Photonic Transistor Realized with Local Plasmon Amplification

Researchers from the Laboratory for Advanced Optical Technology at the National Institute of Advanced Industrial Science and Technology (AIST), the Advanced Technology Research Laboratory at Sharp Corporation, and the Data Storage Technology Center at TDK Corporation have demonstrated a system that has the potential to realize all-thin-film photonic transistors by using local plasmon amplification. Using a technique called super-resolution near-field structure (super-RENS), which was originally developed for optical near-field recording, surface plasmons can be generated, without a prism, by using a specially designed multilayer with a focused laser beam.

In the April 23 issue of *Applied Physics Letters*, J. Tominaga of AIST and co-workers describe a procedure for fabricating a plasmon transistor as well as the experimental setup used to confirm the device. By focusing both a red (635-nm) and a blue (405-nm) laser beam into one small spot on a high-speed rotating optical disk, a large signal enhancement was observed. They found that a plasmon interaction generated between silver light-scattering center and small marks in the optical disk, recorded with a super-RENS, produced a large signal amplification in the spot (<1 mm). The silver light-scattering center was formed by the local decomposition of a silver oxide layer. A modulated signal of the blue laser was enhanced 60× by controlling the red-laser power from 1.5 mW to 3.5 mW. By tuning the size of the light-scattering center, through control of the laser power responsible for generating the scattering center, the signal released from the plasmon reservoir was controlled. In their system, the light-scattering center plays the role of a gate in the photonic transistor.

The researchers' results indicate that a photonic transistor is possible by using local plasmon scattering. The local plasmon photonic transistor has advantages over photonic devices that use surface plasmons. For example, prisms, which were previously required to attain attenuated total reflection, are replaced by a thin film of silver oxide. This enables the devices to be manufactured thinner and smaller, and at a reduced cost, through a combination of micromachining and thin-film technologies. Tominaga believes that "all-thin-film photonic plasmon circuits are no longer a dream, but rather a technology which may soon be manufactured like conventional electronic devices."

STEFFEN K. KALDOR

Optical Recording Fabricated with Dye-Doped Polymer-Dispersed LC Films

A group of researchers from the National Cheng Kung University and the Fortune Institute of Technology in Taiwan has devised a method of recording optical holograph permanent gratings that are electrically switchable. As reported in the April 1 issue of *Optics Letters*, this technique has a combination of high light sensitivity and short recording time.

The recording medium is a homogeneous mixture of liquid crystals, a prepolymer (called NOA65), and a dye (methyl red). Two laser beams (λ = 532 nm, ~6 ns pulses) from a single *Q*-switched Nd:YAG source write the holographic grating. The polymer is then UV-cured at ~11.5 mW/cm^2.

The dye molecules exert a torque on the liquid crystals where they are photoexcited by the laser. This action causes the alignment of the liquid crystals along their director axis. Liquid crystals remain in random orientation in the "unwritten" regions, as confirmed by both polarization and diffraction experiments. According to the researchers, the ease of sample preparation, the good light sensitivity, and the fast recording time of this technique may lead to many future advancements in holography. Although the diffraction grating was "permanent," diffraction could be turned off by applying an ac rms voltage of 140 V at 1 Hz.

JUNE LAU

Seeding of the Reaction-Bonded Aluminum Oxide Process with Submicron Al_2O_3 Particles Reduces the Transformation Temperature

A team of researchers at The Pennsylvania State University has demonstrated that in the production of ceramics, seeding the reaction-bonded aluminum oxide (RBAO) process with ~0.2-µm-sized α-Al_2O_3 particles decreased the phase-transformation temperature to ~962°C. The fine microstructure of the compacts decreases the sintering temperature and improves the densification.

"Reaction-based processing is a novel approach for the fabrication of ceramics and ceramic-matrix composites," said Gary Messing, professor of materials science and engineering at Penn State. "The process is very attractive, as it is environmentally benign and gives compacts with a high green strength and a low net shrinkage."

In the RBAO process, which was developed in 1989, a mixture of aluminum and α-Al_2O_3 powders is used to produce dense α-Al_2O_3-based composites. After attrition milling, the resulting slurry is dried and pressed into pellets. Upon heating, the Al is oxidized and forms γ-Al_2O_3. Further heating leads to transformation to α-Al_2O_3 above 1100°C and sintering above 1550°C.

"There was some evidence in our earlier work that the γ-Al_2O_3 to α-Al_2O_3 transformation can have a significant effect on sintering kinetics, temperature, and microstructure," said Ender Suvaci, who did his PhD research on RBAO with Messing before accepting a position as an assistant professor at Anadolu University in Turkey. "γ-Al_2O_3 can be seeded with α-Al_2O_3 to decrease the sintering temperature, so we decided to investigate whether the RBAO process could be seeded by using fine α-Al_2O_3 starting particles, too."

As reported in the March issue of the *Journal of the American Ceramic Society*, the team carried out comparative studies on two composites using coarse (~6–10-µm) and fine (~0.2-µm) α-Al_2O_3 starting powders. This resulted in a higher seed frequency than the intrinsic nucleation density (2.9×10^{14} as compared to 1.1×10^{11} seeds/cm^3 γ-Al_2O_3) for the fine powder, while the value for the coarse powder is lower (1.1×10^{10} seeds/cm^3 γ-Al_2O_3). The transformation of the as-formed γ-Al_2O_3 to α-Al_2O_3 started at 963°C and 1052°C for the fine and coarse mixtures, respectively, demonstrating the successful seed effect. Sintering was observed at temperatures as low as 1135°C in the composite using fine α-Al_2O_3 (~127°C lower than in the coarse sample). The smaller particle size resulted in better densification during sintering.

Messing said, "Although shown for RBAO, it is clear that seeding is effective for other reaction-based ceramics and especially mixed metal-oxide ceramics where the phase transformation is nucleation-controlled."

CORA LIND

Real-Time X-Ray Microbeam Technique Used to Study Electromigration in Al(Cu) Conductor Lines

Researchers from the IBM T.J. Watson Research Center in Yorktown Heights, NY, and the Microelectronics Division in East Fishkill, NY, have developed an x-ray microtopography technique for studying stresses and interface integrity in thin-film/semiconductor substrate composites. Using this technique, they have measured the evolution of electromigration-induced stress gradients and Cu concentration in Al(Cu) conductor lines. This *in situ* method, which has a strain sensitivity of 10^{-7}, allows for detection of the stress gradient at both low current densities (10^4–10^5 A/cm^2) and early times.

As reported in the April 30 issue of *Applied Physics Letters*, thin-film Al-0.25%Cu conductor lines (200 µm long × 10 µm wide × 0.5 µm thick) deposited on silicon (100) substrates and passivated with a 1.5 µm SiO_2 layer were studied with both x-ray microtopography and energy-dispersive fluorescence analysis. A 5-µm diameter x-ray spot was obtained by using a tapered glass capillary to focus x-rays from a beamline of the National Synchrotron Light Source at Brookhaven National Laboratory. The combination of the 5-µm diameter x-ray spot and a sample translation capability of ±1 µm allowed for spatially resolved measurements along the conductor line length. P.-C. Wang and co-workers said that unlike traditional x-ray stress measurements that rely on the change in a material's lattice parameter for strain information, this topography technique is based on mapping a suitable substrate reflection [in this case, Si(004)] over the region covered by the thin film. The shear-stress maxima present at the film–substrate interface increase the band-pass of the substrate crystal and give rise to enhanced diffracted intensities. The observed contrast between diffracted intensities over different regions of the specimen can be correlated with the stress field in the film. A scintillation and a solid-state Si(Li) detector were used simultaneously to collect the Si diffraction and Cu K_α fluorescence signals, respectively.

At 302°C, an electrical current (1×10^5 A/cm^2) was passed through the conductor line, and the sample was scanned repetitively while topography and fluorescence data were collected. The researchers' results illustrate changes in the stress field and Cu concentration for both the early and late stages of electromigration, as well as the post-relaxation (current turned off) stage. During the initial 5 h of electromigration, Cu was observed to migrate along the direction of electron flow, eventually forming a continuous monotonic concentration gradient. The diffracted Si intensity was enhanced both at the cathode, due to an increase in tensile stress, and at the anode, due to the local compressive stress from the mass pileup there. Measurements in the steady-state regime (~19 h) provided additional information about the local stress profile and the formation of lateral extrusions near the anode region (see figure). After switching off the current, it was observed that Cu flowed back into the depleted regions, resulting in a more uniform Cu distribution, and the electromigration-induced stress gradient was significantly reduced along the line, except at locations where permanent damage had occurred.

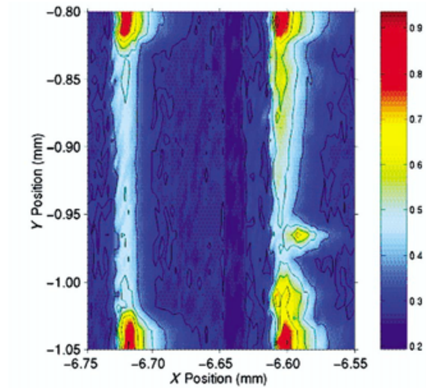

Figure. Intensity contours of Si(004) diffraction over an area containing two Al(Cu) wires, with the electromigrated wire on the right and the control sample on the left. The Cu K_α plot is in a log scale, and the Si(004) plot is in a linear scale, with both intensities normalized by the monitor intensity upstream. Reproduced with permission from 2001 Applied Physics Letters, ***78****(18), 2712.*

"We are very excited about being able to measure the real-time evolution of electromigration stress gradients and Cu migration simultaneously, especially at such low current densities and early times," said the researchers. "We are hopeful that this technique will help us to better understand some of the fundamental issues associated with electromigration."

Silver in Hybrid Membranes Facilitates Separation of Ethene and Ethane

Researchers at the Osaka National Research Institute in Japan have achieved good selectivity of ethene against ethane in separation processes using inorganic–organic hybrid membranes containing silver(I) ions. The organic poly(*N*-vinylpyrrolidone) (PVP) part increased the flexibility of the inorganic network and immobilized the silver ions, which can function as olefin carriers. The membranes showed higher selectivity at higher temperatures, as thermal energy enhances the decomplexation rate of the silver olefin complexes.

Separation of paraffins and olefins is usually carried out by cryogenic distillation. Among the alternatives that were investigated to replace this energy-intensive process, the use of facilitated support membranes containing Ag^+ ions seemed to be promising. While supported liquid membranes and ion-exchange membranes require saturation of the feed gas with solvent, silver polymer membranes can be used to separate paraffins and olefins without water. The limitation of these membranes to low temperatures has now been overcome by replacing the pure polymer membrane with an organic–inorganic hybrid membrane as reported in the March issue of the *Journal of the American Ceramic Society*.

The hybrid membranes were prepared via a sol-gel route using tetraethoxysilane, propyl triethoxysilane, water, and HNO_3. After several hours of stirring, PVP and later $AgBF_4$ were added. Membranes were produced by dip-coating on a porous aluminum tube. Two membranes containing ~10 wt% PVP, one with and one without silver, as well as a membrane containing ~20 wt% PVP and silver ions, were prepared. Fourier transform infrared spectrophotometry measurements suggested that the silver ions were bound to the amide group of the PVP segments. The silica matrix gave the membranes enhanced thermal stability; the PVP made the inorganic network more flexible and nonporous. While the membrane without silver ions showed little selectivity for ethene, both of the silver-containing membranes gave $P_{C_2H_4}/P_{C_2H_6}$ ratios that increased with increasing temperature. At 423 K, values of 1.9 and 2.3 were observed for the membranes containing 10 wt% and 20 wt% PVP, respectively.

The researchers said that selectivity of the membranes could be improved by, "(1) raising the temperature to increase the decomplexation rate of C_2H_4 from Ag^+ and (2) increasing the PVP content." The researchers attribute the latter effect to the ability of the PVP to increase the flexibility of the inorganic framework and the immobilization of Ag^+ in the polymer segments.

CORA LIND

Mesoscopic Hollow Titania Spheres Functionalized on Inner Surface with Silver Nanocrystals

Mesoscopic hollow spheres have potential applications in the fields of catalysis, drug delivery, and coatings. The preparation of hollow titania mesospheres with interior surfaces functionalized with silver nanocrystals was recently reported by Younan Xia and co-workers from the Departments of Chemistry and Materials Science and Engineering at the University of Washington—Seattle. The materials were formed by decorating the surfaces of polystyrene (PS) spheres with nanocrystals and then using the modified spheres as templates for the sol-gel synthesis of titania (see figure). This method allows for facile synthesis of large quantities of hollow spheres with precisely controlled void size, shell thickness, and inner surface functionalization.

As reported in the April issue of *Chemistry of Materials*, commercially purchased PS beads were functionalized with a submonolayer of 10–20-nm-diameter silver nanoparticles using a commercially available electroless silver-deposition kit. The beads were poured into a cell consisting of two glass substrates spaced 10–70 µm apart. Titanium (IV) isopropoxide in isopropanol was then added to the cell, and the assembly was exposed to air to hydrolyze the titanium isopropoxide to amorphous titania. The PS beads were then dissolved in toluene, and the remaining hollow titania shells were released from the glass substrate by sonication.

The researchers demonstrated the versatility of this method for the titania shell/silver-nanocrystal system by preparing hollow shells with void sizes of 0.38 µm and 1 µm by using PS beads with different diameters. The shell thickness was also varied from 30 nm to 170 nm by increasing the concentration of the isopropoxide precursor. The void sizes and shell thicknesses of the hollow spheres were confirmed by transmission and scanning electron microscopy. These micrographs also showed that the silver nanocrystals were securely embedded in the walls of the spheres. The spheres were found to be robust enough to maintain their shape throughout the templating and post-treatment processes.

The researchers believe that this synthetic method can be extended to prepare functionalized hollow spheres having a large variety of core materials and inner surface microstructures. Also, hollow spheres with voids in the walls could be prepared by removing the functionalities through wet etching or calcination. The researchers said that a particularly exciting application involves decorating the inner surface with a catalyst and using the wall of the hollow sphere to control the diffusion of substrate and product species of the catalytic process.

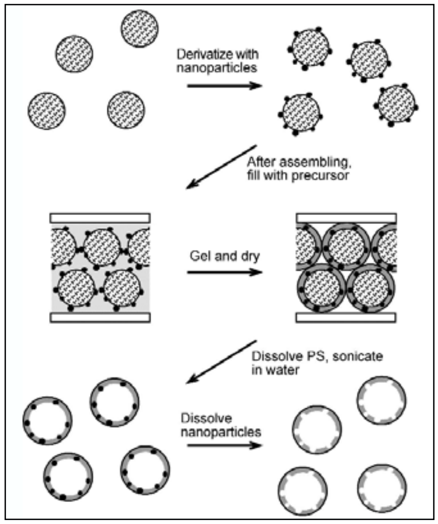

Figure. Schematic outline of the experimental procedure: The polymer template could be either dissolved with a solvent or burnt out through calcination at elevated temperatures. Reproduced with permission from Chem. Mater. ***13*** *(2001) p. 1146. Copyright 2001 American Chemical Society.*

GREG KHITROV

Electromagnetically Induced Transparency Observed in Raman Studies of Nitrogen-Vacancy Color Centers in Diamond

Diamond has been found to have potential for use in electromagnetically induced transparency (EIT) applications. In the March 15th issue of *Optics Letters*, experimental results were presented by researchers from the Hanscom Air Force Research Laboratory, Massachusetts Institute of Technology, and Texas A&M University, showing Raman-excited spin coherences in the nitrogen-vacancy (N-V) color center in diamond. This material was chosen because of its large optical oscillator strength (~0.1), its relatively long spin-coherence lifetimes (1–100 µs range), and its previous exhibition of Raman heterodyne signals. The diamond sample had ~30 parts in 10^6 N-V color centers.

A magnetic field was applied in the (111) orientation of the N-V centers as laser beams at different frequencies were focused into the crystal. The beams originated from one dye laser output that had been shifted with the use of acousto-optic frequency shifters. A nondegenerate four-wave mixing (NDFWM) signal was generated and analyzed as a function of Raman laser-beam intensities in order to determine the saturation curve. The linewidth was then measured at intensities well below the saturation limit. The ~5.5 MHz linewidth indicated that the signal was due to the Raman process.

By reducing the intensity of one beam and using it as a probe, and increasing the intensity of another beam to its maximum intensity and using it as a coupling beam, EIT was observed in the sample. The NDFWM beam was blocked during this experiment. A maximum transparency of 17% was reached, which corresponds to about 70% of what is possible, considering that only one out of four N-V centers are oriented in the (111) direction. A fit to the EIT spectrum gives a Rabi frequency of ~160 MHz.

ERIN CARTER

News of MRS Members/Materials Researchers

Zdeněk P. Bažant, Walter P. Murphy Professor of Civil Engineering and Materials Science at Northwestern University, has been awarded the **honorary degree Doctor of Science h.c. from the University of Colorado—Boulder** for his substantial contributions to structural engineering and solid mechanics worldwide.

Angela M. Belcher, assistant professor in the Department of Chemistry and Biochemistry at the University of Texas—Austin, has received a **2000 Presidential Early Career Award for Scientists and Engineers,** recognizing her pioneering research in combining organic and inorganic substances to produce new materials.

Clifton Draper has accepted a position on the executive team at Sensors Unlimited Inc., in Princeton, New Jersey, where, as liaison between manufacturing and research and development, he will provide key product analysis and assessment, advancing the quantity and variety of fiber optic components that Sensors can deliver to the marketplace. Draper will be retiring from Lucent Technologies, bringing to his new position 23 years of experience in optical-fiber and semiconductor device manufacturing research, as well as fundamental research in the field of laser interactions with materials.

Mary Lowe Good, Founding Dean of the College of Information Science and Systems Engineering at the University of Arkansas at Little Rock and President of the American Association for the Advancement of Science, has been awarded the **2001 J. Herbert Hollomon Award of *Acta Materialia*** in recognition of her outstanding contributions to understanding relations between materials technology and society, and/or contributions to materials technology that have had a major impact on society. The award will be presented at the Fall Meeting of The Minerals, Metals & Materials Society during the ASM International Awards dinner on November 6.

John B. Goodenough, professor of engineering at the University of Texas—Austin, has received the **Japan Prize from the Science and Technology Foundation of Japan** in the category of "Science and Technology of Environment Conscious Materials" for his discovery of lithium manganese oxide, lithium cobalt oxide, and lithium iron phosphates that have been critical to the development of lightweight and high-energy-density rechargeable batteries. Goodenough was honored during a prize ceremony in Tokyo in April.

Ru-Ling Meng, a researcher with the

Texas Center for Superconductivity at the University of Houston, has been recognized as one of the world's most cited authors by the Institute for Scientific Information (ISI) in November 2000, an honor given to less than one-half of one percent of all publishing researchers.

Greg Olsen, founder and president of Sensors Unlimited Inc., received the **Aron Kressel LEOS Award** at LEOS 2000, the annual meeting of the IEEE Lasers and Electro-Optics Society, held on November 13–16, 2000, in Puerto Rico. Olsen was recognized for his unique and visionary work in progressing the use of InGaAs detectors for viable and pragmatic purposes, most notably in the telecommunications industry.

Shigeyuki Sōmiya has received the **Japanese Government Award** for long-time services as Professor at Tokyo Institute of Technology and Teikyo University of Science and Technology, for research and education, and for the promotion of science and technology in the world.

The **American Physical Society** (APS) has announced awards and honors for 2001.

Louis E. Brus (Columbia University) received the **Irving Langmuir Prize** for establishing the field of semiconductor nanocrystals through innovative synthesis, spectroscopy, and theory.

David J. Wineland (National Institute of Standards and Technology) received the **Arthur Schawlow Prize** for an extraordinary range of pioneering studies combining trapped ions and lasers.

Alan Harold Luther (Nordic Institute for Theoretical Physics [Nordita], Copenhagen, Denmark) and **Victor John Emery** (Brookhaven National Laboratory) received the **Oliver E. Buckley Prize in Condensed Matter Physics** for their fundamental contribution to the theory of interacting electrons in one dimension.

Donald M. Eigler (IBM Almaden Research Center) received the **Davisson-Germer Prize** for his seminal contribution to nanotechnology and for pioneering a new methodology for probing matter at the atomic scale.

Masao Doi (Nagoya University) received the **Polymer Physics Prize** for pioneering contributions to the theory of dynamics and rheology of entangled polymers and complex fluids.

Arthur C. Gossard (University of California—Santa Barbara) received the **James C. McGroddy Prize in New Materials** for more than 25 years of major and continuing contributions to the science and technology of molecular-beam epitaxy, and for the growth of heterogeneous compound-semiconductor structures that have furthered both device applications and physical understanding of low-dimensional structures.

W.E. Moerner (Stanford University) received the **Earl K. Plyler Prize for Molecular Spectroscopy** for the development of single-molecule optical detection methods that remove ensemble averaging from spectroscopic measurements, thereby revealing the behavior of individual molecules, and for the application of these methods to the study of spectral diffusion, photon antibunching, photon hole burning, and intermittent fluorescence in solids, proteins, and liquids.

Alex Zunger (National Renewable Energy Laboratory) received the **Rahman Award** for his pioneering work on the computational basis for first-principles electronic structure theory of solids.

Klaus Schmidt-Rohr (Iowa State University) received the **John H. Dillon Medal** for his creative development of new nuclear magnetic resonance methods and their insightful use to elucidate polymer structure and dynamics.

Ellen D. Williams (University of Maryland) received the **David Adler Lectureship Award** for her elegant experimental exploration of the structures and phase transitions of surfaces and for her effective communication on this subject in lectures and publications.

The European Powder Metallurgy Association (EPMA) announced the following awards during the EURO PM2000 Conference in Munich, Germany, on October 18–20, 2000.

Federal Mogul Products of Pont-de-Claix, Grenoble, France, received the 2000 **Premier EPMA Award for Innovation in Powder Metallurgy** for its warm compacted and sintered connecting rod. The connecting rods will go into series production in 2002 for various-sized engines made by European car producers.

MG MiniGears of Padova, Italy, received an **Award of Merit for Innovation in Powder Metallurgy** for its PM helical gear with an inner straight lock slot, which the company started producing in 1999 for a leading manufacturer of electric portable power tools.

GKN Sinter Metals of Bad Brückenau, Germany, received an **Award of Merit for Innovation in Powder Metallurgy** for its sinter-brazed reverse planetary carrier used in a new five-speed automatic transmission developed by the Ford Motor Company.

Fraunhofer Institute for Ceramic Technology and Sintered Materials (IKTS) in Dresden, Germany, received the **Award of Merit for New PM Material** for the development of a hard, wear-resistant tungsten carbide material for tools and wear parts.

Osterwalder AG of Lyss, Switzerland, received the **Award of Merit for PM Processing Technology** for its hybrid mechanical–hydraulic powder-compacting press system, designated KPP, which was first introduced in 1998.

EPMA's **PM Thesis Competition—2000** awarded first prize in the Doctorate category to **Jürgen Raimann** (Friedrich-Alexander University of Erlangen—Nürnberg, Germany) for "The Phase-Doppler Measuring Technique as a Basis for the Production of Metal Powders with Controlled Particle Size," and commendations to **Häkan Engquist** (Uppsala University, Sweden) for "Microstructural Aspects on Wear of Cemented Carbides," **Olivier Gillia** (Institut National Polytechnique de Grenoble, France) for "Constitutive Modeling of a Sintering Material; Application to the Simulation of Industrial Sintering of WC-Co and Al_2O_3 Parts," **Ulrich Heck** (Universität Bremen, Germany) for "Atomization in Free-Fall Atomizers," **Robin Mottram** (University of Birmingham, UK) "Properties of Sintered Neodymium Iron Boron Magnets Produced by a Powder Blending Process," and **Jenni Zackrisson** (Chalmers University of Technology, Gösteborg, Sweden) for "Development of Cermet Microstructures during Sintering and Heat-Treatment."

First prize in the **Masters category** went to **Timo Bernthaler** (University of Applied Science, Aalen, Germany) for "Development of an Efficient Method for Quantification of the Pore Structure of Sintered Parts Using Digital Image Analysis," and commendations went to **Jesús Cintas-Fisico** (Universidad de Sevilla, Spain) for "Three-Step PM Processing of Mechanically Alloyed Aluminium-Base Materials," **Michael Friman** (Helsinki University of Technology, Finland) for "Optimisation of the Cu/Al_2O_3 Functionally Graded Material," and **Michail Melchakov** (Urals State Technical University, Russia) for "Connection Between Copper Powder Granulometric Composition and Its Structure at Different Electrolysis Conditions."

The **Institute of Physics** (IOP) has announced awards and honors for 2001.

Colin Edward Webb (University of Oxford) received the **Glazebrook Medal and Prize** for his leading role in the organization and promotion of laser physics in the United Kingdom and internationally, particularly for his discovery of 30 new laser transitions, and for being a founder of Oxford Lasers.

Laurence Eaves (Nottingham University) received the **Guthrie Medal and Prize** for his outstanding contributions to the field of semiconductor physics, especially on the quantum transport properties of semiconductors, including his involvement with the International Union of Pure and Applied Physics, and the Institute's Condensed Matter and Materials Division, his international collaborations, with international societies, and role in the organization of international conferences.

Brian Kidd Ridley (Essex University) received the **Paul Dirac Medal and Prize** in recognition of his profound influence on semiconductor theory stretching over four decades, for his valuable contributions to both theoretical and experimental semiconductor physics, and more recently for developing novel continuum theories of optical phonon confinement.

Jeremy J. Baumberg (Southampton University) received the **Charles Vernon Boys Medal and Prize** for his outstanding contributions to the application of ultrafast laser spectroscopy to a wide variety of problems in solid-state physics, including the discovery of magnetic coupling between optically injected spin-polarized electrons and the magnetic ions in magnetic semiconductors.

Volker Heine (University of Cambridge) received the **Max Born Medal and Prize** for his pioneering theoretical and computational studies of the electronic structure of solids and their application to physical properties, including his recent contributions to the development of a new field of "mineral physics."

James Kazimierz Gimzewski (IBM—Zurich) received the **Duddell Medal and Prize** for his contribution to nanoscale science in the use of scanning probe microscopy for the understanding and development of nanomechanics and tunneling phenomena in atoms and molecules, for his involvement in nanoscale science for the past 16 years, and for his work to progress nanotechnology from research to consumer products.

Manuel Cardona of Max Planck Institute for Solid-State Research in Stuttgart, Germany, received the **Mott Medal and Prize** in recognition of his broad and important contributions to the detailed understanding of the optical and electronic properties of solids.

Joseph Louis Keddie (University of Surrey) received the **Paterson Medal and Prize** for his major contributions of industrial importance to the understanding of the dynamics of polymers at surfaces, in thin films and in colloidal dispersions, and for his demonstration of both experimental ingenuity and physical insight.

Stephen J. Pennycook (Oak Ridge National Laboratory) received the **Thomas Young Medal and Prize** for his pioneering work in the development of atomic-resolution scanning transmission electron microscopy (STEM), which led to the solution of a wide range of problems in materials science.

The **Minerals, Metals & Materials Society** (TMS) has announced awards and honors for 2001.

Edward A. Loria (retired from Universal-Cyclops Specialty Steel Division of Cyclops Corporation) received the **Application to Practice Award** for transferring significant research results into commercial practice for a wide range of metals and alloys, over a career of more than 50 years with several companies, and application to several industries.

Alex Zunger (National Renewable Energy Laboratory) received the **John Bardeen Award** for his theoretical research into the spontaneous ordering of solids, which demonstrates a potential process for creating new and technologically significant materials for use in electronics and photovoltaic systems.

William J. Boettinger (National Institute of Standards and Technology) received the **Bruce Chalmers Award** for showing how fundamental thermodynamic and kinetic models, with modern computational power, led directly to quantitative predictions of the microstructures generated by solidification.

Carl J. McHargue (University of Tennessee) received the **Distinguished Service Award** for decades of leadership in implementing new initiatives for the TMS Board of Directors, International Affairs Committee, Nuclear Materials Committee, and Accreditation Committee.

Michael J. Vinarcik (Ford Motor Company) received the **Robert Lansing Hardy Award** in recognition as a metallurgist under the age of 30 showing outstanding promise for a successful career in the broad field of metallurgy.

Balazs Gyorffy (University of Bristol) received the **William Hume-Rothery Award** for his article, "On the Quasi-Particle Spectra of Superconducting Random Alloys," as an outstanding scholarly contribution to the science of alloys.

Niels Hansen (Riso National Laboratory) received the **Institute of Metals Lecturer & Robert F. Mehl Medalist** in recognition of his outstanding scientific leadership and will present the lecture "New Discoveries in Deformed Metals" at the TMS annual meeting November 4–8, 2001, in Indianapolis.

John A.S. Green (The Aluminum Association) received the **Leadership Award** for leadership in defining and implementing technology partnerships between industry, government, and academia (in the metallurgy and materials area).

Kwai S. Chan (Southwest Research Institute) received the **Champion H. Mathewson Award** for his series of articles, "Evidence of Void Nucleation and Growth on Planar Slip Bands in a Nb-Cr-Ti Alloy," "Effects of Ti Addition on Cleavage Fracture in Nb-Cr-Ti Solid-Solution Alloys," and "The Fatigue and Fracture Resistance of a Nb-Cr-Ti-Al Alloy" as the most notable contribution to metallurgical science during the period under review.

Chain-Tsuan Liu (Oak Ridge National Laboratory) received the ***Acta Metallurgica* Gold Medal** as an outstanding contributor to materials science.

Election to Fellow, the highest honor bestowed by TMS, has honored **Stan A. David** (Oak Ridge National Laboratory) for significant advancement of welding science and technology through pioneering and definitive research and continued leadership and service to the materials joining community worldwide; **Carl C. Koch** (North Carolina State University) for contributions to the understanding of mechanical alloying and mechanical attrition for the preparation of amorphous and nanostructured alloys; **John W. Morris Jr.** (University of California) for broad and outstanding contributions to metallurgy and materials science, including phase transformations, cryogenic steels and superalloys, electromigration, and joining in electronic packaging; **Gregory B. Olson** (Northwestern University) for advances in the physical metallurgy of steel, pioneering contributions to materials design, and application of design concepts to engineering education; and **Sungho Jin** (Bell Laboratories, Lucent Technology) for seminal discoveries in the fields of high-temperature superconductor processing, diamond thinning, and collossal magnetoresistance.

The **2001 Educator Award** was awarded posthumously to **Lawrence H. Van Vlack** for his outstanding accomplishments as an engineering educator and administrator, author of seminal introductory materials textbooks, and major contributor to the understanding of nonmetallic inclusions in steels. Van Vlack held positions as department chair and professor emeritus at the University of Michigan from 1953 to 1999. His daughter, Laura R. Van Vlack-Ailes, accepted the award in his honor.