

A90-10867 Anisotropic semiconductor-dielectric strip waveguide (Anizotropnyi poloskovyi poluprovodnikovo-dielektricheskii volnovod). G. S. MAKEEVA, O. A. GOLOVANOV, and S. N. BARYSHEV, *Radiotekhnika i Elektronika* (ISSN 0033-8494), Vol. 34, Sept. 1989, pp. 1976-1979. 5 Refs.

The paper presents the results of the mathematical modeling of a semiconductor-dielectric waveguide of strip design, in which the properties of the waveguiding semiconductor strip can change under the effect of such factors as negative differential resistance (NDR) and its anisotropy in strong electric fields. Calculation results are presented for the 10-25 GHz range, and it is shown that amplification can be achieved in a semiconductor-dielectric strip waveguide in the presence of an n-GaAs film under NDR conditions when a constant electric field of superthreshold level is applied to the strip.

A89-54599 The instability of longitudinal oscillations in a limited semiconductor plasma (Neustoiichivost' prodol'nykh kolebaniy v ogranichennoi plazme poluprovodnikov). O. V. GLUKHOV and V. M. IAKOVENKO, *Radiofizika* (ISSN 0021-3462), Vol. 32, July 1989, pp. 905-911. 18 Refs.

Pierce instability in a limited semiconductor sample is investigated. The effects of the external circuit, thermal spread, and electron collision frequency on this instability are studied. Analytical expressions for growth rates are found. The possibility of using this phenomenon for microwave oscillation is shown.

A89-52769 Strain effect in acoustoelectronic devices based on single-crystal gallium arsenide (Tenzoefekt v akustoelektronnykh priborakh na osnovemonokristallicheskogo arsenida galliia). V. M. KOLESHKO and V. V. BARKALIN, *Radiotekhnika i Elektronika* (ISSN 0033-8494), Vol. 34, July 1989, pp. 1541-1543. 5 Refs.

In order to investigate the development of single-crystal GaAs SAW transducers, the strain effect (i.e., the change in the SAW propagation characteristics as the acoustic line is strained) in GaAs single crystals was studied for the main crystallographic planes and different SAW propagation directions. The results indicate that the strain effect in single-crystal GaAs is more pronounced than in structures based on single-crystal silicon.

A89-51042 A silicon-on-sapphire photodetector for an optical logic element (Fotopriemnik na KNS-strukture dlia opticheskogo logicheskogo elementa). V. I. BLYNSKII, S. A. MALYSHEV, S. I. RAKHLEI, and V. D. CHUMAK, *Avtometriia* (ISSN 0320-7102), May-June 1989, pp. 133-135. 7 Refs.

The objective of the study was to investigate the spectral characteristics of photodetectors consisting of 500x1000-micron p-n transitions formed in 0.8- and 1.9-micron epitaxial layers grown on a sapphire substrate. It is found that the spectral sensitivity of the silicon-on-sapphire photodetectors in the visible range is 0.1 A/w or better. Some specific characteristics of the spectral sensitivity of the photodetectors associated with the small length of secondary charge carriers in the thin epitaxial film and the transparency of the sapphire substrate in silicon's proper absorption range are discussed.

A89-51030 Light modulation in quantum well superconductor structures (Modulatsiia sveta v poluprovodnikovykh strukturakh s kvantovymi lamami). V. V. SHASHKIN, *Avtometriia* (ISSN 0320-7102), May-June 1989, pp. 19-30. 37 Refs.

The physical mechanisms underlying optical emission modulation in quantum well structures and the parameters of devices implementing these effects are reviewed. In particular, attention is given to the band structure and optical properties, nonlinear optical phenomena in quantum well structures, electrooptical modulation in quantum well structures, and implementations and applications of light modulators using quantum well structures. It is shown that the use of quantum well effects makes it possible to construct devices with switching speeds ranging from 1 picosecond to 100 seconds for incident emission intensities from 10 to the 6th to 10 to the -5th W/sq cm.

A90-14456 Spectral characteristics of InGaAsP/GaAs 111-line liquid-phase-epitaxy lasers ($\lambda = 0.8$ micron) intended for the pumping of YAG:Nd(3+) (Spektral'nye kharakteristiki InGaAsP/GaAs 111-line ZhFe-lazeroz $\lambda = 0.8$ mkm/, prednaznachennykh dlia nakachki IAG:Nd(3+)). I. N. ARSENT'EV, G. R. BEZHANISHVILI, P. P. BUINOV, L. S. VAVILOVA, N. A. STRUGOV et al., *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 15, Aug. 12, 1989, pp. 45-49. 9 Refs.

It is demonstrated experimentally that ultrasonic treatment primarily affects the Np heteroboundary of GaAs-AlGaAs light-emitting double heterostructures in contrast to heat treatment, which primarily affects the pP heteroboundary. The ultrasonic treatment acts on specific types of defects situated on or near the Np heteroboundary, thus improving the electrical and optical properties of the heterostructure. It is concluded that ultrasonic treatment can be used to suppress the nonlinearities on the watt-ampere characteristics of such structures.

A89-53711 A new model of the small-dose effect in semiconductors (Novaia model' efekta malykh doz v poluprovodnikakh). V. T. MAK, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 15, June 26, 1989, pp. 17-19. 9 Refs.

A model describing the behavior of semiconductors under low irradiation doses (up to 10 to the 8th rad) is presented. According to this model, low doses of nuclear radiation produce solid-phase process that in turn lead to a reduction in the density of energy states generated by microcrystallites and clusters. Such states are effective centers of recombination, leading to changes in all the properties of materials connected with recombination processes.

A89-52739 Investigation of diffraction-coupled open resonators in the short-wave region of the millimeter-wave range (Issledovanie difraktsionno-sviazannykh otkrytykh rezonatorov v korotkovolnovoi oblasti millimetrovogo diapazona dlin voln). A. A. VERTII, I. V. IVANCHENKO, and N. A. POPENKO, *Radiofizika* (ISSN 0021-3462), Vol. 32, June 1989, pp. 788-792. 9 Refs.

The characteristics of diffraction-coupled short-focus open resonators (ORs) are investigated, and it is demonstrated that they can be used as high-Q loaded circuits in semiconductor oscillator-adders. It is shown that the OR near field can be viewed as the superposition of waves radiated by the mirror edges. It is noted that the present approach can be used for the diffraction locking of stabilizing resonators in oscillator-adders.

A89-48072 The feasibility of the orbital gamma spectrometry of the moon and Mars using semiconductor detectors (O vozmozhnostiakh orbital'noi gamma-spektrometrii luny i Marsa s pomoshch'iu poluprovodnikovykh detektorov). I. U. A. SURKOV, L. P. MOSKALEVA, and O. S. MANVELIAN, *Kosmicheskie Issledovaniia* (ISSN 0023-4206), Vol. 27, May-June 1989, pp. 433-437. 8 Refs.

The paper evaluates the feasibility of using semiconductor gamma spectrometers on orbital spacecraft for the element mapping of the moon and Mars. Estimates are made of the minimum concentrations that can be determined with a gamma spectrometer employing ultrapure germanium at a volume of 200 cu cm. The efficiency of the detector according to the total absorption peak and its resolution are equal to 0.1 and 2 keV, respectively, for an energy of 1 MeV.

A89-45014 Photoresponse peculiarities of variable-gap P(+)-N-N(+) diodes. V. M. ARUTIUNIAN and A. T. DARBASIAN, (4th Eidgenoesische Technische Hochschule Zuerich, International Conference on Infrared Physics, Zurich, Switzerland, Aug. 22-26, 1988) *Infrared Physics* (ISSN 0020-0891), Vol. 29, May 1989, pp. 689-692. 8 Refs.

Phenomena taking place in P(+)-N-N(+) variable-gap diodes at low injection levels are studied. They are believed to be important to the construction of new high-efficiency optoelectronic devices. Particular attention is given to the P(+)-N-N(+) structure with a band gap in the N-type base which varies linearly with the coordinate. It is found that the sign of the potential difference created by light in the base may be either positive or negative.

Japanese Aerospace Literature This month: Semiconductors

A90-33268 Noise characteristics of Er3+-doped fiber amplifiers pumped by 0.98 and 1.48 micron laser diodes. MAKOTO YAMADA, MAKOTO SHIMIZU, MASAHARU HORIGUCHI, MASANOBU OKAYASU, TATSUYA TAKESHITA et al., *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 2, March 1990, pp. 205-207. 10 Refs.

Measured noise characteristics of Er3+-doped optical fiber amplifiers pumped by 0.98- and 1.48-micron laser diodes (LDs) are reported. The noise figures estimated from the beat noise between signal and spontaneous emission are 3.2 dB for pumping by 0.98-micron LD and 4.1 dB for pumping by 1.48-micron LD. The beat noise between spontaneous emission components and the spontaneous shot noise for the 0.98-micron pumping are lower than those for the 1.48-micron pumping.

A90-34972 p-type conductivity control of ZnSe highly doped with nitrogen by metalorganic molecular beam epitaxy. A. TAIKE, M. MIGITA, and H. YAMAMOTO, *Applied Physics Letters* (ISSN 0003-6951), Vol. 56, May 14, 1990, pp. 1989-1991. 10 Refs.

p-type ZnSe with resistivity low enough for device application has been realized by metalorganic molecular beam epitaxy. This method has enabled growth of p-type ZnSe doped with nitrogen at concentrations as high as 10 to the 19th/cu cm by using ammonia as a dopant source. The dependence of photoluminescence and electrical properties on substrate temperatures has been investigated. Hall measurements show p-type conductivity with a resistivity of 0.57 ohm cm, a carrier concentration of 5.6 x 10 to the 17th/cu cm, and a Hall mobility of 20 sq cm/V s.

A91-18316 Optimization and characterization of 780 nm AlGaAs quantum well DFB laser diodes. TAKAOKI HIRATA, MASAYUKI SUEHIRO, MINORUMAEDA, MAMORU HIHARA, NORIYUKI YAMADA et al., *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Oct. 1990, pp. L1829-L1832. 24 Refs.

AlGaAs quantum well DFB laser diodes with a wavelength of 780 nm have been fabricated using two-step MOVPE growth and EB lithography. Comparing several quantum well structures emitting 780 nm wavelength, the optimum structure was determined to be about 5 nm thick with a 0.06 Al mole fraction where low threshold current and low internal loss are realized. The GRIN-SCH structure with a carrier blocking layer was also utilized to improve the characteristic temperature of a two-step-growth laser diode. The resulting threshold current, characteristic temperature and spectral linewidth are 11 mA, 244 K and 760 kHz, respectively.

A91-17312 Estimation of tunable wavelength range in surface emitting laser using intra-cavity quantum-well tuner. NORIYUKI YOKOUCHI, FUMIO KOYAMA, and KENICHI IGA, *Institute of Electronics, Information and Communication Engineers, Transactions* (ISSN 0913-574X), Vol. E73, Sept. 1990, pp. 1473-1475. 6 Refs.

A wavelength-tunable surface-emitting laser using a multiple quantum well as a tuning element is proposed. Wavelength can be tuned continuously over 150 Å for a tuner with a refractive index change of 4 percent, a filling factor of 0.3, and without absorption loss. The actual tuning width is limited to be 3.5 Å with a refractive index change of -0.43 to 0.15 percent, considering an absorption loss.

A91-12785 Selectively Se-doped AlGaAs/GaAs heterostructures with reduced DX-center concentrations grown by molecular-beam epitaxy. TOMONORI ISHIKAWA, TAKESHI MAEDA, and KAZUO KONDO, *Journal of Applied Physics* (ISSN 0021-8979), Vol. 68, Oct. 1, 1990, pp. 3343-3347. 16 Refs.

The formation of DX centers in the n-AlGaAs layers constitutes the greatest problem hindering the cryogenic operation of HEMTs based on AlGaAs. In this paper, the DX centers were studied in Si- and Se-doped Al(x)Ga(1-x)As layers grown by MBE. It was found that the concentration of DX centers was considerably lower in Se-doped layers than in the Si-doped ones, because of their shallower energy levels. Selectively doped Al(0.2)Ga(0.8)As/GaAs heterostructures were grown using Se as a dopant, which were almost free of DX centers and displayed two-dimensional electron gas mobility of 70,000 sq cm/V at 77 K.

A91-11644 beta-SiC formation by low-energy ion-doping technique. MASAHIRO DEGUCHI, AKIHISA YOSHIDA, MASATOSHI KITAGAWA, and TAKASHI HIRAO, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Aug. 1990, pp. L1493-L1496. 7 Refs.

beta-SiC was prepared on silicon (Si) substrates by a low-energy ion-doping technique without mass separation. Carbon(C) and hydrogen (H) ions obtained from a discharge of diluted methane gas with hydrogen gas were implanted into Si substrates at the dc acceleration voltage of 3.0 kV. The dependence of carbon dose, dilution ratio, and annealing temperature (Ta) on the Si-C bond formation was investigated. Simultaneous implantation on H ions as well as C ions was effective for tight Si-C bond formation at low Ta (less than 800 C). By annealing at high Ta (greater than 800 C), the beta-SiC network was formed in the implanted layer. With increasing carbon dose, the amount of the beta-SiC increased and was saturated at the dose of about 4 x 10 to the 15th ions/sq cm.

A91-11640 Narrow-linewidth tunable visible InGaAlP laser, application to spectral measurements of lithium, and power amplification. MOTOICHI OHTSU, HIROMASA SUZUKI, KOUHICHI NEMOTO, and YASUAKI TERAMACHI, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Aug. 1990, pp. L1463-L1465. 9 Refs.

Coarse and fine tuning of a 3.3 THz sweep range for an optically stabilized InGaAlP laser were realized for the first time by varying the angle of an external grating surface and the length of an external confocal Fabry-Perot cavity while maintaining the narrow linewidth of less than 50 kHz. Optogalvanic spectral shapes of D1 and D2 lines in Li vapor were measured by this laser, and the spectral splitting due to D.C. Stark effect was clearly observed. The laser power was amplified 25 dB by a dye solution which was optically pumped by the second harmonics of a pulsed YAG laser.

A90-43135 Analysis of distributed feedback semiconductor lasers by two-dimensional theory. YOSHIKAZU HORI and HISANAO SATO, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 26, April 1990, pp. 655-662. 19 Refs.

The two-dimensional theory of distributed feedback (DFB) lasers developed by Sato and Hori (1990) to take account of the planar waveguide structure is applied to the analysis of the DFB laser threshold conditions with respect to the effects of the waveguide structure and the facet reflection. The asymmetric properties of the transverse functions of the coupled modes with respect to the Bragg frequency in the dispersion relations are found to be enhanced by the asymmetric index waveguide structure and by the asymmetric facet reflectivity. Therefore, the resulting confinement factor differences in the grating layer between the two adjacent lasing modes on both sides of the Bragg frequency give large threshold gain differences. A new waveguide design concept is proposed to realize DFB lasers with single-mode operation independent of the corrugated phase at the reflective facet.

A91-16094 Infrared detection by semiconducting fibre. N. MUTO, M. MIYAYAMA, H. YANAGIDA, T. KAJIWARA, N. MORI et al., *Journal of Materials Science Letters* (ISSN 0261-8028), Vol. 9, Nov. 1990, pp. 1269-1271. 13 Refs.

Results are reported of measurements of electrical resistivity and the IR-detection properties of SiC and Si-Ti-C-O fibers and two kinds of commercial carbon fibers: pitch-based and rayon-based. All four types of fibers were found to display NTC resistance-temperature characteristics. It was also found that fibers with the largest thermistor constant display largest output voltage, independent of the fiber material.

A91-11627 Negative differential resistance of strain-free InGaAs/AlAsSb resonant tunneling barrier structures lattice-matched to InP. TSUGUO INATA, SHUNICHI MUTO, YOSHIKI NAKATA, and TOSHIO FUJII, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Aug. 1990, pp. L1382-L1384. 13 Refs.

AlAsSb/InGaAs (4.40 nm) resonant tunneling barrier structures lattice-matched to InP substrates were grown using molecular beam epitaxy. Peak-to-valley current ratios exceeding 10 at room temperature were achieved for the first time with fully lattice-matched resonant tunneling barrier structures (15 with a peak current density, Jp, of 2370 A/sq cm and 11 with Jp of 15,100 A/sq cm. These values are comparable to peak-to-valley current ratios in InGaAs/AlAs pseudomorphic resonant tunneling barrier structures with corresponding peak current densities.

A91-11626 Selective area epitaxy of GaAs using GaAs oxide as a mask. YUJI HIRATANI, YOSHIMASA OHKI, YOSHIMASA SUGIMOTO, KENZO AKITA, MOTOTAKA TANEYA et al., *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Aug. 1990, pp. L1360-L1362. 6 Refs.

The use of GaAs oxide as a mask material for in situ selective area epitaxy of GaAs by metal organic molecular beam epitaxy (MOMBE) was studied. The GaAs oxide mask was patterned by electron-beam-induced chlorine etching. Using trimethylgallium (TMG) and As4 as source materials, an epitaxial layer of GaAs was obtained on the opening of the GaAs oxide mask; no deposition was observed on the GaAs oxide. An observation of the thermal decomposition of TMG by mass spectrometry indicated that the thermal decomposition of TMG occurred above 350 C on an arsenic-stabilized surface, while decomposition did not occur below 550 C on the GaAs oxide surface. This surface-catalyzed reaction explains the selectivity of GaAs growth.

A91-10804 Optical beam scanner with phase-variable semiconductor waveguides. KAZUNORI MORIKI, YOSHIHUMI OHNISHI, HIROSHI UCHIDA, TAKEO HATTORI, KENICHI IGA, *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 29, July 1990, pp. 1276, 1277. 5 Refs.

This paper describes the design and the principle of operation of an optical beam scanner with two phase-variable semiconductor waveguides, which has the possibility of high-speed steering. The maximum deflection angle achieved with the device was 0.67 under 9.5 V reverse bias. A schematic diagram of the fabricated device is presented.

A91-10779 Beam scanning binary logic. HIDEO ITOH, SEIJI MUKAI, MASANOBU WATANABE, MASAHIKO MORI, and HIROYOSHI YAJIMA, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, July 1990, pp. L1268, L1269. 6 Refs.

A beam-scanning laser diode (BSLD) is presently applied to a novel optoelectronic logic operation, designated 'beam-scanning binary logic' (BSBL), that covers the implementation of both the basic logic gates and a spatial code encoder for photodetection, while allowing a greater reduction of the number of active devices than ordinary binary logic operations. BSBL executes multifunctional logic operations simultaneously. The data connections between logic gates in BSLD are flexible, due to the ability to electrically control both output power and laser-beam direction.

A91-10773 Very fast integrated optoelectronic logic for parallel computation using photodiode gates. HIROYUKI KAMIYAMA, ATSUGO SHOONO, TAKESHI KAMIYA, and YASUNARI UMEMOTO, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, July 1990, pp. L1248-L1251. 10 Refs.

A new configuration of an integrated optoelectronic logic unit using GaAs photodiode gates is proposed. Implementation of AND and EOR logic units are performed monolithically using GaAs/AlGaAs multilayer structures. Discussions are made on the realization of the full adder by means of optical feedback between the photodiode logic array and the surface emitting diode laser array.

A90-43131 A rapid optoelectronic half-adder logic composed of a pair of GaAs metal-semiconductor-metal photodetectors. KAZUTOSHI NAKAJIMA, TAKASHI IIDA, KEN-ICHI SUGIMOTO, HIROFUMI KAN, and YOSHIHIKO MIZUSHIMA, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 26, April 1990, pp. 619-621. 18 Refs.

A novel optoelectronic half-adder logic, composed of only two GaAs metal-semiconductor-metal photodetectors (MSM-PDs), is reported. The optoelectronic logic utilizes the features of the MSM-PD for both polarities of electrical bias (positive and negative). Without any other active devices such as transistors, the output delay time is short, less than 100 psec for the entire half-adder operation, which assures a very fast arithmetic operation.

A90-52828 Low-threshold surface-emitting laser diodes with distributed Bragg reflectors and current blocking layers. M. SHIMADA, T. ASAKA, Y. YAMASAKI, H. IWANO, M. OGURA et al., *Applied Physics Letters* (ISSN 0003-6951), Vol. 57, Sept. 24, 1990, pp. 1289-1291, 13 Refs.

Electrical characteristics of poly(3-alkylthiophene) and metal interfaces have been studied. Good Schottky type diodes have been fabricated using aluminum and gold-tin electrodes vacuum-evaporated onto poly(3-alkylthiophene) films. Markedly large temperature dependences are observed for poly(3-alkylthiophene) Schottky diodes and discussed in terms of a temperature-dependent electronic band scheme.

A90-52204 Atomic layer epitaxy of ZnS on GaAs substrates by metalorganic molecular beam epitaxy. YI-HONG WU, TAKASHI TOYODA, YOICHI KAWAKAMI, SHIZUO FUJITA, and SHIGEO FUJITA, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, May 1990, pp. L727-L730, 7 Refs.

ZnS was grown on GaAs (001) substrates by a metalorganic molecular beam epitaxy technique, using sequential dimethylzinc and hydrogen sulfide reactant gas exposures, where these gases were supplied to the substrates after cracking at 950 and 1080 C, respectively. The results show that at a given temperature between 250 and 310 C, the growth rate was observed to be determined by the number of growth cycles, which is typical of atomic layer epitaxy (ALE). In spite of very large lattice mismatch (4.4 percent) between ZnS and GaAs, ZnS layers grown in an ALE mode showed good surface morphology and exhibited strong near-band-edge photoluminescence.

A90-51605 Modulation-doped multi-quantum well (MD-MQW) lasers. I-Theory. KAZUHISA UOMI, *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 29, Jan. 1990, pp. 81-87, 25 Refs.

A number of important parameters, such as gain, modulation response, and threshold current in modulation-doped MD-MQW lasers are theoretically investigated. The analytical results indicate that the relaxation oscillation frequency of p-type MD-MQW lasers is enhanced by a factor of 4 compared with DH lasers, and that the linewidth enhancement factor of p-type MD-MQW lasers is reduced to 1/4 that of undoped MQW lasers. The threshold current density of n-type MD-MQW lasers is reduced to 1/2 to 1/4 that of undoped MQW lasers. The improvements in these properties basically result from the unsatisfied charge neutrality due to the modulation-doped effect and from asymmetry in density of states between conduction band and valence bands in III-V materials.

A90-51192 Efficient optical amplifier using a low-concentration erbium-doped fiber. NOBUYUKI KAGI, KAZUNORI NAKAMURA, and AKIRA OYOBIE, *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 2, Aug. 1990, pp. 559-561, 11 Refs.

A gain coefficient of 3.8 dB/mW was achieved for an erbium-doped fiber amplifier pumped by a 1.48 micron laser diode. The main reasons for the improvement are high NA (0.23) and low concentration (43 ppm). Pump-to-signal energy conversion efficiency was 18 percent at 3 dB gain compression. A decrease in saturation power with increasing erbium concentration was also demonstrated. In high-concentration fiber, fluorescence at 0.98 micron due to cooperative upconversion was detected. These results indicate that several kilometers of distributed fiber amplifier with high gain and high output saturation power could be possible, because the absorption coefficient at 1.48 micron is still two orders higher than the background loss in the 43 ppm fiber.

A90-50048 Time-of-flight measurement of electron velocity in an $\text{In}(0.52)\text{Al}(0.48)\text{As}/\text{In}(0.53)\text{Ga}(0.47)\text{As}/\text{In}(0.52)\text{Al}(0.48)\text{As}$ double heterostructure. NAOTERU SHIGEKAWA, TOMOFUMI FURUTA, and KUNIHITO ARAI, *Applied Physics Letters* (ISSN 0003-6951), Vol. 57, July 2, 1990, pp. 67-69, 10 Refs.

The electron velocity versus electric field (v-E) relationship was measured between 0 and 12 kV/cm at room temperature for a selectively Be-doped $\text{In}(0.52)\text{Al}(0.48)\text{As}/\text{In}(0.53)\text{Ga}(0.47)\text{As}/\text{In}(0.52)\text{Al}(0.48)\text{As}$ double heterostructure. It was found that the observed electron velocity is greater than that previously measured for an $\text{AlGaAs}/\text{GaAs}/\text{AlGaAs}$ double heterostructure over the entire range of field investigated. This indicates the superiority of $\text{In}(0.53)\text{Ga}(0.47)\text{As}$ as a material for high-speed semiconductor devices. The experimental results were also compared with those of the Monte Carlo calculation, and a remarkable discrepancy between the experiment and the calculation was found above the threshold field.

A90-43123 A novel amplified image sensor with a-Si:H photoconductor and MOS transistors. ZHONG-SHOU HUANG and TAKAO ANDO, *IEEE Transactions on Electron Devices* (ISSN 0018-9383), Vol. 37, pt. 1, June 1990, pp. 1432-1438, 18 Refs.

An image sensor and a 16×16 pixel test device consisting of a MOS transistor array overlaid with an a-Si:H photoconductive film are presented. The sensor operates by applying the potential induced on the surface of an a-Si:H film directly to the gates of the MOS transistors, and then reading out the modulated drain currents. Photosensitivity is 4-5.6 $\mu\text{A}/(\text{nJ}/\text{sq cm})$ for incident light of wavelength 600 nm, dynamic range is over 85 dB, and gamma = about 1. The sensor can be constructed in four configurations, depending on whether the carriers of image information in the a-Si:H film or MOS transistor channel are electrons or holes. The properties of signal and gain for the sensors of low and high pixel density, respectively, are analyzed, and it is pointed out that two distinct amplifying effects can exist in the sensor simultaneously.

A90-42375 Laser heterodyne spectrometer using a liquid nitrogen cooled tunable diode laser for remote measurements of atmospheric O₃ and N₂O. H. FUKUNISHI, S. OKANO, M. TAGUCHI, and T. OHNUMA, *Applied Optics* (ISSN 0003-6935), Vol. 29, June 20, 1990, pp. 2722-2728, 14 Refs.

A laser heterodyne spectrometer with a tunable diode laser as a local oscillator has been developed for ultrahigh resolution IR spectroscopy of the absorption spectra of trace constituents in the earth's atmosphere. The spectral resolution and SNR of the developed system are 0.0013/cm and about 500, respectively. This performance is sufficient for retrieving the altitude profile of atmospheric O₃ through an inversion method. The altitude profile of atmospheric N₂O has been also obtained for the first time with this laser heterodyne technique. The high resolution and high SNR have been accomplished by adopting a tunable diode laser which operates at liquid nitrogen temperature and by developing an effective technique to eliminate the optical feedback of the local oscillator laser beam.

A90-41918 Low-temperature ferromagnetism in $\text{La}_4\text{Ba}_2\text{Cu}_2\text{O}_{10}$. F. MIZUNO, H. MASUDA, I. HIRABAYASHI, S. TANAKA, M. HASEGAWA et al., *Nature* (ISSN 0028-0836), Vol. 345, June 28, 1990, pp. 788, 789, 9 Refs.

The origin of the ferromagnetic-like behavior previously observed near 5 K in impure samples of $\text{LaBa}_2\text{Cu}_3\text{O}_7$ prepared under a reduced oxygen atmosphere is identified as the presence of an impurity phase, $\text{La}_4\text{Ba}_2\text{Cu}_2\text{O}_{10}$ (the 422 phase). The 422 phase contains square planar CuO_4 units, with each of these units lying perpendicular to those around it. Magnetization measurements indicate an effective magnetic moment of 1.66 μ_B per copper ion, with a saturation magnetic moment of 0.95 μ_B per Cu. These results suggest that the compound is a localized ferromagnet in which the copper ions are magnetically ordered. It is suggested that the ferromagnetic coupling may originate in the orthogonality of the CuO_4 units. The 422 phase could provide flux-pinning centers in bulk superconducting $\text{LaBa}_2\text{Cu}_3\text{O}_{7-y}$.

A90-39832 Analogue MOS current-mode circuits for three-dimensional integrated smart image sensor. S. KAWAHITO, M. ISHIDA, and T. NAKAMURA, *Electronics Letters* (ISSN 0013-5194), Vol. 26, Feb. 1, 1990, pp. 177-179, 5 Refs.

A novel image signal processing technique using analog MOS current-mode circuits is proposed. The resulting image processing circuits resulting from the technique can be implemented very compactly because the image sensor photocurrent is processed directly and the wired summation in current mode can be effectively used in image processing. The technique shows promise as an approach to achieving the three-dimensional smart image sensor.

A90-39823 A 110 GHz SIS receiver for radio astronomy. H. OGAWA, A. MIZUNO, H. ISHIKAWA, Y. FUKUI, and H. HOKO, *International Journal of Infrared and Millimeter Waves* (ISSN 0195-9271), Vol. 11, June 1990, pp. 717-726, 17 Refs.

A 110 GHz superconductor insulator superconductor (SIS) tunnel junction receiver has been developed and used in regular astronomical observations on the 4m radio telescope at the Department of Astrophysics, Nagoya University. The SIS junction consists of a sandwich structure of Nb/AlOx/Nb, and is cooled to 4.2 K with a closed cycle He-gas refrigerator. The receiver exhibits a best double side band noise temperature of 23 + or - 2 K at 110 GHz. Additional measurements at 98-115 GHz indicate that the receiver has a good response over this input frequency range.

A90-36316 The growth of GaAs, AlGaAs, and selectively doped AlGaAs/GaAs heterostructures by metalorganic vapor phase epitaxy using tertiary butylarsine. T. KIKKAWA, H. TANAKA, and J. KOMENO, *Journal of Applied Physics* (ISSN 0021-8979), Vol. 67, June 15, 1990, pp. 7576-7582, 25 Refs.

The possibility of using tertiary butylarsine (tBAs), instead of the very hazardous AsH₃, as an arsenic source for the growth of GaAs, AlGaAs, and selectively doped AlGaAs/GaAs heterostructures was investigated. The surface morphology of these films was examined by Normarski interference contrast optical microscopy; the electrical mobility of epilayers was measured by the van der Pauw-Hall method; the carrier concentration was obtained by the Hall and C-V methods; the GaAs and AlGaAs growth rates were determined using a stylus profiler and by the C-V method, respectively; and the optical properties of the epilayers were evaluated by photoluminescence (PL) spectroscopy. It was found that the surface morphology of the GaAs and AlGaAs epilayers grown using tBAs were comparable to those obtained using AsH₃. GaAs films grown with tBAs were of high quality, and the carbon incorporation into the GaAs epilayer was as low as could be achieved with AsH₃.

A90-28385 Picosecond laser diode pulse amplification up to 12 W by laser diode pumped erbium-doped fiber. ATSUSHI TAKADA, KATSUMI IWATSUKI, and MASATOSHI SARUWATARI, *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 2, Feb. 1990, pp. 122-124, 14 Refs.

Intense picosecond optical pulse generation from a gain-switched laser diode (LD) was demonstrated using a 1.48-micron LD-pumped Er³⁺-doped fiber laser amplifier. Saturation characteristics of the amplifier output power were also measured as a function of input repetition frequency. An amplified peak power of 12 W and 105-pJ pulse energy were obtained for 9-ps pulses at a 33-GHz repetition frequency. This is the highest peak power yet demonstrated in pulse generation employing all-laser diodes as active devices.