

**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. KOSOVSKII, N. N. KUROCHKIN, G. A. POGOSOV et al., *Akademiia Nauk SSSR, Izvestiia, Seriia Fizicheskaiia* (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 CO2 lasers with intracavity control of the radiation parameters (Volnovodnye CO2-lazery s vnutrizonatornym 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, Seriia Fizicheskaiia* (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 CO2 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 CO2 laser (Eksperimental'noe issledovanie samoobrashcheniia izlucheniia CO2-lazera).** D. A. GORIACHKIN, V. P. KALININ, I. M. KOZLOVSKAIA, and V. E. SHERSTOBITOV, *Kvantovaia 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 CO2 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 CO2-laser radiation by photoexcited carriers in a germanium crystal (Pogloshchenie izlucheniia CO2-lazera na fotovozbuzhdennykh nositeliakh v kristalle germaniia).** A. M. GRIGOR'EV, L. M. LAVRENOV, and V. P. TRUSOV, *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 17, Sept. 1990, pp. 1238-1240. 5 Refs.

The absorption of CO2-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 CO2-laser radiation.

**A91-15408 Formation of long laser sparks in air by a pulsed CO2 laser (Formirovanie dlennykh lazernykh iskr v vozdukhie impul'snym CO2 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 CO2 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 CO2 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 CO2-laser (Aktivnaia sreda, obespechivaiushchaia difraktsionnuu raskhodimost' izlucheniia elektroionizatsionnogo CO2-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 CO2-laser while maintaining high specific energy output. The optimal combination of parameters corresponds to CO2:N2:He = 1:1:6-1:1:8 mixtures.

**A91-11931 Pulsed emission from a CO2 laser with a controllable VO2 mirror (Impul'snaia generatsiia CO2 lazera s upravliaemym VO2 zerkalom).** N. F. BOCHORISHVILI, I. M. GERBSHTEIN, O. B. DANILOV, V. A. KLIMOV, N. I. 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 CO2-laser emission at 10.6 microns using a multilayer optical resonator, i.e., a controllable laser mirror containing a layer of VO2. The control is based on resonator tuning as a result of dielectric-metal phase transition in the VO2 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 (Promyshlennye tekhnologicheskie lazery NITsTL AN SSSR).** G. A. ABIL'SIITOV, A. I. BONDARENKO, V. V. VASIL'TSOV, V. S. GOLUBEV, V. G. GONTAR' et al., *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 17, June 1990, pp. 672-677. 18 Refs.

Several models of kilowatt-class industrial CO2 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 CO2 laser with a pulse width of 40 microsecond (Upravlenie spektral'nym sostavom izlucheniia CO2-lazera atmosfernogo davleniia s dlitel'nost'iu impul'sa 40 mks).** L. N. VITSHAS, I. D. MATIUSHCHENKO, V. G. NAUMOV, V. D. PIS'MENNYI, L. V. SHACHKIN et al., *Kvantovaia Elektronika* (ISSN 0368-7147), Vol. 17, Jan. 1990, pp. 60-62. 7 Refs.

Experiments are reported which demonstrate the feasibility of a high-power CO2 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 CO2 laser in the passive Q-switched mode (Teoreticheskoe i eksperimental'noe issledovanie CO2-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 CO2 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 Br2 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.

**A92-25821 Analysis of current injection efficiency of separate-confinement-heterostructure quantum-film lasers.** HIDEKI HIRAYAMA, YASUNARI MIYAKE, and MASAHIRO ASADA, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 28, Jan. 1992, pp. 68-74. Research supported by MOESC and Research Center for Ultra-High-Speed Electronics. 20 Refs.

Current injection efficiency, i.e., the proportion of current into the active region to total current, is analyzed for separate confinement heterostructure (SCH) quantum film lasers. It is shown that the current injection efficiency changes stepwise with the active layer thickness, and is larger for lower injected carrier density and deeper quantum well. Comparison is made between step-, parabolic-GRIN-, and linear-GRIN-SCH structures. The efficiency of linear-GRIN-SCH is the highest for the same well depth. Threshold current density is discussed for these SCH structures, taking into account the current injection efficiency and the optical loss due to the carrier leakage to the optical confinement layers.

**A92-25813 A submilliampere-threshold multiquantum-well AlGaAs laser without facet coating using single-step MOCVD.** HIRONOBU NARUI, SHOJI HIRATA, YOSHIFUMI MORI, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 28, Jan. 1992, pp. 4-8. 17 Refs.

An extremely low threshold current of 0.88 mA under continuous wave (CW) operation was obtained for a three-quantum-well AlGaAs-GaAs laser without facet coating at room temperature. This laser was fabricated using only single-step metalorganic chemical vapor deposition (MOCVD) on a nonplanar GaAs substrate. The energy conversion efficiency from input electric power to light output power was 42 percent at 1 mW/facet, which is the highest value for all types of lasers. The laser beam shape was nearly round with an aspect ratio of 0.86.

**A92-18428 THz optical-frequency conversion of 1 Gb/s-signals using highly nondegenerate four-wave mixing in an InGaAsP semiconductor laser.** S. MURATA, A. TOMITA, J. SHIMIZU, and A. SUZUKI, *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 3, Nov. 1991, pp. 1021-1023. 8 Refs.

The authors report the application of the highly nondegenerate four-wave mixing (HNDFWM) process to a 1.5-micron InGaAsP semiconductor laser in optical-frequency conversion experiments on 1-Gb/s intensity-modulated signals in a 1-THz conversion range. This conversion is based on a subpicosecond ultrafast nonlinear gain process in the laser. The HNDFWM was generated through the use of an injection-locking technique. The possibility of applying this phenomenon to an optical fiber dispersion compensator is also discussed.

**A92-14919 Electron-wave reflection by multi-quantum barrier in n-GaAs/i-AlGaAs/n-GaAs tunneling diode.** TAKESHI TAKAGI, FUMIO KOYAMA, and KENICHI IGA, *Applied Physics Letters* (ISSN 0003-6951), Vol. 59, Nov. 25, 1991, pp. 2877-2879. 12 Refs.

For the purpose of experimentally demonstrating the enhancement of electron-wave reflection by a multiquantum barrier (MQB) consisting of multiple combinations of quarter de Broglie wavelength heterostacks, two types of n-GaAs/i-barrier/n-GaAs tunneling diodes are fabricated with a bulk Al(x)Ga(1-x)As barrier and an Al(x)Ga(1-x)As/GaAs MQB. From the current-voltage characteristic at 77 K, it is clarified that electrons are well reflected by the MQB. The potential barrier height, virtually increased by the MQB, is estimated to be about 80 meV, which is in good agreement with a theoretical expectation.

**A91-54491 Generation of picosecond blue light pulse by frequency doubling of gain-switched GaAlAs laser diode having saturable absorber.** JUN OHYA, GENJI TOHMON, KAZUHISA YAMAMOTO, TETSUO TANIUCHI, and MASAHIRO KUME, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 27, Aug. 1991, pp. 2050-2059. 31 Refs.

Picosecond pulse generation of blue light by frequency doubling of a GaAlAs laser diode is reported. High power pulse generation is realized by incorporating gain switching of a laser diode with a saturable absorber and frequency doubling in a proton-exchanged MgO:LiNbO<sub>3</sub> waveguide. The laser diode with a longer saturable absorber can produce optical pulses with higher peak power and narrower pulse width. Rate equation analysis verifies the experimental results. It also indicates that there exists an optimum length of the saturable absorber for a given current pulse. The proton-exchanged waveguide efficiently frequency-doubles the gain-switched laser diode oscillating in multilongitudinal modes in the Cerenkov radiation scheme. The spectral bandwidth of second-harmonic generation for the waveguide is evaluated at about 20 nm. This is wide enough to frequency-double all the multilongitudinal modes of the gain-switched laser diode. A blue light pulse of 7.88-mW maximum peak power and 28.7-ps pulsewidth is obtained for a 1.23-W peak pulse of the laser diode.

**A91-35962 High-power operation of 630nm-band transverse-mode stabilised AlGaInP laser diodes with current-blocking region near facets.** H. HAMADA, M. SHONO, S. HONDA, R. HIROYAMA, K. MATSUKAWA et al., *Electronics Letters* (ISSN 0013-5194), Vol. 27, April 11, 1991, pp. 661, 662. 7 Refs.

High-power type AlGaInP laser diodes with the current-blocking region near the facets have been successfully fabricated for the first time, by MOCVD using the (100) GaAs substrates with a misorientation of 5 deg towards the (011) direction. The maximum continuous wave output power was achieved with about 33 mW at 20 C. Fundamental transverse-mode operation was obtained up to 20 mW.

**A92-13668 A photon scanning tunneling microscope using an AlGaAs laser.** SHUDONG JIANG, NAOYUKI TOMITA, MOTOICHI OHTSU, and HISAOH OHSAWA, *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 30, Sept. 1991, pp. 2107-2111. 13 Refs.

A novel super-resolution photon scanning tunneling microscope (PSTM) using diode lasers and optical fibers was demonstrated to measure the samples with submicron structure in a noncontact and nondestructive manner. A reproducible method for fabrication of the fiber probe with the tip curvature radius of 80 nm is reported. The step with the height of 9 nm, optical disk with submicron-sized pits similar to moth-eye structure, and latex particles with 80 nm in diameter have been observed. This is considered to be the smallest particle size resolved by the PSTM.

**A91-52097 Nonlinear gain effects in quantum well, quantum well wire, and quantum well box lasers.** TAKUJI TAKAHASHI and YASUHIKO ARAKAWA, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 27, June 1991, pp. 1824-1829. Research supported by Ogasawara Foundation, Matsuda Foundation, University-Industry Joint Research Program on Mesoscopic Electronics, and MOESC. 16 Refs.

The nonlinear gain effects due to the spectral hole burning in quantum well (QW), quantum well wire (QWW), and quantum well box (QWB) lasers are discussed. It is found that the gain nonlinearity is enhanced by the quantum confinement of carriers, and is further enhanced in the QWW and QWB lasers. These nonlinear gain effects significantly affect the modulation dynamics of the semiconductor lasers under high photon density conditions. It is emphasized that both the damping rate and the resonant relaxation frequency are degraded through reduction of the differential gain. The effects of nonlinear gain on the spectral dynamics are discussed. The result indicates that the gain nonlinearity causes enhancement of the linewidth enhancement factor with the increase of the photon density, which leads to the spectral rebroadening under high photon density conditions.

**A91-52096 Tight binding analysis for quantum-wire lasers and quantum-wire infrared detectors.** TADAAKI YAMAUCHI, TAKUJI TAKAHASHI, and YASUHIKO ARAKAWA, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 27, June 1991, pp. 1817-1823. Research supported by University-Industry Joint Research Program on Mesoscopic Electronics, MOESC, Foundation for the Promotion of Material Science and Technology of Japan, and Ogasawara Foundation. 19 Refs.

The tight binding method is applied to the analysis of the energy band structure of GaAs-AlGaAs quantum-wire lasers and infrared detectors. The authors clarify the differences between the device characteristics based on the conventional Kronig-Penney model and those based on the tight binding method. The results show the importance of considering the band structure carefully when predicting the device characteristics. The tight binding method for the quantum wire is described. The gain and the differential gain characteristics, which are important parameters for the lasing characteristics, are discussed using the band structures calculated by the tight binding method. The absorption spectral properties of the quantum-wire infrared detector are discussed.

**A91-52095 Room-temperature continuous-wave operation of Al-GaAs-GaAs single-quantum-well lasers on Si by metalorganic chemical-vapor deposition using AlGaAs-AlGaP intermediate layers.** TAKASHI EGAWA, TETSUO SOGA, TAKASHI JIMBO, and MASAYOSHI UMENO, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 27, June 1991, pp. 1798-1803. 19 Refs.

The heterointerfaces of single quantum wells and the characteristics of single-quantum-well lasers on Si substrates grown with Al<sub>0.5</sub>Ga<sub>0.5</sub>As-Al<sub>0.55</sub>Ga<sub>0.45</sub>P intermediate layers entirely by metalorganic chemical-vapor deposition are reported. The effects of thermal cycle annealing on the crystallinity and lasing characteristics of GaAs-Si are also reported. Thermal cycle annealing is found to improve the crystallinity of GaAs-Si, and to contribute to room-temperature continuous-wave operation of lasers on Si substrates. By using the Al<sub>0.5</sub>Ga<sub>0.5</sub>As-Al<sub>0.55</sub>Ga<sub>0.45</sub>P intermediate layers, single quantum wells with a specular surface morphology and a smoother heterointerface can be grown on an Si substrate. Under a continuous-wave condition at room temperature, the laser exhibits an average threshold current density of 1.83 kA/sq cm, an average differential quantum efficiency of 52 percent, an internal quantum efficiency of 83 percent, an intrinsic mode loss coefficient of 23/cm, a differential gain coefficient of 1.9 cm/A, and a transparency current density of 266 A/sq cm.

**A91-52078 High-power operation of broad-area laser diodes with GaAs and AlGaAs single quantum wells for Nd:YAG laser pumping.** KIMIO SHIGIHARA, YUTAKA NAGAI, SHOICHI KARAKIDA, AKIHIRO TAKAMI, YOSHIHIRO KOKUBO, HIROSHI MATSUBARA, and SYOICHI KAKIMOTO, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 27, June 1991, pp. 1537-1543. 27 Refs.

The dependencies of the main lasing characteristics on the facet reflectivity for GaAs and AlGaAs single-quantum-well (SQW) separate-confinement heterostructure (SCH) broad-area laser diodes (LDs) are analyzed. Conditions for the facet reflectivity to achieve optimum values are identified. Under these conditions, the authors obtained respective maximum output powers of 2.9 and 2.6 W for GaAs-SQW and AlGaAs-SQW single-stripe LDs for 150 microns stripe width, lasing at about 808 nm under a continuous-wave (CW) condition. These LDs were stably operated for over 2000 h under the condition of 1 W constant output power with automatic power control circuits at 45 C in CW operation.

**A91-52086 Fabrication and characteristics of GaAs-AlGaAs tunable laser diodes with DBR and phase-control sections integrated by compositional disordering of a quantum well.** TAKAOKI HIRATA, MINORU MAEDA, MASAYUKI SUEHIRO, and HARUO HOSOMATSU, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 27, June 1991, pp. 1609-1615. 38 Refs.

GaAs-AlGaAs rib-waveguide graded-index separate-confinement heterostructure (GRIN-SCH) single-quantum-well (SQW) tunable distributed Bragg reflector (DBR) laser diodes were fabricated by (EB) lithography, ion implantation, and two-step metalorganic vapor phase epitaxy (MOVPE) growth. Active and passive waveguides were monolithically integrated by the compositional disordering of quantum-well heterostructures using silicon ion implantation. First-order gratings and rib waveguides were adopted with EB lithography to improve lasing characteristics, and they have wide application to photonic integrated circuits (PICs). Waveguide losses of partially disordered GRIN-SCH-SQW passive waveguides were as low as 4.4/cm at the lasing wavelength. A narrow linewidth as low as 560 kHz and a frequency tuning of more than 2.9 THz were obtained. The results show that this fabrication process is useful for PICs.

**A91-52068 GaAs buried heterostructure vertical cavity top-surface emitting lasers.** AKIRA IBARAKI, KOTARO FURUSAWA, TORU ISHIKAWA, KEIICHI YODOSHI, TAKAO YAMAGUCHI, and TATSUHIKO NIINA, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 27, June 1991, pp. 1386-1390. 12 Refs.

Room-temperature continuous wave (CW) operation was achieved using GaAs buried heterostructure vertical cavity top-surface emitting lasers with both GaAlAs/AlAs and SiO<sub>2</sub>/TiO<sub>2</sub> distributed Bragg reflectors (DBRs). One-step organometallic vapor phase epitaxy (OMVPE) and two-step liquid phase epitaxy (LPE) growth techniques have been developed. In order to improve the reflectivity of both DBRs, the Bragg wavelength was designed to correspond with a longer mode than the lasing mode under pulsed conditions, and a sufficiently flat planar surface was formed by LPE growth. The threshold current was 17.4 mA, and an output power of up to 0.84 mW was obtained. The lasing wavelength was about 911 nm. A 5 x 6 common voltage array was used as a trial structure for a two-dimensional array consisting of the buried heterostructure top-surface emitting laser diodes.

**A91-46556 High-output power and fundamental transverse mode InGaAs/GaAs strained-layer laser with ridge waveguide structure.** TATSUYA TAKESHITA, MASANOBU OKAYASU, and SHINGO UEHARA, *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 30, June 1991, pp. 1220-1224. 25 Refs.

Low-threshold, high-efficiency and high-output-power operation is achieved in an InGaAs/GaAs strained-layer ridge waveguide. A light output power of 80 mW for fundamental transverse mode, and 270 mW for higher-order transverse mode lasers have been obtained.

**A91-44470 Highly reliable 150 mW CW operation of single-stripe AlGaAs lasers with window grown on facets.** KAZUAKI SASAKI, MITSUHIRO MATSUMOTO, MASAKI KONDO, TADASHI TAKEOKA, TAKASHI ISHIZUMI et al., *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 30, May 15, 1991, pp. L904-L906. 8 Refs.

High-power single-stripe AlGaAs lasers with a new type of window structure named 'window grown on facets (WGF)' are described here for the first time. In the lasers, window layers have been grown on cleaved (110) facets, independent of the internal laser structures. A stable fundamental transverse mode has been obtained up to more than 200 mW of output power in the wavelength range of 830 nm. No obvious degradation has been observed beyond 2000 hours under 100 mW and 150 mW CW operation at 50 C.

**A91-41052 Long-term 60 mW operation of 780 nm AlGaAs lasers with extended beam by additional low-Al-content layer in p-type cladding layer.** S. NAKATSUKA, S. YAMASHITA, K. UCHIDA, and T. KAJIMURA, *Electronics Letters* (ISSN 0013-5194), Vol. 27, May 23, 1991, pp. 900-902. 7 Refs.

The catastrophic optical damage level of a 780 nm AlGaAs laser diode is increased by extending the optical beam profile by using a low-Al-content layer in the cladding layer. A higher light output power can be obtained without increasing threshold current, and reliable operation for more than 1000 h at 60 mW output and 50 C ambient is obtained.

**A91-26920 Ultralong dispersion-shifted erbium-doped fiber amplifier and its application to soliton transmission.** MASATAKA NAKAZAWA, YASUO KIMURA, and KAZUNORI SUZUKI, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 26, Dec. 1990, pp. 2103-2108. 16 Refs.

Distributed, dispersion-shifted erbium-doped fiber amplifiers with doping concentrations as low as 0.1-0.5 ppm were fabricated and their gain characteristics studied for the purpose of soliton amplification. A 9.4-km dual-shape-core-type amplifier with a 0.5-ppm concentration had a gain of more than 20 dB at 1.535 micron and 10 dB at 1.552 micron with a forward pumping configuration, and it could successfully amplify and transmit a 20-ps soliton pulse train at a 2.5-GHz repetition rate. The soliton transmission characteristics of an 18.2-km-long fiber amplifier were studied using backward and forward pumping. It was found that  $A \approx 1.5$  soliton pulses with a pulse width of 20 ps could be amplified over 18.2 km at a repetition rate of 5 GHz, where soliton narrowing to 16 ps was observed.

**A91-35912 High-power operation of AlGaAs SQW-SCH broad-area laser diodes for Nd:YAG solid-state laser pumping.** YUTAKA NAGAI, KIMIO SHIGIHARA, AKIHIRO TAKAMI, SHOICHI KARAKIDA, YOSHIHIRO KOKUBO et al., *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 3, Feb. 1991, pp. 97-99. 10 Refs.

AlGaAs single-quantum-well separate-confinement-heterostructure (SQW-SCH) single-stripe broad-area laser diodes (LDs) for Nd:YAG solid-state laser pumping were developed. The high-power operation of the SQW-SCH LD was demonstrated. The maximum output power under continuous wave operation at room temperature was 2.6 W in the range of the Nd:YAG absorption band. Stable operation was also confirmed for over 500 h under the condition of 25 deg C at 1 W under continuous-wave operation.

**A91-26918 Gain saturation characteristics of traveling-wave semiconductor laser amplifiers in short optical pulse amplification.** TADASHI SAITOH and TAKAOKI MUKAI, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 26, Dec. 1990, pp. 2086-2094. 21 Refs.

The gain saturation characteristics of traveling-wave semiconductor laser amplifiers (TWAs) are theoretically and experimentally investigated. In the amplification of an isolated pulse whose repetition period is short compared to the carrier lifetime, the gain saturation is related through the carrier lifetime to the gain saturation in CW amplification. The saturation energy is given as the output pulse energy at which the pulse energy gain is reduced by 2.35 dB from the unsaturated value, while the signal gain in CW amplification is decreased by 4.34 dB from the unsaturated value when the output signal intensity is equal to the saturation intensity. When the output pulse energy is smaller than the saturation energy, short optical pulses can be amplified without pulse shape distortion, whereas high-energy pulses suffer from pulse shape distortion due to the temporal gain variation during the pulse radiation. FWHM pulse duration variation in amplification by TWAs depends on the input pulse shape. The pulse energy gain saturation was experimentally confirmed to be independent of pulse durations and to be determined only by the pulse energy. When the pulse repetition period becomes comparable to or smaller than the carrier lifetime, the initial gain becomes smaller than the unsaturated gain value. In extremely-high-repetition-rate pulse amplification, the saturation of the pulse energy gain is determined by the average signal power. TWAs can amplify ultra-high-speed signals because they have a wide gain bandwidth.

**A91-25813 Characteristics of 4x4 photonic switch array with gain and high contrast.** YOSHIHIRO MORI, *Applied Physics Letters* (ISSN 0003-6951), Vol. 58, Feb. 4, 1991, pp. 438-440. 6 Refs.

A two-dimensional semiconductor photonic switch array with a new operating principle based on the change of the gain coefficient in the GaAs crystal is reported. This switch realizes direct amplification and absorption of the optical signal and features optical gain of 4 dB, contrast of 9.6 dB, applied voltage of 2.2 V, and a simple planar structure. This array is applicable to photonic parallel data transmission systems.

**A91-25811 An ultimately low-threshold semiconductor laser with separate quantum confinements of single field mode and single electron-hole pair.** MASAMICHI YAMANISHI and YOSHIHISA YAMAMOTO, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 30, Jan. 1, 1991, pp. L60-L63. Research supported by MOESC.5 Refs.

A novel semiconductor surface-emitting laser structure is proposed. All spontaneous emission is coupled into a single lasing mode by means of a quantum microcavity, and discrete electron-hole pair emission is made free of absorption by means of a dc-biased quantum dot. The quantum microcavity modifies the angle distribution of a vacuum field fluctuation that is a source of spontaneous emission. The dc-biased quantum dot separates the emission and absorption lines by image-change-induced change in the electric field. The threshold current of such a semiconductor laser can be reduced to below 100 nA.

**A91-24786 Very dense 102-laser arrays with extremely low threshold current.** SHOJI HIRATA, HIRONOBU NARUI, and YOSHIFUMI MORI, *Applied Physics Letters* (ISSN 0003-6951), Vol. 58, Jan. 28, 1991, pp. 319-321. 11 Refs.

Arrays of 102 lasers with a period of 4.5 microns were fabricated using single-step metalorganic chemical vapor deposition and were operated uniformly with a threshold current of 1.8 mA per laser and a total output power of 850 mW/facet under CW conditions at room temperature. The active layer of each laser, which was grown on a periodic-ridge-shaped GaAs substrate and was of a multi-quantum well structure, was separated from the active layer of adjacent lasers by a current blocking layer, so each laser operated in a stable fundamental lateral mode.

**A90-28381 Room temperature continuous wave operation of 671 nm wavelength GaInAsP/AlGaAs VSIS lasers.** TE-HO CHONG and KATSUMI KISHINO, *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 2, Feb. 1990, pp. 91-93. 13 Refs.

Room-temperature continuous-wave (CW) operation of a liquid-phase epitaxy (LPE)-grown GaInAsP/AlGaAs laser that uses a V-channel substrate inner stripe (VSIS) structure to obtain current confinement and transverse mode control is discussed. The threshold current and lasing wavelength were 77 mA and 671 nm, respectively, and the temperature dependence of the threshold current was such that the characteristic temperature was 75 K.