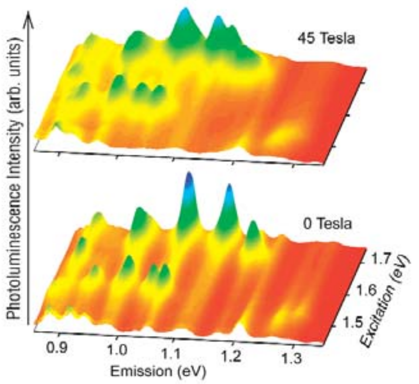

Figure 1. The peaks represent the amount of light emitted by semiconducting carbon nanotubes through interband photoluminescence. The bottom graph depicts light-emission activity in the absence of a magnetic field. The top graph shows a significant shift of light emission peaks to lower energies taken from nanotubes inside a 45-T field. (Figure courtesy of Sasa Zaric, Rice University.)

As reported in the May 21 issue of *Science* (p. 1129), the researchers placed solutions of nanotubes inside a chamber containing very strong magnetic fields. Lasers illuminated the samples, and conclusions were drawn based upon analysis of the light absorbed and emitted by the samples during polarization-dependent magneto-absorption spectroscopy.

Kono said, "Our data show…that the so-called Aharonov-Bohm phase can directly affect the band structure of a solid. The Aharonov-Bohm effect has been observed in other physical systems, but this is the first case where the effect interferes with another fundamental solid-state theorem, that is, the Bloch theorem. This arises from the fact that nanotubes are crystals with well-defined lattice periodicity. I wouldn't be surprised to see a corresponding effect in other tubular crystals like boron nitride nanotubes."

According to the researchers, the bandgap behavior of the nanotubes in a strong magnetic field derives from their quantum properties. Because of the material's tubular, crystalline structure, electrons are limited to moving around the surface of the tube rather than in the hollow center.

Kono said that this discovery may lead to experiments on one-dimensional magneto-excitons, quantum pairings that are interesting to researchers studying quantum computing, nonlinear optics, and quantum optics.

α-SiAlON Ceramics with High Transparency Obtained After Lu_2O_3 Addition

The most widely studied SiAlON ceramics, for which the two major phases are α and β, are those stabilized with Y_2O_3. Oxide additions help to stabilize the α phase of the Si_3N_4-based solution by substituting some of the silicon and nitrogen in the Si_3N_4 lattice. Further addition of a stabilizing element, usually a rare earth, equilibrates the valence difference of the α phase. The smaller the size of the ion added, the larger the temperature

https://doi.org/10.1557/mrs2004.133

and composition ranges where the α phase is stable. In compositions with 100% α phase, the grain-boundary phase is reduced as all of the additives can enter into the structure. Now, by using a novel stabilizing material, Lu_2O_3, a team of scientists from the Agency of Industrial Science and Technology (AIST) and the Fine Ceramics Research Association in Nagoya, Japan, have obtained a highly dense, transparent Lu-α-SiAlON ceramic.

As reported in the April issue of the *Journal of the American Ceramic Society* (p. 714), M.I. Jones and K. Hirao of AIST, H. Hyuga of the Fine Ceramics Research Association, and colleagues hot-pressed a mixture of Si_3N_4, Al_2O_3, AlN, and Lu_2O_3 at 1950°C and 40 MPa for 2 h in a 0.9 MPa nitrogen atmosphere. X-ray diffraction patterns of this material showed that only α-SiAlON was present. Both scanning and transmission electron microscopy observations revealed a fully dense, uniform microstructure of equiaxed grains, with a grain size of ~1 μm and with little or no grain-boundary phase present at triple points. Vickers hardness measurements using 98 N load gave results above 19 GPa, and indentation fracture using 98 N load gave a fracture toughness of ~2.5 MPa $m^{1/2}$. Four-point bend tests with inner and outer spans of 10 mm and 30 mm, respectively, and a crosshead speed of 0.5 mm/min gave a bending strength of 400 MPa.

Optical transmission measurements using spectrophotometry in the wavelength range of 350–800 nm were performed on 0.5-mm-thick samples. At 350 nm, transmission was ~35%, increasing with increasing wavelength. At ~500 nm, transmission was more than 60%, and for wavelengths larger than 600 nm, transmission was ~70%.

Similar measurements reported in the literature on β-SiAlON ceramics gave ~40% transmission maximum at ~4.5 μm wavelength, with low transmission in the visible region. The investigators attribute the high transparency of Lu-α-SiAlON to the lack of grain-boundary phases, lack of porosity, and the small uniform grain size. The investigators said that they will now study the mechanical properties of this material, which are expected to be better than the more commonly studied Y-stabilized SiAlON, at high temperatures.

SIARI SOSA

Nanostructured Biosensors Produced by Nanosphere Lithography

Biosensors rely on the principle of specific interactions between the sensor support and the biomolecule targeted. Thus, high control over the sensor-surface shape and functionality at the nanoscale is needed. Optical lithography can be used to generate patterned surfaces, but becomes complicated for feature sizes below 200 nm because of diffraction limits. Nanosphere lithography is an alternative method capable of producing nanotopography over large surface areas, as explained by A. Valsesia and a team of researchers at the Institute for Health and Consumer Protection, Ispra, Italy. As reported in *Nano Letters* (Web release date, May 8), the researchers produced polymeric nanoislands with biospecific chemical functionalities, combining plasma deposition and etching techniques with colloidal particle masking.

A polymer film of acrylic acid (PAA) was deposited on silicon wafers by plasma-enhanced chemical vapor deposition. The substrate was later covered by a monolayer of polystyrene particles, with an

https://doi.org/10.1557/mrs2004.133

tion in recognition of his invention of the practical light-emitting diode in 1962.

Charles Lieber, Mark Hyman Jr. Professor of Chemistry at Harvard University, has been elected into the **National Academy of Sciences**.

Paras Prasad, SUNY Distinguished Professor in the Department of Chemistry in the University at Buffalo's College of Arts and Sciences and Samuel P. Capen Chair, has been awarded the **2004 Morley Medal** by the Cleveland section of the American Chemical Society.

Gary L. Smith, a staff scientist at the Department of Energy's Pacific Northwest National Laboratory, has been appointed chair of the ASTM International Committee C26 on Nuclear Fuel Cycle. This prominent and influential committee develops standards important to work done on the nuclear fuel cycle, including spent nuclear fuel, waste materials, and repository waste packaging and storage. Smith also was honored with the **Harlan J. Anderson Award**, which is presented annually to a member of C26 who has made outstanding contributions toward the successful operation of the committee.

Robert L. Snyder has been named **Distinguished Fellow** of the International Centre for Diffraction Data (ICDD).

The **Franklin Institute** has announced award recipients for 2004, including:

Roger Bacon, Amoco Corporation and Union Carbide, retired, who received the **Benjamin Franklin Medal in Mechanical Engineering** for his fundamental research on the production of graphite whiskers and the determination of their microstructure and properties, for his pioneering development efforts in the production of the world's first continuously processed carbon fibers and the world's first high modulus, high-strength carbon fibers using rayon precursors, and for his contributions to the development of carbon fibers from alternative starting materials;

Robert B. Meyer, Brandeis University, who received the **Benjamin Franklin Medal in Physics** for his creative synthesis of theory and experiment demonstrating that tilted, layered liquid-crystal phases of chiral molecules are ferroelectric, thus launching both fundamental scientific advancement in the field of soft condensed matter physics and in the development of liquid-crystal displays that meet the demands of current technology; and

Robert E. Newnham, The Pennsylvania State University, who received the **Benjamin Franklin Medal in Electrical Engineering** for his invention of multiphase piezoelectric transducers and their spatial architecture, which has revolutionized the field of acoustic imaging.

The **Presidential Early Career Awards for Scientists and Engineers** have been given to 57 researchers, including the following MRS members:

Susmita Bose (Washington State University);

Christine Orme (Lawrence Livermore National Laboratory);

Michelle L. Pantoya (Texas Tech University);

Bridget Rogers (Vanderbilt University); and

Gregory Neil Tew (University of Massachusetts).

The **Institute for Scientific Information** (Philadelphia, Pa.) has identified the top 10 most cited materials scientists for the period of January 1993–October 2003, including MRS members:

Anthony G. Evans (University of California—Santa Barbara);

Akihisa Inoue (Tohoku University, Japan);

Terry Langdon (University of Southern California);

Galen D. Stucky (University of California—Santa Barbara); and

Ruslan Z. Valiev (Ufa State Aviation Technical University—Russia).

The **International Centre for Diffraction Data** has selected six recipients for the **2004 Ludo Frevel Crystallography Scholarship Program**:

Geoffrey Kwai-Wai Kong, University of Melbourne/St.Vincent's Institute of Medical Research, Australia, for exploration into "Crystallographic Studies of the Amyloid Precursor Protein (AAP)";

Chong Lim, University of Illinois at Urbana-Champaign, Urbana for research concerning "Reaction Path and Crystallography of $CoSi_2$ Formation on Si(001) by Reactive Deposition Epitaxy";

Andrew Locock, University of Notre Dame, for "Crystal Structure and Synchrotron Radiation Study of Uranyl Oxysalts of Phosphate and Arsenate—Implications for Remediation";

Robin T. Macaluso, Louisiana State University, for research involving "X-ray and Neutron Diffraction Studies for Understanding Geometrically Frustrated Systems";

Petra Simoncic, University of Bern, Switzerland, for studies focusing on "Defect Structure of the Natural and Synthetic Zeolites Mordenite—Structure Characterization of Dye Modified, Synthetic Mordenite"; and

Kimberly Tait, University of Arizona, for "Investigations into the Stability, Morphology and the Crystal Structure of the Coexistence of Structure I and Structure II Methane-ethane Clathrate Hydrates—Occurrence and Geological Implications." □

https://doi.org/10.1557/mrs2004.133