

## Russian and Japanese Aerospace Literature

Throughout 1992 the *AIAA Journal* will carry selected abstracts on leading research topics from Russian aerospace literature and, as space permits, from similar Japanese literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features Carbon Dioxide Lasers from Russia and Gallium Arsenide Lasers from Japan.

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### Russian Aerospace Literature This month: Carbon Dioxide Lasers

**A92-23556** A possibility for increasing the scanning rate of a TEA CO<sub>2</sub> laser with a liquid-crystal spatial-temporal light modulator (Ob odnoi vozmozhnosti uvelicheniia skorosti skanirovaniia TEA-CO<sub>2</sub> lazera s ZhK PVMS). V. V. DANILOV, O. B. DANILOV, and A. I. SIDOROV, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 17, Nov. 12, 1991, pp. 58–60. 2 Refs.

A method is proposed for increasing the scanning rate of a TEA CO<sub>2</sub> laser with a liquid-crystal spatial-temporal light modulator based on a cholesteric-nematic transition. The method relies on the use of the transient regime of the cholesteric-nematic transition whereby the scattering capacity of the liquid-crystal modulator decreases monotonically as the control voltage is increased. This makes it possible to gradually vary the intracavity losses and thus control the timing of the emission pulse relative to the onset of discharge in the active medium. Experimental results are presented.

**A92-23532** Information system of the molecular absorption of CO<sub>2</sub>-laser radiation (Informatsionnaia sistema po molekuliarnomu pogloshcheniiu izlucheniia CO<sub>2</sub>-lazera). O. K. VOITSEKHOVSKAIA, S. V. KUZNETSOV, S. V. SAPOZHNIKOV, N. N. TRIFONOVA, and M. R. CHERKASOV, *Optika Atmosfery* (ISSN 0235-277X), Vol. 4, Sept. 1991, pp. 938–953. 36 Refs.

A description is given of an information system (IS) designed to provide studies of gaseous media using CO<sub>2</sub>-laser radiation with data of absolute values of the absorption coefficients of the atmosphere and trace gases. In addition to characteristics of the CO<sub>2</sub> lasing transitions, the IS provides information on the parameters of absorption lines compiled using original calculation techniques. Considerable attention is given to an assessment of the reliability of the information. The IS data are compared with independent experimental results.

**A92-16844** An oscillator of IR radiation at the frequency of the TEA CO<sub>2</sub> laser second harmonic (Generator IK izlucheniia na chastote vtoroi harmoniki TEA CO<sub>2</sub>-lazera). A. A. BETIN, V. G. VOEVODIN, K. V. ERGA KOV, A. B. KIRSANOV, and V. P. NOVIKOV, *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, July 1991, pp. 812–816. 12 Refs.

Possibilities of improving the energy characteristics of oscillators of IR radiation at the frequency of the TEA CO<sub>2</sub> laser second harmonic are explored. It is shown that the optimization of all factors which determine efficiency does not make it possible to raise the internal SHG efficiency in ZnGeP<sub>2</sub> crystals, which the oscillators use, above 20 percent. Wide-aperture beams are converted in these crystals in order to implement the IR-radiation oscillator with a pulse energy of 0.16 J.

**A92-20767** Infra-red radiation focusators. M. A. GOLUB, I. N. SISAKIAN, and V. A. SOIFER, *Optics and Lasers in Engineering* (ISSN 0143-8166), Vol. 15, No. 5, 1991, pp. 297–309. 15 Refs.

This paper presents the results of investigations in the field of diffractive or "binary" computer-generated optics for the infrared region of the spectrum. The problem of a CO<sub>2</sub>-laser beam focusing into a complicated focal domain is considered in detail. Special ray-tracing methods are elaborated to calculate the new analytic functions of diffractive optical elements, called focusators. The development of IR focusators into a ring, uniform planar spots, segments of a straight line, and other focal domains for the CO<sub>2</sub> lasers powered from several watts up to 3 kW is reported. Reflective-type focusators are manufactured by a specific microrelief technology that has some features in common with normal microelectronic technology. Experimental results for focused-beam interaction with rubber, wood, fabric, and plastics are presented for the case of a 30-W laser. Effective laser heat-hardening of steel is achieved by 3-kW CO<sub>2</sub> laser by means of a computer-generated reflective focusator.

**A92-18197** A pulsed CO<sub>2</sub> laser with inductive discharge stabilization (Impul'snyi CO<sub>2</sub> lazer s induktivnoi stabilizatsiei razriada). A. P. LYTKIN, A. V. ROMANOV, and A. F. SUCHKOV, *Zhurnal Tekhnicheskoi Fiziki* (ISSN 0044-4642), Vol. 61, May 1991, pp. 97–102. 6 Refs.

A pulsed CO<sub>2</sub> laser with transverse discharge stabilization is described which employs a sectioned electrode with 200 sections per sq. cm. The electrode sections consist of densely packed ends of insulated conductors which simultaneously serve as inductive ballast loads in the electrical feed circuit of the gas discharge. The specific power output of the laser reaches 60 J/l-atm for an active volume of 0.1 l. The volume discharge stabilization method proposed here can be used for the design of reliable compact repetitively pulsed gas discharge lasers with a pulse repetition rate of 100–1000 Hz.

**A91-47502** Anisotropy of thermal self-defocusing in a CO<sub>2</sub> EIL (Anizotropiia teplovogo samovozdeistviia v CO<sub>2</sub>-EIL). S. V. BARDAKOVSKII, N. A. BLINOV, V. N. ZOLOT KOV, V. N. KOTEROV, A. I. U. STASURA et al., *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, April 1991, pp. 456–458. 4 Refs.

Anisotropy of thermal self-defocusing in a CO<sub>2</sub> electroionization laser was found and theoretically substantiated. The anisotropic effect is investigated via an atmospheric pressure EIL with an excitation duration of 40 microsec. Results of calculations for a Gaussian beam are in good qualitative agreement with an experiment in which a self-filtering unstable resonator was used to obtain a beam close to the Gaussian one.

**A92-16860 A wide-aperture X-ray source for preionization of large-volume electric-discharge lasers (Shirokoaperturnyi istochnik rentgenovskogo izlucheniia dlia predyonzatsii elektrorazriadnykh lazerov bol'shogo ob'ema).** S. N. BURANOV, V. V. GOROKHOV, V. I. KARELIN, A. I. PAVLOVSKII, and P. B. REPIN, *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, July 1991, pp. 891-893, 13 Refs.

The role of X-ray radiation in the creation of the initial plasma in electric-discharge lasers based on electrode formation systems is investigated. It is shown that a high-voltage diffuse atmospheric-pressure discharge in an electric-discharge system consisting of a series of wires and a flat mesh is a highly efficient X-ray source. At a source aperture of 40 x 200 cm, the dose provided in the active medium of electric-discharge CO<sub>2</sub> lasers with a volume up to 0.28 cu m exceeded 60-300 R.

**A92-16843 A ring CH<sub>3</sub>OH laser with bidirectional optical pumping (Kol'tsevoi CH<sub>3</sub>OH-lazer s dvunapravlennoi opticheskoi nakachkoi).** V. N. DIDENKO, V. A. SVICH, V. M. TKACHENKO, and A. N. TOPKOV, *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, July 1991, pp. 809-812, 4 Refs.

Effects of frequency pulling and competition of counterrunning waves are demonstrated experimentally in a ring CH<sub>3</sub>OH laser bidirectionally pumped by CO<sub>2</sub> laser radiation. Different lasing modes are identified which are characterized by the independent existence of two counterrunning waves, energy transfer from one wave to another, and suppression of one of the waves. Dependences of the difference frequency on the relationship of counterrunning pump powers, the CO<sub>2</sub> laser frequency, and the ring resonator eigenfrequency are explained in terms of a model of gain profile formation.

**A92-10887 An experimental study of CO<sub>2</sub> laser light sources for lidars (Eksperimental'noe issledovanie CO<sub>2</sub>-izluchatelei dlia lidarov).** V. P. KOZOLUPENKO, V. S. MEZHEVOV, I. E. SIZOV, and A. A. KHAHLEV, *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, May 1991, pp. 583-585, 4 Refs.

The parameters of unstable resonators of a CO<sub>2</sub> laser-light source for a Doppler lidar are investigated. The longitudinal mode selection was carried out using a scheme with injection of the external CW radiation. Measurements were made of the width of the single-mode-emission region, the beam divergence of the emission, and the frequency sweep during the laser pulse. The output characteristics of a Doppler CO<sub>2</sub> lidar designed for measuring wind velocity in the atmosphere are presented.

**A92-10821 PC correction of distortions in a forming telescope with a diffractive optical element (OVF-korreksiia iskazhenii v formiruiushchem teleskope s difraktsionnym opticheskim elementom).** R. B. ANDREEV, V. D. VOLOSOV, V. M. IRTUGANOV, V. P. KALININ, V. V. KONONOV, and V. E. SHERSTOBITOV, *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, June 1991, pp. 762-765, 2 Refs.

It is demonstrated experimentally that compensation can be obtained for the dynamic aberrations of a forming telescope on the main mirror of which a diffractive optical element is deposited in order to inject the reference radiation into the system with PC, and that angular scanning of the output beam is possible without its distortion. A relay located on the path of the reference beam to the PC mirror and a telescope which precludes transmission of the reference beam through a hole in the main mirror made it possible to bring the range of permissible mirror aberrations to about 65  $\lambda/D$  and the scanning range to about 44  $\lambda/D$ , while retaining the angular divergence of the output beam close to the diffraction limit.

**A92-10810 The structure of flows arising under the effect of doubled CO<sub>2</sub>-laser pulses on a target in the air (Struktura techenii, voznikaushchikh pri vozdeistvii sdvoennykh impul'sov CO<sub>2</sub>-lazera na mishen' v vozdukh).** A. A. BAKEEV, L. I. NIKOLASHINA, M. N. POTASHKIN, and N. V. PROKOPENKO, *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, June 1991, pp. 704-707, 11 Refs.

The effect of two time-separated pulses 6-12 microsec in duration on a target surrounded by air of normal density is analyzed. Attention is focused on the breakdown of air by the second pulse at the boundary which divides a 'cold gas' and a plasma produced by the first pulse ('hot gas'). In this case a gasdynamic complex is formed which consists of an absorption wave traveling along the cold gas opposite to the laser radiation and a wave propagating along the hot gas toward the target. A model in which the absorption wave propagates along the hot gas in the overcompressed detonation mode is shown to produce the best agreement between theory and experiment.

**A91-56517 Four-wave mixing efficiency in InSb at 10.6 microns.** V. I. KOVALEV, *Infrared Physics* (ISSN 0020-0891), Vol. 32, 1991, pp. 235-244, 25 Refs.

InSb characteristics are investigated experimentally and theoretically in order to determine the optical conditions for achieving maximal four-wave mixing (FWM) efficiency in InSb at 10.6 microns. It is shown that the highest nonlinear FWM phase shift, which defines FWM reflectivity, can be about 3 when a signal and the fair pump wave are coherent. The conditions for the highest phase shift realization are presented. The phase shift in InSb at 10.6 microns is found to be weakly dependent on individual parameters of the sample material. It is shown that the dependence of the lifetime of nonequilibrium free carriers on the local intensity of laser radiation should be taken into account at 10.6-micron FWM in InSb.

**A91-50882 Reflection coefficients of composite materials heated in air and in an inert atmosphere by CO<sub>2</sub> laser emission (Koeffitsienty otrazheniia kompozitnykh materialov, nagrevaemykh na vozdukh i v inertnoi atmosfere izlucheniem CO<sub>2</sub>-lazera).** V. A. DLUGUNOVICH, V. A. ZHDANOVSKII, N. S. ZAKHAROV, E. F. ZOLOTOVSKAIA, V. A. KARPENKO, and V. N. SNOPKO, *Akademiia Nauk SSSR, Izvestiia, Seriya Fizicheskaiia* (ISSN 0367-6765), Vol. 55, June 1991, pp. 1227-1232, 5 Refs.

Changes in the directional hemispherical reflection coefficients and thermodynamic surface temperatures of organic fiber/epoxy and glass fiber/epoxy composites during heating in air and in argon by a CO<sub>2</sub> laser were investigated experimentally for wavelengths of 0.63, 1.15, 3.39, and 10.6 microns. It is shown that the oxidizing and inert atmospheres differ significantly in their effect on the reflection coefficients and physicochemical transformations of the materials during CW CO<sub>2</sub> laser heating.

**A91-47512 The influence of the dynamic deformation of the optics on the formation of the radiation front in a laser and in a system composed of a master oscillator and an amplifier (Vliianie dinamicheskoi deformatsii optiki na formirovanie fronta izlucheniia v lazere i v sisteme zadaiushchii generator-usilitel').** L. V. KOVAL'CHUK, R. A. LIUKONEN, A. I. RODIONOV, A. M. TROFIMENKO, S. V. FEDEROV et al., *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, April 1991, pp. 505-508, 10 Refs.

Results are reported from an experimental study tracing the dynamic deformation of metallic laser mirrors upon exposure to radiation. Spatial and temporal changes in the quality of the mirror surface during radiation exposure were observed using the standard shadow method with an exposure time of 1.5 microsec. The effect of the deformation on wavefront formation in a CO<sub>2</sub> laser system composed of a master oscillator and an amplifier is calculated. Quantitative data are presented on the rise of the mirror surface as a function of the absorbed energy, and the size of mirror inhomogeneities that is the most dangerous for the laser (amplifier) and that causes the greatest losses of radiation energy into the prescribed angle is determined. The investigations confirmed the need to consider the dynamic deformation of metal-optical elements in designing lasers and systems based on them with high-quality output radiation.

**A91-45563 Simulation of pumping beams self focusing and defocusing in NH<sub>3</sub> Raman laser.** V. A. BATANOV, V. S. PETRIV, A. O. RADKEVICH, A. L. TELIATNIKOV, and A. I. VOLKOV, *International Journal of Infrared and Millimeter Waves* (ISSN 0195-9271), Vol. 12, July 1991, pp. 703-715, 16 Refs.

A quasi-optical approximation of the numerical solution of the nonlinear wave equation is employed to investigate IR pumping beams self-focusing and defocusing in an NH<sub>3</sub> Raman laser. Several parameters are considered in the numerical simulation including input-pump power, gas pressure, length of interaction, and the frequency offset between the resonance and initial beam divergence. Results of the simulation are found to agree qualitatively with published experimental data, with consideration given to the cases in which the paraxial approximation is not suitable. The spectroscopic features of the active molecules are considered in the model, and optically pumped FIR lasers can be analyzed using the results.

**A91-45040 A regenerative CO<sub>2</sub> amplifier with controlled pulse duration (Regenerativnyi CO<sub>2</sub>-usilitel' s upravliaemoi dlitel'nost'iu impul'sov).** V. V. APOLLONOV, K. KH. KAZAKOV, V. R. SOROCHEV, and I. A. SHAKIR, *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, March 1991, pp. 318-320, 6 Refs.

The paper reports the development of a regenerative TEA CO<sub>2</sub> amplifier with the pulse duration in a train controlled within the range from 10 to 40 ns, the interval between the pulses amounting to 110 ns and their total energy amounting to 4 J. Laser radiation screening by an optical-air-breakdown plasma in a lens telescope focus was used to form the injected pulse. Good reproduction of the temporal parameters of the injected pulse was achieved by virtue of the injection of radiation from a frequency stabilized CW CO<sub>2</sub>-laser into the master oscillator.

**A91-45039 Spectral characteristics of an injection-locked TEA CO<sub>2</sub>-laser (Spektral'nye kharakteristiki TEA CO<sub>2</sub>-lazera s inzhetsiei vneshnego signala).** V. M. GORDIENKO and I. A. PUTIVSKII, *Kvantovaya Elektronika* (ISSN 0368-7147), Vol. 18, March 1991, pp. 316-318, 10 Refs.

The frequency variations of the stimulated emission from a TEA CO<sub>2</sub>-laser in a scheme with ring and linear resonators with injection locking are investigated. The minimum lasing spectral bandwidth of about 0.5 MHz at an output energy of about 0.5 J has been achieved as a result of the optimal working mixture composition and detuning of the injection radiation frequency from the lasing one.

**A91-41361 Volume self-sustained discharge stability in gas lasers.** V. V. APOLLONOV, G. G. BAITSUR, A. V. ERMACHENKO, K. N. FIRSOV, and S. K. SEMENOV, *Proceedings of the International Lasers '89 Conference*, New Orleans, LA, Dec. 3-8, 1989 (A91-41326 17-36). McLean, VA, STS Press, 1990, pp. 330-337, 5 Refs.

An experimental investigation of the basic mechanisms of volume self-sustained discharge (VSD) in CO<sub>2</sub> and N<sub>2</sub>O laser gas mixtures is reported. The influence of low-ionization additives on the VSD stability is reported. A principle for obtaining a discharge for pumping gas lasers is suggested that will make it possible to create high-power, compact, and pulsed CO<sub>2</sub> and N<sub>2</sub>O lasers with large apertures and simple design.

**A91-41434 A Doppler lidar with CO<sub>2</sub>-laser intracavity detection.** A. P. GODLEVSKII, E. P. GORDOV, A. I. ZHILIBA, and P. P. SHARIN, *Proceedings of the International Lasers '89 Conference*, New Orleans, LA, Dec. 3-8, 1989 (A91-41326 17-36). McLean, VA, STS Press, 1990, pp. 1099-1102. 9 Refs.

A version of a high-sensitive Doppler lidar, based on intracavity coherent laser detection is described. The device consists of a CO<sub>2</sub> laser, transmitting-receiving optical system, and signal-processing unit. Laser-intensity stabilization is achieved by decreasing the mechanical disturbance of the laser resonator, and the optical tract is formed by a Cassegrain telescope. A portion of the laser beam reflected back by a Brewster window of the gas discharge tube is focused by a spherical mirror onto a photodetector. Results of laboratory and real-atmosphere experiments are reported, and it is shown that vibrations of a retroreflector with an amplitude of 50 micron are detected at distances up to 500 m.

**A91-39166 A study of beam divergence of a pulsed CO<sub>2</sub> electroionization laser (Issledovanie raskhodimosti izlucheniia impul'snogo CO<sub>2</sub>-EIL).** I. V. GLUKHIKH, A. I. DUTOV, V. N. CHIRKOV, and I. L. IACHNEV, *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 18, Feb. 1991, pp. 214-218. 21 Refs.

Results are presented on the effects of the pumping power and duration, the intensity of stimulated emission intensity, the composition of the mixture, and resonator parameters on the beam divergence of a pulsed CO<sub>2</sub> electroionization laser. It is shown that, the thermal self-induced effect alone (which causes the occurrence of a density wave) will lead to a beam divergence which can exceed the diffraction limit at least threefold.

**A91-35643 Phase conjugation of the CO<sub>2</sub> laser in cryogenic fluids (OVF izlucheniia CO<sub>2</sub>-lazera v kriogennykh zhidkostiakh).** S. S. ALIMPIEV, I. V. MEL'NIKOV, V. S. NERSISIAN, S. M. NIKIFOROV, and B. G. SARTAKOV, *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 17, Dec. 1990, pp. 1613-1618. 22 Refs.

The phase conjugation of CO<sub>2</sub> laser emission under conditions of degenerate four-wave mixing in a cryogenic fluid, Kr:SF<sub>6</sub>, is investigated experimentally. It is shown that three-dimensional periodic modulation of medium polarization results from local vaporization due to the thermalization of the vibrational excitation of SF<sub>6</sub> molecules. An intensity reflection coefficient of 300 percent has been registered at the long-wave wing of the SF<sub>6</sub> absorption line for a pumping energy density of 2 J/sq cm.

**A91-39057 Quasi-continuous optical discharge in a weakly convergent CO<sub>2</sub> laser beam (Kvazinepreryvnyi opticheskii razriad v slaboskhodiaschchemsia luche CO<sub>2</sub> lazera).** A. B. VAGAPOV, N. P. KOZLOV, A. V. PEKSHEV, and V. I. SUSLOV, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 17, Feb. 12, 1991, pp. 63-67. 7 Refs.

A method is proposed for obtaining a quasi-continuous optical discharge in a continuous-wave laser beam of prebreakdown intensity (10 to the 4th -10 to the 6th W/sq cm). The propagation dynamics and frequency characteristics of an optical discharge in a weakly convergent laser beam are discussed with reference to experimental results obtained for a CW CO<sub>2</sub> laser with an output power up to 1000 W.

**A91-37205 CO<sub>2</sub> laser with fast retuning and stabilization of the emission frequency (CO<sub>2</sub>-lazer s bystroj perestroikoi i stabilizatsiei chastoty izlucheniia).** I. M. BELOUSOVA, A. S. GRENISHIN, N. A. GRIAZNOV, V. M. KISELEV, and A. V. PASECHNIK, *Akademiia Nauk SSSR, Izvestiia, Seria Fizicheskaiia* (ISSN 0367-6765), Vol. 55, Feb. 1991, pp. 227-230.

A fast frequency stabilization system for a CW CO<sub>2</sub> laser is described which employs a CdTe electrooptic phase modulator. The system provides for long-term frequency stabilization of 10 to the -8th or better, with compensation of frequency perturbations up to 1 MHz. A block diagram of the laser with a fast frequency stabilization circuit is presented.

**A91-22029 Laser action due to Ar II and Ne II ions pumped by an optical breakdown produced by a CO<sub>2</sub> laser (Lazernaia generatsiia na ionakh Ar II i Ne II s nakachkoi opticheskimi probom, sozdavaemym CO<sub>2</sub>-lazerom).** V. V. APOLLONOV, S. I. DERZHAVIN, D. A. NORAIEV, and A. A. SIROTKIN, *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 17, Sept. 1990, pp. 1154, 1155. 7 Refs.

The paper reports laser action in Ar II at wavelengths of 454.5 and 427.8 nm and in Ne II at 332.4 and 334.5 nm under pumping by X-rays emitted from an optical-breakdown plasma produced by a CO<sub>2</sub> laser. Alternative mechanisms of active-medium formation under optical breakdown are discussed.

**A91-18846 Generation characteristics of high-energy electric-discharge CO<sub>2</sub> lasers based on three-electrode systems (Generatsionnye kharakteristiki vysokoenergeticheskikh elektrorazriadnykh CO<sub>2</sub>-lazerov na osnove trekhelektroodnykh sistem).** A. I. PAVLOVSKII, S. N. BURANOV, V. V. GOROKHOV, V. I. KARELIN, and P. B. REPIN, *Akademiia Nauk SSSR, Izvestiia, Seria Fizicheskaiia* (ISSN 0367-6765), Vol. 54, No. 10, 1990, pp. 2036-2039. 7 Refs.

Results of a study of the performance characteristics of TEA CO<sub>2</sub> lasers with active volumes of 10 and 280 l are reported. The possibility of retuning the emission spectrum by adding xenon to the mixture is demonstrated. It is shown that the generated emission is characterized by a high angular directivity (to within 0.0005 rad).

**A91-37223 Stimulated scattering in the active medium of a pulsed CO<sub>2</sub> laser and the divergence of laser emission (Vynuzhdennoe rasseianie v aktivnoi srede impul'snogo CO<sub>2</sub>-lazera i raskhodimost' lazernogo izlucheniia).** I. V. GLUKHIKH, M. N. GORDEEVA, A. I. DUTOV, S. V. FEDOROV, V. N. SUGIMOTO et al., *Akademiia Nauk SSSR, Izvestiia, Seria Fizicheskaiia* (ISSN 0367-6765), Vol. 55, Feb. 1991, pp. 389-393. 10 Refs.

The theoretically predicted possibility of stimulated scattering suppression in the active medium of CO<sub>2</sub> lasers is demonstrated experimentally. Active media are identified which provide a divergence close to the diffraction limited value with a high specific output. It is shown that scattering suppression is accompanied by the attenuation of chaotic output power fluctuations.

**A91-29966 Formation of a thermal lens in a laser-illuminated cloud medium under kinetic-cooling conditions (Formirovanie teplovoi linzy v prosvetlaemoi oblachnoi srede v usloviakh kineticheskogo okhlazhdeniia).** R. KH. ALMAEV, L. P. SEMENOV, and A. G. SLESAREV, *Atmospheric optics* (A91-29962 11-46). Moscow, Gidrometeoizdat, 1990, pp. 24-28.

The paper presents analytical and numerical investigations of the formation of the temperature field in a region where pulsed CO<sub>2</sub>-laser radiation interacts with a cloud medium. An analysis is made of the effect of kinetic cooling on thermal perturbations of the medium as a function of the altitude above the earth's surface, the cloud water content, the exposure time, and the regime of condensed-phase destruction. The effect of kinetic cooling is shown to be more substantial during the 'explosive' destruction regime than during the regular evaporation regime.

**A91-26666 Electron-beam controlled discharge lasers and laser amplifiers on CO<sub>2</sub>, CO and N<sub>2</sub>O molecular gases.** N. G. BASOV, A. A. IONIN, and A. F. SUCHKOV, *Proceedings of the High-power gas lasers Meeting*, Los Angeles, CA, Jan. 15-17, 1990 (A91-26651 10-36). Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, pp. 389-400. 15 Refs.

The latest results on studying EBCD lasers on CO<sub>2</sub>, CO, N<sub>2</sub>O molecular gases carried out at the Gas Lasers Lab of Lebedev Institute are reported. EBCD CO<sub>2</sub> isotope lasers, cryogenic and supersonic-cooled, pulsed and pulse repetition CO lasers and amplifiers, and high efficiency N<sub>2</sub>O lasers have been investigated. A high-power N<sub>2</sub>O laser has been created with energy, specific output, and efficiency of 106 J, 36 J/l-Amagat, and 10 percent, respectively.

**A91-23864 An IR spectroscopy study of the effect of laser radiation on composite materials (Issledovanie vozdeistviia lazernogo izlucheniia na kompozitsionnye materialy metodami IK spektroskopii).** V. I. EREMIN, I. P. KOVALENKO, G. I. LEVASHENKO, N. V. MAZAEV, A. S. SOKOL'NIKOV et al., *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 17, Oct. 1990, pp. 1317-1320. 13 Refs.

Methods and equipment are described for determining the effective temperature and composition of a jet of composite disintegration products formed during the irradiation of glass and organic fiber reinforced composite targets by a CW CO<sub>2</sub> laser in air (flux density, 300-3000 W/sq cm). The decomposition products of the glass fiber composite are found to consist of 2.3-3.5-micron-diameter metal oxide particles with a volume concentration of 0.06-0.000025 and molecular gases CO<sub>2</sub>, H<sub>2</sub>O, and HCl. The decomposition products of the organic fiber composite consist of 1-1.8-micron-diameter with a volume concentration of 0.4-0.00009 and the same molecular gases. It is also shown that the target emissivity increases with time and reaches 0.8-0.9.

**A91-23863 Emission of plasma produced by a CO<sub>2</sub> laser pulse incident on a target in vacuum (Izluchenie plazmy, sozdannoi pri deistvii impul'sa CO<sub>2</sub>-lazera na mishen' v vakuumie).** I. U. M. VAS'KOVSKII, A. F. GOLOVIN, A. P. GOLUB', S. S. ZEMTSOV, A. S. KORENEV et al., *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 17, Oct. 1990, pp. 1310-1314. 12 Refs.

The emission spectrum of an aluminum plasma produced by a moderate-power CO<sub>2</sub> laser is calculated. The calculated results and experimental data indicate that photons with energies higher than 11 eV are responsible for the main contribution to the thermal emission of the plasma. It is shown that, during target irradiation by a CO<sub>2</sub> laser, the laser-to-thermal energy conversion efficiency, which reaches 30-50 percent, is higher than in the case of a neodymium laser under the same conditions.

**A90-32678 A theoretical and experimental study of a CO<sub>2</sub> laser in the passive Q-switched mode (Teoreticheskoe i eksperimental'noe issledovanie CO<sub>2</sub>-lazera v rezhime passivnoi modulatsii dobrotnosti).** V. V. DEMBOVETSKII, M. V. MATVEEVA, G. I. SURDUTOVICH, and N. P. SHURUPOVA, *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 17, Feb. 1990, pp. 142-146. 18 Refs.

The passive Q-switched mode of a CO<sub>2</sub> laser with nonlinear absorption was investigated theoretically and experimentally. The use of two-level models of active and passive media with allowance for coherence effects was found to be sufficient for determining the limits of the Q-switched mode and its dynamic characteristics. The two-level approximations, however, were insufficient for determining the pulse shape, necessitating the use of more accurate models. The theoretical results obtained were found to be in good qualitative and quantitative agreement with experimental data over a wide range of laser parameters.

**A91-37201 Infrared Doppler laser systems for the remote measurement of winds (Doplerovskie infrakrasnye lazernye sistemy dlia distantsionnogo izmereniia vetrovykh potokov).** S. A. AKHMANOV, V. M. GORDIENKO, L. A. KOSOVSKI, N. N. KUROCHKIN, G. A. POGOSOV et al., *Akademiia Nauk SSSR, Izvestiia, Seriya Fizicheskai* (ISSN 0367-6765), Vol. 55, Feb. 1991, pp. 194-199. 10 Refs.

Theoretical principles are presented for the Doppler lidar measurement of wind velocity. A method for measuring the structural constant of wind velocity fields is proposed. A scheme of a continuous monostatic Doppler lidar is described, and results of full-scale and comparative measurements of wind velocity profiles and structural constant are reported.

**A91-25116 Waveguide CO<sub>2</sub> lasers with intracavity control of the radiation parameters (Volnovodnye CO<sub>2</sub>-lazery s vnutrirezonatornym upravleniem parametrami izlucheniia).** I. U. G. AGALAKOV, S. A. VITSINSKII, N. A. GRIAZNOV, O. B. DANILOV, M. I. ZINCHENKO et al., *Akademiia Nauk SSSR, Izvestiia, Seriya Fizicheskai* (ISSN 0367-6765), Vol. 54, Dec. 1990, pp. 2402-2409. Refs.

The paper presents results of a comparative study of different methods for controlling the pulse duration and emission frequency of waveguide CO<sub>2</sub> lasers which are intended for use in various optoelectronic and optomechanical devices. Experimental models of multifunctional lasers are presented. The lasers that have been developed are single-mode with a nearly diffractive divergence.

**A91-23870 An experimental study of self-induced phase conjugation in a CO<sub>2</sub> laser (Eksperimental'noe issledovanie samoobrashcheniia izlucheniia CO<sub>2</sub>-lazera).** D. A. GORIACHKIN, V. P. KALININ, I. M. KOZLOVSKAIA, and V. E. SHERSTOBITOV, *Kvantovaiia Elektronika* (ISSN 0368-7147), Vol. 17, Oct. 1990, pp. 1349-1355. 14 Refs.

A four-wave mixing scheme has been implemented in (S-34)F6 with a feedback loop amplifier for the microsecond pulsed emission of a CO<sub>2</sub> laser with an energy in the reflected wave of 1.8 J at the maximum gain line. Partial compensation of model inhomogeneities in the loop resonator is demonstrated. An analysis of the spatial characteristics of the reflected wave indicates that exact phase conjugation is absent in all the known feedback configurations that have been tested in the experiments.

**A91-22040 Absorption of CO<sub>2</sub>-laser radiation by photoexcited carriers in a germanium crystal (Pogloshchenie izlucheniia CO<sub>2</sub>-lazera na fotovozbuzhdennykh nositeliakh v kristalle germaniia).** A. M. GRIGOR'EV, L. M. LAVRENOV, and V. P. TRUSOV, *Kvantovaiia Elektronika* (ISSN 0368-7147), Vol. 17, Sept. 1990, pp. 1238-1240. 5 Refs.

The absorption of CO<sub>2</sub>-laser radiation in a germanium crystal excited by Nd-laser radiation was studied experimentally and theoretically. The dependence of the transmittance of the semiconductor in the transparency region on the intensity of the exciting radiation was obtained analytically. This dependence is shown to be in good agreement with experimental data obtained for a Ge crystal in a range of photoexcitation intensity variations of practical interest. A high level of free-carrier concentration has been achieved in the photoexcited Ge, indicating that this material is a promising candidate for use in modulators of CO<sub>2</sub>-laser radiation.

**A91-15408 Formation of long laser sparks in air by a pulsed CO<sub>2</sub> laser (Formirovanie dlinnykh lazernykh iskr v vozdukhie impul'snym CO<sub>2</sub> lazerom).** L. M. VASILIAK, S. P. VETCHININ, I. O. KOVALEV, G. P. KUZ'MIN, D. N. POLIAKOV et al., *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 16, Sept. 26, 1990, pp. 1-4. 9 Refs.

The objective of the study was to investigate the possibility of obtaining one or several long laser sparks from a wide-aperture gigawatt CO<sub>2</sub> laser while shortening the laser emission pulse. It is shown that, in order to produce a long laser spark, the laser pulse width should be reduced to the limit of the existence of the photodetonation mechanism of plasma expansion. An annular laser beam, typical of unstable-resonator lasers, should be used. By using a 100-J gigawatt CO<sub>2</sub> laser, about ten channels of optical breakdown can be generated simultaneously, and a plasma field of several square meters can be created with randomly located plasma sources.

**A91-11943 An active medium providing for the diffraction divergence of the radiation of an electroionization-type CO<sub>2</sub>-laser (Aktivnaia sreda, obespechivaiushchaia difraktsionnuu raskhodimost' izlucheniia elektroionizatsionnogo CO<sub>2</sub>-lazera).** I. V. GLUKHIKH, A. I. DUTOV, S. V. FEDOROV, V. N. CHIRKOV, M. S. IUR'EV et al., *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 16, June 12, 1990, pp. 56-59. 8 Refs.

Experimental results are presented on working mixtures that make it possible to obtain a quasi-diffraction divergence of radiation from an electroionization-type CO<sub>2</sub>-laser while maintaining high specific energy output. The optimal combination of parameters corresponds to CO<sub>2</sub>:N<sub>2</sub>:He = 1:1.6:1:1.8 mixtures.

**A91-11931 Pulsed emission from a CO<sub>2</sub> laser with a controllable VO<sub>2</sub> mirror (Impul'snaia generatsiia CO<sub>2</sub> lazera s upravliaemym VO<sub>2</sub> zerkalom).** N. F. BOCHORISHVILI, I. U. M. GERBSHTEIN, O. B. DANILOV, V. A. KLIMOV, N. I. U. SENTSOV et al., *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 16, May 26, 1990, pp. 8-11.

The paper reports on the control of CO<sub>2</sub>-laser emission at 10.6 microns using a multilayer optical resonator, i.e., a controllable laser mirror containing a layer of VO<sub>2</sub>. The control is based on resonator tuning as a result of dielectric-metal phase transition in the VO<sub>2</sub> layer under heating. The prescribed mode is excited via heating of a specified part of the mirror by pulses from an Nd:glass laser.

**A91-11427 Industrial lasers of the Scientific Research Center on Industrial Lasers of the USSR Academy of Sciences (Promyshlennnye tekhnologicheskie lazery NITsTL AN SSSR).** G. A. ABIL'SITOV, A. I. BONDARENKO, V. V. VASIL'TSOV, V. S. GOLUBEV, V. G. GONTAR' et al., *Kvantovaiia Elektronika* (ISSN 0368-7147), Vol. 17, June 1990, pp. 672-677. 18 Refs.

Several models of kilowatt-class industrial CO<sub>2</sub> lasers are described which satisfy requirements relating to laser-beam optical quality, stability, and controllability through microprocessor-based automatic control systems. Particular attention is given to a 5-kW fast-transverse-flow laser; a diffusion-cooled dc-pumped multibeam laser with a mean power of 2 kW; and a repetitively pulsed TEA laser with a mean power of 2 kW.

**A90-34615 Control of the spectral composition of the emission of an atmospheric-pressure CO<sub>2</sub> laser with a pulse width of 40 microseconds (Upravlenie spektral'nym sostavom izlucheniia CO<sub>2</sub>-lazera atmosfornogo davleniia s dlitel'nost'iu impul'sa 40 mks).** L. N. VITSHAS, I. D. MATIUSCHENKO, V. G. NAUMOV, V. D. PIS'MENNYI, L. V. SHACHKIN et al., *Kvantovaiia Elektronika* (ISSN 0368-7147), Vol. 17, Jan. 1990, pp. 60-62. 7 Refs.

Experiments are reported which demonstrate the feasibility of a high-power CO<sub>2</sub> laser generating 40-microsecond pulses at a single rotational line using a system of coupled selective and nonselective resonators. It is shown that, during operation at a single rotational line, the efficiency and divergence of the laser remain practically constant. The emission divergence is shown to be anisotropic in the presence of a high-velocity flow of the active medium.

**A90-32678 A theoretical and experimental study of a CO<sub>2</sub> laser in the passive Q-switched mode (Teoreticheskoe i eksperimental'noe issledovanie CO<sub>2</sub>-lazera v rezhime passivnoi modulatsii dobrotnosti).** V. V. DEMBOVETSKII, M. V. MATVEEVA, G. I. SURDUTOVICH, and N. P. SHURUPOVA, *Kvantovaiia Elektronika* (ISSN 0368-7147), Vol. 17, Feb. 1990, pp. 142-146. 18 Refs.

The passive Q-switched mode of a CO<sub>2</sub> laser with nonlinear absorption was investigated theoretically and experimentally. The use of two-level models of active and passive media with allowance for coherence effects was found to be sufficient for determining the limits of the Q-switched mode and its dynamic characteristics. The two-level approximations, however, were insufficient for determining the pulse shape, necessitating the use of more accurate models. The theoretical results obtained were found to be in good qualitative and quantitative agreement with experimental data over a wide range of laser parameters.

## Japanese Aerospace Literature This month: Gallium Arsenide Lasers

**A92-20028 Effect of cavity size on lasting characteristics of a distributed Bragg reflector-surface emitting laser with buried heterostructure.** K. MORI, T. ASAKA, H. IWANO, M. OGURA, S. FUJII, T. OKADA, and S. MUKAI, *Applied Physics Letters* (ISSN 0003-6951), Vol. 60, Jan. 6, 1992, pp. 21, 22. 7 Refs.

Transverse-mode characteristics of the distributed Bragg reflector-surface emitting laser diode with buried heterostructure were investigated as a function of the cavity size. Stable, fundamental transverse-mode operation was achieved for cavity openings of 4 microns in diameter and smaller. The effect of cavity size on threshold current and polarization characteristics is also discussed.

**A91-52101 Low-threshold CW operation of square-shaped semiconductor ring lasers (orbiter lasers).** SATOSHI OKU, MASANOBU OKAYASU, and MASAHIRO IKEDA, *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 3, July 1991, pp. 588-590. 11 Refs.

The CW operation of square-shaped semiconductor ring lasers is demonstrated with a threshold current as low as 6 mA. The ring resonator consists of straight waveguides and four total reflection mirrors. The lasers are fabricated using Br<sub>2</sub> dry etching on an InGaAs/GaAs strained single-quantum-well graded-index separate-confinement heterostructure wafer. The low-threshold CW operation is owing to the high differential gain of the wafer and the low-loss total reflection mirror.