ness of the TeSW-prepared p-Si is very thin and the rms roughness is only 1.6 nm.

The researchers also performed a controlled experiment of p-Si formation using NaOH etchant at various pH levels, but they observed no efficient PL emission from any of the NaOH-prepared samples. The researchers pointed out that the reproducibility appeared to be a problem for the photoetched p-Si synthesis technique. They point out that others have suggested that the preexisting state of the Si surface plays a decisive role in determining p-Si formation.

TAO XU

High Frictional Anisotropy Found on Quasicrystal Surface

A collaboration of scientists from Lawrence Berkeley National Laboratory (Berkeley Lab) and the Ames Laboratory at Iowa State University have determined that friction along the surface of a quasicrystal in the direction of a periodic geometric configuration is about eight times greater than in the direction where the geometric configuration is aperiodic (i.e., without regularity). In an article published in the August 26 issue of *Science* (p. 1354), the research collaboration led by Miquel Salmeron, a physicist with Berkeley Lab's Materials Sciences Division, and Patricia Thiel, a chemist in Ames Lab, reports that geometric periodicity was confirmed by rows of atoms that formed a Fibonacci sequence, a numerical pattern often observed in quasicrystals. The research combined the use of scanning tunneling microscopy (STM) and atomic force microscopy (AFM) to observe the surface structures and measure the frictional forces.

"That we can get such a large difference in frictional force just by scratching the surface of a material in a different direction was a major surprise," said Salmeron. "Our results reveal a strong connection between interface atomic structure and the mechanisms by which frictional energy is dissipated."

At the atomic level, when two surfaces come in contact, the chemical bonds and clouds of electrons in their respective atoms create frictional force and cause energy to be dissipated. It has long been known that friction is greater between surfaces of identical crystallographic orientation than between surfaces of differing orientation. Some recent studies have reported frictional differences, or anisotropy, less than a factor of 3 for incommensurate crystal surfaces when there were periodicity differences.

To measure the frictional effects due to periodicity alone and not to other factors such as chemical differences, the researchers worked with decagonal quasicrystals of an aluminum-nickel-cobalt (Al-Ni-Co) alloy. Stacked planes of Al-Ni-Co crystals exhibit both tenfold and twofold rotational symmetry. By cutting a single Al-Ni-Co quasicrystal parallel to its tenfold axis, the researchers were able to produce a two-dimensional surface with one periodic axis and one aperiodic axis, separated by 90°. In order to avoid surface damage and also wear of the tip used in the combined AFM–STM instrument, a TiN tip passivated with a molecular layer of hexadecane thiol was used.

"Strong friction anisotropy was observed when the AFM tip slid along the two directions: high friction along the periodic direction, and low friction along the aperiodic direction," said co-researcher J.Y. Park of Berkeley Lab. "We believe the source of this friction has both an electronic and a phononic contribution." Phonons are quantized vibrations in a crystal lattice. The frictional anisotropy vanished when the samples were oxidized by exposure to air.

The researchers said that new theoretical models are needed to determine whether the electronic or phononic contributions dominate the observed frictional anisotropy.

La-Doped 0.3PZN-0.7PZT Ceramics with Pure Perovskite Phase Synthesized

It is well known that the single-crystal relaxor ferroelectrics, $Pb(Zn_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ (PZN-PT) and $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ (PMN-PT), possess ultrahigh piezoelectric properties. However, in comparison with single crystals, ceramics have advantages including low production cost, homogeneous compositions, tunable properties for applications such as medical ultrasonic probes and microfine actuators. Although pure perovskite PMN-PT ceramics have been synthesized near their morphotropic phase boundary (MPB), until now success has eluded such efforts for PZN-PT. In the August issue of the *Journal of the American Ceramic Society* (p. 2310; DOI: 10.111/j.1551-2916.2005.00391.x), G. Deng and colleagues from the Shanghai Institute of Ceramics, China, have reported their success in synthesizing pure perovskite ceramics of PZN-PZT, as an alternative to PZN-PT, near their MPB. The researchers have observed much higher piezoelectric and electromechanical coupling coefficients for their newly synthesized material than those reported earlier.

Because their goal was to find good piezoelectric values, the researchers explored $0.3Pb(Zn_{1/3}Nb_{2/3})O_3$-$0.7Pb_{0.96}La_{0.04}(Zr_xTi_{1-x})_{0.99}O_3$ [La-doped 0.3PZN-0.7PZT], with x ranging from 50 to 53 stepwise by 0.5 (i.e., values around the MPB). The samples were prepared by the two-step hot-pressing process. X-ray diffractometry (XRD) revealed that the microstructures of these complex compounds experience a gradual transition process from tetragonal to rhombohedral phase with an increase in the Zr/Ti ratio. The MPB is defined as the coexistence of tetragonal and rhombohedral phases. Therefore, the research team deduced that the MPB in their samples can be delimited in the range of Zr/Ti = 51/49–52/48. In addition, XRD revealed that samples in the entire composition range had pure perovskite structure. The piezoelectric coefficient (d_{33}) was measured using a quasi-static piezoelectric d_{33} meter. The maximum of d_{33} was found to be 845 pC/N for Zr/Ti = 51/49, which the researchers indicate is much higher than the previously reported value of 670 pC/N. Electromechanical coupling was measured using an impedance analyzer, and its maximum value was observed to be 0.7 for the same composition Zr/Ti = 51/49 and larger than the previously reported value of 0.65. Dielectric coefficient and dielectric loss were measured using the impedance analyzer. This series of piezoelectric ceramics have high T_{max} (206–213°C) and large dielectric constants (3321–4088 for poled and 2048–2796 for depoled samples). The researchers concluded that these high values of piezoelectric properties make 0.3PZN-0.7PLZT an interesting material for potential applications in transducers, actuators, and probes.

VIVEK RANJAN

News of MRS Members/Materials Researchers

In Memoriam

Morris Cohen, Institute Professor Emeritus at the Massachusetts Institute of Technology, passed away May 27, 2005, at his home in Swampscott, Mass. He was 93.

Morris grew up in Chelsea, Mass., and enrolled as a freshman at MIT in the fall of 1929. By 1936, he had earned a ScD degree in Materials Science and Engineering and was appointed an instructor in metallurgy. He became a full professor in 1946, was named Ford Professor of Metallurgy in 1962, and was recognized across MIT by promotion to Institute Professor in 1975.

Morris Cohen's contributions to the field of science, especially materials science, were broad and deep—from fundamental investigations on the properties of iron and steel, especially the martensitic transformation in steel and how microstructure improves the mechanical properties of steel, to seminal contributions to the mechanism and kinetics of the martensitic transformation, tempering phenomena, strengthening mechanisms, age-hardening of alloys, strain-induced transformations, and rapid solidification of alloys. His work resulted in a much more basic understanding of how to make steel strong and made practical the ultrahigh-strength steels used today.

Morris's extensive service to the United States included work on committees of the National Academy of Sciences, the National Science Foundation, NASA, and the National Academy of Engineering. During World War II, Morris served as associate director of the Manhattan Project at MIT and also contributed to the programs at Los Alamos National Laboratory, the Oak Ridge facilities in Tennessee, and the Hanford Site in Washington. He published nearly 300 refereed research papers and had more than 150 graduate and postdoctoral students. In 1977, Morris was awarded the National Medal of Science, and in 1987, he received the Kyoto Prize in Advanced Technology.

Morris was a visionary in helping to create the new field of materials science and engineering. In the early 1970s, the National Academy undertook a study of the field of materials science and engineering. This study required leadership of national rank, and Morris was unanimously chosen to be the co-chair of the COSMAT study (Committee on the Survey of Materials Science and Engineering). This highly influential report became known as the "Cohen Report," reflecting Morris's role in making this huge effort come to fruition. "Materials and Man's Needs" turned out to have a very large influence on national policy and on materials education and research. Indeed, MIT was one of the first departments to create a materials catholic program under department head Walter Owen, as the metallurgy department at MIT transformed itself from a narrowly focused metals-based effort to become the broadly defined MSE program that is vibrantly continuing today.

Cohen was preceded in death by his wife, Ruth, and his daughter, Barbara Norwind. He is survived by his son Joel; two sisters, Louise Polansky and Charlotte Freed; three grandchildren and five great-grandchildren. Morris's scientific vision, dedication, and talent, along with his warm personality and friendship, will be deeply missed by all who knew him. An endowed MSE Graduate Fellowship at MIT is currently being raised in his honor.

EDWIN L. THOMAS
Department of Materials Science and Engineering
Massachusetts Institute of Technology

News of MRS Corporate Affiliates/Materials Institutions

Veeco and JNCASR Announce Nanoscience Center in Bangalore, India

Veeco Instruments Inc., a leading supplier of instrumentation to the nanoscience community, announced on July 26, 2005, that it is establishing a nanotechnology center in Bangalore, India. The facility will be staffed with local scientists and engineers and equipped with Veeco's latest atomic force microscope (AFM), scanning tunneling microscope (STM) products, and other advanced nanotechnology application modules. The Veeco–India Nanotechnology Laboratory will be jointly operated with the Jawaharlal Nehru Center for Advanced Scientific Research (JNCASR). The JNCASR promotes scientific research in interdisciplinary areas of science and engineering.

Michael Weiss, Veeco's vice president and general manager for Asia, said, "We anticipate continued growth of nanoscience research applications in India and are excited about embarking on this joint and collaborative effort with the JNC and other nanoscience institutions in India."

According to C.N.R. Rao, honorary president of the JNCASR, "Nanotechnology and nanoscience are important opportunities for India. The Indian government has made major allocations for nanotechnology between 2002 and 2007. A nanoscience initiative of the Department of Science and Technology [government of India] that began in 2003 has identified and is working with more than 30 R&D institutions to identify prospective nanotechnology products that can be commercialized. Having access to the appropriate state-of-the-art instruments is critical to future nanotechnology developments in India."

Weiss and Rao will oversee the Veeco–India Nanotechnology Laboratory. G.U. Kulkarni of JNCASR will function as an advisor and C. Venkatram Dattu has been appointed the local Veeco manager responsible for day-to-day activities of the laboratory. The laboratory is located at JNCASR, Jakkur Campus.

Northwestern's MS&E Department Celebrates 50th Anniversary

Northwestern University's Department of Materials Science and Engineering will celebrate its 50th anniversary October 27–28, 2005. The department was founded on the concept that many of the same fundamental principles underlie the behavior of the various classes of materials: metals, polymers, ceramics, and electronic materials. Morris Fine was largely responsible for this breakthrough in viewing the science of materials as a discipline.

The 50th anniversary celebration will include a symposium on the development of the field of materials science and engineering as well as its current frontiers and future promise. Topics will include computational materials science, polymer and molecular electronics, materials design, materials for energy production, mechanical properties of nanomaterials, high-performance ceramics, and materials for regenerative medicine.

To register, or for more information, access Web site http://www.matsci.northwestern.edu/50th/.

UVa MRSEC & Paladin Pictures Recognized for Nanotechnology Educational Video

The University of Virginia's (UVa) Center for Nanoscopic Materials Design and Paladin Pictures Inc. received the Communicator Awards' "Award of Distinction" last spring for their creation

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of a video program titled *The NANO Revolution*. The center, directed by Robert Hull, is a National Science Foundation (NSF)-sponsored Materials Research Science & Engineering Center (MRSEC). *The NANO Revolution* is a seven-minute educational video, filmed primarily in the research laboratories of the UVa MRSEC and designed to introduce the concept of nanotechnology and its applications to a target audience of middle- and high-school students and the general public.

The Communicator Awards is an annual international competition honoring excellence in visual communications. The Award of Distinction formally recognizes the UVa MRSEC/Paladin Pictures production for exceeding industry standards.

The NANO Revolution provides viewers with an introduction to the concept of nanotechnology and its potential for shaping the future. The video highlights rapid developments within industries such as desktop computers, consumer electronics, and textiles and clothing as examples of the growing impact of nanotechnology upon everyday life.

To view *The NANO Revolution* program in its entirety, access Web site www.mrsec.virginia.edu/nugget2nanorev.htm or www.paladinpictures.com.

Penn State's New Materials Research Building Receives Funding

Materials research at the Pennsylvania State University took another step forward when Pennsylvania Gov. Edward G. Rendell released $40 million in state funding on May 18, 2005, for construction of a new materials research building on the University Park campus. The remaining half of the estimated $80 million building cost will come from university funds.

Research is expected to integrate materials with engineering and the biological, medical, and physical sciences and to range from advancing materials understanding in ceramics, polymers, composites, and metals to innovations in micro- and nanotechnology. The building will serve as a hub for innovation, outreach to industry, and technology-based economic development for the region and the state.

Nexia Solutions Opens Technology Centre in Sellafield

Nexia Solutions Ltd. (Cumbria, U.K.), a nuclear technology solutions business, officially opened its Technology Centre at Sellafield on June 24, 2005. The Centre is a focal point for nuclear research and technology in the United Kingdom. Nexia Solutions will operate this world-class resource on behalf of the Nuclear Decommissioning Authority (NDA).

Nexia Solutions' managing director, Peter Bleasdale, said, "We are very proud of the Technology Centre....We are determined to use all the resources at our disposal to deliver tailored technology with the right amount of innovation applied to add value for customers for the lowest possible cost and maintain the national nuclear research capability." □

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