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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

PHYSICS

No. 45

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USSR

UDC 534.26

SOUND RADIATION FROM A PLATE REINFORCED WITH A PROTRUDING STIFFENER

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 24, No 3, May-Jun 78 pp 326-333
manuscript received 9 Mar 77; after revision, 20 Dec 77

BELINSKIY, B.P., Chair of Physics, Scientific Research Institute of Physics;
Leningrad State University imeni A. A. Zhdanov

[Abstract] In continuation of a study concerning the diffraction of a plane wave at a plate reinforced with a single stiffener, the reflection of such a wave at the stiffener surface is considered here without the constraint of rigidity. The stiffener, with small wave dimensions, is regarded as subject to linear and angular displacements as a single body. The sound field, i.e., the radiation pattern (power distribution) in the surrounding fluid and the sound pressure along the stiffener are calculated, both depending on the point of application of a harmonic force to the plate. The author thanks D.P. Kouzov for the interest in this study. Figures 2; tables 3; references 11: 10 Russian, 1 German.

USSR

UDC 534.26

BROADBAND SOUND RADIATION FROM THIN PLATES AND SHELLS WITH STIFFENERS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 24, No 3, May-Jun 78 pp 354-362
manuscript received 13 Apr 77

IVANOV, V.S. and ROMANOV, V.N.

[Abstract] Thin plates and shells with a finite number of stiffeners are considered under a random normal load of spatially concentrated forces with a broad frequency spectrum. With the effect of the resonance characteristics virtually eliminated, the problem of the sound radiation field from such a system is solved by the energy method. The effects of losses and mechanical impedances are evaluated. The results of calculations agree closely enough with experimental data. Figures 5; references: 9 Russian.

USSR

UDC 534.232

A TUNABLE HIGH-FREQUENCY HIGH-POWER PIEZOCERAMIC RADIATOR TRANSDUCER

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 24, No 3, May-Jun 78 pp 372-375
manuscript received 3 Jun 77; after revision, 21 Nov 77

LANINA, E.P., Chair of Physics, Moscow State University imeni M.V. Lomonosov

[Abstract] A radiator transducer has been designed which consists of two active piezoceramic plates and a layer of matching fluid between them, all inside a case of acrylic plastic. One plate is rigidly fastened to an outer flange, the other plate is fastened to a movable piston with means of adjustment to parallelism. The thickness of the oil layer can be varied from 0.5 to 3 mm and the maximum radiation intensity thus held almost constant at 150 W/cm^2 over the frequency range from 1.7 to 1.9 MHz or, with the excitation voltage varied appropriately with the frequency, even to 2.2 MHz. This transducer was tested with both plates 1 mm thick and 30 mm in diameter, radiating into a water pool. Nonlinear effects of the fluid could be detected and shock waves were recorded at distances from the radiator corresponding to velocities of the order of 10^{-3} Mach. The author thanks V. I. Shmal'gauzen for the guidance. Figures 4; references 8: 7 Russian, 1 Western.

USSR

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ACOUSTIC FIELD OF A CYLINDRICAL RADIATOR WITH MIXED BOUNDARY CONSTRAINTS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 24, No 3, May-Jun 78 pp 401-405
manuscript received 21 Mar 77

RUBANOV, I.L.

[Abstract] The steady-state acoustic field of a cylindrical radiator transducer is considered, one segment of the lateral surface being characterized by a vibration velocity $u(\varphi)$ and the other segment being regarded as an acoustically soft body. The problem is reduced to the Helmholtz equation with appropriate boundary conditions and its solution, obtained by the Riemann-Hilbert method, yields the distribution of sound pressure $p(r, \varphi)$. Figures 3; references 8: 7 Russian, 1 Western.

USSR

UDC 535.853.4

HOLOGRAPHIC DEVICE FOR EXAMINING ULTRASONIC FIELDS IN OPTICALLY TRANSLUCENT MEDIA

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 24, No 3, May-Jun 78 pp 420-422
manuscript received 8 Jun 77

GINZBURG, V.M., GUDKOV, L.D., STEPANOV, B.M., and TSARFIN, V.YA.

[Abstract] A holographic interferometer with a single-mode ruby-leucosapphire pulse laser were used for visualization of a traveling ultrasonic wave. The effect of reflections by the walls of the test cell on the interferogram was eliminated by using the radiation of such an ultrasonic wave in the form of a pulse of a few hundred microseconds duration. The outstanding features of this apparatus were a biconvex lens as the first stage of the two collimators forming the signal beam and the reference beam respectively, and a double sensitivity of the optical system which made the signal beam pass the test zone twice. The second exposure was delayed with respect to the beginning of the ultrasonic wave-pulse by means of a special control mechanism. The recording of ultrasonic fields by this method required a careful adjustment of the radiator position relative to the test cell. The interference patterns were reproduced in white light. Figures 3; references: 2 Russian.

USSR

UDC 621.382.2

HIGHLY EFFECTIVE SOLAR PHOTOELECTRIC GENERATORS WITH THIN VARIBAND LAYER

Leningrad, FIZIKA I TEKHNIKA POLUPROVODNIKOV, in Russian, Vol 12, No 5, May 78, pp 948-951, manuscript received 10 Jan 78

IMENKOV, A.N., STAMKULOV, A.A., TAURBAYEV, T.I., TSARENKOV, B.V., SHORIN, V.F. and YAKOVLEV, YU.P., Institute of Physics and Technology imeni A.F. Ioffe, Academy of Sciences, USSR, Leningrad

[Abstract] A report is presented on the creation of highly effective solar photoelectric generators based on n-GaAs with a thin variband p-Ga_{1-x}Al_x-As layer. The structures were created by immersion of a packet of plates of n-GaAs into solution of Ga+Al+Zn. Electrons drift toward the GaAs, and their surface recombination is greatly decreased. A solar-to-electric energy conversion efficiency of 19% is achieved under the conditions beyond the atmosphere, 24% at an altitude of 800 m above sea level (air mass 2.1, intensity of illumination 85 mW/cm²). A cross-sectional diagram of a cassette with a packet of substrates and the solution used is presented. Figures 4; references: 13 8 Russian, 5 Western.

USSR

UDC 621.315.592

OUTLOOK FOR PRACTICAL APPLICATIONS FOR TYPE A^{II}B^{IV}C₂^V SEMICONDUCTORS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian, Vol 12, No 2, Feb 78 pp 209-233 manuscript received 28 Sep 76

PROCHUKHAN, V.D. and RUD', YU.V., Physico-Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] Since the discovery of diamond-like ternary A^{II}B^{IV}C₂^V compounds in 1955, their properties and possible applications have been extensively studied in many countries including the Soviet Union. Foremost among these applications rank nonlinear optical devices based on birefringence, for which anisotropic CdGeAs₂, ZnGeP₂, and ZnSiAs₂ crystals are eminently suitable. Such devices include parametric oscillators and harmonic generators for laser tuning. Another type of applications are light sources and photo detectors. Homodiodes have been produced in the laboratory with CdGeP₂, CdSiAs₂, CdGeAs₂, and ZnSiAs₂ crystals, featuring excellent photoelectric characteristics of the respective junctions. A peculiar characteristic of oriented A^{II}B^{IV}C₂^V structures is their photosensitivity in linearly polarized light being, within the specific spectral range for each compound, a function of the angle between the electrical vector of the

light wave and the optical c-axis of the crystal. Heterodiodes have first been produced with CdSnP_2 crystals by epitaxial growth, featuring a small mismatch of the lattice parameter within 5%. The photoluminescence characteristics of these compounds, furthermore, make light emitting diodes and lasers with highly polarized radiation feasible, which cubic $\text{A}^{\text{III}}\text{B}^{\text{V}}$ crystals are not suitable for. Other possible applications are switches and memory cells, especially where a short high-current pulse may be needed for "erasing" a state of high-conductivity which has existed over a long period of time, also thermistors with a high temperature coefficient of resistance (ZnSiAs_2) or a very strong temperature dependence of the resistivity (CdGeP_2) usually produced in vitrified form. These semiconductors exhibit, furthermore, a resistivity jump within a narrow temperature interval at the glass-crystal transition. Noteworthy further possible applications are Hall probes, infrared optics, optoelectronic modulators, piezoelectric transducers, and tentatively acoustoelectric transducers. This survey paper was presented at the All-Union Conference on Ternary Semiconductors and Their Applications in Kishinev, 1976. Figures 13; tables 9; references 148: 95 Russian, 1 Hungarian, 52 Western.

USSR

UDC 621.315.592

STUDY OF THE ANNIHILATION OF POSITRONS IN THE SEMICONDUCTING COMPOUNDS
GaAs AND GaP

Leningrad, FIZIKA I TEKHNIKA POLUPROVODNIKOV, in Russian, Vol 12, No 5, May 78, pp 891-894 manuscript received 8 Jul 77; in final form, 9 Nov 77

ARIFOV, P.U., ARUTYUNOV, N. YU., IL'YASOV, A.Z., PROKOP'YEV, YE.P.,
KUZNETSOV, YU.N. and IVANYUTIN, L.A.

[Abstract] Correlation curves are measured for the process of two-gamma annihilation in compounds $\text{A}^{\text{III}}\text{B}^{\text{V}}$ -GaAs and GaP with varying relationships between deep and shallow impurity centers. The measurements were performed on an installation which assured approximation of point-line geometry in the experiments. An estimate is produced of the lower level of sensitivity of the method of measurement of the angular correlation of annihilation and the concentration of impurity atoms with deep acceptor levels. The results of the measurements show that the positrons in GaP and GaAs are apparently localized and annihilated in the area of the P and As atoms. The data produced on the capture cross sections of positrons in GaAs yield a lower limit of sensitivity of the method of annihilation of 10^{16} - 10^{17} cm^{-3} for the concentration of deep acceptors. Figures 3, references 16: 12 Russian, 4 Western.

USSR

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PLASMA SURFACE STATES OF ELECTRONS IN SEMICONDUCTORS IMMERSSED IN A QUANTIZING MAGNETIC FIELD

Leningrad, FIZIKA I TEKHNIKA POLUPROVODNIKOV, in Russian, Vol 12, No 5, May 78, pp 861-865, manuscript received 14 Jun 77; in final version, 18 Oct 77

GRYKANOV, M.F. and KORNEYEV, V.V.

[Abstract] A study is made of the surface state of electrons in a degenerate semiconductor (one-band model), immersed in a quantizing magnetic field parallel to the surface, in the self-consistent field approximation. An approximate analytic expression is derived for the self-consistent potential, assuming it to be quasiclassical. Results are presented from simultaneous numerical solution of the Schroedinger and Poisson equations in a semi-bounded specimen. It is shown that the depth and dimensions of the potential well depend on the magnetic field. Local deviations of paramagnetic susceptibility from its value in the body are found near the surface and studied as functions of H. Many other physical phenomena require consideration of the self-consistent electric field near the surface; for example, a space charge may significantly influence the dispersion of surface oscillations. Figures 2; references 15: 3 Russian, 12 Western.

USSR

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INFLUENCE OF HEATING OF ELECTRONS BY LIGHT ON PHOTOELECTRIC PHENOMENA IN n-TYPE ALLOYS $Cd_{0.2}Hg_{0.8}Te$

Leningrad, FIZIKA I TEKHNIKA POLUPROVODNIKOV, in Russian, Vol 12, No 5, May 78, pp 855-860, manuscript received 23 Feb 77, in final form, 8 Sep 77

IVANOV-OMSKIY, V.I., LINK, R., Humboldt Univesity, Berlin, East Germany, and MAL'KOVA, A.A., Institute of Physics and Engineering imeni A.F. Ioffe, Academy of Sciences, USSR, Leningrad

[Abstract] The photoconductivity and photomagnetic effect are studied using specimens of $Cd_{0.2}Hg_{0.8}Te$ of type n with a lifetime which is long in comparison to the characteristic times of dissipation of energy in the case of predominant contribution of acoustical phonons to the scattering of the energy of electrons, and when the intensity of their interaction with optical phonons is comparable to the interaction between electrodes. The charge-carrier concentration is about $2 \cdot 10^{15} \text{ cm}^{-3}$ in the 10-100 K interval. It is found that the influence of heating of electrons by light

on photoconductivity is small, whereas the photomagnetic effect at 10 K is essentially determined by the heating of the electrons by the exciting light. The effects observed are related to heating of the electrons by the electric field. The critical field value is found to depend linearly on the magnetic field intensity. This linear variation indicates predominant influence of piezoelectric oscillations in the dissipation of energy and "bottleneck" conditions. Figures 5; references 16: 10 Russian, 6 Western.

USSR

ENTRAINMENT OF ELECTRON-HOLE DROPLETS BY PHONONS IN QUANTIZING LONGITUDINAL MAGNETIC FIELDS

Moscow, PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 27, No 10, 20 May 78 pp 584-587 manuscript received 19 Apr 78

ASNIN, V.M., SABLINA, N.I., and STEPANOV, V.I., Physico-Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences

[Abstract] Electron-hole droplets in germanium are considered and their entrainment by phonons propagating along a magnetic field. According to expressions derived for the electron entrainment force, the phonon energy density, and the drift velocity, it appears that the velocity of entrained electron-hole droplets is an oscillating function of the magnetic field intensity which depends on oscillations of the entrainment force. This magnetoacoustic effect was studied, and found to occur, in an experiment with rectangular prismatic specimens of pure germanium much longer than the mean-free-path of electron-hole droplets. These specimens were placed inside a superconducting solenoid and p-n point junctions were used as detectors for tracking the electron-hole droplets. The theoretical expression for the drift velocity does not fully describe the experimentally established trend, but quite accurately indicates the relative magnitudes of the delay-time minima (velocity maxima) and the magnetic field intensities at which they occur. The authors thank A.A. Rogachev for the interest in this study and I.N. Yassiyevich for the helpful discussion of problems touched upon in this report. Figures 1; references 11: 7 Russian, 4 Western.

SOME OPTICAL PROPERTIES OF RARE-METAL OXIDE FILMS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 5, May 78
pp 895-900 manuscript received 11 Feb 77

ANDREYEVA, A.F. and GIL'MAN, I.YA.

[Abstract] Films of rare-metal oxides were produced by reactive thermal evaporation of metal specimens in oxygen, with KBr or NaCl single crystals used for substrates. The film thickness, varying from 0.1 and 1 μm , was measured with an interference microscope. Transmission and reflection spectra of unannealed and air-annealed oxides (Me_2O_3 , also CeO_2 and Tb_4O_7) were measured with a Specord Uv Vis instrument over the 0.2-0.8 μm range, with an IKS-12 instrument over the 0.75-3 μm range, and with a UR-20 instrument over the 2-25 μm range. From these data were then calculated the refractive index as well as the permittivity at high and low frequencies, and the films of these oxides were found to be highly translucent. Measurement of their absorption spectra revealed a 4.0-5.6 eV energy gap separating the valence band and the conduction band. The energy of 4f \rightarrow 5d transitions seems to exceed this energy gap, but it was not possible to establish a definite correlation for the height of the 4f-level. Figures 3; tables 1; references 9: 4 Russian, 5 Western.

USSR

EMISSION OF 'HOT' ELECTRONS FROM METALS UNDER THE ACTION OF MICROSECOND LASER PULSES

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 20, No 5, May 78 pp 1505-1510 manuscript received 8 Jun 77, after final revision 6 Jan 78

ARIFOV, U.A., deceased, LUGOVSKIY, V.B. and MAKARENKO, V.A., Institute of Electronics, Academy of Sciences Uzbek SSR, Tashkent

[Abstract] An analysis is made of experimental data on electron emission under the action of regular ruby laser pulses on tungsten. Studies were done with a series of laser pulses of 0.1-0.25 μs duration with fluxes of 5-30 MW/cm^2 at a residual gas pressure of about 10^{-6} mm Hg. Although the process of "hot" electron emission shows features typical of the four-quantum effect and thermionic emission, these mechanisms do not suffice to explain the phenomenon. It is suggested that the stimulated electrons form their own subsystem with weak exchange of energy with "cold" electrons and phonons, or that dynamic equilibrium is established in the electron gas in which the sum of the integrals of electron collision with electrons absorbed by photons and phonons is equal to zero, rather than the electron-electron collision integral. Figures, 2 references 12: 7 Russian, 5 Western.

EXPERIMENTAL EVALUATION OF THERMAL EXPANSION OF SINGLE-CRYSTAL ALUMINUM OXIDE

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May-Jun 78, pp 542-547 manuscript received 22 Sep 77

AMATUNI, A.N., SHEVCHENKO, YE.B. and MALYUTINA, T.I., All-Union Scientific Research Institute of Metrology imeni D.I. Mendeleev

[Abstract] The thermal expansion of corundum single crystals is studied on several batches of specimens made from raw materials coming from different Soviet enterprises. The purpose of the research was: 1) to determine the temperature dependence of characteristics of thermal expansion for different crystallographic directions; 2) to study the stability of the temperature coefficients of linear expansion of single-crystal aluminum oxide in time and with repeated changes in temperature as a basis for feasibility studies on using this material to make first-class standards for checking dilatometers; 3) to determine how the temperature coefficient of linear expansion depends on manufacturing technique. The temperature coefficients of linear expansion were measured on the DI-2 laboratory dilatometer at the All-Union Scientific Research Institute of Metrology imeni D.I. Mendeleev. The construction of the instrument and measurement techniques are explained. The measurements were done in the temperature range of 20-800°C. An analysis of the results shows that deviations of thermal expansion for one specimen of corundum over a period of many years with repeated heating do not exceed $7 \cdot 10^{-8} \text{ K}^{-1}$. This is within the limits of the theoretically expected errors of the instrument. Comparison of measurements for specimens made from raw materials from different enterprises shows that manufacturing techniques cause no deviations greater than instrument error. References 8: 5 Russian, 3 Western.

USSR

UDC 532.517.4:533.6

TURBULENT FLOW AND HEAT EXCHANGE IN A GRAVIATIONAL FORCE FIELD

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May-Jun 77
pp 624-639 manuscript received 22 Feb 78

PETUKHOV B. S., POLYAKOV, A. F. and SHEKHTER, YU. L., Institute of High
Temperatures, Academy of Sciences USSR

[Abstract] The paper is a state-of-the-art survey on research in hydrodynamics and heat exchange under various conditions of action of a gravitational force field on turbulent forced flow of fluid in channels. Three characteristic cases are distinguished depending on the orientation of the system relative to the gravitational force field: 1. the direction of forced flow is collinear with the direction of acceleration due to gravity with steady density distribution (flow in vertical channels downward with cooling or upward with heating); 2. the direction of forced flow is collinear with the direction of acceleration due to gravity with unsteady density distribution (flow in vertical channels downward with heating and upward with cooling); 3. forced flow is perpendicular to the direction of acceleration due to gravity (flow with heating and cooling in horizontal channels). Results of theoretical analysis are given as well as experimental data for vertical and horizontal tubes. An examination is made of the influence of thermogravitational forces on averaged velocity and temperature fields, and also on pulsation characteristics of flow. An analysis is made of relations that generalize experimental data on localized heat transfer. Figures 17, references 54: 34 Russian, 20 Western.

USSR

UDC 535.41 + 621.375.826

INTERFEROMETRIC METHOD FOR THE MULTIPLICATION OF LASER BEAMS

Kiev, DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI RSR, SERIYA A=FIZYKO-MATEMATYCHNI TA TEKHNIChNI NAUKY

HNATOV'S'KYY, O. V., LOHINOV, O. P., MEDVID', N. V., NIKOLAYEV, M. V. and SHPAK, M. T.

[Abstract] A study is presented on splitting a laser beam, of any wave front, into several secondary equivalent beams possessing better space-angular characteristics, in particular, a much lower scattering. Theoretical discussions, with derivation of appropriate formulas, were verified experimentally with helium-neon and ruby lasers. Diffraction gratings of different sizes were used as modulators, as well as the plane and three-dimensional phase holograms. The suggested method makes possible to produce laser beams with a required space-angular structure suitable for purposes of holography, optical processing of information and laser metal welding. Figures 4, references 2: 1 Russian, 1 Western.

USSR

UDC 551.521.3

CALCULATION OF THE LASER ECHO SIGNAL FROM A CLOUD CONSIDERING MULTIPLE SCATTERING

Gorkiy RADIOFIZIKA in Russian Vol 21, No 2, pp 275-281 manuscript received 16 Jun 77

BELOV, V. V., GLAZOV, G. N. and KREKOV, G. M., Institute of Atmospheric Optics, Siberian affiliate, Academy of Sciences, USSR

[Abstract] The linearity of a system consisting of a radiator, transmitting medium and receiver with respect to power is used to divide the problem of calculation of the form and width of a laser pulse reflected by a cloud into two stages. During the first stage, the pulse transient characteristic of the system, its response to a delta-shaped probing pulse, is determined. During the second stage, the signal received is found as a convolution of the transient characteristic $h(t)$ and the probing signal. A convenient approximation of the pulse transient function is calculated by a Monte-Carlo method. Expressions are presented for the signal to be received with typical forms of the probing pulse, and this signal is compared with the approximation of one-time scattering. The method allows detailed study of the variation in the solution as a function of the variable parameters of the problem considering repeated scattering. Figures 2; Tables 3; References 5: 4 Russian, 1 Western.

USSR

UDC 535.338.332:621.378.325

THE OPTICAL-ACOUSTIC METHOD IN HIGH-RESOLUTION LASER SPECTROSCOPY

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 4, Apr 78
pp 636-641 manuscript received 14 Feb 77

ANTIPOV, A.B. and SAPOZHNIKOVA, V.A.

[Abstract] The article describes the results of the first attempts to apply the laser optical-acoustic method to precision spectroscopic measurements in the 3.39 μm range. A single-mode He-Ne laser was used with tuning by a longitudinal magnetic field. Continuous tuning to the central frequency of one of the Zeeman components provided a range of ± 1740 MHz relative to the lasing frequency of the unit in the absence of a field. A disk modulator was used with frequency of 120 Hz. The spectrophone was a brass cell with thick walls fastened to the casing of a sensitive capacitor microphone. Windows were made of GaF_2 . The radiation pickup was a PbSe photoresistor. This installation was used for studying the spectra of CH_4 , C_2H_4 and C_2H_6 with a spectral resolution of ± 15 MHz. Laser power was $1\text{--}7 \mu\text{W}$, the standard was atmospheric air with hydrocarbon content of $66\text{--}10^6$ ppm. The position of the centers of the absorption lines of the hydrocarbons was determined, line intensity was measured for methane and ethylene, the relation between the half-width of the absorption line of methane and pressure of expanding gas (air, O_2) is found, the factor is determined for shift of the line center for methane absorption with increasing pressure of the expanding gas. A distinguishing feature of the method is proportionality of the spectrophone signal to the coefficient of absorption k_v in the range $10^{-7} \leq k_v \leq 10^{-2} \text{ cm}^{-1}$. The authors thank Yu. V. Knyazhev for providing the photocell. Figures 4, references 16: 11 Russian, 5 Western.

USSR

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INCREASING THE PROBABILITY OF TOTAL SELF-MODE LOCKING IN A RUBY LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 4, Apr 78
pp 632-635 manuscript received 28 Feb 77

KOROCHKIN, L.S. and MIKHNOV, S.A.

[Abstract] An investigation is made of the formation of ultrashort pulses in a laser with two passive shutters exposed to beams of different intensity. Experiments are done with a ruby rod in a two-lamp illuminator with diffuse reflector. A system with variable focal length is made by using a special element that combines a positive lens, a cell with a solution of cryptocyanine in ethyl alcohol and an opaque mirror. In contact with the

cryptocyanine solution is an output mirror with coefficient of reflection of 60%. The pumping pulse is tailored to improve reproducibility of ultrashort lasing pulses. The proposed laser system improves the probability of total self-mode locking by a factor of 1.5. The presence of two passive shutters in the laser cavity increases the number of passes of fluctuation emission through the filter, leads to longer interaction of the emission with the shutter, shortens the duration of the ultrashort pulses and increases their power. Placing the shutters in different cross sections of the radiation intensities enables the shutter to operate in a broader range of intensities of the fluctuation emission, stabilizes the operation of the laser and should increase the contrast of ultrashort lasing pulses. The authors thank V. P. Khyupenen for constructive criticism. Figures 2, references 4: Russian.

USSR

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CONCERNING THE INFLUENCE OF ELECTRON BOMBARDMENT ON THE STIMULATED EMISSION CHARACTERISTICS OF GAS LASERS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 4, Apr 78
pp 622-626 manuscript received 25 Mar 77

BALOSHIN, YU. A.

[Abstract] An investigation is made of the influence that bombardment with beams of fast electrons with energies of several MeV has on the parameters of gas lasers, and the mechanism of this influence is discussed. Experiments were done with standard He-Ne gas laser tubes type LG-55 and CO₂ tubes type LG-15. A power supply with discharge current stabilization was used for excitation. An electron linac with supplementary extraction of the electron beam was used for irradiation. Electron energy was 10 MeV and beam current was 10 μ A. The electron beam was perpendicular to the axis of the laser tube to that only the positive discharge column was exposed. The results show that the electrons that arise in the glass of the laser tube under the action of the linac beam diffuse to the inside of the tube, increasing its negative potential, and the electron distribution function follows the increase in negative potential in such a way as to maintain the condition of balance. As this happens, the average energy of the electrons in the discharge should increase. These changes continue until the flux of electrons from the plasma to the glass is compensated by their runoff due to secondary electron emission and the surface conductivity of the glass. In view of these results, consideration should be given to proper choice of the glass for laser tubes that are to operate under conditions of electron bombardment. Secondary emission of electrons from the material under the action of radiation may be a criterion for choice of material. Figures 2, references 7: 5 Russian, 2 Western.

USSR

UDC 621.373.8

NEW ACTIVE SUBSTANCES FOR LASERS ON VAPORS OF COMPLEX ORGANIC COMPOUNDS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 5, May 78
pp 906-908 manuscript received 10 Oct 77

BORISEVICH, N.A., GORELENKO, A.YA., KALOSHA, I.I., POVEDAYLO, V.A., and
TOLKACHEV, V.A.

[Abstract] Vapors of thirteen complex organic compounds pumped transversely from a nitrogen laser were found to be capable of laser activity, with the aid of a buffer gas such as pentane. Particularly interesting among them is p-quaterphenyl, because of its high thermal stability, emitting at the 364 μm wavelength and characterized by a short-wave absorption spectrum. The emission of this or any other compound in the group can be shifted toward shorter wavelengths by lowering the emission threshold with a higher pressure of the buffer gas. Figures 1; tables 1; references 12: 9 Russian, 3 Western.

USSR

UDC 621.375.8

BROADENING THE EMISSION SPECTRUM OF CO_2 PULSE LASERS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 5, May 78
pp 804-807 manuscript received 2 Aug 77 (also submitted to PISIMA V
ZHURNAL TEKHNICHESKOY FIZIKI 4 May 77)

BERTEL', N.M., KUNTSEVICH, B.F., PETUKHOV, V.O., TRUSHIN, S.A., and
CHURAKOV, V.V.

[Abstract] It is theoretically demonstrated that the emission spectrum of a CO_2 pulse laser can be made broader without raising the pressure of the active medium above 1 atm, namely by electrical or optical excitation at sequence-band lines $00^0_n - [10^0_{(n-1)}, 02^0_{(n-1)}]_{I, II}$ ($1 < n \leq 7$). The energy density as a function of the pulse time and the gain are calculated for a $\text{CO}_2:\text{N}_2:\text{HE} = 1:1:3$ mixture at 400 K and under a pressure of 1 atm as well as for pure CO_2 at 300 K and under a pressure of 100 mm Hg. An energy density of approximately $0.4 \cdot 10^{-5}$ J/cm³ in an emission pulse of approximately 170 ns duration, at an efficiency (ratio of emission power to pumping power) of approximately 1.4%, is found possible. The authors thank B.I. Stepanov for the helpful discussion of the results. Figures 3; references 8:
4 Russian, 4 Western.

USSR

UDC 621.375.82

SECOND ALL-UNION CONFERENCE ON ORGANIC DYE LASERS AND THEIR APPLICATIONS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 5, May 78
pp 938-942

SMOL'SKAYA, T.I. and TOMIN, V.I.

[Abstract] The second All-Union Conference on Organic Dye Lasers and Their Applications was held in Dushanbe 28-30 September 1977, organized by the Science Council on Coherent and Nonlinear Optics at the USSR Academy of Sciences, jointly with the Republic Science Council on Spectroscopy and Quantum Electronics at the Academies of Sciences of the Belorussian SSR and the Tadzhik SSR. Nine plenary and eleven guest papers were presented dealing with general progress and specific achievements in laser technology and measurements. In addition, special topics were considered and discussed by the eight individual sections of the conference. These included: dye lasers and emission of ultrashort pulses, new active laser media, spectroscopy of active media, lasers with coherent pumping, lasers with flashtube pumping, control of the spectral emission characteristics, and applications of dye lasers. The next conference should take place in 1979.

USSR

UDC 621.378.35

ON SPATIAL DISTRIBUTION AND MODES OF LASING OF $\text{CdS}_{1-x}\text{Se}_x$ SINGLE-CRYSTAL PLATELETS WITH ONE-PHOTON OPTICAL EXCITATION

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 23, No 5, May 78 pp 838-843 manuscript received 28 Nov 77

BRODIN, M.S., VITRIKHOVSKIY, N.I., KIPEN', A.A., SHEVEL', S.G. and YANUSHEVSKIY, N.I., Institute of Physics, Academy of Sciences UkrSSR, Institute of Semiconductors, Academy of Sciences UkrSSR, Kiev

[Abstract] The paper gives the results of investigations of a system of mixed platelet single crystals of $\text{CdS}_{1-x}\text{Se}_x$ containing from 0 to 25 mol.% CdSe grown by synthesis from the gas phase. Emission was stimulated by a pulsed nitrogen laser. The spatial characteristics of the lasing action of the crystals were studied at 77 and 300 K (and in some cases with heating to about 360 K). The pumping wavelength was 3371 Å, and the wavelength of the stimulated emission at 300 K varied from about 5200 Å for crystals without selenium to 5600 Å for $\text{CdS}_{0.75}\text{Se}_{0.25}$. It is shown that the simple Fabry-Perot cavity model does not explain the main peculiarities of the

distribution of laser emission. The experimental data are interpreted in terms of the rectangular dielectric microbox cavity model proposed previously by these authors for Zn Cd_{1-x}S lasing action [see "Kvantovaya elektronika," Vol 5, No 6, 1978 pp 1272-1278]. Figures 2, references 4: 1 Russian, 3 Western.

USSR

UDC 621.375.826

A RING LASER WITH A HOLOGRAPHIC DISPERSION ELEMENT

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 23, No 5, May 78 pp 866-869 manuscript received 5 Jan 78

KRAVCHENKO, V. I., MARUSIY, T. YA., SOSKIN, M.S., TARANENKO, V. B. and ZHZHNYAK, A. I., Institute of Physics, Academy of Sciences UkrSSR, Kiev

[Abstract] The paper describes a neodymium glass ring laser with a holographic volumetric phase grating as the dispersion element. The GLS-1 laser rod with faces cut at the Brewster's angle for this material is placed in a cavity with length of 220 cm formed by the holographic grating and two mirrors with 100% reflection on the lasing wavelength. A suppressing mirror is added to achieve unidirectional emission. The emission spectra of this system were studied on a Fabry-Perot interferometer with 8 mm base. The grating has a period of 1.4 μm with oblique lines to prevent coupling between opposed waves in the laser cavity. The angle between the reflected and diffracted waves is 8° . The grating has a dispersion of $20''/\text{cm}^{-1}$. This type of laser produces high spectral brightness even for a standing wave. The integral width of the spectrum is a few tenths of an inverse centimeter, which is maintained to almost double the threshold pumping level. Time scans of lasing intensity in the standing wave mode take the form of damped pulsations. With transition to the traveling wave mode, the variation in amplitude of spikes becomes sharply irregular. The main advantage of the proposed type of optical cavity is high selectivity with minimum insertion losses. This advantage is realized in a cavity with an even number of reflections and diffraction efficiency that may be less than 50%. A ring laser with such a cavity can be Q-switched or mode-locked since the grating has high radiation strength and can withstand a power of the order of $100 \text{ MW}/\text{cm}^2$. Figures 2, references 7: 5 Russian, 2 Western.

EFFECT THAT SURFACE RELIEF OF A TARGET HAS ON THE EMISSION AND ABSORPTION SPECTRUM OF A LASER PLASMA IN THE VACUUM ULTRAVIOLET

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77
pp 26-29 manuscript received 1 Mar 76

ANTONOV, G. S. and KISELEVSKIY, L. I.

[Abstract] The authors study the feasibility of controlling the emission and absorption spectrum of a laser plasma when the radiation is focused on a solid target. The spectrum control technique involves variation of the surface relief and target geometry. A neodymium glass laser was used with pulse length of 50 ns at an energy of 5 J. Emission was focused on the target by a lens with focal length of 125 mm. Spot diameter was 0.6-0.7 mm. The target was a steel plate 3 mm thick in a vacuum chamber. Cylindrical pits ranging in depth from 0.5 to 2.5 mm and in diameter from 0.8 to 1.5 mm were made in the target surface. A comparison was made of flare intensity with laser focusing on the flat surface and inside the pits. It was found that focusing on the flat surface causes rapid dispersal of the plasma with abrupt cooling, the region of luminescence being relatively small. Focusing in a pit causes an increase in size of the flare and elongation in the direction of the incident flux. This effect is attributed to the shaping action of the pit and intensification of the role of plasma heating by laser emission, since the pulse duration is longer than the time of plasma formation. As a rule, the spectral intensity increases with the size of the flare. When the plasma emission is integrated with respect to volume, the intensity gain from using targets with surface pits may reach a factor of 7. Spectral intensity reaches a maximum at a pit depth of about 2 mm for fixed diameter, and at a pit diameter of about 1 mm with fixed depth. The intensity of the continuous spectrum increases more rapidly than that of the line spectrum with a change from flat to pitted targets. This indicates greater plasma density in the case of pits. At a certain depth in the pit, plasma emission in the given spectral region (150-80 nm) becomes totally continuous. This can be observed through an additional small hole (0.4 mm in diameter) made perpendicular to the main pit that receives the laser emission. In addition to the flares ejected from the pits, spurious flares are also observed on isolated sections of the target surface not exposed to laser emission. These are apparently due to the radiation action of the plasma, and also ion recombination. By proper choice of target configuration, these spurious flares can be intensified and used as an absorption medium for the continuous emission issuing from the pits in the target. This provides a simple method of recording the absorption spectra of ions and atoms. Figures 4, references 6 Russian.

USSR

UDC 621.375.8

POSSIBLE FREE EMISSION MODES OF TRAVELING-WAVE RING LASERS WITH UNIFORMLY BROADENED AMPLIFICATION LINE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian, Vol 26, No 1, Jan 77
pp 41-48 manuscript received 21 Oct 75

KOTOMTSEVA, L. A., LOYKO, N. A. and SAMSON, A. M.

[Abstract] Balance equations make it possible to obtain all the basic conclusions regarding the stimulated emission kinetics of a traveling-wave solid state ring laser and with certain restrictions they are suitable for describing gas lasers and dye lasers. The stability of the stationary solution for the traveling-wave ring laser for broadening is described by Maxwell equations and equations for the density matrix to determine the regions of instability of the stationary solution inside which the pulsations are stable in the linear approximation if their frequencies are equal to or multiples of the intermode beat frequency.

The limits of applicability of the balance equations for the described lasers coincide with the regions of instability of the stationary solution. Figures 5, references 14: 12 Russian, 2 Western.

USSR

UDC 621.375.8

DOUBLE MONOPULSE RUBY LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77
pp 171-173 manuscript received 18 Feb 76

KOROCHKIN, L. S., MIKHOV, S. A., and SHAKHLAY, I. P.

[Abstract] The described monopulse laser with passive shutter generates two monopulses with smoothly regulatable delay between them using a double pumping pulse method. The delay ranges from 15 to 850 microseconds. In the 20 to 420 microsecond range the mean square deviation of the time of appearance of the second monopulse is from 1.3 to 2.3 microseconds. This deviation is plotted as a function of the time interval between pulses. In a laser with a shutter in the form of a plane parallel plate in the near zone the generation of the first and second monopulses takes place from different regions of the active material. Figures 3, references 6: 4 Russian, 2 Western.

USSR

UDC 535.34

THRESHOLD PUMPING ENERGY AS A FUNCTION OF LOSSES IN A RUBY LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77
pp 49-53 manuscript received 8 Dec 75

IVANOV, V. A., LEBEDEV, V. I., TRUB, YE. P., KUZ'MICHEV, A. G., and
DUBOVITSKIY, F. S.

[Abstract] More than 100 standard ruby elements of different size, optical quality and concentration were investigated to obtain an empirical relation between the relative threshold pumping energy, the laser loss index and the ruby absorption index. This simple linear empirical expression is in the form of $Z = 1 - \exp \{1 - (E/E_0)\} = k/B$, where k is the index of useful losses related to reflectivities of the cavity mirrors r_1 and r_2 by the expression $k = \frac{1}{2} \ln \frac{1}{r_1 r_2}$ is the length of the active rod, and β is a proportionality factor. It can be used as a simple means of estimating the chromium ion concentration as well as for quality control of rubies on the production level. References 8: 7 Russian, 1 Western.

USSR

UDC 539.184.01

RESONANT CHARGE EXCHANGE IN A LASER RADIATION FIELD

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 44, No 5, May 78 pp 857-862 manuscript received 12 Oct 77

VETCHINKIN, S. I., BAKHRAKH, V. L. and UMANSKIY, I. M.

[Abstract] The authors consider the shape of the secondary radiation line in the process of resonant charge exchange of atoms $A(S) + A^+ \rightarrow A^+ + A(S)$ in a laser field of frequency lower than the electron transition frequency in the atom. The analysis takes consideration only of exchange interaction of the atoms, which has the most appreciable effect on the nature of secondary radiation. It is shown that the spectrum of secondary radiation is continuous, and that collision dynamics can be analyzed by studying the frequency dependence of this spectrum. Figure 1, references 6 Russian.

SOME STRUCTURAL CHANGES IN CELLULOSE UNDER THE ACTION OF PULSED LASER EMISSION

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 4, Apr 77
pp 687-690 manuscript received 10 Jun 76

ZHBANKOV, R. G., IVANOVA, N. V., IN SAROVA, N. I., KOROLIK, YE. V. and
CHUMAKOV, A. N.

[Abstract] An examination is made of spectroscopic manifestations of the structural changes that may occur in acetate and hydrated cellulose films exposed to laser pulses. The specimens were industrial cellulose triacetate films of various thicknesses, triacetate films produced by pouring a polymer solution in a mixture of methylene chloride and methanol on the surface of mercury, and hydrated cellulose films made by de-esterification of cellulose triacetate films. The specimens were exposed to neodymium glass, ruby and CO₂ laser pulses. Exposure of cellulose triacetate to neodymium laser emission results in spectroscopic absorption bands typical of crystallized specimens. When the flux density is reduced to $2.5 \cdot 10^6$ W/cm², these bands do not show up, and the only spectroscopic changes are observed in the structurally sensitive region. Thus the macromolecules of cellulose triacetate are profoundly altered by intense radiation over a period as short as 10^{-4} s. Spectroscopic signs of three-dimensional ordering occur even when the material is exposed to ruby laser pulses as short as $3 \cdot 10^{-8}$ s. Laser exposure of hydrated cellulose leads to changes in the accessibility of the hydroxyl groups of the polymer for deuterium exchange. This may be due to a change in the density of the specimen, but the authors feel that more complicated processes take place involving the reactivity and other properties of the polymer. Further research is needed to unravel these processes. The authors thank L. Ya. Min'ko and V. K. Goncharov of the laboratory of nonequilibrium processes for assistance in doing the experiments and for constructive criticism. Figures 2, references 11: 7 Russian, 1 Polish, 3 Western.

CONVERSION OF THE Nd-LASER RADIATION TO THE VISIBLE AND INFRARED RANGES OF THE SPECTRUM IN GLASS ACTIVATED BY THE Er^{3+} AND THE Yb^{3+} IONS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 4, Apr 77
pp 651-656 manuscript received 11 Apr 75, revised version 29 Nov 76

ANTIPENKO, B. M., ZUBKOVA, V. S., and LUNTER, S. G.

[Abstract] The anti-Stokes mechanisms of excitation of luminescence and the analysis of the conditions controlling the effectiveness of absorbed energy conversion are discussed in terms of an experimental study of the effect of the conversion of radiation in the Yd^{3+} absorption bands to visible and infrared luminescence of the Er^{3+} ion in magnesium aluminum calcium glass. The microscopic picture of the processes occurring in the tested glass can be described by a system of nonstationary kinetic equations illustrated by the presented experimental curves. Up-conversion and down-conversion are plotted as a function of the lifetime of the intermediate level. The experimental and calculated values of the yield and maximum population of $^4\text{S}_{3/2}$ agree for $\tau(^4\text{I}_{11/2}) \sim 10^{-6}$ s, $A_{17} \sim 3 \times 10^{-6}$ cm⁶/s, $A_{187} \sim 3 \cdot 10^{-16}$ cm⁶/s, and A_{65} for any of the range of 3×10^{-16} to 3×10^{-187} cm⁶/s, where A_{ij} is the energy transport rate constant and τ_i is the excitation lifetime on the i-th level. Figures 5, references 7: 2 Russian, 5 Western.

BEAT FREQUENCY STABILITY IN A RING LASER WITH PARAMETERS THAT VARY SLOWLY WITH TIME

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 4, Apr 77
pp 639-644 manuscript received 29 Jan 76

KUTSAK, A. A. and KRUGLIK, G. S.

[Abstract] The authors consider the phase equation

$$\dot{\psi} = \nu(t) + \nu_3(t) \sin(\psi + \phi(t))$$

that describes the frequency response of a ring laser in a system with parameters that vary slowly with time. Here ψ is the phase difference of the opposed waves, $\nu(t) = \nu_0 + \Delta\nu(t)$ is the difference frequency ("pedestal") that carries information on rotation (ν_0 is the constant component of the difference frequency, $\Delta\nu(t)$ is the variable component), $\nu_3(t)$ and $\phi(t)$ are the modulus and phase of the feedback coefficient. A modification of the Krylov-Bogolyubov averaging procedure is used to find an asymptotic solution of this equation. On the basis of this solution an analysis is made of the beat frequency. It is shown that the error of the method is determined both by the magnitude of the variable corrections to the steady-state values of the parameters and by their derivatives. References 6 Russian.

DEGREDEATION OF HETEROLASERS AND CHANGE OF THEIR INTERNAL PARAMETERS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 4, Apr 77
pp 633-638 manuscript received 6 Apr 76

GRIBKOVSKIY V. P., KONONENKO, V. K., PAK, G. T., RYABTSEV, G. I.,
YASHUMOV, I. V. and CHERNOUSOV, N. P.

[Abstract] The paper gives the results of a study of the power and threshold of stimulated emission of heterolasers with gradual degredation in the pulse mode of operation. An analysis is made of the change of internal parameters during degredation of a semiconductor laser. The experiments were done at 300 K on laser diodes with double heterostructure in the GaAs-Al_xGa_{1-x}As system in which the active region was either undoped or doped with silicon. The pattern of the near field was photographed at about double the threshold current density. The lasing threshold was determined from the appearance of a bright spot against the laser diode luminescence. The frequency of the stimulated emission was measured with an infrared spectrometer and lasing power was measured by a photodiode. The laser diode was then installed on a test stand and a certain degredation current density was applied. Excitation of the lasers was by 100 ns current pulses at a prf of 6 kHz. The lasing power, threshold and frequency were periodically measured, and the pattern of the near field of the emission was monitored. The emission power for an undoped active region showed stepwise drops in time, coinciding with the appearance of dark spots on the pattern of the near field of the radiation. The silicon-doped specimens also showed abrupt drops in lasing power, but they do not correlate with the near field; instead, they correlate with corresponding abrupt increases in lasing threshold. Theoretical analysis of the time change of internal parameters shows that lasing power may fall exponentially with a linear increase in internal optical losses. Figures 5, references 11: 6 Russian, 5 Western.

CRITERIA OF ADIATHERMANCY OF ACTIVATED GLASS FOR LASERS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 4, Apr 77
pp 667-672 manuscript received 16 Mar 76

MIT'KIN, V. M. and SHCHAVELEV, O. S.

[Abstract] An attempt is made to find the best choice of parameters for describing thermo-optical distortions introduced into a laser cavity by the active element. It is experimentally shown that the thermo-optical characteristics P and Q that characterize the induced optical nonhomogeneity and induced anisotropy respectively give the best description of optical distortions resulting from thermal loading in the case of a rod element. Total adiathermancy corresponds to the case $P = 0, Q = 0$. In the case of non-zero Q , the system can be athermalized by using orthogonal polarizations: $P + Q = 0$ or $P - Q = 0$ for a rectangular rod, and $P + Q/2 = 0$ or $P - Q/2 = 0$ for a cylindrical rod. In the case of a disk element, optical nonhomogeneity is characterized by $W + R$, where $W = \beta + \alpha(n - 1)$, n is the index of refraction, $\beta = dn/dT$ is the temperature coefficient of the index of refraction and α is the coefficient of thermal expansion. The induced birefringence in the case of a disk active element is proportional to the thermo-optical characteristic Q' . In this case, total adiathermancy corresponds to $W + R = 0$ and $Q' = 0$. The authors thank A. A. Mak for constructive criticism. Figures 4, references 16: 13 Russian, 3 Western.

SEMI-SELF-MAINTAINED GAS DISCHARGE EXCITING CW CO₂-LASERS

Moscow, NADEZHNOST' I KONTROL' KACHESTVA No 2, 1978 p 419

VELIKHOV, YE. P., PIS'MENNYI, V. D., and RAKHIMOV, A. T., Nuclear Power Institute imeni I. V. Kurchatov, Nuclear Physics Institute of Moscow State University imeni M. V. Lomonosov

[Abstract] A survey is made of the state of the art with respect to analyzing physical processes determining the stability of uniform volumetric gas discharges for exciting high-pressure CO₂-lasers. The discussion includes homogeneous self-maintained glow discharge in high-pressure gases, burning and stability of a semi-self-maintained glow gas discharge, the physical processes in the semi-self-maintained gas discharge, the instability mechanisms developing in a semi-self-maintained gas discharge, a steady-state semi-self-maintained gas discharge in high-pressure gases, and the optical characteristics of gas media based on CO₂ excited by a steady-state semi-self-maintained gas discharge. A significant increase in the uniform burning time of a semi-self-maintained gas discharge occurs on reduction of the specific electric power released in the discharge. This opens the way for practical conversion of the discharge to steady-state burning at increased gas pressure. The expediency of using the described discharges as a stationary plasmochemical reactor is noted.

USSR

UDC 621.378.325

REGULATION OF ULTRA-SHORT PULSE DURATION IN A MODE-LOCKED LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77
pp 37-40 manuscript received 29 Jan 76

ZAPOROZHCHENKO, R. G. and ZAPOROZHCHENKO, V. A.

[Abstract] A procedure based on using the dependence of ultra-short light pulse duration on the position of the modulator in the resonator is proposed as a method of varying the duration of ultra-short light pulses generated by standing-wave pulse lasers with electrooptical modulation of the resonator process at the intermode peak frequency. The duration of the generated pulses can be varied smoothly by moving the modulator relative to the mirror surface. Graphs are presented of the pulse duration and relative intensity as a function of the spacing between the modulator and the mirror, and of the output energy and efficiency of second-harmonic stimulated emission as a function of spacing between the modulator and the mirror. The two-photon luminescence tracks recorded by a microdensitometer at $\ell = 16.5$ and 31.5 cm show that the pulse duration is shorter and the pattern contrast higher for $\ell = 31.5$ cm than for $\ell = 16.5$ cm. The authors thank P. A. Apanasevich for constructive criticism, and I. S. Zakharova for assisting with the calculations. Figures 3, references 7: 3 Russian, 4 Western.

USSR

UDC 621.378.34

SPECTRAL KINETICS OF DYE LASERS WITH FLASHTUBE PUMPING

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77
pp 30-36 manuscript received 27 May 76

DAVYDOV, S. V. and GRUZINSKIY, V. V.

[Abstract] Theoretical and experimental data are compared on the kinetics of the spectrum of stimulated emission of rhodamine 6G with pulse rise time of 1 and $6 \mu\text{s}$ and pulse energy of 300 J. The Minsk-22 computer was used for calculating emission kinetics on the basis of balance equations. It is shown that predominance of gain over losses that depend on the rise time of the pumping pulse widens the emission band and causes a long-wave shift of the spectral maximum of stimulated emission at the onset of radiation. The emission bandwidth varies depending on the rate of increase in pumping power, the Q of the cavity and the molecular constants in the initial period of stimulated emission, and it may be several times the emission bandwidth in the ensuing quasi-steady state. The authors consider the ways that the pumping duration and power, the parameters of the triplet state, the losses associated with absorption of stimulated emission by photoproducts, and the nonhomogeneity of the medium influence the kinetics of the emission spectrum. Satisfactory agreement is observed between theory and experiment. The authors thank N. A. Borisevich for discussing the results. Figures 4, references 17: 15 Russian, 2 Western.

USSR

A POSSIBLE SELF-FOCUSING MECHANISM IN PLASMAS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 27, No 10, 20 May 78 pp 557-561 manuscript received 5 Apr 78

KOROBKIN, V. V. and MOTYLEV, S. L., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The magnetic field of the electric current produced by the light pressure from a beam traveling through a plasma affects the refractive index of that plasma so as to possibly result in self-focusing. On this premise, expressions are derived here for the self-focusing threshold power and for the focal length. The self-focusing effect depends largely on the electron concentration and its proximity to the critical level. The calculations are rather simple for the case of uniform laser radiation intensity over the beam section. The aid of a computer is needed in the case of a beam with a Gaussian profile. The authors thank V. N. Lugov for the discussion and helpful comments. References 4: 3 Russian, 1 Western.

USSR

UDC 621.313.12:538.4

DYNAMIC CHARACTERISTICS OF A FREE-PISTON DIESEL-MHD GENERATOR

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May/June 78 pp 611-619 manuscript received 16 May 77

ANTONOV, B. M., BASHKATOV, V. A., KIRILLOV, YU. M., POSTNIKOVA, I. N., SAFRONOVA, S. S. and SHPIL'RAYN, E. E., Institute of High Temperatures, Academy of Sciences USSR

[Abstract] The authors investigate the dynamics of a self-oscillating system that combines a free-piston diesel and a liquid-metal MHD generator. On the basis of expressions derived for the dynamic characteristics of the system, calculations are done on the dynamic, thermodynamic and economic characteristics of combinations with different cross sectional areas of the MHD generator pistons. Analysis of the results shows that changing the ratio of the velocities of liquid metal in the MHD channel and moving elements of the machine within the investigated limits has no appreciable effect on the kinematics of the working process. It is shown that a number of combinations of magnetic field induction in the MHD channel and load factor can be used to get the same thermodynamic working conditions in the proposed diesel-MHD system. Figures 4, references 5: 4 Russian, 1 Western.

ON CONSTRUCTING A MATHEMATICAL MODEL OF THE ARC MODE OF OPERATION OF THE ELECTRODES OF AN MHD GENERATOR

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May/June 78
pp 620-623 manuscript received 16 Nov 77

POBEREZHSKIY, L. P., VNIIPITransprogress [expansion not known]

[Abstract] An analysis is made of the possible influence that the non-uniformity of current distribution when arcing occurs near MHD generator electrodes may have on the characteristics of the interelectrode gap, and also of the influence that electrode zones with distributed (diffuse) and arc discharge conditions have on each other. The analysis is restricted to the case where the Hall effect plays no part ($\beta \ll 1$). It is assumed that in the diffusion mode the main resistance of the interelectrode gap is concentrated in a layer that is thin compared with the thickness of the thermal boundary layer, that the electrical conductivity and current density in the discharge column are much greater than in the main volume of the plasma, that the characteristic dimensions of the arc column are small compared with the distance between electrodes and compared with the distance between separate arcs on the same electrode, and that plasma conductivity is independent of the current flowing outside of the discharge column and the layer where the resistance to diffuse current is concentrated. It is shown that diffuse current may shunt and quench the arc current, and that the arc current in turn may suppress the diffuse current, thus reducing the probability of electrical breakdown and the appearance of a new arc near one that is already burning. It is demonstrated that arc development necessitates an increase in perturbations of diffuse current (electric or thermal breakdown), and steady-state coexistence of diffuse and arc discharge conditions. Figures 2, references 12 Russian.

USSR

LEPTONS AND QUARKS IN THE QUARTERNION MODEL

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 27, No 10, 20 May 78 pp 590-594 manuscript received 27 Feb 78

CHKAREULI, DZH. L., Institute of Physics, Academy of Sciences of the Georgian SSR

[Abstract] The quarternion model is considered, as well as the possibility of describing in it a classification of leptons and quarks, whereupon a gage theory of this model is taken to serve as a unified theory of weak electro-magnetic interactions. The analysis is based on the Lgrangian of a free Fermi field, invariant with respect to global transformations of the quarternion state. Covariant derivatives and gage fields are derived therefrom, the Tiomno matrix is introduced, and the properties of the transformed model-theory are established with symmetry properly taken into account. The author thanks A. A. Ansel'm, D. D. D'yakonov, O. V. Kancheli, L. B. Okun, and especially V. I. Ogiyevetskiy for the discussion of these results. References: 4 Western.

USSR

UDC 621.385.6

THE GYROCON -- AN EFFICIENT HIGH-POWER RELATIVISTIC BEAM-ENERGY CONVERTER FOR MICROWAVE CHARGED PARTICLE ACCELERATOR POWER SUPPLY

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 5, May 78 pp 397-403 manuscript received 25 Dec 77

BUDKER, G. I., KARLINER, M. M., MAKAROV, I. G., MOROZOV, S. N., NEZHEVENKO, O. A., OSTREYKO, G. N. and SHEKHTMAN, I. A.

[Abstract] The paper describes the gyrocon -- a microwave oscillator with deflection of a relativistic beam of particles -- invented by G. I. Budker in 1967. The device was developed for providing high-power rf supply for new particle accelerators. The working principle of the installation is based on modulation of a powerful relativistic particle beam by deflection with subsequent complete deceleration in a traveling-wave ring cavity. Estimates of attainable parameters show that the gyrocon is able to develop rf power at high efficiency at a considerably higher power level than conventional microwave devices. Different gyrocon designs are presented. Technical specifications are given on gyrocons developed for supply of crossed-beam electron-positron accelerators and accumulators. Some test results are given. Figures 6, references 14: 7 Russian, 7 Western.

ELECTRON ACCELERATORS OF THE INSTITUTE OF NUCLEAR PHYSICS, SIBERIAN DEPARTMENT OF THE ACADEMY OF SCIENCES USSR FOR THE NATIONAL ECONOMY

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 5, May 78 pp 403-408 manuscript received 16 Jan 78

AUSLENDER, V. L. and SALIMOV, R. A.

[Abstract] A review of work started in 1966 at the Institute of Nuclear Physics on producing electron accelerators for industry. By the end of 1977 more than 45 such accelerators had been provided to various enterprises and organizations in the Soviet Union. These accelerators are being used for many radiation-chemical processes, and in particular for irradiation of polyethylene insulation, production of thermosetting items, disinfection of grain and so forth. Two series of accelerators -- ELV and ILU -- are produced at the Institute with average power of several tens of kW and an energy range from 400 to 2000 keV. These accelerators are designed for use in production processes. In addition, the ELIT and ESU accelerators have been developed for other purposes. The paper gives the technical specifications and design of the ILU-6 accelerator. The main accelerator is a toroidal resonator operating on a frequency of 100-127 MHz with storage factor of $2 \cdot 10^4$ and shunt impedance of $4 \cdot 10^6 \Omega$. The resonator is enclosed in a steel vacuum tank. Beam power is 20 kW, pulse duration is up to 700 μ s, and pulse recurrence rate is up to 300 Hz. The design of the ELV series is described in another paper (see "Atomnaya energiya," Vol 40, No 3, 1976 p 216). These accelerators have electron beam energies of 400-1500 keV, beam powers of 20-50 kW, accelerating voltage pulsation within 2.5% under load and total losses of 3.5-5 kW at maximum power. The ELIT series comprises pulse accelerators with average electron pulse energy of 0.8-1.5 MeV, average beam power of 0.8-10 kW, energy spread in the beam 10-15%, pulse duration 1-3.5 μ s, pulse power 8-30 MW. The ESU series comprises superhigh-power accelerators. The ESU-2 has an electron energy range of 30-500 keV, electron current up to 10 A, accelerating voltage pulsations within 2.5%, and is designed for continuous duty. The ESU-1 operates only with short gaps. In operation on a vacuum target in the 10-second mode it develops a power of 1100 kW with energy of 250 keV. This accelerator can produce a concentrated beam for extraction into air with a power of 400 kW. Beam extraction equipment is described. Figures 4, references 9 Russian.

USSR

UDC 621.039.75

DECONTAMINATION OF THE STEAM GENERATORS AT THE NOVovorONEZHsk NUCLEAR
POWER PLANT

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 5, May 78 pp 438-439 manu-
script received 24 Jun 77

GOLUBEV, L. I., LYKOV, V. F., PLOTNIKOV, I. M., SEDOV, V. K., SMIRNOV, A. A.
and SOTNIKOV, A. F.

[Abstract] A description of the system for self-contained decontamination of steam generators at the Novovoronezhsk Nuclear Electric Power Plant. The system provides for continuous circulation of the decontaminating solution heated to a fixed temperature. Decontamination is by the oxidation-reduction method with alternating use of an alkali solution of potassium permanganate and a solution of oxalic and nitric acids at 90°C. The concentration of the deactivating solutions in grams per liter: potassium hydroxide 30, potassium permanganate 3, oxalic acid 15, nitric acid 1. Heating and constant circulation in a self-contained loop appreciably increase the effectiveness of decontamination. Gamma spectrometric analysis of the deactivating solutions shows that radioactivity in the steam generators at this facility is due to activated corrosion products (averages ⁶⁰Co 30%, ⁵⁴Mn 15%, ⁵⁸Co 10%) and fission fragments (averages ⁹⁵Nb 10%, ⁹⁵Zr 5%, ¹⁰³Ru 2%, ¹⁰⁶Ru 2%). Figures 1.

USSR

UDC 539.1.074.55:539.1.074.3:550.379

USE OF Ge(Li)-DETECTORS FOR GAMMA-SPECTROMETRIC ANALYSIS OF ENVIRONMENTAL
SAMPLES

Moscow ATOMNAYA ENERGIYA in Russian Vol 44, No 5, May 78 p 453 manuscript
received 8 Jun 77, after final revision 25 Nov 77

[Summary of article No 959/9336 deposited in the All-Union Institute of
Scientific and Technical Information, complete text 4800 words, figures 4,
tables 4, references 7]

TERTYSHNIK, E. G., BOCHKOV, L. P. and VAKULOVSKIY, S. M.

[Abstract] The sensitivity of a spectrometer with DGDK-60A semiconductor Ge(Li) detector is compared with that of a scintillation spectrometer based on a thallium-activated sodium iodide single crystal. The effectiveness of registration of gamma quanta was checked by using radioactive standard solutions and a laboratory set of spectrometric gamma sources. It was

found that the spectrometer with Ge(Li) detector was as good as the scintillation unit at energies of 200-1600 keV as determined by the quality factor $\xi(E)/\sqrt{n}$, where $\xi(E)$ is the effectiveness of registration of gamma quanta with energy E in the total absorption peak, and n is the background count rate in the energy interval equal to twice the width of the peak at half its height. In 1975, the installation with semiconductor detector was used to analyze specimens of atmospheric aerosol, radioactive fallout and bottom deposits. The DGDK-60A detector can measure a ^{137}Cs concentration of $4 \cdot 10^{-11}$ Ci/kg with a 50% relative error in 2 hours against a background of naturally radioactive U, Th and K in a 1-liter sample.

USSR

A VECTOR MESON IN A QUANTUM ELECTROMAGNETIC FIELD

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 35, No 3, Jun 78 pp 401-405 manuscript received 13 Sep 77

ZHULEGO, V. G., RADYUK, A. F. and FEDOROV, F. I., Institute of Physics, Academy of Sciences BSSR

[Abstract] General covariant methods of exact solution of relativistic wave equations for particles with arbitrary spin in a classical plane electromagnetic field are used to find the exact wave function of a vector meson in the quantum field of a linearly polarized monochromatic electromagnetic wave. The resultant solution is a linear combination of three partial solutions of the problem in accordance with the spin of the particle. References 15: 11 Russian, 4 Western.

USSR

UDC 533.9

TIME DISTRIBUTION OF THE VELOCITY OF PLASMA COMPONENTS IN A PULSE ELECTROMAGNETIC ACCELERATOR

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77 pp 19-25 manuscript received 14 Nov 75

IVANOVA, L. YE.

[Abstract] A study was made of the time distribution of the velocity of plasma components in a pulsed electromagnetic accelerator with the capacitor bank charged 3 to 5 kV, a characteristic discharge time of 38 to 40 microseconds, a residual gas pressure of 5×10^{-5} mm Hg, and the polyfluoroethylene

insulation and partly the electrode material used as the working medium. The slit scanning method, the drift method with photoelectric recording and the Doppler shift of the spectral lines were used to measure the velocities of the particles on accelerators 26 cm and 4 cm long. The variation in concentration of the charged particles and the variation of the directional velocity are discussed. In the longer model there was some difference in velocities for different ions probably connected with the point of ion production (the Cu III, Al III, and F II ions appear near the breakdown point and are accelerated in the channel whereas the C II and Al II ions are basically formed at the exit from the accelerator and at later points in time). The difference in charge and mass of the ions contributes to a difference in the velocities. The order higher concentration for the shorter model leads to very similar velocities of the various plasma components. The photoelectric method of recording and the peculiarities of the discharge pattern from the accelerator are also discussed. The author thanks G. M. Bam-Zelikovich for constructive criticism. Figures 4, references 14.

USSR

OPTICAL RESONATORS WITH PERIODIC BOUNDARIES

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian, Vol 74, No 3, Mar 78, pp 872-884, manuscript received 1 Jul 77

MARCHENKO, V. M., MAKHVILADZE, T. M., PROKHOROV, A. M. and SARYCHEV, M. YE.,
Institute of Physics imeni P. N. Lebedev, Academy of Sciences, USSR

[Abstract] Results are presented from a theoretical and experimental study of open optical resonators with mirrors consisting of a 2-dimensional grid. Based on the solution of the boundary-value problem of the equations of electrodynamics, natural internal types of oscillations of these resonators are studied, and the fields inside and outside the resonators are calculated for various periodic structures. Conditions of excitation of various modes of the resonators are experimentally studied and interpreted. It is shown that the angular divergence of individual lobes of the radiation pattern is near the diffraction divergence at the output aperture, and a method of control of divergence is demonstrated. Resonators of this type are found to have periodic modes, the fields of which fill the entire output aperture. With resonator length L , these modes are oscillations with wavelengths which are multiples of $p^2/2L$. The distribution of fields and the spectral composition of internal oscillations is described rather precisely if the mirrors are assumed infinite. Figures 6; References 10: 7 Russian, 3 Western.

USSR

UDC 535.34

A NEW METHOD OF REVEALING THE LINE STRUCTURE IN NONUNIFORMLY BROADENED
ABSORPTION SPECTRA OF ORGANIC MOLECULES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 5, May 78
pp 839-844

KHARLAMOV, B. M., BYKOVSKAYA, L. A., and PERSONOV, R. I.

[Abstract] For revealing not very deep gaps within the vibronic region of the absorption spectrum of organic molecules, a sensitive method is proposed by which the difference of two absorption (transmission) spectra is recorded: that of a "burned out" specimen and that of a "not burned out" specimen. This differential spectrum represents the vibronic absorption spectrum of "burned out" centers without uniform broadening

and with hyperfine structure. This method was tried and a DFS-12 spectrometer and various CW lasers with a 0.5 cm^{-1} line width. The experiment revealed a rather general burnout effect of laser radiation, the energy density of which on the specimens had been varied from 0.005 to 0.5 W/cm^2 . The spectral data for ethanol solutions of perylene and zinc-tetraphenylporphin are shown here, with the hyperfine structures clearly revealed. This paper was presented at the Fourteenth All-Union Conference on Molecular Luminescence in Minsk, 24-27 May 77. Figures 4; tables 1; references 18; 8 Russian, 10 Western.

USSR

UDC 533.9

FEASIBILITY OF PRODUCING HIGHLY EFFICIENT RADIATION SOURCES BASED ON DISCHARGE ALONG HYPERSONIC PLASMA JETS AND OPERATING AT SOME PULSE REPETITION RATE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 5, May 78
pp 787-790 manuscript received 3 Mar 77

KOZLOV, N. P., MALASHCHENKO, V. A., and PROTASOV, YU. S.

[Abstract] Many quantum-electronic devices require highly efficient sources of visible and ultraviolet radiation. The use of hypersonic plasma jets in vacuum is proposed for this purpose, with the velocity of the cooling plasma higher than the thermal velocity so that the plasma is expelled from the radiation zone and thus no contamination of optical surfaces by condensing metal vapor occurs. An experimental study was made of a high-current discharge along a hypersonic plasma stream, with an erosion type magnetic plasma compressor serving as the plasma injector. Teflon and cesium iodide served as the plasma forming substances, with the energy characteristics of the injector and the geometry of the accelerating electrodes optimized, the distributions of the brightness temperature and of the compression-zone diameter along the jet axis were measured, and the source efficiency as a function of the stored energy was determined. Figures 2; references: 5 Russian.

USSR

UDC 533.932

ON CALCULATING THE OPTICAL PROPERTIES OF PLASMA AT HIGH PRESSURES

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May/Jun 78
pp 464-472 manuscript received 30 May 77

VOROB'YEV, V. S., Institute of High Temperatures, Academy of Sciences USSR

[Abstract] The author considers plasma radiation at pressures and temperatures where the effects of Coulomb nonideality become noticeable. The emission of the continuum is calculated by formulas taken from the survey by Biberman and Norman [see Uspekhi fizicheskikh nauk, Vol 91, 1967, p 193] in which the equation of state is supplemented by changes due to transition to a large canonical ensemble. The supplementary formulas describe the spectral brightness of the continuum with consideration of the emission of the aggregate of overlapping spectral lines determined by the optical reduction of the ionization potential, and also define the coefficients of absorption derived from the brightness formulas by Kirchhoff's law. The boundaries of superposition of the upper levels in the spectra of complex atoms are considered, and it is shown that for the infrared region of the spectrum there is an appreciable contribution from the spectral lines adjacent to the boundaries of the overlapping spectral series and from the broadening and superposition of the different series perceived as a continuous spectrum. Emission in the continuous spectrum of an inert gas plasma is analyzed, and the theory is compared with experimental data on the radiation of argon and xenon plasmas. It is found that the part played by the aggregate of merging lines is particularly pronounced in the infrared region, and that these lines must be accounted for to avoid discrepancies between theory and experiment. Figures 5, references 30: 18 Russian, 12 Western.

USSR

UDC 669.1:535.327

INFLUENCE OF TEMPERATURE ON THE OPTICAL CONSTANTS OF IRON

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May/Jun 78
pp 520-525 manuscript received 12 Jul 77

SHVAREV, K. M., GUSHCHIN, V. S. and BAUM, B. A., Ural Polytechnical Institute imeni S. M. Kirov

[Abstract] The indices of refraction and extinction coefficients are determined for solid and molten iron (20, 1400 and 1600°C) at wavelengths of 0.6-3.39 μm by the Beattie method. The optical constants are also

plotted as functions of temperature for wavelengths of 0.6 and 3.39 μm . The extinction coefficient is practically independent of temperature. The index of refraction remains nearly constant in the visible region, and increases with temperature in the infrared region. The electron characteristics are calculated from the results of spectral analysis in the infrared region: the plasma frequency and relaxation time corresponding to slowly relaxing s-like electrons at 20, 1400 and 1600°C. The results show that the relaxation time decreases rapidly with increasing temperature, and this change corresponds to the change in resistivity of the iron. Thus it is concluded that the temperature dependence of resistivity of iron is due mainly to the contribution from slowly relaxing electrons. Figures 4, references 15: 10 Russian, 5 Western.

USSR

INTRACAVITY SPECTROSCOPY USING CW AND QUASI-CW LASERS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 74, No 1, Jan 78 pp 43-56 manuscript received 1 Apr 77

BAYEV, V. M., BELIKOVA, T. P., SVIRIDENKOV, E. A. and SUCHKOV, A. F.,
Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] A theoretical and experimental study is done on the emission spectrum of cw dye lasers when used for intracavity laser spectroscopy. Particular emphasis is placed on longitudinal nonuniformities in depletion of inverse population with consideration of the fact that the thickness of the active region is a small fraction of cavity length. The position of the active region relative to the mirrors, the angle of turn of the plane of the jet to the axis of the cavity and spontaneous emission are also taken into consideration. It is found that factors limiting the sensitivity of intracavity laser spectroscopy are the selective properties of the cavity, finiteness of the cw lasing time in the vicinity of the investigated line, spontaneous emission of the active medium and spatial nonhomogeneity of inversion depletion in the active medium. The selective properties are improved by simplifying the cavity and reducing internal surfaces. The ideal cavity is one with a single surface separating the active medium from the medium being studied. The influence of spatial nonhomogeneities of inversion depletion can be disregarded in comparison with spontaneous emission. Experiments yield a sensitivity of 10^{-9} cm^{-1} on wavelengths of 0.6 and 1.06 μm . The attainable sensitivity is determined by the time of quasi-cw lasing action in the neighborhood of the investigated absorption line. A concentration sensitivity better than 10^{-9} mole/mole is achieved in detection of I_2 and NO_2 . Figures 5, references 27: 18 Russian, 9 Western.

DEVICE FOR REMOTE DETECTION OF ATMOSPHERIC POLLUTION BY THE RAMAN SCATTERING SPECTRA OF LIGHT

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 1, Jan 77
pp 174-179 manuscript received 15 Dec 75

MALYAVKIN, L. P., VAYNER, YU. G. and ZOLOTAREV, V. V.

[Abstract] The work described in a previous article by A. V. Bobrov, et al, OPTIKA I SPEKTROSKOPIYA, No 39, 1975, p 86 is continued. The sensitivity of the previously described device for remote detection of atmospheric pollution by the Raman scattering spectra of light has been improved, and minimum detectable concentrations of a number of polluting gases have been measured. The signals for the basic components of the atmosphere in photoelectrons per laser pulse are tabulated. The photomultiplier load was selected at 50 ohms in order to improve the time resolution of the recording system. The device can be used to detect local sources of pollution at distances of up to 100 meters with gaseous pollutants in concentrations of 4 to 20 mg per liter (10^3 to 10^4 ppm). There is strong interference from fluorescence of the pollutants, and the application of the Raman scattering technique is limited for analyzing gases which have strong absorption on the exciting laser frequency. The minimum detectable concentration of atmospheric water vapor by the method is 150 ppm. The authors thank A. V. Bobrov for assistance in preparing the facility for testing. Figures 3, references 14: 4 Russian, 10 Western.

USSR

UDC 621.315.592

PHOTOELECTRIC MEMORY IN GALLIUM ARSENIDE COMPENSATED WITH OXYGEN

Leningrad, FIZIKA I TEKHNIKA POLUPROVODNIKOV, in Russian, Vol 12, No 5, May 78, pp 915-919 manuscript received 14 Nov 77

PEKA, G. P., BRODOVOY, V. A., MIRETS, L. Z., Kiev State University, and MISHOVA, I. I., Institute of Electric Engineering, Sofia, Bulgaria

[Abstract] A study was made of semi-isolated GaAs single crystals compensated with oxygen, of n type with $\rho = 10^5 - 10^7 \Omega\text{-cm}$ at 300 K. The phenomenon of long-term conservation of the nonphotosensitive state in the area of spontaneous emission after exposure to radiation at $h\nu = 1.06 - 1.2 \text{ eV}$ is studied. In darkness, the nonphotosensitive state is conserved for some dozens of hours at 80 K. A special study is made of the role of various recombination centers in GaAs(0) and their optical recharging during the phenomenon of photoelectric memory. The residual damping involved is related to relocalization of electrons from r centers with energy position 0.34-0.40 eV from the v band to h centers with energy position about 0.42 eV from the c band and the resulting transition of recombination from the r channel to a faster channel. Figures 6; references 10: 1 Russian, 9 Western.

USSR

UDC 535.41+621.375.826

REDUCING DIVERGENCE OF THE LIGHT BEAM AT THE OUTLET FROM A FIBER-OPTICS CABLE

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 23, No 5, May 78 pp 863-866 manuscript received 9 Dec 77

VOLYAR, A. V., GNATOVSKIY, A. V., LOGINOV, A. P., MEDVED', N. V. and SHPAK, M. T., Institute of Physics, Academy of Sciences UkrSSR, Kiev

[Abstract] An investigation is made of the feasibility of improving the output characteristics of cable by an interferometric method of conversion of coherent light fields by an optical system made up of a wave front modulator and an element that performs an integral operation of correlation. Experiments were done in which the modulator was a Fresnel zone plate and the correlator was a hologram. The results show a bright central maximum in the output field of the cable regardless of the initial field. By proper selection of modulators, the proposed technique can be used to produce a beam with a predetermined angular structure, and may enable a new approach to interfacing different parts of fiber-optics systems. Figures 2, references 3 Russian.

Plasma Physics

USSR

EXPERIMENTAL STUDY OF QUASISTABLE WAVES EXCITED UPON PERIODIC INJECTION OF ELECTRON CLUSTERS INTO A PLASMA

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian, Vol 74, No 3, Mar 78, pp 984-992, manuscript received 20 Sep 77

GLADKII, A. M. and KOVALENKO, V. P., Institute of Physics, Academy of Sciences, Ukrainian SSR

[Abstract] Results are presented from an experimental study of Bernstein-Green-Kruskal or BGK waves in the specific case when the captured electrons have a delta-shaped velocity distribution function and the quasistable waves are excited by injection of a preliminarily formed electron cluster into a plasma. An electron beam with an energy of about 300 eV and a current of 1-10 mA was formed by a 3-electrode gun and entered a metal plasma chamber 10 cm in diameter filled with argon at about 10^{-3} mm Hg through a channel 0.8 cm in diameter and 1.5 cm in length, which served to create a pressure drop. The experiment showed that injection of a preliminarily density-modulated electron beam into a plasma can excite both initially increasing waves and nonlinear quasisteady BGK waves. An equation is given for the conditions of excitation of these waves by a beam with a single energy level. Due to the equilibrium distribution of captured particles, the BGK wave propagates with a constant profile and amplitude over a distance sufficient for complete attenuation of waves in an ordinary plasma-beam system. The quasistable wave maintain the plasma-beam discharge over its entire length. The attenuation of waves excited by equilibrium electron clusters results from an increase in satellite waves due to instability. Figures 8; references 16: 10 Russian, 6 Western.

USSR

UDC 537.25.5

THERMOCHEMICAL NONEQUILIBRIUM IN AN ELECTRIC-ARC DISCHARGE PLASMA WHERE THE DISCHARGE IS STABILIZED BY NITROGEN BLOWN IN THROUGH A POROUS CHANNEL WALL. EXPERIMENTAL STUDY OF THE ARC PLASMA PARAMETERS

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May/Jun 78 pp 485-491 manuscript received 27 Oct 77

KUROCHKIN, YU. V., POLAK, L. S., PUSTOGAROV, A. V., SLOVETSKIY, D. I. and UKOLOV, V. V., Institute of Petrochemical Synthesis, Academy of Sciences USSR

[Abstract] An examination is made of the state of a high-current high-pressure arc discharge stabilized by strong blow-in of gas through a porous channel wall. This particular part of the research gives the results of

an experimental study of equilibrium and nonequilibrium discharge parameters in nitrogen, and investigates problems of deviation from local thermodynamic equilibrium. In the experimental installation an electric arc is struck between a tungsten cathode and a copper anode. The working gas -- nitrogen -- was forced into the discharge space through a porous foam ceramic wall. A lens and mirror system was used to focus the image of the arc and of a tungsten lamp on the slit of a spectrograph. The nitrogen flowrate was $2-16 \text{ kg} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$, current was 50-500 A and the pressure in the channel was $(1-20) \cdot 10^5 \text{ Pa}$. Spectrometric methods were used for determining the profiles of the temperatures of distribution and population of the energy levels of nitrogen atoms, the profiles of translational temperature of heavy particles and the electron concentration. The electron temperature was determined from the equation of energy using experimentally measured plasma parameters. An analysis is made of the influence that the gas, discharge current and pressure in the channel have on deviations of the plasma from the equilibrium state. The results show that there are deviations from local thermodynamic equilibrium in a nitrogen arc discharge plasma stabilized by strong blow-in of gas through the porous wall of the discharge channel. Deviations from local thermodynamic equilibrium show up more strongly in such discharges than when other methods of discharge stabilization are used. Figures 8, references 19: 10 Russian, 9 Western.

Superconductivity

USSR

SUPERCONDUCTIVITY OF MULTIPLE-VALLEY SEMIMETALS DUE TO COULOMB INTERACTION BETWEEN ELECTRONS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 27, No 10, 20 May 78 pp 565-568 manuscript received 8 Apr 78

BABICHENKO, V. S., Institute of Spectroscopy, USSR Academy of Sciences

[Abstract] A semimetal is considered with a large number of electron and hole valleys. These valleys are assumed to be spherical in form and only Coulomb interaction between electrons is taken into account, disregarding the logarithmic singularities in the dielectric electron-hole channel. An analysis of Feynman diagrams reveals the formation of Cooper pairs, depending on the electron concentration, and the conditions of superconductivity. The author thanks L. V. Keldysh for the discussion of the results. Figures 2, references: 5 Russian.

USSR

RESISTIVE DOMAIN IN A LONG SUPERCONDUCTOR OF SMALL CROSS SECTION IN A MICROWAVE ELECTROMAGNETIC FIELD

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 20, No 5, May 78 pp 1454-1458 manuscript received 10 Oct 77, after final revision of 16 Dec 77

KASHCHEY, V. A., Institute of Radio Physics and Electronics, Academy of Sciences UkrSSR, Khar'kov

[Abstract] The resistive state of a long superconductor with small cross section is studied in terms of electron superheating in metals. An examination is also made of the conditions of onset, propagation and disappearance of the normal phase of the electron gas in such a superconductor in a microwave field, and it is shown that a resistive domain may be formed that has a length that is constant in time, and that is analogous in its properties to the domain that arises in a superconductor with transmission of direct current. The author determines the critical power levels of microwave emission leading to phase changes in a long superconductor. It is assumed that there is an interface between the superconductive and normal phases of the electron gas, that the microwave frequency precludes heating of conduction electrons in the superconductive regions, and that heated regions of the superconductor do not have time to cool off in the microwave signal period. An explanation is given for the experimentally observed relation between the hysteresis of

the critical microwave power and conditions of matching the superconductor to the microwave source. It is noted that the rate of displacement of the resistive domain can be studied as a function of the level of absorbed microwave power by analyzing the form of oscillations of the coefficient of reflection of the microwave signal from the superconductor. The author thanks F. G. Bass for interest in the work and discussion of the results, and S. A. Peskovatskiy for examination of the manuscript and constructive criticism. References 18: 17 Russian, 1 Western.

USSR

UDC 536.23

HEAT CONDUCTION OF XENON AT TEMPERATURES OF 170-1300 K AND PRESSURES UP TO 200 MPa

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May/Jun 78 pp 509-515 manuscript received 21 Jun 77

BAKULIN, S. S. and ULYBIN, S. A., Moscow Power Engineering Institute

[Abstract] This paper is one of a series on the thermophysical properties of technically important gases [see S. A. Ulybin, S. S. Bakulin, "Teplo-energetika," No 1, 1976; S. A. Ulybin, V. I. Makarushkin, "Teplofizika vysokikh temperatur," Vol 15, No 6, 1977], and contains new experimental results on the heat conductivity of xenon. A table is given summarizing the experimentally determined values of thermal conductivity of xenon from 1931 to 1976 in different temperature ranges, mostly at atmospheric pressure. Studies done since 1969 have shown thermal conductivities 6-10% lower than those previously determined in the temperature range above 1000 K. The authors of this paper give a table summarizing their own research by the hot-filament method in liquid xenon at 235-307 K and pressures of 10-50 MPa. A table is also given showing recommended values of heat conduction of xenon at temperatures of 170-1300 K and pressures of 0.1-200 MPa calculated by an approximation formula. Estimates show that the error of the tables does not exceed 5% at 270-600 K and pressures up to 100 MPa. Figure 1, references 20: 12 Russian, 8 Western.

USSR

UDC 535.34

INTEGRAL HEMISPHERICAL DEGREE OF BLACKNESS AND RESISTIVITY OF Kh20N80 AND KhN45V30 HIGH-TEMPERATURE ALLOYS

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May/Jun 78 pp 516-519 manuscript received 14 Sep 77

ZHOROV, G. A., PANASYUK, I. O. and SAMOYLOV, A. I., All-Union Institute of Aviation Materials

[Abstract] Experiments are done to determine the integral hemispherical degree of blackening and resistivity of Kh20N80 and KhN45V30 alloys at 1000-1650 K. The studies were done on polished specimens and on preoxidized specimens with the same surface treatment. Both properties were determined simultaneously on the same specimen on an installation with stepwise heating in vacuum with holding for 15 minutes at each 100°C. The error in

determination of blackening is 4.2%, and in resistivity -- 1.8%. At temperatures above 1000 K both alloys showed an irreversible increase in emittance due to chromium oxidation. The integral hemispherical degree of blackening of the oxidized surface of Kh20N80 alloy lies in a range of 0.7-0.75; however, in vacuum above 1500 K there is an irreversible reduction in blackening due to destruction of the oxide film. The more stable oxide phases formed on KhN45V30 alloy with heating in air and vacuum result in high emittance of the oxidized surface ($\epsilon=0.8-0.85$) right up to the melting point of the alloy. The resistivity of both alloys remains almost constant in the investigated temperature range, and is lower for KhN45V30. Figures 2, references 5: 4 Russian, 1 Western.

USSR

UDC 537.33

ELECTRICAL RESISTANCE OF Zn-Sn AND Zn-Bi MELTS

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 16, No 3, May/June 78 pp 526-530 manuscript received 10 Aug 77

MAGOMEDOV, A. M., Dagestan State University imeni V. I. Lenin

[Abstract] The resistivity of zinc-tin and stratified zinc-bismuth alloys is studied as a function of temperature and concentration at temperatures of 20-800°C. The alloys were made in pretreated and evacuated quartz ampules. Resistivity was measured by a four-probe contact method. A direct current of 0.5 A was sent through the specimen and the potential drop was measured by an R-345 potentiometer with accuracy of 0.1 μ V. Temperature control was by three chromel-alumel thermocouples. The temperature coefficients of resistivity were calculated in the solid and liquid phases. Data are given on the change in resistivity with transition from the solid phase to the two-phase region, and from the solid to the liquid phase. Bismuth-zinc alloys show a region of immiscibility in the liquid state at 416°C that stretches from 15.5 to 98.1% Zn. This region narrows with increasing temperature. The concentration dependence of resistivity is not additive. Figures 2, references 11: 10 Russian, 1 Western.

USSR

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INTENSIFICATION OF HEAT EXCHANGE WHEN STEAM CONDENSES IN AN ELECTRIC FIELD

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[Abstract] An investigation is made of the mechanism and governing principles of electrohydrodynamic action on the process of film condensation to determine the optimum conditions of using an electric field to maximize heat exchange. The research was done in a condenser in which the heat exchange surfaces were a vertical plate and a tube that were cooled by running water. A high-voltage electrode was placed around the tube with slits for steam inlet. The temperature of the outside of the tube was measured by thermocouples and a resistance thermometer. It was found that the heat exchange increases as a function of electric field strength and is independent of the geometry of the field. The main factors that determine the intensification of heat exchange under electrohydrodynamic action are the reduction in film thickness and the increase in condensation surface. An equation is derived that describes heat exchange with film condensation of pure stationary vapor of a dielectric liquid on vertical flat and tubular surfaces under the action of a constant electric field that is valid over a wide range of dimensionless parameters. Figures 10, references 14: 13 Russian, 1 Western.

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