

Fifth International Conference on Synchrotron Radiation in Materials Science Highlights Latest Research Developments

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More than 250 scientists from 22 countries gathered at the Drake Hotel in downtown Chicago from July 30 to August 2, 2006, to participate in the Fifth International Conference on Synchrotron Radiation in Materials Science (SRMS-5). The SRMS conference is held every two years, bringing together leading-edge researchers in the materials sciences making use of synchrotron radiation. The conference, which was organized and hosted this year by Argonne National Laboratory and the Advanced Photon Source, provided an overview of the latest research developments in a broad range of areas such as polymers and biomaterials, magnetic and superconducting materials, glasses and ceramics, engineering materials, materials under extreme conditions, complex oxides, innovative instrumentation, membranes, and thin films. The aim of SRMS-5 was to highlight recent breakthroughs in materials science using synchrotron radiation and to open doors to future innovation and discovery.

The meeting was divided into plenary sessions—with lectures across a broad range of topics—and breakout sessions that were generally more focused on a particular area of research. Poster presentations



A. Manceau (CNRS) delivers an invited lecture on the defects and chemistry of environmental nanoparticles.

followed along the lines of the breakout sessions of each day. In all, there were 35 plenary and invited talks, 37 contributed talks, and 134 poster presentations at SRMS-5.

The conference opened with a plenary lecture by J.C. Campuzano (Argonne Natl. Lab; Univ. of Illinois at Chicago), in which he laid out many details of the elec-

tronic structure of high-temperature superconductors determined by angle-resolved photoemission. Attempts to explain these structures by means of band theory, Landau–Fermi liquid theory, or Bardeen–Cooper–Schrieffer (BCS) theory have not thus far succeeded, leaving this challenge open for the future. Next, H. Dosch (Max Planck Inst., Stuttgart, Germany) spoke on the challenges in understanding phase behavior of metallic alloys and its relation to physical properties in nanoconfined geometries, where he speculated that some of the results may be understood in terms of misfit strains. T.P. Russell (Univ. of Massachusetts, Amherst) and E.E. Fullerton (Hitachi Global Storage Technologies, San Jose) spoke on orienting domains in block copolymer thin films and on magnetic reversal in antiferromagnetically coupled films, respectively.

On the second day, C.S. Yoo (Lawrence Livermore Natl. Lab, Livermore) presented the challenge of understanding the exotic states of matter that can be created in extreme environments. High pressure, coupled with high temperature, can induce non-molecular phases in simple molecular solids. Synchrotron x-ray experiments have made it possible to observe and begin to understand the pressure-induced materials chemistry. C.S. Nelson (Brookhaven Natl. Lab, Upton, NY) followed with a lecture on orbital ordering in calcium ruthenates. Her x-ray resonant scattering studies showed some surprising results. For example, in Ca_2RuO_4 , the temperature at which the onset of orbital ordering takes place is far below the metal–insulator transition and is also well below the temperature at which the crossover from elongated to compressed octahedra occurs. In $\text{Ca}_2\text{Ru}_2\text{O}_7$, the anisotropy of the structural change in a magnetic field applied along the two in-plane directions was consistent with earlier published results, but there was no evidence of orbital order to orbital disorder behavior. C.G. (Kees) de Kruijff (NIZO Food Research; Utrecht Univ., the Netherlands) delighted the audience with his lecture on synchrotron methods for food science and soft-matter investigations into protein–polysaccharide correlations. In a breakout session on polymers, J.C.P. Goossens (Eindhoven Univ. of Technology, the Netherlands) presented results from shear-induced crystallization small-angle x-ray studies probing structure



R. Barabash (ORNL) explains her poster on the arrangement of dislocations in shock-recovered Al single crystals.

development. These were able to elucidate mechanisms for improvement in the processing and performance of polymer systems. E.J. Kramer (Univ. of California, Santa Barbara) presented results on self-assembly of multilayer films of spherical-domain diblock copolymers. In a comprehensive study, he was able to delineate the evolution from hexagonal symmetry in two dimensions to bcc symmetry in three dimensions, where the symmetry was found to change continuously with increasing film thickness from four to 14 layers. X. Liu (Northwestern Univ.) also spoke on controlled evolution, in this case, of polymer single crystals, where he presented results from dip-pen nanolithography. J. Yoon (Pohang Accelerator Lab., South Korea) discussed the structural analysis of thin films of PS-*b*-PMMA block copolymer. He made use of a distorted-wave Born approximation analysis to discover cylindrical microdomains perfectly oriented normal to the substrate surface.

The third day's plenary session began with a lecture by T. Rayment (Univ. of Birmingham, UK) on x-ray absorption spectroscopy above, below, and at electrodes. These challenging experiments have been able to follow structural and electronic changes as a function of depth below the electrode surface. A.Q.R. Baron (SPring-8, Harima, Japan) spoke on electron-phonon coupling in high- T_c superconductors as measured by meV-resolved inelastic x-ray scattering. The studies he described followed the softening of in-plane longitudinal bond-stretching modes and their dependence on doping. P.M. Derlet (Paul Scherrer Inst., Villigen, Switzerland) explained the use of Green's functions and molecular dynamics to understand dislocations and lattice vibrations in small metal grains and grain boundaries. Nanocrystalline fcc metals have unique mechanical and structural properties and are difficult to characterize, and thus atomic simulations such as those described in this lecture have played a guiding role in the elucidation of these



Meeting attendees discuss research at an afternoon poster session of SRMS-5.



G.N. Greaves of the University of Wales and chair of the International SRMS committee (center) converses with researchers during a poster session.

structures. L. Paolasini (European Synchrotron Radiation Facility, Grenoble) spoke on x-ray resonant scattering as a site- and shell-selective technique for

measuring structural modifications of SmS and CeFe₂ under extreme conditions.

SRMS-5 took place at a time when a large proportion of the scientific research at synchrotron user facilities is in materials science and condensed-matter physics. Furthermore, with the rapid increase in interest in membranes, biomaterials, and nanostructured materials, this fraction can only be expected to grow. It is noteworthy that among the research papers published during 2005 in the highly cited journals *Nature* and *Science*, 19% and 27% reported on materials research and, of these, more than 28% and 35%, respectively, made use of synchrotron radiation.

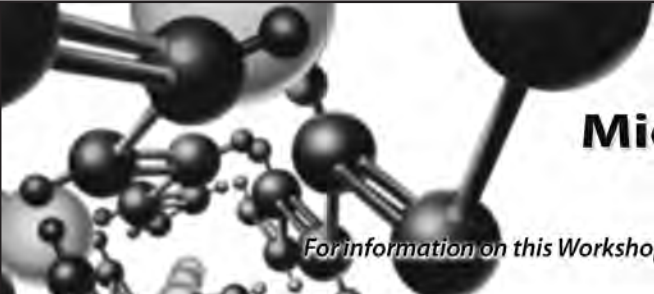
In addition to the scientific program, conference attendees took a boat ride along the Chicago River while hearing about the city's famed architecture. They were regaled with a mini-operetta and attended a reception amid the world-class collection of the Art Institute of Chicago, followed by a conference banquet held in the institute's famous Trading Room.

A local organizing committee that included representatives from Northwestern University, the University of Chicago, the Illinois Institute of Technology, Iowa State University, and the University of Illinois at Urbana-Champaign was invaluable to the success of the conference, as was the international advisory committee chaired by Neville Greaves of the University of Wales (Aberystwyth, UK). The conference was endorsed by the Materials Research Society.

Full-color versions of the conference contributions can be viewed and downloaded from the Web site www.aps.anl.gov/SRMS5/Contributions.

The SRMS international advisory committee has selected Laboratório Nacional de Luz Síncrotron in Brazil to host the 2008 SRMS.

GABRIELLE LONG
Chair, SRMS Local
Organizing Committee



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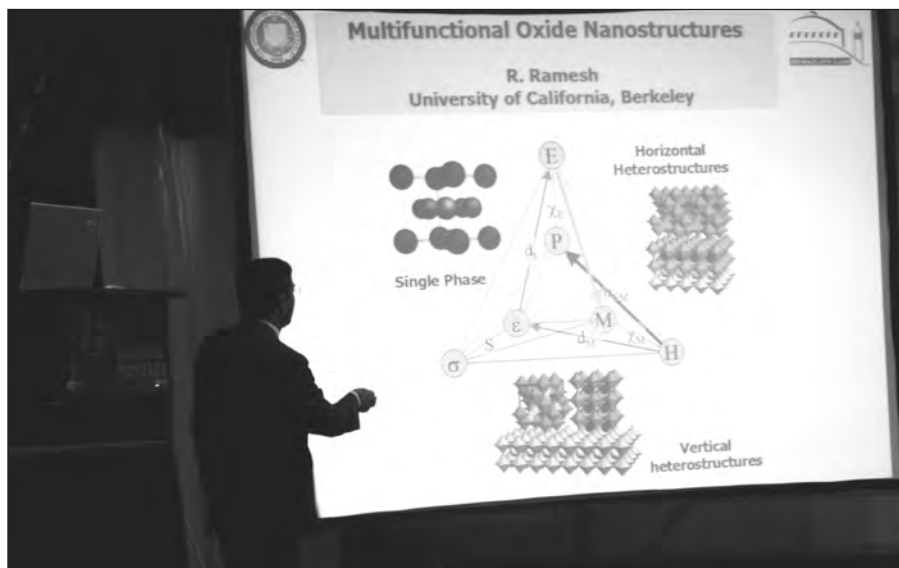
The 10th International Conference on Electroceramics was held in Toledo, Spain, June 18–22, 2006. J.F. Fernandez, chair of the conference, and M. Villegas, conference secretary, both from the ICV-CSIC, Spain, greeted 460 participants from 38 countries.

Electroceramics X consisted of plenary presentations, 29 invited speakers, 201 oral presentations, and 294 posters. The program offered traditional topics focused on ceramic processing, ferroelectric thin films, and ionic conductors, as well as new topics, including semiconductor bioceramics.

Discussions on the use of nanotechnology tools for integration were among the highlights of the conference. Plenary speaker L. Gauckler (Swiss Federal Institute of Technology, Zurich) described the way solid-oxide fuel cells generate clean energy through use of a self-supported membrane. The “cellular” concept consists of a self-supported thin-film membrane confined as a microelement. This system, which may become available commercially within five years, might serve as a portable electrical power supply for computers, electronic devices, or other products.

Plenary speaker R. Ramesh (Univ. of California, Berkeley) showed how strong coupling in self-assembled nanostructures induce switching in magnetization by applying an electric field. Heteroepitaxial growth of nanopillar films served as base materials for new photonic applications.

Among the new topics discussed during the technical sessions were the future roles that electroceramic and bioceramic materials may play in neural and osseous growth. Also, one of the innovative topics in electroceramics was lead-free piezoceramics. The recent growth of piezo-



Plenary speaker R. Ramesh (Univ. of California, Berkeley) discussed multifunctional complex oxide heterostructures at Electroceramics X, held in Toledo, Spain, in June 2006.

ceramic applications—in particular, those related to automotive applications such as electronic injection and vehicle sensors—has increased spectacularly. Currently, the best piezoelectric ceramics contain a high percentage of lead. The toxicity is low because the lead is in solid solution and is stable, but due to recycling requirements, new environmentally friendly materials are needed. At the conference, 23 presentations on lead-free ceramics showed both how this new topic is emerging and how the science community is reaching alternatives that may solve the problem in just a few years.

Other topics of interest were related to nanoengineering processes, such as low-agglomeration nanoparticles and SiO₂ nanocoating of nanoparticles for new dielectric materials. Another emerging topic was a spintronic base material for multifunctional applications. M.A. Garcia (Instituto Magnetismo Aplicado, Spain) presented a new class of interface magnetism recently discovered in the Mn-Zn-O system.

The conference was endorsed by the Materials Research Society.

J.F. FERNÁNDEZ
Chair, Electroceramics X

SPECIAL THANKS

The following events at the 2006 MRS Fall Meeting have been funded, in part, by the generous contributions of these organizations.

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CISGM-4 Enlightens Materials Scientists Gathered in Algeria

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The Fourth International Congress on Materials Science and Engineering (CISGM-4), organized by the University of Tlemcen, Algeria, and the Algerian Materials Research Society, and endorsed by the Materials Research Society, was held in Tlemcen, Algeria, May 2–4, 2006. Ghouti Merad from Tlemcen University and H. Aourag, chair of the Algerian Materials Research Society (AMRS), chaired the organizing committee.

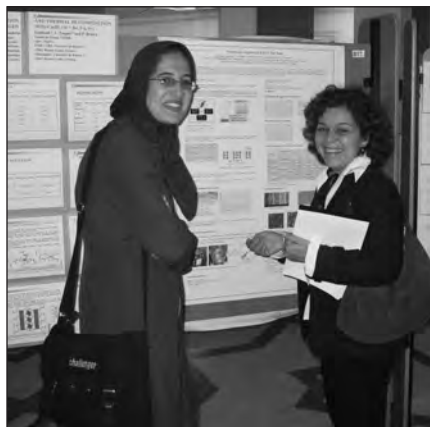
Merad opened the conference with a brief welcome and an introduction to Tlemcen. Aourag then spoke briefly on the past CISGM conferences and their substantial interest in materials science in developing countries. He presented his vision that close interaction between scientists in developed and developing countries would contribute greatly to the promotion of materials science in developing countries. He predicted that the 21st century will be the “Materials Century.”

Plenary speaker A. Tadjedine, head of the synchrotron radiation project at CNRS, France, discussed recent progress on synchrotron radiation and its large capabilities as a tool for materials characterization. S. Pantelides from Vanderbilt University gave a plenary presentation on the role of the nanoscale in nanocatalysis. Pantelides discussed the use of *ab initio* calculation for the prediction of new nanomaterials in heterogeneous catalysis. The closing plenary talk was given by M. Eberhart, from the Colorado School of Mines, entitled “A Rose by Another Name: The Reverse Problem,” in which Eberhart discussed the use of topology theory as applied to charge density to predict new classes of materials.

As part of the conference, a one-day workshop was organized on recent progress on *ab initio* techniques. Invited speakers included B. Bouhafs (Univ. of Sidi Bel-Abbes, Algeria), who addressed problems in computing the properties of PtN; S. Baroni (International School for Advanced Studies and INFN DEMOCRITOS National Simulation Center, Trieste, Italy), who discussed density functional pertur-



Opening ceremony of the Fourth International Congress on Materials Science and Engineering (CISGM-4), held in Algeria: (left to right) H. Aourag, chair of the Algerian Materials Research Society (AMRS); G. Merad, chair of CISGM-4; and B. Bouzabata, vice chair of AMRS.



Graduate students participate in the CISGM-4 poster session.

bation theory and how it is used for lattice dynamics calculations; V. Eyert (Augsburg Univ., Germany), who spoke about ordering phenomena in oxides; and S. Scandolo

(International School for Advanced Studies and INFN DEMOCRITOS National Simulation Center, Trieste, Italy), who gave a survey on the use of *ab initio* molecular dynamics for the determination of the properties of materials at high pressure and their behavior at the center of the Earth.

Altogether, 380 attendees heard 151 presentations and viewed 292 posters. Of the oral presentations, 21 were invited and 130 were contributed. Proceedings were published in a special issue of the *Algerian Journal of Advanced Materials*, which was distributed at the congress at a special conference price.

The busy schedule included two local cultural events: an Algerian craft exhibition and “Fantasia” show, and the conference dinner held in the Palais de la Mansourah, where the attendees could taste Algerian dishes while listening to Andalusian music.

H. AOURAG (AMRS)
G. MERAD (University of Tlemcen)
Chairs of CISGM-4

WOMEN IN MATERIALS SCIENCE BREAKFAST

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