

A91-33855 Field transducer without background (Besfonovyi preobrazovatel' polia). M. L. PERELASLAVETS, A. N. SIVOV, and A. D. CHUPRIN, *Radiotekhnika i Elektronika* (ISSN 0033-8494), Vol. 36, Jan. 1991, pp. 42-47. 10 Refs.

The paper develops a method for designing a two-dimensional electromagnetic-field transducer which is formed by three curvilinear or four plane semitransparent surfaces having a transparency that is variable along the surface. It is shown that the spatial structure of different microwave fields in the waveguide or in free space (antenna devices) can be transformed precisely (without background). Numerical results are presented.

A91-32418 Propagation of electromagnetic fields from seismic sources into the upper ionosphere (Prokhozhdenie elektromagnitnykh polei ot seismicheskikh istochnikov v verkhniulu ionosferu zemli). O. A. MOLCHANOV, *Geomagnetizm i Aeronomiya* (ISSN 0016-7940), Vol. 31, Jan.-Feb. 1991, pp. 111-119. 13 Refs.

A theoretical analysis indicates that the propagation of wideband electromagnetic radiation from a seismic source through the earth's surface, the lower atmosphere, and the ionosphere leads to the excitation of oblique Alfvén waves in the 0.3-10 Hz range in the upper ionosphere and magnetosphere. The propagation efficiency is greater for a magnetic-type source than for an electric-type source, and increases with decreasing conductivity of the earth. The excitation zone is circular with a radius of 100-150 km.

A91-37245 Reflection properties of an optically controlled panel based on a semiconductor-dielectric-metal structure (Otrazhatel'nye svoistva optoupravliaemoi paneli na osnove struktury poluprovodnikov-dielektrik-metal). A. E. ZAIKIN, P. I. PETROV, and A. V. POLIAKOV, *Radioelektronika* (ISSN 0021-3470), Vol. 34, Feb. 1991, pp. 81-84.

The design of an optically controlled semiconductor-dielectric-metal panel for use in microwave visualization devices is described. Experimental results are shown to agree well with the theoretical design considerations.

A91-37247 Oscillation spectrum of a cylindrical resonator tuned by a dielectric rod (Spektr kolebanií tsilindricheskogo rezonatora, perestraivomogo dielektricheskim sterzhnem). I. U. G. BELOV, A. S. KOGTEV, L. G. RUDOLASOVA, and G. I. SHISHKOV, *Radioelektronika* (ISSN 0021-3470), Vol. 34, Feb. 1991, pp. 90-92.

The method of partial regions is used to analyze the resonant mode spectrum of a cylindrical resonator tuned by a dielectric rod. The resonant value of the wavenumber of the working mode E₀₁₀ is calculated as a function of the relative length of the dielectric rod.

A91-33863 Nonstationary processes in a gyrotron with an unfixed RF-field structure (Nestatsionarnye protsessy v girotrone s nefiksirovannoi strukturoi VCh-polia). N. A. ZAVOL'SKII and G. S. NUSINOVICH, *Radiotekhnika i Elektronika* (ISSN 0033-8494), Vol. 36, Jan. 1991, pp. 135-141. 7 Refs.

A theory is developed which makes it possible to describe nonstationary processes in a gyrotron with an oversize low-Q resonator whose Rf field can be unfixed with respect to both the longitudinal and the azimuthal coordinate. The results obtained make it possible to determine the limiting dimensions of resonators in the case of which high-efficiency stable single-mode oscillation is possible.

A91-37229 Structure of the energy spectrum of the radiation field of active phased-array antenna for the case of the monochromatic signal of the exciter (Struktura energeticheskogo spektra polia izlucheniia aktivnykh FAR pri monokhromaticheskoi signale vozбудitelia). V. L. GOSTIUKHIN and V. N. TRUSOV, *Radioelektronika* (ISSN 0021-3470), Vol. 34, Feb. 1991, pp. 21-26.

The characteristics of secondary radiation of active phased arrays in the presence of noise at the input of the active modules are analyzed. A spectral-correlation investigation of the problem makes it possible to obtain analytical expressions for the components of the complete energy spectrum and to establish their dependence on the spatial coordinates.

Japanese Aerospace Literature This month: Optoelectronic Devices

A92-38955 Optoelectronic adaptive neuro-device. H. YONEZU, K. KANAMORI, K. TSUJI, T. HIMENO, Y. TAKANO, and K. PAK, *Electronics Letters* (ISSN 0013-5194), Vol. 28, No. 8, April 9, 1992, pp. 715-717. Research supported by MOESC and Research Foundation for the Electrotechnology of Chubu. 5 Refs.

The development of a new adaptive neurodevice with a nonvolatile memory function is reported. The adaptive neurodevice is based on EEPROM technology and has additional control electrodes; the synaptic weights are varied during operation depending on target signals. The device can be used for implementing learning algorithms for self-organizing neural networks. It can also be used in hardware implementing learning algorithms without a teacher or in other adaptive circuits where the desired output varies according to reference signals.

A92-32428 A new optical neuron device for all-optical neural networks. KOJI AKIYAMA, AKIO TAKIMOTO, MICHIOH MIYAUCHI, YASUNORI KURATOMI, JUNKO ASAYAMA, and HISAHITO OGAWA, *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 30, Dec. 1991, pp. 3887-3892. 9 Refs.

A new optical neuron device has been developed. The device can perform both summation and thresholding operations in optics, and consists of a PIN a-Si:H photoreceptor, aluminum neuron electrodes and a ferroelectric liquid crystal light modulator. The a-Si:H photoreceptor shows characteristics of an ideal quantum efficiency and a good linearity. The optical neuron device exhibits a response time of about 300 microns for incident light power of 9 microW and a contrast ratio of 300:1. Using this neuron device, a lenslet array and a memory mask, an all-optical neural network has been constructed. The network demonstrates an associate memory function on purely optical parallel processing without any help from electric computation.

A92-31744 Operational wavelength range of GaInAs(P)-InP intersectional optical switches using field-induced electrooptic effect in low-dimensional quantum-well structures. KAZUHIKO SHIMOMURA, SHIGEHISA ARAI, and YASUOHARU SUEMATSU, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 28, Feb. 1992, pp. 471-478. Research supported by MOESC and Tepco Research Foundation. 32 Refs.

Operational wavelength range for low insertion loss and high extinction ratio of GaInAs(P)-InP intersectional optical switches consisting of low-dimensional quantum-well structures, such as quantum-box, quantum-wire, and quantum-film structures, is theoretically analyzed. It is found that superior operation characteristics can be attained with the lower-dimensional quantum-well structure. For instance, an operational wavelength range of around 10 nm for an insertion loss less than 1 dB and an extinction ratio higher than 50 dB can be obtained with the device using a quantum-box structure.

A92-38834 Dynamic set and reset operations with a single optical beam for an InGaAsP/InP optoelectronic latching device. KENICHI MATSUDA and JUN SHIBATA, *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 4, No. 5, May 1992, pp. 483-485. 11 Refs.

A novel optoelectronic latching device is proposed and demonstrated. The device has a stacked structure consisting of a light-emitting diode (LED) and two heterojunction phototransistors (HPTs). The LED and one of the HPTs are connected electrically in series to form a bistable switch based on optical positive feedback. The other HPT is connected in parallel to the switch for reset operation. A single optical beam modulated with pulse signals is input to both HPTs simultaneously. The optical pulse with a peak power ranging from 7 to 30 micro-W turns on the switch, and the pulse with higher optical power turns it off.

A92-34846 Novel optoelectronic RS flipflop based on optically coupled inverters. T. CHINO, K. MATSUDA, H. ADACHI, and J. SHIBATA, *Electronics Letters* (ISSN 0013-5194), Vol. 28, No. 7, March 26, 1992, pp. 641, 642. 5 Refs.

An optoelectronic RS flipflop emitting differential output has been proposed and demonstrated. It consists of two optical inverters. Optical interconnections are used to couple these inverters. Stable operation for the variation of bias voltage is demonstrated, which exhibits the possibility for 2-dimensional integration.

A91-41060 Organic patch sensor for electro-optic measurement of electrical signals in integrated circuits. T. NAGATSUMA, M. YAITA, M. SHINAGAWA, M. AMANO, and Y. SHUTO, *Electronics Letters* (ISSN 0013-5194), Vol. 27, May 23, 1991, pp. 932-934. 6 Refs.

A highly sensitive, versatile and low-cost electric field sensor has been developed for measuring internal electrical signals in integrated circuits using an electrooptic sampling technique. This sensor uses an organic nonlinear optical (NLO) polymer coated on thin polyimide films and is directly bonded to the circuit under test without a mirror coating. Electrooptic sampling was conducted using the sensor, and a voltage sensitivity of less than a few tens of millivolts was obtained.

A90-51592 Proposed for device transplantation using a focused ion beam. TSUYOSHI OHNISHI, YOSHIMI KAWANAMI, TOHRU ISHITANI, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Jan. 1990, pp. L188-L190. 19 Refs.

Device transplantation using a focused ion beam (FIB) has been proposed as a new high-resolution technique for microdevice assembly as well as device repair. FIB sputtering, redeposition, and FIB-induced deposition each work as a cutter or a fixer. Feasibility experiments have been carried out both for dummy-device transplantation on a silicon substrate and for microgear fabrication.

A92-32959 Optical nonlinear responses of a quantum well photodiode with a non-ohmic contact. YUJI ABE, YASUNORI TOKUDA, KYOZO KANAMOTO, and NORIAKI TSUKADA, *Applied Physics Letters* (ISSN 0003-6951), Vol. 60, April 6, 1992, pp. 1664-1666. 15 Refs.

The dependence of photocurrent properties on incident optical power in a quantum well p-n photodiode with a nonohmic contact was investigated. The experimental results showed that a significant absorption peak shift, in an extremely low optical power range, as well as a notable modification in the spectral shape at a higher power range was observed, without any external feedback element. The mechanism for the optical nonlinear responses can be explained in terms of the built-in field screening at the p-i-n junction or by taking into account the load characteristics of the Schottky-like contact.

A92-31758 Oscillation modes of laser diode pumped hybrid bistable system with large delay and application to dynamical memory. TAHITO AIDA and PETER DAVIS, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 28, March 1992, pp. 686-699. 32 Refs.

An electrooptical bistable system with a very large delay was constructed, and self-oscillation phenomena were investigated. Many multistable self-oscillation modes were observed, including second-order bifurcations of the 265th harmonic. The dynamical memory function was demonstrated by locking second order bifurcated modes to external clock oscillations and performing WRITE and READ of binary data sequences in the waveforms of the bifurcated modes. The nonlinear bifurcation phenomena in this system are applicable for large-capacity memory and signal processing. Spurious preferential excitation of particular harmonic modes was related to the fine structure in the transfer spectrum of the open loop associated with spurious resonances in the electrooptical modulator used as a nonlinear element. Missing harmonics could be recovered by pumping with small sinusoidal signals of the corresponding frequencies.

A92-31749 Effects induced by transit time on a coupled two-element optical bistable device. JYH-LONG CHERN, KENJU OTSUKA, PAUL MANDEL, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 28, Feb. 1992, pp. 555-561. Research supported by NTT. 21 Refs.

The authors study the effects of finite transit time, i.e., delay, on dynamics in a coupled two-element optical bistable device. Finite transit time is considered because of signal propagation between the elements. It is shown that delay can be used as a measure of crosstalk between the coupled elements and it will increase the lethargy time. Thus, many interesting, transient phenomena take place both in hysteresis and pitchfork (symmetry-breaking) regimes. Symmetry-recovering crisis originating from the collision between the unstable periodic orbit and chaotic asymmetrical solution is predicated to occur for T roughly τ (T : transit time, τ : response time of nonlinear medium). It is shown that symmetry-recovering crisis results in switching failure in set-reset (S-R) flip-flop operations with a pitchfork bifurcation structure.

A92-31745 Analysis on interband-resonant light modulation by intersubband-resonant light in n-doped quantum wells. SUSUMU NODA, TETSUYA UEMURA, TAKAO YAMASHITA, and AKIO SASAKI, *IEEE Journal of Quantum Electronics* (ISSN 0018-9197), Vol. 28, Feb. 1992, pp. 493-500. Research supported by MOESC and Inamori Foundation. 27 Refs.

The authors describe a theoretical analysis on interband-resonant light modulation by intersubband-resonant light in the n-doped quantum well. The modulation principle is briefly explained. The theoretical formulation for the modulation is derived by using density matrix theory. The modulation characteristics concerning the absorption coefficient and refractive index are calculated for various parameters. It is shown that the absorption coefficient for the interband-resonant light can be greatly changed by the incidence of intersubband-resonant light.

A92-18427 InGaAsP/InP optoelectronic exclusive-OR (XOR) gate operating with optical inputs and outputs. H. ADACHI, K. MATSUDA, T. CHINO, and J. SHIBATA, *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 3, Nov. 1991, pp. 1013-1015. 7 Refs.

An optoelectronic exclusive-OR (XOR) gate operating with optical inputs and outputs was fabricated. The gate is based on an optoelectronic bistable switch consisting of a light emitting diode (LED) and a heterojunction phototransistor (HPT). The inverter function indispensable for the XOR logic is attained optically by connecting an additional HPT to the bistable switch in parallel. Successful operation of the XOR logic was demonstrated.

A91-24004 Optoelectronic integrated components for digital optical computing systems. OSAMU WADA and SHIGENOBU YAMAKOSHI, *Digital optical computing II; Proceedings of the Meeting*, Los Angeles, CA, Jan. 17-19, 1990 (A91-24001 08-74). Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, pp. 28-37. 28 Refs.

This paper discusses basic component technologies for the development of digital optical computing systems. The establishment of integration technologies, including optoelectronic and photonic integrations, is important for the application of optoelectronic devices in computing systems, especially for use in optical interconnections. The development of optical bistable devices is a prerequisite for improving computing performance. Both of these technologies are a significant basis for optoelectronic computing systems, and can be built up by using III-V semiconductor materials. Recent advances in these fields will be presented.

A91-44461 Theory of optical second-harmonic generation in slab waveguides. TOMOHIRO ONDA and RYOICHI ITO, *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 30, May 1991, pp. 957-982. 20 Refs.

A theory of optical second-harmonic generation in a slab waveguide with a nonlinear dielectric core is presented; two types of second-harmonic generation, the guided-mode and the Cerenkov-radiation types, are systematically treated on an equal basis. Exact analytical solutions for the field distribution and the power of TE-mode second-harmonic waves are obtained, neglecting the depletion of the fundamental waves and assuming isotropic and nondissipative mediums. Conditions for attaining high conversion efficiency are discussed on the basis of the results of numerical calculations.

A91-50087 Complex multistable responses of serially connected optical bistable devices. YASUNORI TOKUDA, YUJI ABE, KYOZO KANAMOTO, and NORIAKI TSUKADA, *Applied Physics Letters* (ISSN 0003-6951), Vol. 59, Aug. 26, 1991, pp. 1016-1018. 18 Refs.

The response characteristics of two bistable elements optically connected in series, i.e., vertically integrated self-electrooptic effect devices are reported. The experimental results demonstrated that a variety of the multistable responses are obtained by controlling the electrical parameters. The composite characteristics of the two-tier system can be clearly predicted and interpreted in terms of the overlap of three bistable regions.

A91-46837 Monolithic integration of a new optoelectronic device based on a modulation-doped heterostructure. Y. HONDA, I. SUEMUNE, and M. YAMANISHI, *Applied Physics Letters* (ISSN 0003-6951), Vol. 59, Aug. 5, 1991, pp. 621-623. 9 Refs.

Monolithic integration of a new type of optoelectronic device which functions not only as a lateral-current-injection laser but also as a junction field-effect transistor based on a modulation-doped heterostructure is proposed and demonstrated for the first time. The static and dynamic modulation characteristics of the integrated device were studied. The dynamic on/off ratio of 9 in the light output was observed with the preliminary modulation experiment at the repetition frequency of 50 MHz.

A91-36334 Electro-optical Q-switched tunable forsterite laser. AKIKO SUGIMOTO, YUSABURO SEGAWA, YUIKO NOBE, KIYOSHI YAMAGISHI, and YASUhide YAMAGUCHI, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 30, March 15, 1991, pp. 495, 496.

The tunable Q-switching operation of forsterite (Cr:Mg₂SiO₄) laser was demonstrated. The typical Q-switched pulse was 60 ns to 80 ns in width, varied with lasing wavelength. A smooth tuning curve that extends from 1206 nm to 1264 nm was obtained.

A91-34388 Optoelectronic associative memory using an advanced optical neurochip. YOSHIKUNO NITTA, JUN OHTA, KAZUMASA MITSUNAGA, SYUICHI TAI, and KAZUO KYUMA, *Applied Optics* (ISSN 0003-6935), Vol. 30, April 10, 1991, pp. 1328-1330. 10 Refs.

An optical associative memory using the optical neurochip is demonstrated. The efficiency and the uniformity of the device characteristics were improved and the optical crosstalk was reduced in order to increase the recognition rate of the associative memory.

A91-34355 Internal light-coupled optical device array. YOSHINORI NAKANO, MASAHIRO IKEDA, WATARU KAWAKAMI, and KEN-ICHI KITAYAMA, *Applied Physics Letters* (ISSN 0003-6951), Vol. 58, April 22, 1991, pp. 1698-1700. 7 Refs.

A novel internal light-coupled optical device (ILCOD) array is proposed, where the element consists of a pnpn digital optoelectronic switch and an npn phototransistor. The ILCOD with seven point-symmetric elements was fabricated. Quenching the light emission of the center element due to light coupling between the peripheral elements is observed. This quenching is achieved with an input optical power of 2.5 micro-W.

A91-10796 Optoelectronic implementation of bipolar analog neural network using shadow casting. WEI ZHANG, JUN TANIDA, KAZUYOSHI ITOH, and YOSHIKI ICHIOKA, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, July 1990, pp. L1325-L1327. 8 Refs.

Based on the optical shadow casting technique, an optoelectronic implementation of a neural network with bipolar analog neurons and interconnection weights is proposed. Experimental results of an associative memory based on the Hopfield model using the proposed method are also described.

A91-18332 Single-shot picosecond optical pulse waveform measurements based on a spatial sampling system. MICHIOYUKI ENDO, *Japanese Journal of Applied Physics, Part 1* (ISSN 0021-4922), Vol. 29, Oct. 1990, pp. 1956-1959. 12 Refs.

Single-shot picosecond optical pulse waveform measurement has been investigated by an electrooptic sampling technique. A spatial optical gate driven by an ultrafast photoconductive switch is employed as an optoelectronic sampler. Discrete sampled signals are coupled into an optical-fiber array consisting of fibers of different lengths to control the time delay. The output of the optical-fiber array is detected by a photodetector, and its envelope is displayed on an oscilloscope with an expanded time scale. For measurement of an optical pulse of 100 ps duration, the temporal resolution of the system is estimated to be about 13 ps.

A91-14373 Optical and electrical logic operations by a liquid crystal bistable optical device. TOSHIKI NOSE and SUSUMU SATO, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Sept. 1990, pp. L1679-L1681.

A liquid-crystal bistable optical device with internal optical feedback is prepared using a twisted nematic liquid-crystal cell, a photoconductive (CdS) cell, and a polarizing film. Its picture elements are arranged in a 3 x 5 matrix structure, and the bistable properties are measured as a function of optical input and electrical input. Then two-dimensional logic operations are demonstrated.

A90-41577 Uniformity in the performance characteristics of an 8 x 8 vertical to surface transmission electro-photon device matrix. Y. TASHIRO, I. OGURA, M. SUGIMOTO, N. HAMAO, and K. KASAHARA, *Electronics Letters* (ISSN 0013-5194), Vol. 26, May 10, 1990, pp. 628, 629, 6 Refs.

Characteristic uniformity in a vertical-to-surface transmission electrophotonic device (VSTEPs) fabricated by MBE is reported. The VSTEP matrix elements are shown and described, and the switching voltage distribution for 64 integrated elements is shown along with the switching energy dependence on bias voltage. The high uniformity offered by the VSTEP matrix, together with its successful application as an optical memory in parallel operations, shows promise for use in the larger-scale integration of VSTEPs in optical data processing systems.

A91-11650 Multiple beam elements using linear zone plate array suitable for parallel optoelectronic computing. JING LI CHEN, KASHIKO KODATE, and TAKESHI KAMIYA, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Aug. 1990, pp. L1539-L1541, 9 Refs.

The feasibility of applying two orthogonal linear zone plate arrays (LZPAs, fabricated by deep-UV lithography) to an optical computing system is shown. Using these two-dimensional arrays, the divergent laser diode beam was focused and divided simultaneously into ten spots with 3.6 micron diameter. To assess possible applications of the components, the duplicator action of image patterns suitable for optical computing was examined experimentally.

A91-10793 An optoelectronic synaptic connection circuit with variable analog and nonvolatile weights. HIROO YONEZU, TOSHIHIKO HIMENO, KOHJI KANAMORI, KANGSA PAK, and YASUSHI TAKANO, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, July 1990, pp. L1314-L1316, 8 Refs.

An artificial synaptic connection circuit was constructed using an optical interconnection and a nonvolatile memory device. Nonvolatile analog synaptic weights were realized, which were varied electrically and operated at a low current level. The possibility of a remarkable reduction of the number of electric wires was verified, which could lead to a realization of a large scale one-chip OEIC using a conventional wiring technique in Si LSI's.

A91-22748 Second harmonic generation in the binary system of pi-conjugated compounds. KATSUYA WAKITA, NOBUO SONODA, TOKIHIKO SHIMIZU, and SATOSHI KADA, *Journal of Applied Physics* (ISSN 0021-8979), Vol. 69, Jan. 1, 1991, pp. 545-547, 8 Refs.

A large second harmonic generation (SHG) intensity, which was 60 times as large as that of urea was observed in a p-nitroaniline (PNA)/N-(p-nitrophenyl)ethylenediamine (NPEN) system. This SHG intensity was related to the cooling rate for solidification. The optimum cooling rate for SHG intensity was in the range of 2-10 C/s. X-ray and thermal analysis done for this new system show that the hydrogen bond and the unique nonplanar structure of NPEN play an important role for SHG and its stability.

A91-10773 Very fast integrated optoelectronic logic for parallel computation using photodiode gates. HIROYUKI KAMIYAMA, ATSUO SHOUNO, 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.

A91-10772 Liquid-crystal-based optoelectronic hybrid structure for optical parallel processing devices. HIROFUMI YAMAZAKI and MASAYASU YAMAGUCHI, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, July 1990, pp. L1244-L1247.

The use of an optoelectronic hybrid structure, consisting of liquid crystal polarization controllers and polarizing beam splitters, as bases for optical parallel-processing devices is presently demonstrated with experimental memory and AND cells. The hybrid structure yields easy handling, stable operations, and functional versatility. Minimum dimensions for such a device are theoretically limited by diffraction, and practically limited by fabrication techniques. It is expected that a 30 x 30 array device could be used for parallel processing in photonic switching.

A91-11654 Construction of modularized OPALS using optoelectronic devices (Optical Parallel Array Logic System). DAISUKE MIYAZAKI, JUN TANIDA, and YOSHIKI ICHIOKA, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Aug. 1990, pp. L1550-L1552, 8 Refs.

An experimental system of the modularized optical parallel array logic system (OPALS) was constructed, which is a version of the OPALS composed of optically linked functional modules implemented by microoptics and semiconductor integration techniques. The most remarkable feature of the modularized OPALS is that various types of processing systems can be constructed easily by configuring the connection of junctional modules (mixing/distributing, encoding, correlating, and decoding modules). The operation of the system was verified by executing several kinds of parallel processing, including neighborhood operations and three-bit addition.

A91-33549 Variable-sensitivity photodetector that uses a metal-semiconductor-metal structure for optical neural networks. Y. NITTA, J. OHTA, and K. KYUMA, *Optics Letters* (ISSN 0146-9592), Vol. 16, April 15, 1991, pp. 611-613, 11 Refs.

A novel type of photodetector called a variable-sensitivity photodetector has been developed for optical implementation of neural networks. It utilizes a metal-semiconductor-metal structure whose quantum efficiency can be modulated by an applied bias voltage. A linear dependence of the sensitivity on the bias voltage was obtained with the bipolar current flow. This device operated as a multiplier of the incident light intensity and the bias voltage. It is shown that this device is suitable for achieving dynamic synaptic interconnections. A 4 x 4 array device was fabricated and demonstrated.

A90-52220 Fast optical switching in polymer waveguide using ferroelectric liquid crystal. MASANORI OZAKI, YUTAKA SADOHARA, TAKASHI HATAI, and KATSUMI YOSHINO, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, May 1990, pp. L843-L845, 11 Refs.

Fast electro-optical switching in a polymer waveguide using the control of total reflection by a surface-stabilized ferroelectric liquid crystal (SSFLC) is demonstrated. The SSFLC layer is fabricated on one conducting glass plate, and a polymer waveguide is formed by coating on another conducting glass plate. The SSFLC layer is used as the active material with the passive polymer waveguide. The device has a high contrast ratio and a switching time on the order of several microseconds.

A91-11653 Locally controllable image amplification by two-wave coupling with a BSO crystal. YOSHIMASA KAWATA, SATOSHI KAWATA, and SHIGEO MINAMI, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 29, Aug. 1990, pp. L1547-L1549, 9 Refs.

This paper considers the concept of locally controllable amplifier (as a parallel optical transistor array) of images, using two-wave coupling (TWC) in a Bi12SiO20 photoreactive crystal. In this concept, two coherent beams incident to the crystal form an interference fringe pattern in the crystal. The image is locally amplified by TWC in the crystal, and the portion to be amplified is controllable through the reference beam pattern. This phenomenon is simulated by a computer program with practical parameters, using a resistance-network model, and the analytical results are verified experimentally.

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.

A91-12076 Opto-electronic implementation of a large-scale neural network using multiplexing techniques. JUN OHTA, MASAYA OITA, SHUICHI TAI, KUNIHICO HARA, and KAZUO KYUMA, *Institute of Electronics, Information and Communication Engineers, Transactions* (ISSN 0913-574X), Vol. E73, Jan. 1990, pp. 41-45, 8 Refs.

Two kinds of architectures for implementing large-scale optoelectronic neural networks are proposed. These architectures are based on time- and frequency-division multiplexing (TDM and FDM) techniques, respectively, in which both the neuron state vector and the interconnection matrix are divided in the time and frequency domains. The computer simulations, which were carried out for the Hopfield associative memories in the neuron number of 400 and the memory number of 20, have shown their usefulness, providing almost the same recognition rate as the conventional architectures. Using the TDM technique, moreover, an optoelectronic implementation of the Hopfield associative memory was experimentally demonstrated. The experimental results showed that the number of the neurons was effectively increased.