykh splavov. (Strengthening heat resistant and titanium alloy components.) Moskva. Izd-vo Mashinostroyeniye, 1971, 120p.

Gulyayev, A. P., N. N. Morgunova, and N. M. Malkhasyan. Shock viscosity and brittleness threshold of molybdenum. Problemy prochnosti, no. 8, 1971, 70-73.

Hermoch, V., J. Novak, L. Bakos, and H. Urbankova. Oxidation of materials in an oxygen plasma. Czechosl. J. Phys., no. 11, 1971, 1222-1224, (RZhF, 4/72, # 4G148)

Ivanov, V. V., and I. L. Dunin. Investigation of boundary layer heat transfer, taking surface radiation into account. IAN Energ, no. 2, 1972, 167-172.

Karnozhitskiy, V. P. Experimental investigation of the strength of compressed heated three-layer plates beyond the proportional limit. IVUZ Aviatsionnaya tekhnika, no. 1, 1972, 128-131.

Khodos, M. Ya., B. V. Shul'gin, A. A. Fotiyev, and A. L. Shalyapin. Spectral characteristics of europium, holmium and thulium orthovanadates. IN: Trudy Instituta khimii Ural'skogo nauchnogo tsentra AN SSSR, no. 23, 1971, 29-37. (LZhS, 20/72, #63548)

Koretskaya, L. S., V. G. Koretskiy, and A. S. Mikhnevich. Service life of polyethylene coatings under atmospheric conditions. VAN BSSR. Seriya fiziko-tekhnicheskikh nauk, no. 2, 1972, 124-125.

Kramarenko, O. Yu., O. V. Kulikovskaya, and R. F. Kubyak. Kinetics of fatigue damage under programmed loading. IAN Metally, no. 3, 1972, 184-189.

Krivov, M. A. Dielectric losses in inorganic glasses, simple crystals and ceramics. (Review of the work of the Laboratory of Electrophysics, SFTI). IN: Sbornik. Itogi issledovaniy po fizike 1917-1967. Izd-vo Tomskiy universitet, 1971, 128-143. (RZhF, 4/72, #4Ye310)

Landau, A. I., and V. M. Borzhkovskaya. Potential of dislocation interaction with local defects in a crystal lattice (stoppers) as one of the microscopic mechanisms for relaxation phenomena in solids. IN: Sbornik. Mekhanizmy relakstsionnykh yavleniy v tverdykh telakh. Moskva. Izd-vo Nauka, 1972, 27-31. (RZhMekh, 5/72, #5V415)

Lemeshko, A. M., and A. A. Rogozinskaya. Investigation of surface layer changes in refractory metal carbines following electro-spark processing. EOM, no. 2, 1972, 18-22.

Lomakin, Ye. V., V. G. Lyuttsau, A. F. Mel'shanov, and Yu. N. Rabotnov. Propagation of longitudinal elastoplastic waves in low carbon steels. MTT, no. 2, 1972, 180-185.

Makara, V. A., N. N. Novikov, and S. V. Mnyshenko. Movement characteristics of dislocations in KCl crystals. Problemy prochnosti, no. 11, 1971, 64-68. (RZhMekh, 4/72, #4V639)

Metallidy -- stroyeniye, svoystva, primeneniye. (Metallides: composition, properties and applications.) Institut metallurgii AN SSSR. Moskva. Izd-vo Nauka, 1971, 167p. (RZhF, 4/72, #4Ye482K)

Mekhanika deformiruyemogo tverdogo tela. (Mechanics of deforming solids.) Izd-vo Elm. (for publication in 1972). (NK, 24/72, #46)

Meshcheryakov, G. N., and V. G. Zhukov. Ionizing radiation effect on physical and mechanical properties of steel. EOM, no. 2, 1972, 71-72.

Mityagin, A. Yu., N. Ya. Cherevatskiy, and V. F. Dvoryankin. Application of electron Auger-spectroscopy to surface properties investigations. IAN Neorganicheskiye materialy, no. 12, 1971, 2121-2133. (RZhF, 3/72, #3Ye907)

Morozov, Ye. M. Energy criteria of destruction for elastoplastic bodies. IN: Kontsentratsiya napryazheniy, no. 3, 1971, 85-90. (LZhS, 15/72, #47129)

Morozov, Yu. A., M. P. Sidel'kovskiy, and V. M. Rozenberg. Enhancing the heat resistance of Kh14G14N3T steel by micro-alloying with boron. MiTOM, no. 4, 1972, 38-42.

Motulevich, V. P., Yu. N. Vorontsov, and V. M. Yeroshenko. Combustion of carbon particles in supersonic flow of a chemically active gas. FGiV, no. 3, 1971, 345-352.

Mozharovskiy, N. S., and Ye. A. Antipov. Plasticity and destruction of refractory materials at elevated temperatures and variable loading. Problemy prochnosti, no. 12, 1971, 3-8.

Nekotoryye zadachi teorii uprugosti o kontsentratsii napryazheniy i deformatsii uprugikh tel. (Problems in theory of elasticity and stress concentration and deformation of elastic bodies. Collection of articles.) Izd-vo Saratovskogo universiteta, no. 6. 1971, 112p. (KL, 12/72, #9820)

Novichenok, L. N., and Z. P. Shul'man. Teplofizicheskiye svoystva polimerov. (Thermophysical properties of polymers.) Minsk. Izd-vo Nauka i tekhnika, 1971, 117p.

Oshcherin, B. N. Structural and thermodynamic calculation of concentration of surface enthalpy. IN: Sbornik. Fizicheskaya khimiya poverkhnostykh yavleniy v rasplavakh. Kiyev. Izd-vo Naukova dumka, 1971, 29-32. (RZhF. 3/72, #3Ye152)

Panasyuk, V. V., S. Ye. Kovchik, and L. V. Nagirnyy. Surface active media effects on strength properties changes in type U8 steel in high strength state. DAN SSSR, v. 203, no. 5, 1972, 1041-1043.

Pereverzev, D. D., and Ye. A. Markovskiy. Plastic pre-deformation effect on diffusion processes in a copper-zinc system under electron irradiation. F-KhMM, no. 2, 1972, 21-24.

Petrovskiy, V. A. Surface layer and the metastable state. IN: Sbornik. Fizicheskaya khimiya poverkhnostykh yavleniy v rasplavakh. Kiyev. Izd-vo Naukova dumka, 1971, 55-57. (RZhF, 3/72, #3Ye153)

Ponomarev, P. V. Energetic method for calculation of propagation of elastic waves leading to fatigue failure. IN: Uchenyye zapiski Kurskogo GPI, 1971, 253-259. (RZhMekh, 4/72, #4V680)

Prochnost' metallicheskikh materialov. (Strength of metallic materials. Collection of articles.) Trudy Severo-zapadnyy PI, Leningrad, 1971, 88p. (KL, 10/72, #8286)

Pyatyy vsesoyuznyy simposium po rasprostraneniyu uprugikh i uprugo-plasticheskikh voln. (Fifth All-Union symposium on elastic and elasto-plastic wave propagation.) Alma-Ata, October, 1971. PM, no. 5, 1972, 138-139.

Ratner, S. B. Loading effect on intensity of destruction and deformation of polymers. Mekhanika polimerov, no. 2, 1972, 366-368.

Ratner, S. B., S. G. Agamalyan, S. T. Buglo, and A. V. Stinskas. Fatigue curve characteristics for plastics. DAN SSSR, v. 204, no. 2, 1972, 335-337.

Rodichev, Yu. M. Factors of weakening of sheet asbotextolite under intense unilateral heating. Problemy prochnosti, no. 5, 1972, 51-53.

Sabodash, P. F., and V. G. Cheban. Cylindrical and spherical thermoelastic waves in an unbounded medium with allowance for finite rate of heat propagation. IAN Mold, no. 2, 1971, 16-22. (LZhS, 19/72, #61048)

Samoylovich, S. S. Role of vacancies in destruction processes. IN: Uchenyye zapiski Gor'kovskogo universiteta, no. 126, 1971, 35-37. (LZhS, 18/72, #56839)

Shermergor, T. D., and V. N. Dolinin. Rheological characteristics of orthotropically reinforced polymer materials. Mekhanika polimerov, no. 2, 1972, 276-283.

Shul'gin, B. V., M. Ya. Khodos, and A. A. Fotiyev. Luminescence spectra of rare earth vanadates. IN: Trudy Instituta khimii Ural'skogo nauchnogo tsentra AN SSSR, no. 23, 1971, 23-28. (LZhS, 20/72, #63570)

Starodubtsev, S. V., Sh. G. Makhkamov, L. G. Gurvich, L. A. Ivanov, N. T. Lazutkin, and Yu. V. Polyak. Device for measuring thermal and electrical conductivity of metals in the radiation field of an atomic reactor reactive zone. IN: Sbornik. Metod radiatsionnykh vozdeystviy v issledovaniy struktury i svoystva tverdykh tel. Tashkent. Izd-vo Fan, 1971, 138-141. (RZhF, 4/72, #4Ye1644)

Sterlikov, V. V., and A. S. Sheyn. Effect of an indium coating, applied by vacuum treatment method, on the contact strength of bearing steel and the durability of bearings. IN: Trudy instituta (VsesNI konstruktornyy tekhnologicheskiy institut podshipnikovoy promyshlennosti), no. 3, 1971, 64-69. (LZhS, 20/72, #64853)

Tret'yachenko, G. N., and V. K. Fedchuk. Device for investigating destruction of structural elements in supersonic high temperature gas flow containing a controlled amount of abrasive particles. Problemy prochnosti, no. 5, 1972, 112-113.

Troitskiy, O. A. Current-stimulated radiative plastic deformation of metals. IN: Sbornik. Teoriya i praktika vysokoskorostnoy deformatsii metallicheskikh materialov. Moskva, 1971, 10. (RZhMekh, 5/72, #5V979)

Tseytlin, V. I., G. A. Gromov, and A. N. Kryuchkova. Low-cycle fatigue of titanium alloys. MiTOM, no. 4, 1972, 57-58.

Udovskiy, A. L., N. O. Gusman, and V. N. Barabanov. Effect of temperature tests on the energy of destruction of graphite. Problemy prochnosti, no. 5, 1972, 83-84.

Urzhumtsev, Yu. S. Second All-Union conference on polymer mechanics. Mekhanika polimerov, no. 2, 1972, 378-380.

Uskenbayev, S., and S. S. Budnevich. Experimental investigation of nitrogen heat exchange in the near-critical region of states at supercritical pressures. I-FZh, v. 22, no. 5, 1972, 926-929.

Vakula, V. L., S. K. Gantsova, and S. A. Balezin. Adhesion of polyvinyl acetate to steel. IN: Vysokomolekulyarnyye soyedineniya. Seriya B, v. 13, no. 10, 1971, 967-771. (LZhS, 20/72, #64849)

Vekshin, B. S., A. A. Vol'skiy, V. P, Dmitriyev, G. Kh. Yenikeyev, B. A. Kapitanov, V. S. Kraposhin, B. G. Livshits, Ya. L. Linetskiy, Yu. I. Milyavskiy, V. L. Pashkova, and A. N. Savich. Magnetic properties of rare earth element alloys. IVUZ Chernaya metallurgiya, no. 5, 1972, 118-120.

Vitkin, A. I., S. S. Guseva, Z. I. Sokolova, and G. M. Vorob'yev. Heating rate effect on recrystallization texture of type 08 kp low carbon steel. MiTOM, no. 4, 1972, 63-67.

Volynets, F. K., Ye. P. Smirnaya, and L. G. Bochkareva. Temperature dependence of strength limit of type K0-1 and K0-2 optical ceramics. OMP, no. 4, 1972, 60-61.

Voprosy prochnosti i plastichnosti metallov. Materialy 6-y Nauch. konf. molodykh uchenykh AN BSSR. (Problems on strength and plasticity of metals. Papers of sixth scientific conference of junior scientists from the AN BSSR.) Minsk. Izd-vo Nauka i tekhnika, 1971, 251p. (RZhF, 4/72, #4Ye700K)

Vorob'yev, V. F., and Yu. I. Dudar'kov. Nonstationary temperature field in a flat plate under internal interaction of thermal conductivity with radiation. I-FZh, v. 22, no. 5, 1972, 899-906.

Voronin, V. I., and A. Ye. Blazhkov. Thermal boundary layer on a nonisothermic plate. IVUZ Aviatsionnaya tekhnika, no. 1, 1972, 119-123.

Vysokoostrovskaya, N. A. Deformation effect on a semimetal quantized film. IN: Uchenyye zapiski Gor'kovskiy universitet. Seriya fizika, no. 126, 1971, 8-10, (RZhF, 4/72, #4Ye1478)

Yatsimirskiy, V. K. Calculation of metal surface energy using the concept of finite thickness of the surface layer. IN: Sbornik. Fizicheskaya khimiya poverknostnykh yavleniy v rasplavakh, Kiyev. Izd-vo Naukova dumka, 1971, 47-51. (RZhF, 3/72, #3Ye906)

Yegorov, B. N., V. S. Kilesso, V. N. Levina, and T. K. Trunova. True heat capacity of glass in the molten state. IN: Sbornik. Elektronicheskaya tekhnika, no. 6, 1971, 37-41. (RZhF, 4/72, no. 4Ye190)

Yenikeyev, E. Kh. Defects on the true surface of a semiconductor. IN: Sbornik. Fiziko-khimicheskiye problemy kristallizatsii. Alma-Ata, no. 2, 1971, 35-41. (RZhF, 4/72, no. 4Ye670)

Yushchenko, V. S., and B. D. Summ. Initial stage of surface diffusion of melts. IN: Sbornik. Fizicheskaya khimiya poverkhnostnykh yavleniy v rasplavakh. Kiyev. Izd-vo Naukova dumka, 1971, 36-40. (RZhF, 4/72, no. 4Ye480)

Zima, Yu. V., O. N. Romaniv, and G. V. Karpenko. New morphological element of microsurface ductile fracture in hypoeutectoid steels. DAN SSSR, v. 203, no. 5, 1972, 1033-1036.

v. Superconductivity

Alekseyevskiy, N. Ye., V. I. Tsebro, V. M. Zakosarenko, Ye. I. Al'shits, and R. I. Personov. Superconducting transition temperature, electrical resistance and optical absorption spectra of Be and Zn films simultaneously vapor deposited on various dielectrics. ZhETF P, v. 15, no. 11, 1972, 668-673.

Aronov, A. G., and V. L. Gurevich. Quasi-field in superconductors and enhancement of T_c under nonequilibrium conditions. ZhETF P, v. 15, no. 9, 1972, 564-567.

Bogomolov, V. N. Superconductivity of mercury in channels of NaX zeolite. FTT, no. 5, 1972, 1575-1578.

Bogomolov, V. N., and V. K. Krivosheyev. Magnetic characteristics of superconducting mercury in serpentine asbestos. FTT, no. 4, 1972, 1238-1240.

Bondarenko, S. I., A. I. Verdyan, and L. D. Demyanov. Alternating current effect on steady-state characteristics of Josephson contact points. ZhTF, no. 5, 1972, 1039-1042.

Botoshan, N. I., V. F. Garabadzhui, and V. A. Moskalenko. Density states of a two-region superconductor with a nonmagnetic impurity. IN: Sbornik. Issledovaniye po kvantovoy teorii sistem mnogikh chastits. Kishinev, Izd-vo Shtiintsa, 1971, 18-26. (RZhF, 4/72,# 4Ye1352)

Botoshan, N. I., V. A. Moskalenko, and A. M. Ursu. Density of electron states of a two-region superconductor with a paramagnetic impurity. IN: Sbornik. Isledovaniye po kvantovoy teorii sistem mnogikh chastits. Kishinev. Izd-vo Shtiintsa, 1971, 70-77. (RZhF, 4/72, no. 4Ye1353)

Boyko, A. A., B. N. Kodess, and V. Sh. Shekhtman. Anomalous temperature dependence of thermal expansion coefficients for superconducting niobium and tantalum carbides. Kristallografiya, no. 3, 1972, 683-684.

Bulayevskiy, L. N. Paramagnetic properties and lower excitation states of long molecules with conjugate bonds. IAN Kh, no. 4, 1972, 816-823.

Dzergach, A. I. Synchrotron superconducting electromagnet. Author's certificate SSSR no. 300137, 3/9/71. (RZhF,4/72, no 4A518 P)

Dzhikayev, Yu. K. Joule heat effect on current destruction of superconductuvity. ZhETF, v. 62, no. 5, 1972, 1918-1926.

Golub, A. A., and L. Z. Kon. On the theory of superconductivity in semiconductors. IN: Sbornik. Issldovaniye po kvantovoy teorii sistem mnogikh chastits. Kishinev. Izd-vo Shtiintsa, 1971, 27-32. (RZhF, 4/72, no. 4Ye1460)

Gubankov, V. N., K. K. Likharev, and N. M. Margolin. Properties of superconducting point contacts. FTT, no. 4, 1972, 953-960.

Handstein, A. Magnetization and size effect of hard superconductors. PSS (a), no. 10, 1972, 425-435.

Kadykova, G. N., and L. N. Fedotov. Structure of superconducting alloys types 35BT, 50BT and 65BT. FMM, no. 4, 1972, 708-714.

Kafka, W. Sverkhprovodyashchiy generator postoyannogo toka. (Superconducting dc generator.) IPP-Berichte, # 4/90, 1971, 24p. (RzhF, 4/72, no. 4G283)

Karasik, V. R., N. G. Vasil'yev, and V. S. Vysotskiy. Surface superconductivity of a Ti-22 at. % Nb alloy. ZhETF, v. 62, no. 5, 1972, 1818-1826.

Kolodeyev, I. D. Superconducting reactive dc electric motors. PTE, no. 2, 1972, 233-234.

Krasnopolin, I. Ya., R. Radzh, and M. S. Khaykin. Anisotropy of the surface superconductivity of lead single crystals. ZhETF P, v. 15, no. 9, 1972, 516-520.

Likharev, K. K., and V. K. Semenov. Spectral fluctuations in superconducting point contacts. ZhETF P, v. 15, no. 10, 1972, 625-629.

Martinelli, A. P. Ispol'zovaniye sverkhprovodimosti v issledovaniyakh po probleme upravlyayemogo termoyadernogo sinteza. (Application of superconductivity in thermonuclear fusion research.) IPP-Berichte, no. 4/91, 1971, 23p. (RZhF, 4/72, no. 4G284)

Problemy sverkhprovodyashchikh materialov. (Problems of superconducting materials. Proceedings of the Fifth All-Union conference on the physical chemistry, metallurgy, and metallophysics of superconductors.) Moskva. Izd-vo Nauka, 1970, 231p.

Rauluszkiewicz, J. Tunneling phenomena in superconductors. Postepy fizyki, v. 23, no. 2, 1972, 181-200.

Savitskiy, Ye. M., B. Ya. Sukharevskiy, V. V. Baron, E. Ye. Anders, V. A. Frolov, and I. V. Shestakova. Temperature dependence factors for thermal conductivity coefficients of niobium-zirconium solid solutions. DAN SSSR, v. 203, no. 5, 1972, 1044-1046.

Shmidt, V. V. Theory on pinning effect in type II superconductors. ZhETF, v. 62, no. 5, 1972, 1963-1973.

Sniadower, L. Superconducting semiconductors. Postepy fizyki, v. 23, no. 2, 1972, 157-179.

Superconductivity in tantalum nitride. Soviet science review, no. 3, 1972, 70.

Sychev, V. V., V. B. Zenkevich, and V. A. Al'tov. Superconducting magnet with saddle-shaped winding. PTE, no. 2, 1972, 185-187.

Titov, V. S., P. P. Pashkov, and A. A. Fridman. Structure of wire made with type 35BT superconducting alloy. IN: Trudy VsesNII Elektromekhaniki, v. 35, 1971, 119-124. (LZhS, 19/72, no. 61583)

Trubnikov, B. A. Model of a superconductor with sigma-shaped electron interaction. IN: Sbornik. Fizika plazmy, no. 3, Moskva, Izd-vo Atomizdat, 1971, 80-84. (RZhF, 3/72, 3Ye1590)

Vereshchagin, L. F., Yu. S. Konyayev, E. M. Berzon, and M. V. Veller. Temperature variation in the superconducting transition of deformed niobium stannide. DAN SSSR, v. 203, no. 6, 1972, 1270-1271.

Yemtsev, M. New state of matter, or how to turn metal into non-metal. Science and Engineering, APN Newsletter, no. 23, 1972, (3) 1-2.

Yeremenko, O. N., M. L. Khidekel', D. N. Fedutin, and E. B. Yagubskiy. Highly conductive complexes of 7, 7, 8, 8-tetracyanquinodimethane with tetrathiotetracene. IAN Kh, no. 4, 1972, 984.

Zenkevich, V. B., and V. V. Sychev. Magnitnyye sistemy na sverkhprovodnikakh. (Superconductor magnetic systems.) Moskva. Izd-vo Nauka, 1972, 260p. (KL, 22/72, no. 18827)

vi. Epitaxial Films

Blinnikov, G. A., and G. A. Kalyuzhnaya. Using a liquid epitaxy method to study CdS crystallization. NM, no. 4, 1972, 641-643.

Bokiy, G. B., G. F. Kuznetsov, I. M. Kotelyanskiy, V. V. Panteleyev, and B. I. Rybkin. Substructure of heteroepitaxial single crystal layers of cadmium sulfide on germanium. IN: Sbornik. Problemy kristallologii. Moskva. Izd-vo Moskovskiy universitet, 1971, 206-213. (RZhF, 4/72, no. 4Ye606.)

Borman, D. V. Method for measuring lifetime of nonequilibrium charge carriers in epitaxial films. FTP, no. 4, 1972, 692-697.

Deryagin, B. V., B. V. Spitsyn, D. V. Fedoseyev, V. A. Ryabov, A. V. Bochko, and A. V. Lavrent'yev. Synthesis and properties of diamond autoepitaxial films. IN: Sbornik. Fiziko-khimicheskiye problemy kristallizatsii. Alma-Ata, no. 2, 1971, 90-95. (RZhF, 5/72, no. 5A536)

Distler, G. I., and L. A. Shenyavskaya. Memory of photoepitaxy semiconductor crystals. FTT, no. 5, 1972, 1400-1405.

Erlikh, R. N., N. A. Belov, V. I. Sokolov, and T. I. Guseva. Hardness of epitaxial layers. IN: Nauchnyye trudy Leningradskogo gornogo instituta. Novyye issledovaniya v geologii, no. 2, 1971, 33-38. (LZhS, 19/72, no. 60340)

Fedotov, Ya. A., S. G. Madoyan, G. Kh. Avetisyan, and V. D. Managarov. Properties of a p^+Ge-nGaAs structure obtained by liquid epitaxy. IN: Elektronnaya tekhnika. Sbornik. Poluprovodnikovyye pribory, no. 4(61), 1971, 31-38. (RZhF, 4/72, 4Ye605)

Kamadjiev, P. R., L. K. Mladjov, L. D. Pramatarova, and A. D. Anghelova. Preparation and microstructure of a cadmium telluride epitaxial layer on germanium by the sandwich method. Dokl. Bolg. AN, no. 9, 1971, 1155-1158. (RZhKh, 11/72, no. 11B621)

Kazarskaya, S. T. Active growth points of crystals during epitaxy from solutions. IN: Nauchnyye trudy Leningradskogo gornogo instituta. Novyye issledovaniya v geologii, no. 2, 1971, 29-33. (LZhS, 19/72, no. 60226)

Kulish, U. M. Calculation of growth rate of semiconductor layers obtained by epitaxy from liquid metal solutions. IVUZ Fiz, no. 2, 1971, 112-116.

Lavrent'yeva, L. G. Preparation and investigation of gallium arsenide films and their p-n transitions. IN: Sbornik. Itogi issledovaniy po fizike 1917-1967. Izd-vo Tomskiy universitet, 1971, 50-71. (RZhF, 5/72, no. 5A565)

Lisenker, B. S., I. Ye. Maronchuk, Yu. Ye. Maronchuk, and A. I. Sherstyakov. Plane orientation effect on alloying level and impurities distribution in gallium arsenide epitaxial layers. NM, no. 4, 1972, 670-675.

Magomedov, N. N., A. I. Rodionov, T. A. Zeveke, and N. N. Sheftal'. Epitaxial GaAs prepared by HCl transfer. Kristallografiya, no. 3, 1972, 687-690.

Markaryan, A. B., and G. A. Kurov. Thermal effects from film growth in a vacuum. IN: Sbornik nauchnykh trudov po probleme mikroelektroniki. Moskovskiy institut elektronnoy tekhniki, no. 7, 1971, 19-25. (RZhF, 5/72, no. 5A541)

Muszynski, Z. Kinetics and optimal growth conditions for gallium arsenide prepared by epitaxial growth from a solution. Elektronika, v. 12, no. 8, 1971, 324-329. (RZhF, 4/72, no. 4A772)

Palatnik, L. S. Epitaksial'nyye plenki. (Epitaxial films.) Moskva. Izd-vo Nauka, 1971, 480p.

Palatnik, L. S., O. A. Obol'yaninova, M. N. Naboka, N. T. Gladkikh, and V. I. Khotkevich. Effect of molecular beam composition on the structure of niobium vacuum condensates. IAN Metally, no. 3, 1972, 81-84.

Ratcheva-Stambolieva, T., Yu. D. Tchistyakov, D. H. Djoglev, and V. S. Bakardjieva. Production of CdS and CdSe epitaxial layers from the vapor phase. PSS (a), no. 10, 209-214.

Sandulova, A. V., I. D. Gortynskaya, A. Ye. Nosenko, and A. D. Goncharov. Optical and photoelectrical properties of thin layers of tellurium prepared by pressure from the melt. FTP, no. 5, 1972, 976-977.

Skvortsov, I. M., and B. V. Orion. Effect of impurities on growth of silicon epitaxial layers at low temperatures. Elektronnaya tekhnika. Sbornik. Poluprovodnikovyye pribory, no. 4(61), 1971, 99-106. (RZhF, 4/72, no. 4A738)

Vanyukov, A. V., I. I. Krotov, and N. G. Mnatsakanyan. Approximation method for analysis of conditions for preparing $A^{II}B^{VI}$ compound epitaxial films. NM, no. 4, 1972, 644-647.

Varnin, V. P., D. V. Fedoseyev, and B. V. Deryagin. Combined crystallization of diamond and graphite at low pressures. IN: Sbornik. Fiziko-khimicheskiye problemy kristallizatsii. Alma-Ata, no. 2, 1971, 18-23. (RZhKh, 10/72, no. 10B883)

Yemel'yanenko, O. V., D. N. Nasledov, D. D. Nedeoglo, and I. N. Timchenko. Magnetoresistivity of n-GaAs epitaxial layers. IAN Mold, no. 1, 1972, 61-67.

Yudina, L. A., L. A. Chebotkevich, L. G. Yeliseyenko, Yu. D. Vorob'yev, and V. V. Veter. Structure and dislocation boundaries of iron silicide epitaxial films. IN: Uchenyye zapiski Dal'nevostochnogo universiteta, no. 51, 1970, 62-70. (RZhF, 4/72, No. 4Ye664)

Zhitar', V. F., S. I. Radautsan, V. Ya. Raylyan, V. Ye. Tezlevan, and F. G. Donika. Epitaxial growth of thin layers of a $CdS-In_2S_3$ section. IAN Mold, no. 2, 1971, 74-76. (RZhF, 4/72, no. 4A771)

Zhuravleva, L. I., N. A. Toptygina, and L. P. Zverev. Interference method for control of epitaxial film thickness. IN: Uchenyye zapiski Ural'skogo universiteta, no. 118, 1971, 28-35. (RZhF. 4/72, no. 4A737)

vii. Magnetic Bubble Materials

Anisotropy of magnetization in $Nd_3S_{1.35}Fe_{3.65}O_{12}$ garnet. Czech. J. Phys. B, no. 21, 1971, 1316-1318.

Antonov, A. V., A. M. Balbashov, and A. Ya. Chervonenkis. Domain structure characteristics of rare earth orthoferrites. IVUZ Fiz, no. 5, 1972, 146-148.

Belov, K. P., A. N. Goryaga, and T. Ya. Gridasova. Coercive force anomalies in temperature compensation region of ferrite-spinels. FTT, no. 5, 1972, 1428-1431.

Durasova, U. A., I. S. Kolotov, O. S. Kolotov, and R. V. Telesnin. Dynamic domains arising during incoherent rotation in thin magnetic films. PSS, (a), no. 10, 1972, K101-K103.

Gendelev, S. Sh., L. D. Fedorovich, and B. V. Zaytsev. Effect of crystallization conditions on dislocation density in $Y_3Fe_5O_{12}$. NM, no. 5, 1972, 858-860.

Levitin, R. Z., and A. S. Pakhomov. Technique for separating anisotropy components of ferrimagnets. FTT, no. 5, 1972, 1489-1493.

Novikov, N. N., and V. A. Satsyuk. Etching and polishing of yttrium-iron crystals in orthophosphoric acid. Kristallografiya, no. 3, 1972, 684-686.

Tanasoiu, C. Orthoferrites used as computer logic elements. Stud. si cerc. fiz., v. 23, no. 9, 1971, 1107-1122. (RZhF, 4/72, no. 4Ye1179)

Timofeyev, Yu. A., Ye. N. Yakovlev, and A. N. Ageyev. Dependence of yttrium-iron garnet magnetic anisotropy on temperature and pressure. FTT, no. 5, 1972, 1314-1320.

Vorob'yev, Yu. P., S. A. Leont'yev, V. A. Kozlov, A. N. Men', A. Ya. Chervonenkis, and G. I. Chufarov. Thermodynamic properties of gadolinium, europium and holmium orthoferrites. DAN SSSR, v. 204, no. 3, 1972, 619-621.

viii. Surface Waves

Bryksin, V. V., and Yu. A. Firsov. Microscopic theory of surface oscillations in ionized crystal plates. FTT, no. 4, 1972, 1148-1163.

Kaliski, S., and L. Solarz. Surface wave propagation in a wave medium. Biul. WAT J. Dabrowskiego, no. 12, 1971, 11-24. (RZhRadiot, 4/72, no. 4B122)

Kanunnikov, V. P. Calculation of continuous surface wave propagation along rods with varying conductivity. IN: Sbornik. Nekotoryye problemy sovremennoy fiziki. Dnepropetrovsk, 1971, 65-70. (RZhF, 4/72, no. 4Zh244)

Kaufman, R. N. Surface wave propagation along the boundary plane of two magnetoactive plasmas. ZhTF, no. 4, 1972, 746-751.

Khokhlov, V. I., and B. G. Yemets. Spectrum of surface spin waves in an isotropic antiferromagnet. UFZh, no. 4, 1972, 623-627.

Kirpichnikova, N. Ya. Propagation of surface waves concentrated near rays in an inhomogeneous arbitrarily-shaped elastic body. IN: Trudy Matematicheskogo instituta imeni Steklova, v. 115. Matematicheskiye voprosy teorii difraktsii i rasprostraneniya voln, no. 1, 1971, 114-130.

Kondratenko, A. I. Kinetic theory of surface waves in a plasma cylindrical waveguide. ZhTF, no. 4, 1972, 743-745.

Nesterov, S. V. Resonance interaction of surface and internal waves. FAiO, no. 4, 1972, 447-452.

Tolmachev, M. M., and M. B. Tseytlin. Transformation of body and surface waves in plasma systems. IVUZ Radiofiz, no. 4, 1972, 635-637.

6. Miscellaneous Interest

A. Recent Selections

Akhiezer, I. A., and A. E. Ginzburg. Slow electromagnetic waves in antiferromagnets close to the transition point in the ferromagnet phase. UFZh, no. 5, 1972, 850-851.

Andriyakhin, V. M., Ye. P. Velikhov, V. V. Vasil'tsov, S. S. Krasil'nikov, V. D. Pis'mennyy, I. V. Novobrantsev, A. T. Rakhimov, A. N. Starostin, and V. Ye. Khvostionov. High pressure gas laser with preionization by a reactor. ZhETF P, v. 15, no. 11, 1972, 637-639.

Aref'yev, K. M. et al. Osnovy termoelektronnogo i magnitogidrodinamicheskogo preobrazovaniya energii. (Principles in thermolectronic and magnetohydrodynamic conversion of energy. Moskva. Izd-vo Atomizdat, 1970, 215p.

Arkhipenko, V. I., A. B. Berezin, V. N. Budnikov, V. Ye. Golant, K. M. Novik, A. A. Obukhov, A. D. Piliya, V. I. Fedorov, and K. G. Shakhovets. Investigation of transformation and absorption of high frequency waves in plasma, directed towards the development of methods for plasma heating. IN: Plasma Physics and Controlled Nuclear Fusion Research, 1971. Proceedings 4th International Conference, Madison, Wisc. USA, 1971, v. 3. Vienna, 1971, 525-541. (RZhF, 5/72, no. 5G291)

Arkhipenko, V. I., and V. N. Budnikov. Pogloshcheniye SVCh-voln plazmoy, sushchestvenno neodnorodnoy vdol' magnitnogo polya. Absorption of superhigh frequency plasma waves, appreciably nonuniform along a magnetic field. AN SSSR Fiziko-tekhnichekiy institut. Preprint no. 359, Leningrad, 1971, 22p. (RZhF, 5/72 no. 5G173)

Arkhipenko, V. I., V. N. Budnikov, and A. A. Obukhov. Ob odnom nelineynom effekte pri pogloshchenii SVCh-voln plazmoy. (A nonlinear effect during absorption of superhigh frequency plasma waves.) AN SSSR. Fiziko-tekhnicheskiy institut. Preprint, no. 353. Lenigrad, 1971, 9p (RZhF, 5/72, no. 5G175)

Batanov, G. M., and K. A. Sarksyan. Nonthermal radiation of a magnetoactive plasma in a superhigh frequency wave pumping field. ZhETF, v. 62, no. 5, 1972, 1721-1724.

Belikov, V. S. Ya. I. Kolesnichenko, and V. N. Orayevskiy. Reaction synthesis effect on performance of thermonuclear devices. IN: Plasma Physics and Controlled Nuclear Fusion Research, 1971. Proceedings 4th International Conference. Madison, Wisc. USA, 1971, v. 3. Vienna, 1971, 411-421. (RZhF, 5/72, no. 5G321)

Chizmadzhev, Yu. A. Makrokinetika protsessov v poristykh sredakh (Toplivnyye elementy) (Macrokinetic processes in porous media. Fuel cells.) Moskva. Izd-vo Nauka, 1971, 363p.

Dobrovol'skiy, V. N., and M. N. Vinoslavskiy. Pinch effect in electron-hole germanium plasma. ZhETF, v. 62, no. 5, 1972, 1811 - 1817.

Ferencz, C. Wave propagation in arbitrary linear media. Acta Technica Academiae Scientiarum Hungaricae 71, no. 1-2, 1971, 109 -115.

Feyzulin, E. I. Optical imaging of a two-dimensional target using ultrasonic light diffraction. IVUZ Radiofiz, no. 5, 1972, 713-717.

Fleyer, A. G. Ultralong radio wave propagation and nonequilibrium rotation of the earth. IN: Trudy Sibirskogo nauchno-issledovatel'skogo instituta metrologii, no. 11, 1971, 23-52. (LZhS, 19/72, no. 61412)

Frenkina, I. P. Machine language for dynamic problems. IN: Sbornik. Uprugost' i neuprugost'. Moskva. Izd-vo Moskovskiy universitet, no. 1, 1971, 259. (RZhMekh, 5/72, no. 5V105)

Galushkin, Yu. I. Population of levels of hydrogen-like ions. ZhPS, v. 16, no. 5, 1972, 788-796.

Ganchev, B. G., V. V. Lozovetskiy, and V. M. Nikitin. Hydrodynamics and heat transfer processes during liquid film runoff along a vertical surface. IN: Trudy Movskovskogo vysshego tekhnicheskogo uchilishcha im. N. E. Baumana, no. 144, 1971, 40-47. (RZhMekh, 5/72, no. 5B1024)

Glagolev, V. M., N. A. Krivov, and Yu. V. Skosyrev. Experimental investigation of plasma heating on a frequency close to the lower hybrid resonance. IN: Plasma Physics and Controlled Nuclear Fusion Research 1971. Proceedings 4th International Conference, Madison, Wisc USA, v. 3. Vienna, 1971, 559-569 (RZhF. 5/72, no 5G290)

Govorkov, V. G., Ye. I. Kozlovskaya, Kh. S. Bagdasarov, N. N. Voinova, and Ye.A. Fedorov. Anisotropy of local plastic deformation in corundum crystals. Kristallografiya, no. 3, 1972, 599-606.

Gulyayev, Yu. V. New type of surface acoustic waves in conducting crystals. FTT, no. 5, 1972, 1534-1536.

Gulyayev, Yu. V., and V. V. Denisenko. Nonlinear effects during propagation of high-intensity surface acoustic waves in a semiconductor. FTT, no. 5, 1972, 1475-1477.

Inozemtseva, A. D. X-ray and optical investigation of liquid crystals structure. Kristallografiya, no. 3, 1972, 656-658.

Issledovaniye istochnikov nizkotemperaturnoy plazmy. (Sources of low temperature plasma.) (Collection of articles.) Uchenyye zapiski GPU im. Gertsena. Leningrad, no. 466, 1971, 140 p. (RZhF, 5/72, no. 5G44K)

Ivanov, A. et al. Raketno-yadernoye oruzhiye i yego porazhayushcheye deystviye. (Nuclear missile weapons and their destructive effects.) Moskva. Izd-vo Voyenizdat, 1971, 224p.

Kessenikh, G. G., V. N. Lyubimov, and D. G. Sannikov. Surface elastically-polarized waves at ferroelectric domain boundaries. Kristallografiya, no. 3, 1972, 591-594.

Khalatnikov, I. M. Teoriya sverkhtekuchesti. (Theory of superfluidity.) Moskva. Izd-vo Nauka, 1971, 320 p.

Kharchenko, L. Yu., and P. V. Klevtsov. Hydrothermal synthesis of rubidium-rare earth tungstates. Kristallografiya, no. 3, 1972, 694-695.

Kovpik, O. F., Ye. A. Kornilov, and Yu. Ye. Kolyada. External high frequency modulation of an electron beam and absorption of beam instability oscillations in a corkscrew configuration magnetic field. UFZh, no. 5, 1972, 830-833,

Krupenio, N. N. Radiolokatsionnyyee issledovaniya Luny. (Radar studies of the moon.) Moskva. Izd-vo Nauka, 1971, 172p.

Kurushin, A. D., I. A. Pan'shin, and V. A. Fabrikov. Application of brightness hysteresis to ferromagnetic tape image recording. ZhNiPFiK, no. 3, 1972, 219-220.

Levitin, R. Z., Ye. M. Savitskiy, V. F. Terekhova, O. D. Chistyakov, and V. L. Yakovenko. Nature of magnetic anisotropy of dysprosium: investigation of anisotropy of dysprosium-gadolinium alloys. ZhETF, v. 62, no. 5, 1972, 1858-1866.

Liberman, M. A., B. E. Meyerovich, and L. P. Pitayevskiy. Anomalous skin effect in a plasma with a diffuse boundary. ZhETF, v. 62, no. 5, 1972, 1737-1744.

Pankratov, V. G., V. G. Mikhalev, V. N. Stepanov, and A. V. Khokhlov. Recombination continuum in lithium plasma spectrum. ZhPS, v. 16, no. 5, 1972, 785-787.

Rosciszewski, K. Incoherent cross-section for neutron quasi-elastic scattering in a liquid crystal. APP, no. 5, 1972, 549-561.

Sayapina, V. I., and D. Ya. Svet. Radiation from a metal-oxide film system. ZhPS, v. 16, no. 5, 1972, 896-902.

Sergeyev, A. Radioelektronika pod vodoy. (Underwater radio electronics.) Leningrad. Izd-vo Energiya, 1971, 142p.

Sitenko, A. G. All-Union conference on plasma theory. (Kiyev, 19-23 October, 1971) UFN, v. 107, no. 1, 1972, 161-171.

Stepanov, V. A. Amplitude and phase changes of a 16 kc signal propagating over a path of 5200 km. IN: Trudy Sibirskogo nauchno-issledovatel'skogo instituta metrologii, no. 11, 1971, 64-71. (LZhS, 19/ 72, no. 61408)

Telesnin, R. V., Ye. N. Il'icheva, N. B. Shirokova, A. G. Shishkov, and N. A. Ekonomov. Magnetic reversal rate and domain boundaries motion in single crystal Mg-Mn ferrite films. Kristallografiya, no. 3, 1972, 566-572.

Terent'yev, O. P., L. K. Kovalev, V. N. Suvorov, and V. I. Makarov. Assembly for ion-plasma deposition of materials. OMP, no. 5, 1972, 23-25.

Tovbina, A. I., and L. S. Chuykova. Time distribution of shortwave time signals on three channels. IN: Trudy Sibirskogo nauchno-issledovatel'skogo instituta metrologii, no. 11, 1971, 72-88. (LZhS, 19/72, no. 61409)

Trukhanov, K. A. et al. Aktivnaya zashchita kosmicheskikh korabley. (Active protection of space vehicles.) Moskva. Izd-vo Atomizdat, 1970, 231p.

Vasil'yeva, A. N., I. A. Grishina, V. D. Pis'mennyy, and A. T. Rakhimov. Superheating instability in fully-ionized current carrying plasma. ZhETF P, v. 15, no. 10, 1972, 613-615.

Zaroslov, D. Yu., Ye. K. Karlova, N. V. Karlov, G. P. Kuz'min, and A. M. Prokhorov. Plasma jet CO_2 laser. ZhETF P, v. 15, no. 11, 1972, 665-668.

Zhevandrov, N. D. Trends in molecular luminescence investigations. (Conference at Sukhumi, October 1971.) VAN, no. 3, 1972, 119-120.

7. SOURCE ABBREVIATIONS

APP	-	Acta physica polonica
DAN ArmSSR	-	Akademiya nauk Armyanskoy SSR. Doklady
DAN AzSSR	-	Akademiya nauk Azerbaydzhanskoy SSR. Doklady
DAN BSSR	-	Akademiya nauk Belorusskoy SSR. Doklady
DAN SSSR	-	Akademiya nauk SSSR. Doklady
DAN TadSSR	-	Akademiya nauk Tadzhikskoy SSR. Doklady
DAN UkrSSR	-	Akademiya nauk Ukrainskoy SSR. Dopovidi
EOM	-	Elektronnaya obrabotka materialov
FAiO	-	Akademiya nauk SSSR. Izvestiya. Fizika atmosfery i okeana
FGiV	-	Fizika goreniya i vzryva
FiKhOM	-	Fizika i khimiya obrabotki materialov
F-KhMM	-	Fiziko-khimicheskaya mekhanika materialov
FMiM	-	Fizika metallov i metallovedeniye
FTP	-	Fizika i tekhnika poluprovodnikov
FTT	-	Fizika tverdogo tela
IAN Arm	-	Akademiya nauk Armyanskoy SSR. Izvestiya
IAN Az	-	Akademiya nauk Azerbaydzhanskoy SSR. Izvestiya
IAN B	-	Akademiya nauk Belorusskoy SSR. Izvestiya. Seriya fiziko-matematicheskikh nauk
IAN Energ	-	Akademiya nauk SSSR. Izvestiya. Energetika i transport
IAN Fiz	-	Akademiya nauk SSSR. Izvestiya. Fizika
IAN Fizika zemli		Akademiya nauk SSSR. Izvestiya. Fizika zemli

IAN Kh	-	Akademiya nauk SSSR. Izvestiya. Seriya khimicheskaya
IAN Metally	-	Akademiya nauk SSSR. Izvestiya. Metally
IAN Mold	-	Akademiya nauk Moldavskoy SSR. Izvestiya. Seriya fiziko-tekhnicheskikh i matematicheskikh nauk
IAN Tadzh	-	Akademiya nauk Tadzhikskoy SSR. Izvestiya. Otdeleniye fiziko-matematicheskikh i geologo-khimicheskikh nauk
IAN UzbSSR	-	Akademiya nauk Uzbekskoy SSR. Izvestiya. Seriya fiziko-matematicheskikh nauk
I-FZh	-	Inzhenerno-fizicheskiy zhurnal
ILEI	-	Leningradskiy elektrotekhnicheskiy institut. Izvestiya
IT	-	Izmeritel'naya tekhnika
IVUZ Aviatsion-naya tekhnika	-	Izvestiya vysshikh uchebnykh zavedeniy. Aviatsionnaya tekhnika
IVUZ Chernaya metallurgiya	-	Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya
IVUZ Energ	-	Izvestiya vysshikh uchebnykh zavedeniy. Energetika
IVUZ Fiz	-	Izvestiya vysshikh uchebnykh zavedeniy. Fizika
IVUZ Radioelektr	-	Izvestiya vysshikh uchebnykh zavedeniy. Radioelektronika
IVUZ Radiofiz	-	Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika
IVUZ Tsvetnaya metallurgiya	-	Izvestiya vysshikh uchebnykh zavedeniy. Tsvetnaya metallurgiya
KL	-	Knizhnaya letopis'
Kristall	-	Kristallografiya
KSpF	-	Kratkiye soobshcheniya po fizike

LZhS	-	Letopis' zhurnal'nykh statey
MiTOM	-	Metallovedeniye i termicheskaya obrabotka materialov
MP	-	Mekhanika polimerov
MTT	-	Akademiya nauk SSSR. Izvestiya. Mekhanika tverdogo tela
MZhiG	-	Akademiya nauk SSSR. Izvestiya. Mekhanika zhidkosti i gaza
NK	-	Novyye knigi
NM	-	Akademiya nauk SSSR. Izvestiya. Neorganicheskiye materialy
OiS	-	Optika i spektroskopiya
OMP	-	Optiko-mekhanicheskaya promyshlennost'
Otkr izobr	-	Otkrytiya, izobreteniya, promyshlennyye obraztsy, tovarnyye znaki
Phys abs	-	Physics abstracts
PM	-	Prikladnaya mekhanika
PMM	-	Prikladnaya matematika i mekhanika
PSS	-	Physica status solidi
PTE	-	Pribory i tekhnika eksperimenta
RiE	-	Radiotekhnika i elektronika
RZhElektr	-	Referativnyy zhurnal. Elektronika i yeye primeneniye
RZhF	-	Referativnyy zhurnal. Fizika
RZhKh	-	Referativnyy zhurnal. Khimiya
RZhMekh	-	Referativnyy zhurnal. Mekhanika
RZhMetrolog	-	Referativnyy zhurnal. Metrologiya i izmeritel'naya tekhnika
RZhRadiot	-	Referativnyy zhurnal. Radiotekhnika

TKiT	-	Tekhnika kino i televideniya
TMF	-	Teoreticheskaya i matematicheskaya fizika
TVT	-	Teplofizika vysokikh temperatur
UFN	-	Uspekhi fizicheskikh nauk
UFZh	-	Ukrainskiy fizicheskiy zhurnal
VAN	-	Akademiya nauk SSSR. Vestnik
VAN BSSR	-	Akademiya nauk Belorusskoy SSR. Vestnik
VAN KazSSR	-	Akademiya nauk Kazakhskoy SSR. Vestnik
VLU	-	Leningradskiy universitet. Vestnik. Fizika, khimiya
VMU	-	Moskovskiy universitet. Vestnik. Seriya fizika, astronomiya
ZhETF	-	Zhurnal eksperimental'noy i teoreticheskoy fiziki
ZhETF P	-	Pis'ma v Zhurnal eksperimental'noy i teoreticheskoy fiziki
ZhFKh	-	Zhurnal fizicheskoy khimii
ZhNKh	-	Zhurnal neorganicheskoy khimii
ZhNiPFiK	-	Zhurnal nauchnoy i prikladnoy fotografii i kinematografii
ZhPMTF	-	Zhurnal prikladnoy mekhaniki i teoreticheskoy fiziki
ZhPS	-	Zhurnal prikladnoy spektroskopii
ZhTF	-	Zhurnal tekhnicheskoy fiziki
ZhVMMF	-	Zhurnal vychislitel'noy matematiki i matematicheskoy fiziki

8. AUTHOR INDEX