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

## CHEMISTRY

**The Anodic Behavior of Gold in Sulfuric Acid Solutions Effect of Chloride and Electrode Potential.** R. P. Frankenthal and D. E. Thompson, J. Electrochem. Soc., *123* (June 1976), pp. 799–804. Gold corrosion in the passive and transpassive potential regions is affected by $Cl^-$. Soluble Au(III) and $Au(OH)_3$ film are the reaction products. Chloride promotes dissolution and restricts film formation. Mechanism of $O_2$-evolution is different on a filmed than on a film-free surface.

**Brillouin Scattering from Polymer Films.** G. D. Patterson, J. Polym. Sci., Part A-2, Polym. Phys., *14* (1976), pp. 143–149. Many polymers cannot be prepared as clear amorphous blocks suitable for classical light-scattering studies. However, most linear polymers can be prepared as films which are somewhat transparent. With the advent of high-contrast multipass interferometers, these films can now be studied by Brillouin scattering. This work demonstrates the wide range of polymeric materials that can now be studied by Brillouin spectroscopy.

**Direct Measurement of Spontaneous Predissociation Using Coaxial Laser-Molecular Beams.** R. M. Lum and K. B. McAfee, Jr., J. Chem. Phys., *63*, No. 11 (December 1975), pp. 5029–5033. A laser-molecular beam technique has been devised to enable direct observation of radiationless transitions of isolated single molecular states. Spontaneous predissociation, detected as a modulation of the molecular beam, has been observed in $Br_2$ at laser wavelengths which produce selective excitation of the individual $Br_2$ isotopic species.

**Neutron Scattering Study at High Pressure of the Structural Phase Transition in Paratellurite.** D. B. McWhan, R. J. Birgeneau, W. A. Bonner, H. Taub,* and J. D. Axe,* J. of Phys. C. Lett, *8* (1975), pp. L81–L85. The dispersion relation for the transverse acoustic phonon mode propagating along ⟨110⟩ polarized along ⟨1$\bar{1}$0⟩ in $TeO_2$ has been measured at P = 1 atm, $P_c$ ($\approx$9.0 kbar), and $2P_c$ where $P_c$ is the tetragonal-to-orthorhombic structural transition pressure. Measurements of the order parameter are consistent with a mean field theory of a pressure induced elastic instability. *Brookhaven National Laboratory.

## COMPUTING

**Integrated Injection Logic: A Bipolar LSI Technique.** R. A. Pedersen, Computer, *9*, No. 2 (February 1976), pp. 24–29. Integrated Injection Logic ($I^2L$) is a novel bipolar circuit design approach to achieve high-density large-scale integration. As the basic logic unit, it uses multicollector npn transistors which are powered from merged multicollector lateral pnp transistors. $I^2L$ can be fabricated with standard buried collector technology and is therefore compatible with conventional bipolar circuitry—digital or linear—on the same silicon chip.

## ELECTRICAL AND ELECTRONIC ENGINEERING

**Behavior of Tandem Buffers with Geometric Input and Markovian Output.** J. Hsu and P. J. Burke, IEEE Trans. Commun., *COM-24* (March 1976), pp. 358–361. A discrete-time system of infinite-capacity buffers in tandem is studied. Input to the first buffer is geometric and the output for all but the last buffer (which can be arbitrary) is Markovian. The analysis shows that, in equilibrium, each buffer can be analyzed separately and independently.

**Chemisorption and Schottky Barrier Formation of Ga on Si(111)7 × 7.** G. Margaritondo, S. B. Christman, and J. E. Rowe, J. Vacuum Sci. Technol., *13* (January–February 1976), pp. 329–332. The chemisorption of gallium atoms on Si(111)7 × 7 was studied using photoemission, electron-energy-loss, LEED and Auger spectroscopy. Most of the states formed at the metal-semiconductor interface are due to the first 1–2 metal monolayers and need a microscopic-atomic bonding or surface-band-structure theoretical description.

**A Comparison of Chemical Etches for Revealing ⟨100⟩ Silicon Crystal Defects.** D. G. Schimmel, J. Electrochem. Soc., *123*, No. 5 (May 1976), pp. 734–741. Etch pit results of the Sirtl, Dash, Secco, and an experimental etch are compared for ⟨100⟩ silicon wafers after various device processing steps. Factors influencing etch-pit formation on silicon surfaces are discussed. A recommendation is given for the etch formation with the best etch-pit development.

**Fabrication and Performance of Offset-Mask Charge-Coupled Devices.** A.M. Mohsen and T. F. Retajczyk, Jr., IEEE J. Solid State Circuits, *SC-11* (February 1976), pp. 180–188. The use of the offset-mask technique to fabricate two-phase and uniphase charge-coupled device (CCD) electrode structures is described. A new two-phase electrode structure with polysilicon-electrodes and self-aligned gates for the peripheral circuits has been developed. The polysilicon offset-mask electrode structure is very attractive for charge-coupled memories. Compared to other two-polysilicon level CCD structures, it has a higher packing density, is more tolerant to intralevel shorts, and does not require large numbers of small contact windows to connect the gate electrodes to the phase bus lines.

**High Repetition-Rate and Quasi-CW Operation of a Waveguide $CO_2$ TE Laser.** P. W. Smith, C. R. Adams, P. J. Maloney, and O. R. Wood II, Opt. Commun., *16*, No. 1 (January 1976), pp. 50–53. We report operation of a waveguide $CO_2$ TE laser at excitation pulse repetition frequencies as high as 40 kHz. Quasi-continuous laser output was obtained yielding an average output power of 1.5 W from an active volume of 0.1 cc. Details of laser construction and excitation circuitry are given.

**Hydrogen Embrittlement of Electroless Copper Deposits.** Y. Okinaka and S. Nakahara, J. Electrochem. Soc., *123* (1976), pp. 475–478. Electroless copper deposits were investigated for ductility, impurity content, void distribution, and fracture surface morphology. It is concluded that the brittleness of electroless copper deposits is due to the internal hydrogen embrittlement rather than the incorporation of cuprous oxide or morphological effects.

**Multicomponent Photopolymer Systems for Volume Phase Holograms and Grating Devices.** W. J. Tomlinson, E. A. Chandross, H. P. Weber, and G. D. Aumiller, Appl. Opt., *15*, No. 2 (February 1976), pp. 534–541. Novel photopolymer systems for the fabrication of high-resolution volume phase holograms and gratings devices are reported. We use a mixture of components chosen to have differing reactivities and polarizabilities. The image-forming exposure results, ultimately, in a modulated chemical composition. Peak-to-peak refractive index differentials of up to 1.5 percent were achieved.

**Multipoint Private Line Access Delays Under Several Interstation Disciplines.** C. D. Pack and B. A. Whitaker, IEEE Trans. Commun., *COM-24* (March 1976), pp. 339–348. Performance objectives for some types of computer-communications networks are stated in terms of access-delay statistics which measure the grade of service experienced by stations bidding for access to a multipoint private line (MPL). Using simulation and some analysis, we examine the access delay statistics for an MPL under each of four service disciplines.

**Observations on the Influence of Processing Steps on the Magnetic Hysteresis Parameters of a Co/Fe/Nb Alloy.** M. R. Pinnel, IEEE Trans. Magn., *MAG-12* (May 1976), pp. 236–243. The variation of both magnetic and mechanical properties and microstructure of a Co/Fe/Nb alloy (Nibcolloy) with changes in processing has been characterized. Results indicate the use of a softening anneal prior to the final aging anneal can alter magnetic properties. A nonstability of coercivity to subsequent brief elevated temperature exposures of around 1000°C was also observed.

**Profile Parameters of Implanted-Diffused Arsenic Layers in Silicon.** R. B. Fair and J. C. C. Tsai, J. Electrochem. Soc., *123* (April 1976), pp. 583–586. Equations have been derived that describe the important variables that are required to characterize the diffusion of As-implanted layers for the surface doping concentration range $C_{To} \gtrsim 1 \times 10^{19}$ cm$^{-3}$. In addition, data obtained from differential conductivity profile measurements and SIMS profile measurements have been used to obtain experimental parameters for these equations.

**Qualitative Observations on the Diffusion of Copper and Gold Through a Nickel Barrier.** M. R. Pinnel and J. E. Bennett, Met. Trans., *7A* (May 1976), pp. 629–635. The interdiffusion behavior in planar-layered couples of Cu/Ni/Au at temperatures between 150 and 750°C have been characterized. Results demonstrate that the nickel barrier layer retards but does not block the transport of copper to the gold surface. Possible mechanisms for the anomalous buildup of copper at the gold/nickel interface and gold at the copper/nickel interface are discussed.

**Signaling and Switching As We Enter the Second Century.** J. S. Ryan, Telecommun. J., *43*, No. 111 (March 1976), pp. 206–219. During the first century of the telephone, switching evolved from the 21-line New Haven switchboard to the 104,000-trunk No. 4 ESS, and signaling from voice alerting to CCIS. This centennial issue article traces the history and reviews the status of signaling and switching as we enter the second century.

**A Study of Deep Levels in GaAs by Capacitance Spectroscopy.** D. V. Lang and R. A. Logan, J. Electron. Mater., *4*, No. 5 (1975), pp. 1053–1066. We show how the DLTS capacitance spectroscopy technique can be used to detect small amounts of deep-level impurities in GaAs p-n junctions. The DLTS spectra associated with Cu, Fe, Cr, O, and two unidentified, but commonly occurring, deep levels in GaAs are shown. The LPE distribution coefficients are obtained for Cu, Fe, and Cr. The carrier capture cross sections for six levels are measured and give evidence for capture by multiphonon emission.

## MATERIALS SCIENCE

**Detection of Catalytic Oscillations by Differential Thermal Analysis.** P. K. Gallagher and D. W. Johnson, Jr., Thermochim. Acta, *15* (May 1976), pp. 238–240. Oscillations in DTA curves associated with the oxidation of CO using Pt containing catalysts were observed. This offers a relatively quick and simple technique for studying instabilities that arise from the interaction of the catalytic mechanism and the exothermic nature of the reaction.

**Kinetics of Formation of $LiFeO_2$ from $2Li_2CO_3 \cdot Fe_2O_3$ Mixture.** P. K. Gallagher and D. W. Johnson, Jr., J. Amer. Ceram. Soc., *59* (March–April 1976), pp. 171–172. Mixtures of $2Li_2CO_3 \cdot Fe_2O_3$ were found to form $LiFeO_2$ at <600°C. Excess $Li_2CO_3$ did not react until higher temperatures. Isothermal and dynamic kinetic studies gave an activation energy of 42–50 kcal/mole. A model involving the rapid surface diffusion of $Li_2CO_3$ is proposed.

**Diffusion Kinetics of Au Through Pt Films About 2000 and 6000 Å Thick Studied with Auger Spectrscopy.** C. C. Chang and G. Quintana, Thin Solid Films, *31* (1976), pp. 265–273. Pt–Au couples with 2000 Å and 6000 Å Pt films were heat treated between 250° and 350°C in 1 atm $N_2$. Au was found to diffuse initially through Pt films <6000 Å by grain boundary migration and more than $10^{15}$ atoms $cm^{-2}$ of Au crossed the Pt when the bulk of the Pt contained little Au ($\lesssim$1 at.%). For 2250 Å Pt on Au, the time for half-saturation of the Pt surface with Au was $t(0.5) = 1.2 \times 10^{-7} \times \exp(0.96\ \text{eV}/kT)$ min.

**Domain Wall Image Contrast in the SEM.** D. C. Joy, H. J. Leamy, S. D. Ferris, D. E. Newberry,* and H. Yakowitz,* Appl. Phys. Lett., *28* (April 15, 1976), pp. 466–468. Contrast from domain walls in materials with cubic magnetic anisotropy has been observed in scanning electron microscope images. This contrast, which is visible in both the backscattered and absorbed current images, arises from the interaction of the convergent incident electron beam with the domains on either side of the wall. * National Bureau of Standards.

**Ultranarrow, Forbidden, Singlet-Triplet Anticrossings in $H_2$.** T. A. Miller and R. S. Freund, J. Chem. Phys., *63* (1975), pp. 256–263. Forbidden singlet-triplet anticrossings have been observed between different Zeeman sublevels of the i (3d) $^3\Pi_g$, v = 1, N = 6 and W(?) $^1\Sigma_g^+$, v = 1, N = 4 states of $H_2$. The anticrossings are quite sharp and hence allow accurate determinations of the states' zero field separation, linear and quadratic Zeeman parameters, coupling perturbation, and radiative lifetimes.

## PHYSICS

**The Determination of Energy-Level Shifts Which Accompany Chemisorption.** Homer D. Hagstrum, Surface Sci., *54* (1976), pp. 197–209. This paper discusses the ionization limit with respect to which the electronic energy levels of an adsorbed complex on a solid surface should be referenced, and how this limit is defined and measured. This leads to a reasonable procedure for determining energy-level shifts, at least for simple systems.

**The Linear Electric Field Effect for Low Spin Ferric Heme Compounds.** W. B. Mims and J. Peisach*, J. Chem. Phys., *64*, No. 3 (February 1, 1976), pp. 1074–1091. Measurements were made on the linear electric field induced $g$ shifts for a series of low-spin ferric heme compounds by the electron spin echo method on noncrystalline samples at liquid helium temperatures. Some of these samples consisted of proteins and protein derivatives; others were made from heme reacted with small ligand molecules. Analytic expressions relating the observed changes in spin echo amplitude to certain of the $g^2$-shift coefficients $B_{ij}$ were derived. Results suggest the presence of extensive back bonding between the $Fe^{3+}$ ion and the axial ligands of the heme complex. Results also suggest that myoglobin hydroxide is characterized by a crystal field which is exceptionally low for the $S = (1/2)$ ferric heme group of compounds.

* Departments of Pharmacology and Molecular Biology, Albert Einstein College of Medicine of Yeshiva University.

**Elastic Constants of bcc $^4$He.** D. S. Greywall, Phys. Rev. B (Nucl. Phys.), *13* (February 1976), pp. 1056–1068. Longitudinal and transverse sound velocities were measured in single crystals of bcc $^4$He with known orientation at 21.00 cm$^3$/mole and at 1.612 K. The temperature dependence of sound velocities along an isochore and along the melting curve was measured for several samples. No premelting effects were observed. The ratios of bcc $^3$He to $^4$He elastic moduli at the same molar volume are considerably larger than the classical ratio of unity but in excellent agreement with the quantum-mechanical calculations of Horner. Existing calorimetric data are compared with the present determination of the Debye temperature.

**Isotope Abundances in Interstellar Molecular Clouds.** P. G. Wannier, A. A. Penzias, R. A. Linke, and R. W. Wilson, Astrophys. J., *204*, No. 1 (February 15, 1976), pp. 26–42. We use the $J = 1 \rightarrow J = 0$ transitions of $^{12}C^{16}O$, $^{13}C^{16}O$, and $^{12}C^{18}O$ at $\approx$ 110 GHz to measure abundance ratios of carbon and oxygen isotopes throughout our galaxy. The measured values of $[^{12}C]/[^{13}C]$ seem to be different than the terrestrial values, suggesting significant galactic chemical evaluation since the birth of the sun.