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EPITAXIAL GROWTH OF GOLD FILMS UNDER ION IRRADIATION

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 41, No 5, May 77 pp 995-998

BYKOV, YU. V., GUSEVA, M. B., KEVEDO, KH., and ABDRAHITOVA, D. KH.

[Abstract] Nucleation and growth of gold films on the surface of ionic crystals was studied, of particular interest being the effect of ion irradiation either during or before film condensation from the vapor phase. Gold films were deposited on (100)-wafers of NaCl crystals under vacuum ($1 \cdot 10^{-6}$ torr) and checked for continuity by the optical interference method. A structural analysis under an electron microscope indicated an appreciable orientation effect of both modes of ion irradiation. According to the results, simultaneous ion irradiation and condensation facilitates epitaxial growth by lowering the necessary temperature and stimulating oriented nucleation so as to yield a higher concentration of centers at earlier stages of the process. Prior ion irradiation requires a flux of much higher density and energy for producing the same high particle concentration of $10^{12}/\text{cm}^2$ in a film. While a complete unidirectional orientation parallel to 100 Au 100 NaCl results from simultaneous irradiation, moreover, orientation in also several other directions results from prior irradiation. These findings are attributed to the structure of point defects formed by an ion flux and the kinetics of particle diffusion, to a charging of the substrate, and to stimulation or inhibition of oriented growth of particularly bounded microcrystals. Figures 4, references 4: 3 Russian, 1 Western.

USSR

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EXAMINATION OF EPITAXIAL HETEROSTRUCTURES ON GaAs UNDER A RASTER-TYPE ELECTRON MICROSCOPE OPERATING IN THE CATHODOLUMINESCENCE MODE

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 41, No 5, May 77 pp 987-990

GOVORKOV, A. V. and DRUZHININA, L. V., State Scientific Research and Design Institute of the Rare-Metals Industry

[Abstract] A raster-type JSM-2 electron microscope with a cathodoluminescence attachment was used for examination of epitaxial heterostructures on GaAs. The cathodoluminescence radiation was collected by a reflecting objective, focused on the inlet aperture of a monochromator behind the microscope tube, and recorded with a photomultiplier through a germanium photodiode. Epitaxial layers and multilayer specimens of GaAs-GaSb solid solutions were built up, considering that the respective lattice parameters of

of these two compounds differ more than those of any other A^{III}B^V pair. The intensity of cathodoluminescence was found to be lower adjacent to heterojunctions and to be decreasing periodically in built up layers so as to yield a mesh of dark fringes. The latter effect is attributed to a multi-level mesh of incompatibility dislocation. In regions of high defect concentration around dislocations there form centers of nonradiative recombination. The nature of these phenomena has not been quite explained. There also form, however, oblique dislocations in such GaAs_xSb_{1-x} layers which can be revealed by chemical etching. Figures 3; references: 3 Western.

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UDC 548.25+548.52+620.191+620.187

MECHANISM OF EPITAXIAL ORIENTATION

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 41, No 5, May 77 pp 975-980

VLASOV, V. P., DISTLER, G. I., and KANEVSKIY, V. M., Institute of Crystallography imeni A. V. Shubnikov, USSR Academy of Sciences

[Abstract] The mechanism of epitaxial orientation was studied on the model system of triglycine sulfate and silver chloride, considering the distinct domain structure of the former and extremely high sensitivity of oriented coalescence of the latter to the electrical relief of the substrate. The fundamental atomic structure of crystalline substrates was eliminated as a possible factor affecting the orientation process by the use of amorphous selenium interlayers. TGS crystals for this experiment were grown synthetically by the temperature dropping method. Selenium was deposited by vacuum evaporation from a tungsten coil and silver chloride was deposited from a molybdenum vessel, with the TGS crystals at 290 K. The kinetics of structure formation and the orientation mechanism were examined under an electron microscope, with the AgCl layer built up to 200 Å thickness on continuous 55-200 Å thick selenium interlayers. The results of this study suggest that the selective interaction between linear components of the reticulate electrically active structure determines the orientation effects during epitaxial growth, at the crystal-substrate interface as well as on the other side of amorphous interlayers. Figures 2; references 24: 10 Russian, 14 Western.

PHOTOELECTRIC CHARACTERISTICS OF GaP PIN-DIODES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 27, No 1, Jul 78
pp 143-145 manuscript received 14 Jun 76

NIKOLAYEV, YU. N. and TARASOV, V. M.

[Abstract] The photosensitivity spectrum of GaP diodes is characterized by an exponential rise and by high levels under a forward bias. An experimental study of these characteristics was made on such diodes having the n-region doped with tellurium and oxygen and the p-region doped with zinc. A modulated light beam parallel to the plane of their p-n junctions illuminated these diodes. The photocurrent, as a function of the bias voltage and as a function of the incident quantum energy, was measured with the aid of a synchronous detector. An analysis of the results indicates the presence of a large compensated i-region containing oxygen atoms and having n-type conductivity. Most of the voltage drop under a positive bias across the p-n junction occurs across this region and the photocurrent here, proportional to the voltage, is opposite in direction to the short-circuit photocurrent. A photoconduction signal in this region is one or two orders of magnitude larger than a signal under a reverse bias, which makes such diodes with a compensated i-region very suitable as photoresistors. Figures 2; references 9: 2 Russian, 7 Western.

USSR

UDC 621.375.8

INTERACTION OF MODES IN A GAS LASER WITH IDENTICAL DEGENERACY OF THE ENERGY LEVELS OF THE WORKING TRANSITION

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 26, No 4, Apr 77
pp 626-632 manuscript received 12 Apr 74

GONCHUKOV, S. A., YERMACHENKO, V. M., PETROVSKIY, V. N. and PROTSENKO, YE. D.

[Abstract] Stimulated emission of two orthogonally polarized modes in a gas laser is considered and it is shown that the strong coupling between these modes when the moments of the energy levels of the working transition are $j_b = 1$, $j_a = 2$ can be completely eliminated when the working levels are equally degenerate. Attenuation of the coupling between the fields of the interacting modes through the magnetic sublevels of the excited atoms on the transition $j_b = j_a = 1$ eliminates the critical frequency regardless of the nature of line broadening, thus enabling continuous control of intermode spacing within the limits of the lasing band. Experiments were done with a helium-neon laser with emission on the $3s_2-3p_2$ transition ($\lambda_1 = 3.3913 \mu\text{m}$), giving the proper combination of moments. The results confirm the conclusion that two-mode lasing action occurs throughout the entire range of intermode spacing ω_{12} from 0 to $c/2L$, where c is the speed of light and L is the distance between laser mirrors. This range is considerably extended by using a waveguide laser: a range of 750 MHz has been attained, and optimization of laser parameters should make it feasible to reach a width considerably exceeding 1000 MHz. Figures 3, references 11: 8 Russian, 3 Western.

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SPECIFICS OF THE SPECTRAL KINETICS OF LASERS BASED ON POLYATOMIC ORGANIC MOLECULES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 2, Feb 78
pp 224-232 manuscript received 24 Mar 77

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

[Abstract] A theoretical analysis is presented of the influence of the spectral characteristics of lasing media, changes in the population of energy levels, pumping conditions, resonator parameters and many other factors on the nature of change of wavelength at the maximum of the generation band and of the entire band of radiation with time. Uniform expansion

of spectral absorption and emission bands is assumed. The calculation model used allows good description of the spectral and kinetic characteristics of the radiation over a broad range of pumping lengths. The calculated change in wavelength of the generation maximum as a function of time is confirmed by numerical calculations using more precise kinetic equations. The behavior of the spectrum of radiation as time passes is quite sensitive to changes in the spectral parameters of the active medium and the pumping conditions. Figures 4; references 22: 14 Russian, 8 Western.

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OPTICAL MEASUREMENTS OF THE TEMPERATURE UPON LASER HEATING OF A SOLID SURFACE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 2, Feb 78 pp 233-237 manuscript received 5 Nov 76

DLUGUNOBICH, V. A., SNOPKO, V. N.

[Abstract] Measurements were performed of the surface temperature of several dielectrics (glass, quartz, hetinax, textolite) and graphite exposed to the focused radiation of a CO₂ continuous laser of up to 200 W. The temperature of the specimens was measured by means of a 4-channel spectrometer. When glass was irradiated at $1.5 \cdot 10^2$ -- $2 \cdot 10^3$ W/cm², a flame develops, increasing the effective radiation capacity. This increase is probably related to radiation in the 1.14--1.18 μ m range from excited Na and K atoms contained in the flame. An increase in the incident radiation flux from $1.5 \cdot 10^2$ to $2 \cdot 10^3$ W/cm² causes no change in the steady value of the temperature of the glass and the quartz, which results from the phase transition. The temperatures of hetinax and textolite, after achieving a maximum value, decrease with time. This decrease probably results from the formation of a carbonized surface area, changing the coefficient of reflection and the heat conductivity of the material. The radiation capacity of these carbonized areas is practically the same as that of graphite for the same wavelengths and temperatures. Figures 4; references 9: 8 Russian, 1 Western.

USSR

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THE SPECTRUM OF RADIATION OF A LASER AND CERTAIN PROPERTIES OF SPECTROSCOPY WITHIN THE CAVITY

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 2, Feb 78
pp 238-244 manuscript received 16 Aug 76

GORCHARUK, I. M., KOTOMTSEVA, L. A., SAMSON, A. M.

[Abstract] A description is presented of the spectral form of quasisteady laser generation in the simplest case with a uniformly expanded amplification band. The primary factors influencing the spectrum are explained and the degree of change of the form of the contour upon insertion of a substance with a relatively narrow absorption band or amplification band into the cavity is estimated. The study is performed by means of balance equations for the populations of the operating levels of a 2-level active medium and transfer equations for radiation density, considering the spectral characteristics of the system. The equations derived allow the maximum permissible frequency-dependent deviations in loss coefficient not causing changes in the generation spectrum to be determined, thus indicating the sensitivity of the ruby laser to heterogeneity of its loss coefficients, Figures 3; references 17: 15 Russian, 2 Western.

USSR

UDC 621.375.8

CALCULATION OF THE WIDTH OF THE AREA OF SYNCHRONIZATION OF A RING LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 2, Feb 78
pp 245-248 manuscript received 14 Sep 76

TIMOFEYEVA, G. I.

[Abstract] The width of the area of synchronization of the oppositely directed waves in a ring laser is found and analyzed with arbitrary relationships between the phases of the coupling coefficients. Possible types of transition from single-frequency to double-frequency modes are considered. It is noted that at the boundary of the area of synchronization, the presence of coupling between oppositely directed waves does not cause a change in the lasing threshold, while the threshold within the synchronization area depends on the magnitude and phase of coupling. Figures 2; references 9: 8 Russian, 1 Western.

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NONLINEAR OPTICAL EFFECTS IN THE GENERATION OF HIGHER HARMONICS IN A NEODYMIUM LASER IN ORGANIC MOLECULAR CRYSTALS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 1, 1978 pp 20-27
manuscript received 30 Sep 77

GAYLIS, A. K., KOLESNIKOV, V. A., SILIN'SH, E. A., Institute of Physics and Power Engineering, Academy of Sciences, Latvian SSR

[Abstract] The nonlinear optical susceptibility of an organic crystal is determined to a great extent by the structure and symmetry of the molecules of which it is composed. A study is made of the nonlinear optical effects in crystals of a number of derivatives of 1, 3-indanedione and molecular auto-complexes. Over 120 different compounds were studied, including a group of intramolecular salts--the betaines, sulfur-containing derivatives and donor-acceptor compounds in which conjugation is transmitted through a bridge, and enamines. Polycrystalline specimens of these compounds were excited by a pulsed neodymium laser and the relative intensity of lasing at the second and third harmonics was related to the intensity of lasing at the corresponding harmonics of a standard compound, metanitroaniline, the effectiveness of which was taken as 1. The greatest effectiveness was observed for the betaines and sulfur derivatives. Nonlinear optical effects can be maximized by selecting organic crystals consisting of molecules with highly developed π -electron conjugation (polyconjugate aromatic and heterocyclic compounds) containing polar radicals and heteroatoms which disrupt the symmetry of the π -electron system, or heteroatoms with high polarization properties such as S and I. Tables 2; references 15: 10 Russian, 5 Western.

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NONLINEAR SHIFTING AND SPLITTING OF LASING FREQUENCIES OF COUNTER-DIRECTED WAVES IN A RING LASER WITH A SPATIALLY HETEROGENEOUS MEDIUM

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 44, No 3, Mar 78,
pp 550-556 manuscript received 15 Feb 77

BOYTISOV, V. F.

[Abstract] A ring laser is analyzed, the resonator of which is a cylindrical mirror with a uniform coefficient of reflection and two flat total-reflection mirrors. All the mirrors are assumed large enough that diffraction can be ignored. Formulas are produced and analyzed for the nonlinear frequency shift, proportional to the relative excess of pumping over the threshold. It is demonstrated that in order to produce low levels of

splitting of lasing frequencies, resonators which are nearly confocal should be used, regardless of the ratio between effective transverse dimensions of the medium and resonator field. Frequency shift is independent of the tuning of the laser frequency from the center of the transition line. Frequency shift depends linearly on the dimensionless length of the laser tube, since the difference in the fields of the counter-directed waves is formed as a result of diffraction in the (heterogeneous) medium itself. References 9: 7 Russian, 2 Western.

USSR

UDC 621.373:535

LASER FREQUENCY DIFFERENCE OF ELLIPTICALLY POLARIZED COUNTER-DIRECTED WAVES IN A RING LASER IN A MAGNETIC FIELD

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 44, No 3, Mar 78, pp 557-560 manuscript received 26 Jul 77

TIUNOV, YE. A. and FRADKIN, E. YE.

[Abstract] A ring gas laser is studied, which has arbitrary polarization anisotropy and contains no independent elements. A weak longitudinal magnetic field is applied to the active medium. Scalar equations for single-mode lasing are produced for this laser. These equations are used to generate an expression for the difference in lasing frequencies of the counter-directed waves in the case, important in practice, when their polarizations differ little and are near linear. This equation is analyzed for single- and dual-isotope composition of the gas. It is assumed that the gain is greater than the losses only for one type of oscillations, that with the highest Q, in each direction. Figure 1; references: 5 Russian.

USSR

UDC: 621.373:535+541.6

THE STRUCTURE OF POLYMETHINE DYE MOLECULES AND THEIR LASER PROPERTIES

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 44, No 3, Mar 78, pp 480-485 manuscript received 7 Jun 76; after revision 10 May

PRIZHONSKAYA, O. V. and TIKHONOV, YE. A.

[Abstract] The structural factors of molecules influencing their vibronic interactions and the shift between maximum bands of absorption and fluorescence, proportional to the vibronic interaction, are determined. Structural elements influencing the quantum yield of solutions of polymethine dyes are

also determined. The study was intended to optimize the parameters of lasers based on symmetrical polymethine dyes. It was concluded that the introduction of aromatic or heterocyclic substituents at the nitrogen atoms of heterocycles on the ends of conjugate chains allows the shape of the vibrational bands to be changed, increasing the half width and decreasing the overlap of absorption and fluorescence bands. This can significantly decrease the lasing threshold and increase the range of tuning of a laser. Changing of the terminal substituents changes the quantum yield in molecular dyes. Figures 2; table 1; references 22: 18 Russian, 4 Western.

USSR

UDC 621.378.3

EXISTENCE AND STABILITY OF A BEAT MODE AT RESONATOR FREQUENCY IN A RING LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 3, Mar 78 pp 421-424 manuscript received 11 Apr 77

FEDCHENYA, I. I. and KRUGLIK, G. S.

[Abstract] A ring laser is considered and the quantum equations of motion describing the dynamics of a signal due to interference between two opposing waves with a phase shift. On the basis of these equations, it is proved first that a beat mode at resonator frequency exists and then that such a mode can be asymptotically stable. The stability condition, based on Lyapunov's and Malkin's theorems, does not depend on the initial phase difference. References 8: 7 Russian, 1 Western.

USSR

UDC 621.378.3

KINETICS OF RADIATION EMISSION FROM SOLUTIONS OF COMPLEX ORGANIC COMPOUNDS AS A RESULT OF LASER PUMPING WITH LINEARLY POLARIZED RADIATION

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 27, No 1, Jul 78 pp 53-58 manuscript received 2 Jun 76

PIKULIK, L. G. and YAROSHENKO, O. I.

[Abstract] Steady as well as pulse emission from a dye laser with transverse pumping linearly polarized and with the electric vector orthogonal to the resonator axis is analyzed, taking into account the anisotropic distribution of molecules but disregarding their Brownian motion. The fundamental

equations of kinetics have been derived from the equations of balance and one-dimensional energy transfer. Dye molecules are simulated by a linear oscillator, the same one for absorption and emission. The resulting system of first-order differential equations describes the polarization process and is solved here numerically by the Euler method, with the loss factor varied. The amplification characteristic, calculated in terms of maximum and minimum values, corresponds and thus reflects an anisotropy of emission too. According to the results of this analysis, linearly polarized pumping radiation which produces and sustains anisotropic distribution of molecules in the state of excitation will yield linearly polarized laser emission which opposes this effect and thus tends to reduce but cannot completely suppress such anisotropy. Figures 2; references 7: 5 Russian, 2 Western.

USSR

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POLARIZATION-FREQUENCY CHARACTERISTICS OF ANISOTROPIC COMPOUND RING RESONATORS WITH ONE OR TWO COUPLING MIRRORS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 27, No 1, Jul 78
pp 46-52 manuscript received 29 Jan 76

LEDNEVA, G. P. and CHEKALINSKAYA, YU. I.

[Abstract] A method is shown of calculating the natural frequencies, the loss factors, and the intrinsic polarizations of compound ring resonators with any kind of anisotropy in both the active and the passive stage. This method is based on the plane-wave approximation and Jones matrices of wave transformation by an anisotropic device. According to the expressions derived here, generally two series of oscillation modes with different respective parameter values appear in each direction. The results are applied to a ring resonator with one coupling mirror and to a ring resonator with two coupling mirrors. On this basis are then analyzed the polarization and frequency characteristics of ring resonators with such anisotropic devices as a partial polarizer and a circular phase plate, or a partial polarizer and a Faraday rotator, or a Faraday rotator between two orthogonal quarter-wavelength plates (one principal axis of one plate in this nonreciprocal device at a 45° angle to the plane of the resonator). The active medium is assumed to be inside a tube with a Brewster window and the reflection coefficients of all reflectors in the passive stage, except that of a coupling reflector, are assumed to be equal to unity. Figures 2; references: 8 Russian.

USSR

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DIELECTRIC COATINGS ON REFLECTORS FOR TWO-WAVE LASERS EMITTING AT 0.63 AND 3.39 μm WAVELENGTHS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 27, No 1, Jul 78
pp 37-41 manuscript received 7 May 76

POPOV, A. I., PROTSENKO, YE. D. and SKACHKOV, YU. F.

[Abstract] Helium-neon lasers emitting radiation at the infrared wavelength $\lambda_{\text{ir}} = 3.39 \mu\text{m}$ can be switched to the red wavelength $\lambda_r = 0.63 \mu\text{m}$ by a change of reflectors mounted on a revolver device or by means of compound stationary reflectors with appropriately coated surfaces. The effectiveness of such a compound set was studied experimentally, with the opaque reflector having a coat of aluminum deposited on its inside surface. Both surfaces of the output reflector were coated with different numbers of alternating dielectric interference layers, the optical thickness of a layer corresponding either to $\frac{1}{2} \lambda_r$ or to $\frac{1}{2} \lambda_{\text{ir}}$. The numbers of these layers, zinc selenide and cryolite, were varied and the laser output power in both one-wave modes as well as in the two-wave mode was measured. Also the effect of angular misalignment of one reflector on the output power was measured in each case. The results indicate that switching of a two-wave laser does not appreciably affect the resonator adjustment. On this basis, one-wave lasers LG-75 and LG-56 have been modified for operation in the two-wave mode delivering approximately the same power of 1.5 mW at each wavelength. Figures 4; references 18: 10 Russian, 1 German, 7 Western.

USSR

UDC 621.378.33

EFFECT OF THE DISPERSION OF THE ACTIVE MEDIUM ON THE EMISSION INTENSITY OF A GAS LASER IN A LONGITUDINAL MAGNETIC FIELD

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 27, No 1, Jul 78
pp 32-36 manuscript received 28 Jul 76

VOYTOVICH, A. P. and DUBOVETS, V. G.

[Abstract] A ring laser inside a resonator is considered and the matrix of its active medium in a longitudinal magnetic field is calculated, with transformation from Cartesian to polar coordinates. Components of the susceptance tensor are defined at the frequency of the resonator mode and related to the relaxation parameters of a three-level quantum system. The propagation of a plane electromagnetic wave along the resonator, the latter first empty and then containing an active medium, is analyzed and the resulting emission intensity is calculated, with amplification as well as dispersion

of the active medium taken into account accordingly and assuming the radiation to be linearly polarized. Saturation due to the real part of susceptibility is found to lower the emission intensity much more than do additional losses in the case of Zeeman splitting. In weaker magnetic fields the effects of both factors become equal, and they vanish in the absence of a magnetic field. Both factors also depend on the detuning, which can thus affect the stability range of one-mode and two-mode lasing. This feature can be used for mode selection. The authors thank P. A. Apanasevich for the discussion of the results. Figures 1; references 4: 3 Russian, 1 Western.

USSR

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EFFICIENCY OF CO₂ EXCITATION IN A GAS-DYNAMIC LASER WITH GAS MIXING

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 924-926
manuscript received 28 Aug 77

OSTROUKHOV, N. N. and TKACHENKO, B. K., Moscow Physicotechnical Institute

[Abstract] The characteristics of a gas-dynamic CO₂-laser were studied experimentally in the pulse mode, with nitrogen heating by hydrogen combustion in atmospheric oxygen. The efficiency of vibrational CO₂ excitation upon mixing with nitrogen in a supersonic nozzle would be indicated by the ratio of the number of actually excited molecules to the maximum number of molecules excitable with the same amount of vibrational energy without relaxation losses. This efficiency was measured in terms of gain at the center of the rotational line with $N_{001} \gg N_{100}$, regardless of the line broadening mechanism, as a function of the molar CO₂ fraction under various pressures. A lower estimate of this efficiency (gain), on the basis of measurements and assuming a negligible amplification at the walls where it cannot be measured, is 0.7-0.9% maximum. Figures 3; references 4: 3 Russian 1 Western.

A STATIONARY CLOSED-CYCLE CO₂-LASER RATED AT 6 kW FOR INDUSTRIAL PROCESSES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 920-922
manuscript received 2 Aug 77

ARTAMONOV, A. V., YEGOROV, YU. A., KAZHIDUB, A. V., KATSURO, N. I.,
LEBEDEV, F. V., SIDORENKO, YE. M., SUMERIN, V. V. and FROLOV, V. M.

[Abstract] A stationary closed-cycle laser for industrial processes has been developed which operates without expensive and scarce helium in the active mixture. The latter consists of CO₂ and N₂ with air under a pressure of 30 mm Hg. The optimum air content corresponds to a ratio of water to CO₂ concentration within the 0.1-0.15 range (optimum CO₂ concentration within 3-4%), depending on the air temperature and humidity. The equipment consists of two parallel gas dynamic channels forming a closed loop through the discharge chamber with a resonator, each channel including a compressor and two heat exchangers with gas ducts. Both compressors are driven by a high-speed (15,000 rpm) electric motor. The mixture is pumped in the discharge chamber, where the electric current (up to 60 A) and the gas stream (up to 120 m/s) flow orthogonally to each other and to the optical axis. The charging voltage varies from 2200 V across the first row of electrodes to 1400 V across the last row. Preliminary performance tests included measurement of the amplification of a weak signal along the resonator axis and of the output power as well as of the electrooptic conversion efficiency, all as functions of the input power to the discharge column. An output power of 6 kW was obtained at a peak efficiency of 8%. According to estimates, the efficiency can be doubled by using a longer discharge chamber and a multi-pass resonator. The authors thank A. F. Vitshas and V. Ye. Gerts for participation in the engineering work, F. K. Kosyrev and Ye. I. Lunev for the discussion and useful comments concerning the laser construction, also V. P. Seleznev, P. N. Smirnov, M. M. Nikiforov, Yu. R. Terakopov, and N. P. Shcherbakov for the assistance in setting up the equipment. Figures 3; references 10: 4 Russian, 6 Western.

USSR

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GENERATION OF NANOSECOND PULSES BY A CO₂-LASER OPERATING IN THE FREE-EMISSION MODE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 918-919
manuscript received 2 Aug 77

ADAMOVICH, V. A., BARANOV, V. YU., SMAKOVSKIY, YU. B. and STREL'TSOV, A. P.

[Abstract] An experimental study was made to establish the feasibility of generating nanosecond pulses with a CO₂-laser operating in the free-emission mode. The active medium was ionized with an electron beam of 60 A/cm² current density and 300 keV energy. The energy of the laser radiation was measured calorimetrically, the pulse characteristics were measured oscillographically. Reducing the resonator length from 75 to 40 cm and increasing the pressure of the CO₂:N₂:He = 4:1:8 mixture to 3 atm yielded pulses of 7 ns duration, with an energy remaining almost constant over a wide range of the CO₂ pressure and proportional to its input energy. The authors thank V. D. Pis'mennyy, A. N. Starostin, and Yu. V. Petrushevich for the useful comments, also A. N. Alparov and R. K. Bekov for helping with the experiments. Figures 3; references 6: 4 Russian, 2 Western.

USSR

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A SIMPLE AND RELIABLE ULTRAVIOLET LASER ON NITROGEN MOLECULES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 915-917
manuscript received 15 Jul 77

ANTONOV, V. S., Institute of Spectroscopy at the USSR Academy of Sciences, Moscow

[Abstract] A modification of a nitrogen laser is proposed which ensures adequate stability and reliability as well as high efficiency and long life of miniature electrical components. The design features a discharge cell 85 mm long and 36 mm in diameter, with copper-tube electrodes moved away from the walls and toward each other symmetrically so as to leave an 18 mm wide discharge gap at the center and to produce a uniform discharge over a 60 mm wide active zone. The electrodes can be water cooled when the pulse repetition rate is high. The laser cell is mounted inside a resonator consisting of an opaque reflector with a quartz outlet window. The electric circuit includes a bank of four 10 nF - 40 kV capacitors in parallel, charged from a TGI-1000/25 high-voltage thyatron rectifier through a 20 μ H inductance. While the thyatron fires, the charge transfers resonantly

from this capacitor bank to another one consisting of thirty 1 nF - 40 kV capacitors uniformly spaced along the laser cell so as to make the discharge circuit noninductive. The inductance of the thyatron circuit is 150 nH and thus prevents overloading, also eliminates the need for coaxial leads. The optimum nitrogen pressure is 25-40 mm Hg, depending on the charging voltage. A pulse of 4.5 mJ energy and 12 ns duration can be generated with a voltage of 25 kV. A maximum efficiency of 0.1% can be attained with a voltage of 10 kV. The laser beam through the quartz window has a 19x6 mm cross section. The author thanks A. N. Shibano for the useful comments. Figures 5; references 8: 2 Russian, 6 Western.

USSR

UDC 535.43

ANALYSIS OF INHOMOGENEITIES INSIDE TRANSLUCENT MEDIA ON THE BASIS OF THE LASER RADIATION BACKSCATTER EFFECT

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 913-914
manuscript received 15 Jul 77

KIKIN, P. YU., SMIRNOV, YU. I., and KHANIN, YA. I., Institute of Applied Physics at the USSR Academy of Sciences, Gor'kiy

[Abstract] It has been demonstrated that scattering of light by inhomogeneities inside the volume of translucent media can be analyzed by measurement of the backscatter of laser radiation, with a helium-neon laser serving simultaneously as the light source and the backscatter indicator. This method was used for analyzing the backscatter in such a laser material as ruby grown by the Verneuil process and the ruby-leucosapphire composites. Both flat and cylindrical specimens with various degrees of defectiveness were tested, also patterns of anomalous birefringence were recorded. The authors thank I. L. Bershteyn for the useful comments. Figures 2; references: 6 Russian.

USSR

UDC 621.378.33+621.373.826.038.823

FEASIBILITY OF GENERATING SHORT LASER PULSES DURING PHOTOLYSIS OF A COOLED HYDROGEN-FLUORINE MIXTURE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 907-909
manuscript received 8 Jun 77

BASHKIN, A. S., IGOSHIN, V. I., NIKITIN, V. YU., and ORAYEVSKIY, A. N.,
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[Abstract] The performance of an H_2-F_2 laser at a low initial temperature of the active medium has been analyzed and the conditions of the H_2-F_2 reaction established under which the latter peaks after the triggering stage. According to this study, such a laser-chemical process requires a mixture ratio $H_2:F_2 = 1:3$ under a pressure of $1/3$ atm and at an initial temperature of 100 K, a triggering light pulse shorter than $4 \mu s$ and a concentration of active fluorine centers generated during photolysis $n_F = 10^{18} \text{ cm}^{-3}$. A laser radiation pulse of 0.573 J/cm^3 energy and 60 ns duration can be generated in this manner. Figures 1; references 9: 8 Russian, 1 Western.

USSR

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EMISSION FROM A HYBRID CO_2 -LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 897-905
manuscript received 18 May 77

LIKHANSKIY, V. V., MYL'NIKOV, G. D., NAPARTOVICH, A. P., SEMEROK, A. F.,
and SOBOLENKO, D. N.

[Abstract] A hybrid CO_2 -laser has a high-pressure pulse-discharge chamber, a low-pressure steady-discharge chamber, and a resonator. Its characteristics and performance were studied under pressures of 150-760 mm Hg in the $CO_2:N_2:He=1:1:0$ chamber and 1-10 mm Hg in the $CO_2:N_2:He=1:3:7$ chamber. An analysis of the experimental results, on the basis of an emission model taking into account excitation exchange between N_2 and CO_2 molecules, reveals a stable longitudinal mode in the resonator at a sufficiently high gain in the low-pressure stage. A lower gain in the low-pressure stage results in an unstable one-mode emission with side modes. At a low gain in the low-pressure stage, down to zero, the emission becomes multimodal. By varying the gain, it is thus possible to regulate the delay of the emission pulse relative to the discharge current pulse in the high-pressure stage, depending also on the resonator parameters. Figures 3; references 12: 4 Russian, 8 Western.

USSR

UDC 621.378.4.6

POSSIBILITY OF SELF-FOCUSING DURING EVAPORATION OF A CLOUD BY CO₂-LASER RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 892-896
manuscript received 16 May 77

SVIRKUNOV, P. N., Institute of Experimental Meteorology, Obninsk

[Abstract] Propagation of intensive radiation from a CO₂-laser through a mist fraction in the atmosphere is accompanied by heating and evaporation of droplets, followed by thermal defocusing and convective refraction with formation of high-translucence zones. It is demonstrated here theoretically that, in the case of a laser beam with a Gaussian radial profile, the refraction dynamics in such a zone may cause it to become self-focusing. The calculations are based on the equation of transient heat generation, with randomly distributed droplets constituting point heat sources of dimensions much smaller than the wavelength. The cloud is assumed to be stationary and most of the liquid mass to evaporate diffusively. The possibility of self-focusing is shown for a radiation wavelength 10.6 μ m and intensity 200 W/cm², spherical droplets of a radius $5 \cdot 10^{-4}$ cm at an ambient temperature $T_0 = 273$ K. With beam compression and increasing radiation intensity, defocusing will again occur. Figures 2; references 11: 8 Russian, 3 Western.

USSR

UDC 621.378.3

DESIGN OF MULTIPASS TELESCOPIC AMPLIFIER FOR CONTINUOUS-WAVE CHEMICAL HF-LASERS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 883-890
manuscript received 16 May 77

VIRNIK, YA. Z., KRUTOVA, V. G., MASHCHENKO, A. I., ORAYEVSKIY, A. N., STEPANOV, A. A., and SHCHEGLOV, V. A., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The design of two telescopic amplifiers for diffusion HF-lasers is reviewed in the geometrical optics approximation. Both designs are based on multiple reflections by two cylindrical mirrors facing each other symmetrically, a smaller convex one and a larger concave one with a center aperture. In the first "inverted" version the radiation flux enters around the smaller convex mirror and is reflected by the larger concave one, leaving after several back-and-forth passes through the center aperture of the

concave mirror. In the second version the flux enters through the center aperture from behind the larger concave mirror and is reflected by the smaller convex one, leaving after several back-and-forth passes around the smaller convex mirror. The field distributions in the planes of both mirrors are derived by integrating the equations of flux transmission. Both designs are evaluated on the basis of performance characteristics, namely gain and chemical efficiency as functions of the incident flux intensity and as functions of the telescope magnification. Figures 4; references 11: 9 Russian, 2 Western.

USSR

UDC 621.378.9+546.02

EFFECT OF ATOMIC COLLISIONS ON THE SELECTIVITY OF RESONANT EXCITATION
IN SEPARATION OF ISOTOPE MIXTURES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 877-882
manuscript received 13 May 77

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[Abstract] The selectivity of intrinsic laser action in separating isotope mixtures is diminished by resonant excitation exchange and charge transfer processes. Here the effect of resonant excitation exchange between isotopes, with atomic collisions, in dense atomic vapors is examined on the basis of the theoretical kinetic relations and experimental data obtained with a dye laser and a scanning Fabry-Perot interferometer. Such laser spectroscopy of metals with a natural complex isotope content, namely europium and samarium, requires close attention to overlapping absorption lines. The enrichment factor was also found to decrease rapidly with increasing atom concentration in the vapor. The authors thank V. A. Alekseyev for the useful comments and A. M. Prokhorov for the unwavering support of this study. Figures 5; references 9: 8 Russian, 1 Western.

USSR

UDC 541.14.535.375.2.621.373.826

LASER PHOTOLYSIS OF PERFLUOROALKYL IODIDES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 863-876
manuscript received 11 May 77

YERSHOV, L. S., ZALESSKIY, V. YU., and SOKOLOV, V. N.

[Abstract] Quantum yields of metastable and unexcited iodine atoms are important in the application of an iodine photodissociation laser. These yields, within the range of continuous ultraviolet absorption bands, were measured with a neodymium laser (1064 nm) and auxiliary optics by the method of fourth-harmonic (266 nm) generation. The perfluoroalkyl iodides CF_3I , $1-C_3F_7I$, and $(CF_3)_3CI$ were used in the experiment, after multiple distillation and subsequent dilution in pure argon or sulfur hexafluoride. Luminescence signals (1315 and 580 nm) were measured oscillographically and, with these data, the concentrations of both kinds of iodine atoms as well as of the radical and of iodine molecules were calculated according to the equations of recombination and diffusion after a laser pulse. The oscillograms are interpreted here qualitatively, and the numerical results compared with those obtained earlier by others. The authors thank A. M. Kokushkin for the interest as well as for the useful comments and help in numerical computations. Figures 5; tables 1; references 30: 17 Russian, 13 Western.

USSR

UDC 535.376

CONCENTRATION DEPENDENCE OF THE LUMINESCENT QUANTUM YIELD IN NEODYMIUM-ACTIVATED LASER MATRICES AND ITS DETERMINATION FROM THE MICROSCOPIC STANDPOINT

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 847-856
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DENKER, B. I., OSIKO, V. V., PROKHOROV, A. M., and SHCHERBAKOV, I. A.,
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[Abstract] Trivalent neodymium ions are the most widely used activators of solid-state laser media. On the basis of the band structure of such an ion, the mechanisms of nonradiative relaxation and annihilation from the metastable $^4F_{3/2}$ -state are considered, which depend solely on multipole interaction between the Nd^{3+} ions and which determine the concentration dependence of the luminescent quantum yield in crystals. The luminescence quenching by the concentration effect is subsequently calculated by analyzing

the experimentally established relation from the microscopic view on energy transfer within an aggregate of interacting particles. The results should prove to be very useful in the search for new high-concentration laser media. Figures 3; references 56: 35 Russian, 21 Western.

USSR

UDC 535.323

MEASURING THE ELECTRONIC NONLINEARITY COEFFICIENT OF OPTICAL AND LASER GLASSES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 841-846
manuscript received 11 May 77

BONDARENKO, N. G., YEREMINA, I. V. and MAKAROV, A. I., Institute of Applied Physics, USSR Academy of Sciences, Gor'kiy

[Abstract] The electronic nonlinearity coefficient, which determines the field-induced increment of the refractive index, is one of the principal parameters affecting the breakdown threshold of translucent dielectrics in power lasers. This electronic nonlinearity coefficient of several grades of glass (KGSS 1621, GLS 1, LG 247) and the critical power were determined by the self-focusing method with nanosecond pulses from a single-mode neodymium-glass laser, self-focusing being a manifestation of the threshold effect and the critical power depending on the effective (self-focusing) length of test specimens. Calculations based on these measurements of the pulse characteristics in this method assume a noninertial nonlinearity mechanism and a Gaussian field distribution in the laser beam. The authors thank V. A. Gaponov and V. I. Talanov for the useful comments. Figures 5; tables 1; references 11: 4 Russian, 7 Western.

USSR

UDC 535.375.5

STIMULATED RAMAN SCATTERING ON ROTATIONAL AND VIBRATIONAL TRANSITIONS IN GASEOUS NITROGEN

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 823-829
manuscript received 11 May 77

AVERBAKH, V. S., MAKAROV, A. I., and TALANOV, V. I., Institute of Applied Physics, USSR Academy of Sciences, Gor'kiy

[Abstract] The pressure thresholds of vibrational and rotational stimulated Raman scattering have already been estimated from available experimental

data on spontaneous scattering and gain calculations for the Stokes component. Gain increments within the low-pressure range, where splitting of components occurs, are now measured in a special experiment with a narrower spectrum, higher pumping power, and a more versatile receiver. The results, in terms of threshold characteristics and spectral characteristics of both scattering modes are reported here in more detail than at the Eighth All-Union Conference on Coherent and Nonlinear Optics in Tbilisi in May 1976. Figures 6; references 15: 3 Russian, 12 Western.

USSR

UDC 621.378.4

SHIFT OF THE $\lambda = 3.39 \mu\text{m}$ TRANSITION FREQUENCY IN METHANE IN THE FIELD OF A RING LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 813-822
manuscript received 10 May 77

BELENOV, E. M. and USKOV, A. V., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] The hyperfine structure of the $3.39 \mu\text{m}$ methane line contains two faint components of different intensities and differently saturable in a laser field. This causes a saturation-dependent frequency shift in a gaseous ring laser. For the purpose of analysis of nonlinear power resonances and frequency stability in a helium-neon laser with a methane absorption cell, this shift of the center frequency is calculated here from a solution to the self-consistent system of equations describing the electric field intensity inside the resonator and the polarization of the active medium, with both represented as oppositely traveling waves. Figures 3; references 6: 4 Russian, 2 Western.

USSR

UDC 536.421.1

SHAPE OF THE FREE SURFACE OF THE LIQUID PHASE DURING MELTING OF HIGHLY ABSORPTIVE MEDIA BY LASER RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 804-812
manuscript received 10 May 77

TRIBEL'SKIY, M. I.

[Abstract] In laser treatment of industrial materials, especially of highly absorptive ones such as metals with a radiation intensity of 10^6 - 10^7 W/cm^2 ,

it is necessary to consider transient melting and flow under the reaction pressure of vapor generated in the process. This problem is solved here analytically in the quasi-stationary approximation, assuming the laser pulses to be of a sufficiently long duration and the metal to be melting under vacuum. With the distribution of radiation intensity over the surface given, the temperature distribution over it is determined as well and, on this basis, the vapor pressure and the density of saturated vapor as functions of the temperature. The shape of the free surface and its oscillations are now calculated from applicable differential equations. The effect of deep melting on the surface deformation and the effect of the radiation intensity on evaporation of the material are each found to involve a transition threshold. Experimental and theoretical data for thirteen common metals do not quite agree, but oscillations of the free surface seem to always decay following a laser pulse, owing to attenuation of capillary waves and relaxation of reactive vapor pressure. The authors thank S. I. Anisimov, F. V. Bunkin, N. N. Rykalin, and A. A. Uglov for the discussion and helpful comments. Figures 2; tables 2; references 19: 15 Russian, 4 Western.

USSR

UDC 621.373.826.038.823

EXCITATION OF HIGH-PRESSURE LASER MEDIA WITH DISCHARGE THROUGH A DIELECTRIC

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4 Apr 78 pp 788-794
manuscript received 22 Mar 77

ISHCHENKO, V. N., LISITSYN, V. N., and SOROKIN, A. R., Institute of Semiconductor Physics, Siberian Division of the USSR Academy of Sciences, Novosibirsk

[Abstract] The energy characteristics of discharge through a dielectric are examined and, accordingly, the appropriate dielectric material is selected for exciting a high-pressure gaseous laser medium. Experiments were performed with CO_2 ($\text{CO}_2\text{-N}_2$) lasers under pressures up to 10 atm and with lasers on inert-gas transitions under pressures up to 17 atm, discharge through glass or fiberglass plastic material being effected by steep nanosecond high-voltage pulses coming from conventional capacitive pulse generators or from an oscillator with a saturable reactor across the tank circuit and the load. The latter scheme makes it feasible to attain a high E/p ratio, owing to the absence of preionization, and to regulate this ratio over a rather wide range. Figures 4; references 7: 6 Russian, 1 Western.

USSR

UDC 621.375:535.323

ELECTROSTRICTIVE BIREFRINGENCE INDUCED IN ISOTROPIC SOLID MATERIALS BY INTENSIVE LASER RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 780-787
manuscript received 22 Mar 77

DEMEN'YEV, A. S., MALDUTIS, E. K., and SAKALAIUSKAS, S. V., Institute of Semiconductor Physics, Academy of Sciences of the Lithuanian SSR, Vil'nyus

[Abstract] Analytical expressions are found for the deformation of an isotropic solid material by electrostrictive forces that arise under the action of an elliptically polarized axisymmetric laser beam. The steady-state solution of the equation of equilibrium, with appropriate boundary conditions and with the electrostrictive force averaged in time, is found in the approximation of the plane stressed state. According to this analysis, the electrostrictively induced change in the refractive index depends on the polarization of the incident laser beam and, as long as it remains relatively small, results in a birefringence pattern in the body with an attendant depolarization of the transmitted laser beam. While the magnitude of the electrostrictive birefringence effect is comparable to that of the Kerr effect, depolarization of the laser beam can be caused only by electrostriction or a thermal mechanism. Figures 4; references 19: 4 Russian, 15 Western.

USSR

UDC 621.379.826

EXPERIMENTAL DETERMINATION OF THE MAXIMUM PERMISSIBLE LEVELS OF PICOSECOND-PULSE LASER RADIATION AT THE 1.06 μ m WAVELENGTH

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BEREZIN, YU. D., BAYANOV, V. I., GUDAKOVSKIY, YU. P., MURATOV, V. R., and SEREBRYAKOV, V. A.

[Abstract] An experimental study was made to determine the maximum permissible levels of laser radiation, in terms of safety to the eye tissues, and the dependence of these safe energy levels at $\lambda = 1.06 \mu$ m on the duration of sub-nanosecond pulses. Eyes of chinchilla rabbits weighing 2.2-2.8 kg were used as worst-case models of accommodation to infinity in this experiment, with a helium-neon laser and appropriate shutters, filters, prisms, and auxiliary optics, also a calorimeter and an ophthalmoscope. The threshold was taken as the minimum detectable change in the retina immediately after irradiation. Laser pulses were recorded on oscillograms and chronograms.

Based on a statistical evaluation of the test data, the probability of threshold damage was plotted as a function of the pulse-train energy, in the form of histograms and regression lines. According to the results, the maximum safe energy of laser pulses at the given wavelength is $2.6 \cdot 10^{-5}$ and $1.5 \cdot 10^{-5}$ J/cm² respectively in the case of a 130 ns train of 100 ps pulses and in the case of a single 100 ps pulse. While the hypothesis of thermal interaction between laser radiation and the biological eye structures appears to be correct for subnanosecond pulses, the mechanism of threshold action by shorter pulses may be a different one. Figures 3; references 9: 5 Russian, 4 Western.

USSR

UDC 533.6.08

LASER-RADAR MEASUREMENT OF WIND VELOCITY BY THE METHOD OF SPATIAL FILTERING

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VINTSLAV, G. YE., GUSAROV, V. P., KOSTKO, O. K., KRAVETS, O. K.,
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Observatory, Moscow

[Abstract] Wind velocity measurement with a laser-radar instrument is proposed which involves frequency processing of the photocurrent spectrum, this spectrum resulting from an intensity modulation of scattered laser radiation by movement of the image of a spatial inhomogeneity across the raster. Theoretically this method is based on filtration of fluctuations due to intensity contrast only, inasmuch as laser radiation ceases to be coherent upon being scattered by aerosol particles in continuous Brownian motion and, therefore, interference effects vanish. The method was tested with an LG-36A helium-neon laser and an MTO-1000 optical radar receiver antenna in two series of measurements: one in a dynamic wind tunnel for calibrating the laser-radar, another in the free atmosphere for determining the fluctuations of wind velocity at a reference distance from the instrument. With the use of suitable lasers, it is possible to extend the range of measurements to hundreds of metres. The authors thank Ch. D. Zichenkov and V. I. Dovbishchuk for helping perform the tunnel experiments. Figures 5; tables 1; references 12: 7 Russian, 5 Western.

USSR

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CONTINUOUS-WAVE DYE LASER WITH FREQUENCY TUNING BY MEANS OF A HOLOGRAPHIC
DIFFRACTION GRATING

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 753-758
manuscript received 29 Jan 77

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of Optics and Spectroscopy, Academy of Sciences of the German Democratic
Republic, Berlin

[Abstract] A continuous-wave dye laser is considered which operates with
a combination of semitranslucent reflector and holographic diffraction grat-
ing for wavelength selection over the entire visible range. Such a diffrac-
tion grating can be regarded as a Fabry-Perot etalon with one narrow-band
reflector, its maximum reflection coefficient corresponding to antiresonance.
The performance of such a selector is compared to that of a conventional
selector consisting of two prisms and a Fabry-Perot etalon. The emission
characteristics of this selective laser are compared with those of a non-
selective laser, in terms of losses and gain as well as output power to
pumping power ratio. Experimental data were obtained with a laser on
rhodamine 6G and a diffraction grating having 2040 lines/mm (reflection of
the E_{\perp} -mode at the 580 nm wavelength $R_0 = 85\%$ in the first-order spectrum).
The authors thank V. S. Letokhov and Ye. N. Antonov for the useful comments,
also S. Poltze for supplying the holographic diffraction grating. Figures 5;
references: 10 Western.

USSR

A METHOD OF PRODUCING POLARIZED PROTONS BY LASER RADIATION

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian
Vol 27, No 5, 5 Mar 78 pp 305-308 manuscript received 2 Feb 78

LETOKHOV, V. S., LOBASHEV, V. M., MINOGIN, V. G. and MISHIN, V. I.,
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[Abstract] The authors consider the feasibility of producing an intense
beam of high-energy polarized protons. The approach is based on combining
the techniques of optical orientation of atoms in circularly polarized
light and selective photoionization of atoms by laser radiation. The pro-
posed scheme involves extinction of hydrogen atoms from the $2S_{1/2}$ state
assuming selectivity with respect to projections of the total momentum,

followed by effective ionization of atoms with a certain momentum projection via the Rydberg state. At the current level of tunable laser technology such an approach should yield a beam of polarized protons with nearly 100% nuclear polarization and an angular aperture of less than 0.2 radian comprising very nearly 25% of the polarized protons from the total number of atoms in the metastable $2S_{1/2}$ state. The proposed method is applicable for producing polarized ions of other elements than hydrogen. The authors thank Professor I. I. Sobel'man for constructive criticism. Figures 2; references 4: 3 Russian, 1 Western.

USSR

UDC 621.378.325

PICOSECOND SPECTROSCOPY OF PARAMETRIC SUPERLUMINESCENCE

Vil'nyus LITOVSKIY FIZICHESKIY SBORNIK in Russian Vol 18, No 1, 1978
pp 93-108 manuscript received 16 May 77

DANELYUS, R., DIKCHYUS, G., KABELKA, V., PISKARSKAS, A., STABINIS, A.,
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[Abstract] Theoretical and experimental research is reported on parametric amplification and stimulated parametric scattering (parametric superluminescence) of light in fields of picosecond stimulation pulses. Crystals of ADP, MKP, α - HfO_3 , LiIO_3 and LiNbO_3 were studied. The fundamental, second, third and fourth harmonics of emission from a YAG:neodymium monopulse laser were used for pumping. The efficiency of converting radiation to parametric superluminescence reached 15% with spectral width of the superluminescence line of $4-8 \text{ cm}^{-1}$. Picosecond emission is tunable in a range of 300-4800 nm, the power of the parametric superluminescence varying from 1 to 17 MW. Pulse duration is 6-30 ps depending on conditions. Light amplification with respect to energy was 10^5 in MKP and α - HfO_3 crystals. This high gain enables more accurate measurements of the time envelopes for picosecond pulses by stroboscopic methods than by conventional nonlinear optics methods. A picosecond parametric spectrometer is developed to handle a wide range of problems in the spectroscopy of picosecond processes in atoms and molecules. The technique of stimulating tunable parametric superluminescence in the picosecond range opens up possibilities for precision measurements of fast photoinduced processes in biological objects without destruction of molecules. Figures 7, references 19: 11 Russian, 8 Western.

CHARACTERISTICS OF LASER GLASSES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 725-752
manuscript received 3 Aug 77

AVAKYANTS, L. I., BUZHINSKIY, I. M., KORYAGINA, YE. I., and SURKOVA, V. F.

[Abstract] Glass activated with neodymium Nd^{3+} ions is the most widely applicable material for solid-state lasers. All 26 Soviet grades and 29 foreign grades (made by American, West German, Japanese, and French manufacturers) surveyed in this report fall into the two categories of silicate and phosphate glasses. Their physico-chemical and optical properties as well as radiation and luminescence characteristics are tabulated. The spectral distribution curves of their optical density are given in the form of graphs. Discussion of these data covers the methods of measurement and calculation, also applicable standards including laser emission and performance parameters of these glasses. Figures 6; tables 9; references 131: 115 Russian, 16 Western.

EFFECT OF LASER RADIATION ON THE ADHESION OF ELECTRONS TO MOLECULES

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[Abstract] An experimental study was made which revealed the effect of laser radiation on the formation of negative ions in sulfur hexafluoride. Into a cell was pumped molecular SF_6 gas and through it was passed radiation from a CO_2 laser, with an electron collector and a ion collector in addition to the cathode mounted inside the cell. For the purpose of separating the ion component of the current of negatively charged particles from the electron component, a longitudinal magnetic field was applied by placing the cell inside a solenoid. For the purpose of extracting the signal component due to the laser radiation, the latter was chopped mechanically at a frequency of 130 Hz. The current of negative ions was found to peak sharply at an SF_6 pressure slightly above 0.1 mm Hg, at which an alternating component due to the laser radiation appeared. The latter peaked sharply at an SF_6 pressure slightly above 0.2 mm Hg and vanished at a not much higher pressure. These results are interpreted in terms of collision and adhesive dissociation

mechanisms, explaining the strong dependence of the adhesion coefficient on the electron energy. The sensitivity of the adhesion effect to the energy of vibrational excitation can be utilized for laser separation of isotope mixtures with electronegative features. Figures 2; references 6: 2 Russian, 4 Western.

USSR

UDC 621.378.325

ONE POSSIBILITY OF GENERATING OPTICAL PICOSECOND PULSES OF TUNABLE FREQUENCY AND VISIBLE OR ULTRAVIOLET WAVELENGTHS

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manuscript received 16 Sep 77

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[Abstract] It has been demonstrated that, by excitation of the continuum in such a medium as D_2O or H_2O with a subsequent addition of its frequency and the frequency of a laser in a crystal such as $LiIO_3$, one can generate radiation of 1-5 MW power which is tunable over the 330-700 nm range of wavelengths. Spectral analysis of this radiation has revealed that within the 480-550 nm range this radiation occurs on a single line not wider than 40 cm^{-1} . Within both other ranges, 330-480 nm and 550-700 nm, this tunable radiation splits into two lines not wider than 20 cm^{-1} each. In this case to every frequency on one side of the center frequency there corresponds a conjugate frequency on the other side, and addition of both satisfies the condition of phase synchronism. When radiation with a continuous spectral band and some center frequency enters a nonlinear crystal, then all conjugate frequencies will add pairwise simultaneously while the second harmonic of that center frequency is emitted. As a result, the original frequency band is transformed in the nonlinear crystal to a much narrower frequency band at a higher level. The spectrum of the converted radiation depends on the dispersion of the medium and on the geometry of the interaction space. The author thanks professor M. L. Ter-Mikayelyan and R. N. Gyuzalyan for the useful discussion of the results. Figures 5; references 11: 6 Russian, 5 Western.

USSR

UDC 621.375.826:551.574

NONLINEAR PROPAGATION OF LASER RADIATION THROUGH SOLID AEROSOL

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 934-937

ZAKHARCHENKO, S. V., PINCHUK, S. D., and SKRIPKIN, A. M., Institute of Experimental Meteorology, Obninsk

[Abstract] An experimental study was made of aerosol transillumination with a laser beam. The aerosol consisted of solid corundum particles with low absorptivity. A neodymium glass laser operating in the free emission mode was used, generating pulses of up to 10^3 J energy and 1μ s duration at the 1.06μ m wavelength. The radiation intensity was varied from 10^2 to 3 W/cm^2 at a constant pulse width. Both incident and transmitted radiation were recorded with photodiodes through neutral and interference filters. An analysis of the results reveals glow and motion of aerosol particles within the region traversed by the laser beam. Heating of particles by the absorbed optical radiation is the most likely cause of this phenomenon, with additional attenuation of the radiation intensity due to scattering by thermal aureoles occurring at higher temperatures below the melting point. The radiation intensity necessary for heating corundum aerosol to the melting point is calculated here theoretically on the basis of the energy balance. The authors thank V. Yu. L'vov and L. G. Akul'shina for the help, also P. N. Svirkunov for the useful discussion. Figures 3; references 12: 11 Russian, 1 Western.

USSR

UDC 621.373.8.029.71

PERIODIC-PULSE OPERATION OF A CF_4 -LASER WITH OPTICAL PUMPING AND AN AVERAGE EMISSION POWER OF 0.2 W

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 5, No 4, Apr 78 pp 940-943
manuscript received 19 Dec 77

BARANOV, V. YU., VASIL'YEV, B. I., VELIKHOV, YE. P., GOROKHOV, YU. A., GRASYUK, A. Z., DYAD'KIN, A. P., KAZAKOV, S. A., LETOKHOV, V. S., PIS'MENNYI, V. D., and STARODUBTSEV, A. I., Institute of Spectroscopy at the USSR Academy of Sciences, Moscow, Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] An experimental study was made to establish the feasibility of generating pulses at a high repetition rate and thus high average power with a CF_4 -laser. Pumping was by a CO_2 -laser generating 100 ns wide periodic

pulses of up to 5 J energy at a repetition rate of up to 200 Hz. The optics consisted of two diffraction gratings and a laser resonator with opaque mirrors. The output energy was measured as a function of the pumping energy at a pulse repetition rate of 4 Hz and found to increase linearly. It was also measured as a function of the CF_4 pressure at a pulse repetition rate of 5 Hz and found to peak sharply at approximately 2 mm Hg. On the basis of diffusion estimates, transition from single-pulse to periodic-pulse operation of such a laser is possible at a repetition rate of 5 Hz. At higher repetition rates the diffusion time becomes shorter than the interval between two successive pumping pulses and the gas begins to heat up. Its temperature rise is estimated here theoretically, on the assumption of a cylindrical laser beam with a Gaussian intensity distribution. The repetition rate can be increased by repumping the gas so fast as to replace the entire mass in the cell during the interval between two successive pulses. An average emission power of 200 mW at a pulse repetition rate of 100 Hz was attained even without gas repumping. The authors thank R. V. Ambartsumyan and N. P. Furzikov for the useful comments. Figures 4; references 6: 3 Russian, 3 Western.

AN AUTOMATIC SYSTEM FOR MEASURING THE CONCENTRATION OF SEEDING ATOMS IN AN MHD-GENERATOR

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 3, Mar 78
pp 402-407 manuscript received 12 Jan 76; after revision, 17 Oct 77.

NEFEDOV, A. P. and URINSON, A. S.

[Abstract] The parameters of a cold plasma stream vary over the channel section. In an MHD-generator the wall temperature is much lower than the plasma temperature and, furthermore, varies in the axial direction so that self-reversal of the resonance lines of alkali metals used for plasma diagnostics can occur. This has already been utilized for determining the concentration of easily ionizable seeding atoms. In order to determine their concentration, it is necessary to know not only the plasma temperature and pressure but also the thickness of the emitting layer and the plasma non-homogeneity parameter. Here an experimental apparatus is shown which consists of an ISP-51 spectrograph with a UF-89 camera, a spectral plasma thermometer, a pressure transducer, a reference radiation source, an integrating amplifier, a recording instrument, a control panel, and a computer with a teletypewriter. The computer automatically either calculates the concentration of atoms from the independently recorded and measured center-to-peak distance in the resonance line, or by also first processing the contour of the resonance line. The error is in both cases within 25-30%. Typical results are shown which have been obtained in an experiment with an MHD generator heated by natural gas and using K_2CO_3 as ionizable additive. Figures 3; tables 1; references 6: 4 Russian, 2 Western.

POLAND

ON-LINE TESTING IN NUCLEAR FUEL REPROCESSING

Warsaw NUKLEONIKA in English Vol 22, No 9, 1977 pp 759-776 manuscript received 25 May 77 (article in Russian)

PARUS, J., KIERZEK, J. and ZOXTOWSKI, T., Institute of Nuclear Research, Warsaw

[Abstract] The reprocessing of spent nuclear fuel is primarily a chemical process and its testing should reflect the trends of development in the chemical industry. This article therefore analyzes trends in the development of methods of control of chemical processes and continuous analytical devices. The specifics of methods of on-line testing in the reprocessing of spent nuclear fuel are discussed. This review also covers pH measurement, spectrophotometers, mass spectrometry, liquid chromatography, gas chromatography and other methods of continuous measurement, the general characteristics of on-line measurement methods, radiometric methods, measurement of alpha radiation, gamma radiation and X-ray fluorescence, methods based on neutron radiation measurement, physical-chemical methods, methods not requiring the addition of reagents, as well as methods which do require their addition. The latest trends in process control based on dynamic process models are also presented. References 72: 9 Russian, 13 East European, 50 Western.

ELECTRONIC COOLING AND NEW POSSIBLE APPLICATIONS IN PHYSICS OF ELEMENTARY PARTICLES

Moscow USPEKHI FIZICHESKIKH NAUK in Russian Vol 124, No 4, Apr 78 pp 561-595

BUDKER, G. I. and SKRINSKIY, A. N., Institute of Nuclear Physics, Siberian Division of the USSR Academy of Sciences, Novosibirsk

[Abstract] According to the Liouville theorem, the density of a beam of elementary particles in the six-dimensional ("generalized coordinates--conjugate momenta") phase space is invariable and determined by the initial conditions. Focusing or acceleration, or any combination of both, can only alter the shape of the phase volume and perhaps decrease the effective phase density, but increasing the phase density is possible only by means of dissipation. Friction, for instance, will inhibit vibration of particles and their deviation from equilibrium motion. This principle has been applied to electronic cooling of proton beams. The choice of mode of electron acceleration and subsequent injection into the beam of heavy particles depends on the energy level, electrostatic rectilinear acceleration being appropriate for low energy levels and magnetic closed-path acceleration being more appropriate for higher energy levels. It is important to maintain a low effective electron temperature over a long cooling path and to compensate for the nonuniform radial distribution of electron energy in a beam. The kinetics of electron cooling can be analyzed best in the most basic and important case of a single-pass electron beam. Such an analysis takes into account the effects of electron-proton interaction, in the form of collisions and scattering, on friction and on damping of proton vibrations as well as on random diffusive dispersion of proton momentum and on electron entrapment with resulting recombination. It also takes into account proton-proton interaction in the form of internal scattering of protons by protons within the proton beam. An experimental study of electron cooling was made with a special proton and antiproton accumulator, after a great deal of engineering development and design. The results have so far yielded much information about proton beams and the effects of electronic cooling. They also have established the feasibility of accumulating high-intensity antiproton beams, particularly with hyperfine internal gaseous or vaporous targets, of accelerating these antiprotons, of continuously cooling opposed proton and antiproton fluxes, of producing proton-antiproton interaction at extremely low and at extremely high energy levels. It appears feasible, furthermore, to generate antiatom beams (atoms of antihydrogen), antideuteron beams, and polarized antiproton beams. The authors thank Ya. S. Derbenev, N. S. Dikanskiy, I. N. Meshkov, V. V. Parkhomchuk, D. V. Petsrikov, R. A. Salimov, B. N. Sukhina, V. I. Kudelaynen, and others for the collaboration in the development of the electronic cooling method, also V. N. Bayer, V. Ye. Balakin, L. M. Barkov, S. T. Belyayev, A. I. Vainshteyn, T. A. Vsevolozhskaya, V. G. Zelevinskiy, A.S. Patashinskiy, I. Ya. Protopopov, S. G. Popov, D. D. Ryutov, V. A. Sidorov, G. I. Sil'vestrov,

I. B. Khriplovich, and other colleagues at the Institute of Nuclear Physics for the helpful comments. Figures 11; tables 3; references 68: 44 Russian, 22 Western, 2 International.

USSR

ELECTRONIC COOLING

Moscow PRIRODA in Russian No 5, May 78 pp 3-14

BUDKER, G. I. (deceased), Institute of Nuclear Physics, Siberian Division of the USSR Academy of Sciences

[Abstract] Experiments with opposed high-energy beams of elementary particles provide much basic information sought in modern physics research. The gist of these experiments is to produce narrow and monochromatic beams with a small phase volume, by damping out both longitudinal and transverse vibrations of particles. This cannot be achieved by any external force, according to the Liouville theorem, but only by dissipation forces such as friction. The "electronic cooling" method had been proposed in the nineteen sixties for application to opposed beams of heavy particles (protons or antiprotons). Here along such a beam is injected a beam of electrons with the same mean velocity. The efficiency of electron scattering by protons is inversely proportional to the fourth power of the relative velocity of interacting particles. With the mean velocities of both being equal in this case and their difference thus equal to zero, the scattering cross section depends now on the velocity dispersion. If the relative velocity dispersion in the electron beam does not exceed 10^{-3} and the mean velocities of protons and electrons coincide within the same limits, then a scattering cross section 12 orders of magnitude larger than with a cluster of free electrons can be attained. Experiments based on implementation of this principle were subsequently performed in the early nineteen seventies. Recombination processes in a two-component plasma produced during cooling were, furthermore, found to result in a narrow-angle monochromatic beam of neutral particles. The effectiveness of this method and the validity of its principle have been confirmed by the author (G.I. Budker), Ya. S. Derbenov, N. S. Dikanskiy, I. N. Meshkov, V. V. Parkhomchuk, D. S. Pestrikov, R. A. Salimov, A. N. Skrinskiy, and B. N. Sukhina. These experiments, performed with proton beams from 1.5 to 85 MeV, have provided a great deal of information about thermal effects and nuclear photoemission as well as about the feasibility of anti-proton generation and accumulation.

EFFECT OF NEUTRON AND GAMMA IRRADIATION ON THE CATHODOLUMINESCENCE SPECTRA OF EPITAXIAL DIODE STRUCTURES ON $\text{Al}_x\text{Ga}_{1-x}\text{As}$

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 41, No 5, May 77 pp 991-994

BRZHEZINSKIY, V. A., DOBRYNINA, YE. S., PETROV, V. I., and CHUKICHEV, M. V.

[Abstract] A study was made concerning the effect of neutron and gamma irradiation on radiative recombination in $\text{Al}_x\text{Ga}_{1-x}\text{As}$ solid solutions on GaAs-Zn substrates. Both "direct" and "indirect" radiating $p^+(\text{GaAs-Zn})-p-(\text{Al}_x\text{Ga}_{1-x}\text{As-Zn})-n(\text{Al}_x\text{Ga}_{1-x}\text{As-Te})$ heterostructures were produced for this experiment by the method of twofold liquid-phase epitaxy. The specimens were irradiated in a pulse reactor with a neutron flux of 1.6 MeV mean energy ($E_{\text{min}} \geq 0.1$ MeV) and a 10^{14} neutrons/cm² density as well as with 10^8 - 10^9 R doses of gamma quanta. Cathodoluminescence was excited and examined under a raster-type JSM-50A electron microscope. The results indicate an overall decrease of cathodoluminescence intensity after irradiation and selective quenching of the low-energy band associated with recombination through zinc levels. This is attributed to a definite kind of defects which form as a result of irradiation and become annealed at a fairly low temperature. Figures 2; references 5: 3 Russian, 2 Western.

USSR

UDC 535.375.5

THE RESONANT NONLINEAR OPTICS OF GAS SYSTEMS

Novosibirsk AVTOMETRIYA in Russian No 1, Jan/Feb 78 pp 112-128 manuscript received 29 Sep 77

POPOV, A. K.

[Abstract] One of the most important tasks of nonlinear optics is that of expanding the range of frequencies in which coherent radiation can be produced. The use of nonlinear processes in gas media is promising for the solution of the problem. Due to the low concentration of active particles in gas media, high levels of pumping power must be used to achieve high conversion factors, though the use of resonant and quasiresonant nonlinear processes does help. This literature review indicates that these processes have already resulted in the creation of devices, but the further development of this branch of nonlinear optics will require a deepening of our understanding of strong field resonant nonlinear effects such as phase capture, self-focusing and self-curvature of radiation under conditions of two-photon resonance, nonmonochromatic effects and dispersion, and coherent effects. With pumping by short, powerful pulses, the development of nonlinear processes is significantly influenced by cooperative processes in the system of atoms or molecules. An increase in nonlinear susceptibility can be achieved in many cases by the use of radiative collisions. Figures 5; references 92: 50 Russian, 42 Western.

USSR

UDC 539.194:621.373:535

LASER MOLECULAR SPECTROSCOPY. DETERMINATION OF PARAMETERS OF THE VIBRATIONAL-ROTATIONAL LINE ν_2 (1,1) OF THE ν_2 BAND OF AMMONIA IN AN ATMOSPHERE OF FOREIGN GASES

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 44, No 3, Mar 78, pp 444-449 manuscript received 11 May 77

BULANIN, M. O., BULYCHEV, V. P., LADVISHCHENKO, YU. M., KHODOS, E. B.

[Abstract] A study is made of the absorption of the radiation of a CO_2 laser in the 10.6 μ m band by ammonia in mixtures with N_2 , H_2 , Ne, Ar, Kr and Xe. In the experimental installation, the CO_2 laser, resonator length 150 cm, is carried by a framework of heat-insulated invar rods. Absorption was measured with various pressures of the foreign gases. The experimental data were used to determine the spreading and shifting of the ν_2 (1,1) line of the ν_2 band of N^{14} ammonia. A modified Lorentz function was used to

describe the absorption line. Particular attention is given to the effects of the noble gases. Figures 2; tables 3; references 15: 2 Russian, 13 Western.

USSR

UDC 621.378.325

PARAMETRIC PICOSECOND SUPERLUMINESCENCE OF LiIO_3 CRYSTALS

Vil'nyus LITOVSKIY FIZICHESKIY SBORNIK in Russian Vol 18, No 2, 1978
pp 255-262 manuscript received 10 Mar 77

ARUTYUNYAN, A. G., ARZUMANYAN, G. M. and SHARKHATUNYAN, R. O., Yerevan State University; DANELYUS, R., KABELKA, V. and YASEVICHYUTE, YA., Vil'nyus State University imeni V. Kapsukas

[Abstract] Parametric superluminescence of ultrashort light pulses in LiIO_3 crystals was studied both theoretically and experimentally. The fundamental interaction equations involving the envelopes of three waves were solved numerically on a high-speed digital computer. Measurements were made using a YAG: Nd^{3+} laser with self-mode locking, a Fabry-Perot resonator with one fully reflective and one semireflective mirror, a second-harmonic generator on a KDP crystal, an LiIO_3 parametric oscillator, an LiIO_3 parametric amplifier, a photodiode, and appropriate auxiliary optics including a filter. Pumping with pulses at the 532 nm wavelength yielded superluminescence pulses of five times shorter duration, close to 6 ps, and smoothly tunable over the 608-4250 nm range. After spatial and frequency filtration, the spectrum of parametric superluminescence was found to be still very wide in the degenerate mode ($\Delta\lambda_{\text{psl}} = 12$ nm in the 1064 nm band), but to narrow down farther away from this mode ($\Delta\lambda_{\text{psl}} = 1$ nm in the 900 nm band). An emission power of 1 MW was attained, at an energy conversion efficiency of 2%. The results indicate that LiIO_3 crystals, with such a high energy conversion efficiency and such an extremely narrow emission spectrum, tunable over a wide range down to infrared wavelength, are very suitable for application in spectroscopy. Figures 5; references 18: 10 Russian, 1 German, 7 Western.

USSR

UDC 533.36

RING METHOD OF RECORDING THE SCATTERING INDICATRIX IN A DIFFRACTION
STRUCTUROMETRE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 3, Mar 78
pp 551-554 manuscript received 30 Dec 75; after revision 14 Nov 77

USHAKOV, V. V.

[Abstract] Conventional diffraction structurometres for analyzing polydisperse media operate by the method of small angles and record the diffraction pattern in the focal plane of the receiver lens inside the diaphragm, with the photoreceiver (photomultiplier) at the focal distance behind. The magnitude of the useful signal generated here decreases rapidly with increasing diffraction angle, inasmuch as the scattering indicatrix is very forward elongated. Two features of a laser beam, its only slight divergence and small diameter, can be utilized to make such an instrument more accurate and sensitive. The solid angle which subtends the laser beam entering the diaphragm should increase with increasing diffraction angle so as to compensate the signal attenuation due to elongation of the indicatrix. This is achieved by placing an annular diaphragm of opaque material directly on the outside flat cathodic surface area of the glass envelope of the photomultiplier. With the narrow laser beam aimed at the center of this diaphragm, the diffraction angle is varied by moving the photomultiplier in the envelope along the beam. Figures 3; references: 3 Russian.

USSR

UDC 533.9

CONTINUOUS RADIATION SPECTRUM OF A HELIUM PLASMA

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 27, No 1, Jul 78
pp 22-27 manuscript received 5 Apr 76

VOLKOV, A. N., GIPPIUS, YE. F., and KOLESNIKOV, V. N.

[Abstract] Absolute intensities of the continuous radiation spectrum of a highly ionized helium plasma were measured over the 180-710 nm range of wavelengths (visible and ultraviolet). These measurements involved also a determination of the plasma parameters, namely its ion content as well as electron concentration and electron temperature. Both a VMR-2 monochromator and a 512-channel LP-4050 pulse analyzer were used for the 180-290 nm part of the spectrum, with UFS-1 and UFS-2 optical filters for reducing the level of scattered light. Discharge in spectrally pure helium under a pressure equal to 3 mm Hg inside a quartz tube 28 cm long and 1 cm in diameter

was produced at an ignition voltage of 10 kV with a bell-shaped current pulse of 45 A amplitude and 8.5 μ s base width. Intensity calculations for the entire range of the spectrum are found to agree closely with the experimental data, except in the regions preceding the cutoff frequencies ($[1.0-1.3] \cdot 10^{15} \text{ s}^{-1}$ in the recombination spectrum of He-II, and $[0.68-0.82] \cdot 10^{15} \text{ s}^{-1}$ in the spectrum of He-I), where the measured intensities are appreciably higher than the theoretical values. The authors thank N. N. Sobolev for the interest and the discussion of the results, also A. M. Urnov for the help in calculating the cross sections. Figures 2; references 10: 8 Russian, 2 Western.

USSR

UDC 621.378.9:535.343

AN INTRACAVITY SPECTROMETER WITH A CONTINUOUS-JET DYE LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 28, No 3, Mar 78
pp 417-420 manuscript received 3 Feb 77

ADAMUSHKO, A. V., BELOKON', M. V., and RUBINOV, A. N.

[Abstract] An intracavity spectrometer is described which combines a high sensitivity with a fine spectral resolution. It consists of an argon laser pumping a continuous-jet dye laser, a scanning interferometer and a wedge interferometer, a resonator cavity between three spherical mirrors, a discharge tube, another mirror, a modulator, a monochromator, a photoreceiver, a synchronous detector, and a recording instrument. The spectrometer was successfully used for measuring and analyzing absorption spectra, after calibration against the lines of high excitation levels in orthohelium. Figures 3; references 15: 7 Russian, 8 Western.

USSR

UDC 533.9

RADIATION CHARACTERISTICS OF THE ZONE OF INTERACTION BETWEEN HYPERSONIC PLASMA FLOWS AND BARRIERS IN THE VACUUM ULTRAVIOLET REGION

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 27, No 1, Jul 78
pp 28-31 manuscript received 21 Jun 76

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

[Abstract] In a search for efficient plasmatic sources of vacuum-ultraviolet radiation, the energy characteristics of the plasma focus inside an erosion-type magnetic plasma compressor were measured within the range with

an open binary inert-gas ionization chamber. Hypersonic streams of dense plasma were generated within the cylindrical vacuum space 3 m long and 0.5 m in diameter under a residual pressure of 10^{-5} torr. Discharge in Teflon-4 was produced by a current pulse of 500 kA amplitude and 20 μ s width through copper electrodes from a 750 μ F capacitor charged to 5 kV. According to the results, axial confinement of supersonic plasma streams in such a compressor by means of immovable barriers can increase by a factor of 1.3-3 the efficiency of energy conversion, from electric energy stored in capacitors to radiation energy in the far vacuum-ultraviolet range corresponding to $h\nu = 10-70$ eV. Figures 3; references: 5 Russian.

USSR

UDC 621.375.9

ROLE OF THE PIEZO-OPTIC EFFECT IN THE DYNAMICS AND THE SPECTRAL DISTRIBUTION OF RADIATION FROM A LASER WITH AN ELECTRO-OPTIC SHUTTER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 27, No 1, Jul 78
pp 42-45 manuscript received 3 Nov 75

KOVALEV, A. A., RAZVIN, YU. V., TYUSHKEVICH, B. N. and SERAK, S. V.

[Abstract] An experimental study was made of the piezo-optic effect as well as of its role in the dynamics and the spectral distribution of radiation from a ruby laser with an electro-optic shutter. The latter, a reflector made of a KDP crystal, was controlled by a high-voltage pulse with a steep leading edge and an exponential trailing edge. It was possible to eliminate additional pulses following the main monopulse and to increase the energy of the latter to approximately 0.2 J, by increasing the amplitude of the control pulse to the shutter so as to raise the pumping level higher than 30% above the threshold and to narrow the radiation spectrum to approximately $2.5 \cdot 10^{-3} \text{ cm}^{-1}$. The reflection coefficient of the shutter was then found to be maximum at the beginning of the control pulse and only continue, due to the piezo-optic effect, to fluctuate with decreasing amplitudes. Figures 2; references 7: 6 Russian, 1 Western.

CSO: 1862

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