

# Abstracts of Papers by Bell System Authors Published in Other Journals

## CHEMISTRY

**Amorphous Ferromagnetic Ag-X (X = Ni, Co, Gd) Alloys.** J. J. Hauser, *Phys. Rev. B*, *12* (December 1975), pp. 5160-5165. The critical concentration for the appearance of ferromagnetism (41-at. % Ni) and the increase of  $T_c$  with Ni concentration ( $\approx 9^\circ\text{K/at.}\%$ ) for amorphous Ag-X (X = Ni, Co, Gd) films are quite close to the values reported for crystalline Ni-Cu alloys, suggesting again the validity of the virtual-bound-state model over the rigid-band model.

**Field Evaporation Experiments With a Magnetic Sector Atom-Probe FIM.** T. Sakurai and E. W. Müller\*, *Surface Sci.*, *50* (May 1975), pp. 38-44. Field evaporation of Rh in the presence of  $^3\text{He}$  and  $^4\text{He}$  gases revealed that the formation of the helium compound  $(\text{RbHe})^{2+}$  is quite sensitive to He gas pressure; no helium compounds were observed below  $5 \times 10^{-7}$  Torr and all field-evaporated as helium compounds above  $5 \times 10^{-6}$  Torr at 78 K. \* Pennsylvania State University.

**The Growth of  $\text{LiNbO}_3$  Thin Films by Liquid Phase Epitaxial Techniques.** A. A. Ballman, H. Brown, and P. K. Tien, *J. Cryst. Grow.*, *29* (May 1975), pp. 289-295. A liquid phase epitaxial dipping process has been developed for the growth of thin films of  $\text{LiNbO}_3$  on isostructural  $\text{LiTaO}_3$  substrates. The process, employing a  $\text{Li}_2\text{WO}_4$  flux, produces single crystalline layers from 1 to 10  $\mu\text{m}$  in thickness. Low-loss optical waveguides have been fabricated from these films which show a sharp step-change of index of refraction with the Li-TaO<sub>3</sub> substrate.

**MOS (Si-Gate) Compatibility of RF Diode and Triode Sputtering Processes.** A. K. Sinha, *J. Electrochem. Soc.*, *123* (January 1976), pp. 65-71. The radiation damage induced in the gate regions of CMOS capacitors by various thin-film sputtering processes has been evaluated. It is shown that trapped hydrogen can be used for annealing interface states in sealed MOS structures, which are impervious to hydrogen during post-damage annealing.

**Photoreactions of Ketones With Amines. CIDNP Criteria for the Intermediacy of Aminoalkyl Radicals and Aminium Radical Ions.** H. D. Roth and M. L. Manion, *J. Amer. Chem. Soc.*, *97* (November 1975), pp. 6886-6888. The photoreactions of aromatic ketones with tertiary amines result in nuclear spin polarization and nmr line broadening. The intensity pattern of the polarization and the degree of line broadening depend upon the hyperfine coupling patterns of the paramagnetic intermediates and may distinguish between neutral aminoalkyl radicals and aminium radical ions resulting from net hydrogen abstraction and electron transfer, respectively.

**Preparation of  $\text{BaTi}_5\text{O}_{11}$  by Solid-State Reaction.** H. M. O'Bryan, Jr. and J. Thomson, Jr., *J. Amer. Ceram. Soc.*, *58* (September-October 1975), p. 454.  $\text{BaTi}_5\text{O}_{11}$  forms as a reaction intermediate when a mixture of  $\text{BaCO}_3 + 4.5 \text{TiO}_2$  is heated at 1000 to 1100°C. Powder diffraction data are presented for  $\text{BaTi}_5\text{O}_{11}$ . The conditions for forming this compound show similarities with those required to form the unstable  $\text{BaTi}_2\text{O}_5$  compound.

**Thermal Stability of PtSi Films on Polysilicon Layers.** A. K. Sinha, S. E. Haszko, and T. T. Sheng, *J. Electrochem. Soc.*, *122* (December 1975), pp. 1714-1718. Films containing PtSi (2000 Å) on poly-Si (1000 Å) have been considered for application as first-level metallization in bipolar LSI devices. The microstructure, resistivity, and stresses of these films were evaluated for various thermal treatments. No agglomeration was observed at up to 900°C; at 1000°C, a liquid-eutectic phase formed.

## ELECTRICAL AND ELECTRONIC ENGINEERING

**Aberrations and Tolerances in a Double-Deflection Electron Beam Scanning System.** M. G. R. Thomson, *J. Vac. Sci. Technol.*, 12 (November-December 1975), pp. 1156-1159. A magnetic double-deflection system intended for use in an electron-beam lithography instrument has been theoretically analyzed. The first-order chromatic and third-order geometric aberrations are calculated so that the maximum field size can be found. The misalignment tolerance is estimated for different levels of required performance.

**An Annotated Bibliography of Microwave Circulators and Isolators 1968-1975.** R. H. Knerr, *IEEE Trans. Microw. Theory Tech.*, *MTT-23* (October 1975), pp. 818-825. A bibliography of microwave circulators and isolators from 1968 to 1975 is presented (151 references). Some topics, which the author considered the most significant, include the eigenvalue approach to 3-port Y-junction circulator design, the peripheral mode isolator, electronic isolators, and wideband UHF circulators. The bibliography is subdivided into waveguide circulators, stripline circulators, lumped element circulators, other types of circulators, general papers applicable to all circulators, isolators, and books.

**Deep Level Spectroscopy, Low Temperature Defect Motion and Nonradiative Recombination in GaAs and GaP.** C. H. Henry, *J. Electron. Mater.*, 4 (October 1975), pp. 1037-1052. Recent development in junction capacitance measurements allow deep levels in semiconductors to be conveniently studied for the first time. The levels are often strongly coupled to the lattice which causes rapid nonradiative recombination. The released electronic energy causes violent vibrations near the defect which can promote low-temperature defect motion.

**Hopping Conductivity in Amorphous Carbon Films.** J. J. Hauser, *Solid State Commun.*, 17 (December 1975), pp. 1577-1580. The electrical resistivity of amorphous carbon films getter-sputtered at 95°K is well fitted between 300 and 20°K by the relation  $\rho = \rho_0 \exp[(T_0/T)^4]$  with  $T_0 \approx 7 \times 10^7$  K. This behavior suggests a hopping conductivity very similar to that found in other amorphous semiconductors.

**Mass-Spectrometric Sampling of the Ionic and Neutral Species Present in Different Regions of an RF Discharge in Methane.** M. J. Vasile and G. Smolinsky, *Int. J. Mass. Spectrom. Ion Phys.*, 18 (October 1975), pp. 179-192. Ions originating in the sheath between the RF electrode and the plasma are characteristic of higher energy ionization processes than those observed from the plasma itself. Ion-molecule reactions observed in the RF sheath indicate a substantial proportion of encounters which occur at higher than thermal kinetic energy.

**A Per-Channel A/D Converter Having 15-Segment  $\mu$ -255 Companding.** J. C. Candy, W. H. Ninke, and B. A. Wooley, *IEEE Trans. Commun.*, *COM-24* (January 1976), pp. 33-42. This encoder provides 8-bit compressed PCM and 13-bit uniform PCM at 8 kilowords per second. Also available is a 1-bit code that is useful for loop and switching applications. When suitably decoded the processed signal exhibits idle channel noise below 15 dBmCo, harmonic distortion less than -40 dB, and gain tracking within  $\pm 0.5$  dB for circuit tolerances of 2%. The encoder is being integrated on two chips, and a decoder on a single chip.

## PHYSICS

**Adiabatic Following Model for Two-Photon Transitions: Nonlinear Mixing and Pulse Propagation.** D. Grischkowsky,\* M. M. T. Loy,\* and P. F. Liao, *Phys. Rev. A*, 12 (December 1975), pp. 2514-2533. The adiabatic following approximation is used to obtain solutions to a vector model describing a two-photon resonance. Explicit expressions are obtained for power-dependent nonlinear susceptibilities which are responsible for two-photon, resonantly enhanced, parametric processes. The results are also used to study the propagation of pulses nearly resonant with a two-photon transition. \*IBM Thomas J. Watson Research Center.

**Impact Ionization Rates for Electrons and Holes in GaAs<sub>1-x</sub>Sb<sub>x</sub> Alloys.** T. P. Pearsall, R. E. Nahory, and M. A. Pollack, *Appl. Phys. Lett.*, **28** (April 1, 1976), pp. 403-405. We have measured the impact ionization rates for electrons and holes in GaAs<sub>1-x</sub>Sb<sub>x</sub> for alloys with  $x = 0.05, 0.10, \text{ and } 0.12$ . The ionization rates for electrons ( $\alpha$ ) and holes ( $\beta$ ) are different and a function of Sb content. For GaAs<sub>0.88</sub>Sb<sub>0.12</sub>,  $\alpha/\beta = 2.5$ , while for GaAs,  $\alpha/\beta = 0.25$ .

**Ion-Ion Correlations and Diffusion in Beta Alumina.** D. B. McWhan et al., *Phys. Rev. Lett.*, **35** (October 6, 1975), pp. 953-956 and **36** (February 9, 1976), p. 344(e). A comparison of the correlation length for short-range order (5, 6, 11, 18 Å), the attempt frequency for diffusion (56, 28, 80, 85 cm<sup>-1</sup>), and the previously reported values of tracer diffusion coefficient for Na, Ag, K, and Rb, respectively, suggests that ion-ion correlations inhibit diffusion in the  $\beta$ -aluminas.

**Millimeter and Submillimeter Wave Laser Action in Symmetric Top Molecules Optically Pumped Via Perpendicular Absorption Bands.** T. Y. Chang and J. D. McGee, *IEEE J. Quantum Electron.*, *QE-12* (January 1976), pp. 62-65. Ninety-nine new far infrared laser lines from 227  $\mu\text{m}$  to 1.965 mm have been observed in CH<sub>3</sub>CN, CH<sub>3</sub>CCH, CH<sub>3</sub>Cl, CH<sub>3</sub>Br, and CH<sub>3</sub>I by optically pumping these gases with CO<sub>2</sub> laser pulses of 150- $\mu\text{s}$  duration.

**Motion of pn Junctions in CuInSe<sub>2</sub>.** B. Tell, Sigurd Wagner, and P. M. Bridenbaugh, *Appl. Phys. Lett.*, **28** (April 15, 1976), pp. 454-455. We report the first pn junction delineation and diffusion study in a ternary chalcopyrite-type semiconductor. Pn junctions were formed in Zn or Cd plated p-CuInSe<sub>2</sub> by five-minute anneals at 200 to 450°C. By angle lapping and staining techniques, junction depths  $x_j$  varying from  $\sim 1 \mu\text{m}$  to  $\sim 130 \mu\text{m}$  were determined, from which the interdiffusion coefficient derived is  $D(\text{cm}^2/\text{s}) = 164 \exp[-1.19(\text{eV})/kT]$ . The large preexponential term indicates concentrations or mobilities of point defects substantially above those of the related II-VI compounds.

**Novel Technique for Measuring Nitrogen Profiles in GaP:N.** J. Shah, R. F. Leheny, and P. D. Dapkus, *J. Appl. Phys.*, **46** (December 1975), pp. 5244-5247. A high-resolution technique for determining the nitrogen-doping profiles in GaP:N using a laser-pumped dye cell as a broad-band fluorescence source is described. Results obtained suggest that, under some LPE growth conditions, vapor-liquid equilibration may be slow and, as a result, affect the nitrogen incorporated into the solid. The implications of these results for high-efficiency LED's are also discussed.

**Observation of a New Nonlinear Photoelectric Effect Using Optical Levitation.** A. Ashkin and J. M. Dziedzic, *Phys. Rev. Lett.*, **36** (February 2, 1976), pp. 267-270. We observe a new three-photon nonlinear photoelectric effect in glass with visible cw laser light using optical levitation of transparent particles. Electrons are pumped into the conduction band of glass by the absorption of two photons and subsequently ejected in a single photon step.

**Polarization Rotation Induced by Resonant Two-Photon Dispersion.** P. F. Liao and G. C. Bjorklund, *Phys. Rev. Lett.*, **36** (March 15, 1976), pp. 584-587. A polarization rotator is demonstrated which utilizes the dispersion associated with 3S to 5S two-photon transitions in sodium vapor. A linearly polarized beam at  $\nu_1$  is rotated by a circularly polarized beam at  $\nu_2$ , and  $\nu_1 + \nu_2$  is near the two-photon transition frequency. When combined with a polarizer, a rapid optical shutter is obtained.

**Preparation and Properties of InP/CdS and CuInSe<sub>2</sub>/CdS Solar Cells.** J. L. Shay et al., *Proc. 11th IEEE Photovoltaic Specialists Conf.*, 1975 (Scottsdale, Arizona, May 6-8), pp. 503-507. Described are the preparation and properties of the recently reported InP/CdS and CuInSe<sub>2</sub>/CdS single-crystal solar cells. Solar power conversion efficiencies of 12.5 and 12% have been observed. The ultimate efficiency achievable with InP/CdS using state-of-the-art liquid encapsulated Czochralski p-type InP is calculated to be 17.2% for AM2 conditions and 14.0% for AMO conditions.

**Push-rod AC Susceptibility Apparatus.** J. J. Hauser and C. M. Antosh, *Rev. Sci. Instrum.*, 47 (January 1976), pp. 156-157. A push-rod ac susceptibility apparatus which permits the measurement of ultrathin films of superconductors and ferromagnets as a function of temperature and magnetic field is described. Films prepared at 77° K can be mounted under liquid nitrogen and measured without warmup.

**Water and Its Relation to Broken Bond Defects in Fused Silica.** R. H. Stolen and G. E. Walrafen,\* *J. Chem. Phys.* 64 (March 15, 1976), pp. 2623-2631. Vibrational modes associated with OH in fused silica were studied by Raman scattering. Intensities of lines at 604 and 490  $\text{cm}^{-1}$  decrease with increasing OH and increase with fictive temperature, suggesting that OH is trapped at defect sites. A weak 970  $\text{cm}^{-1}$  line was seen in fibers and assigned to the Si-(OH) stretch. \*Dept. of Chem., Howard University.