2016 MRS Spring Meeting launches in Phoenix, Ariz.

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The Materials Research Society (MRS) held its Spring Meeting for the first time in Phoenix, Arizona, on March 28–April 1, with more than 4400 people in attendance and 145 exhibitors. The Meeting Chairs, **Christopher A. Bower** (X-Celeprint Ltd.), **Andrew M. Minor** (University of California, Berkeley and Lawrence Berkeley National Laboratory), **Roger Narayan** (UNC/NCSU Joint Department of Biomedical Engineering), **Izabela Szlufarska** (University of Wisconsin–Madison), and **Osamu Ueda** (Kanazawa Institute of Technology), put together 62 symposia that comprised the technical core of the Meeting. They were grouped into six topic clusters: Characterization and Modeling of Materials; Energy and Environment; Electronics and Photonics; Materials Design; Nanotechnology; and Soft Materials and Biomaterials.

Symposium presentations

Of the symposia at the Meeting, more than 15 were directly related to sustainability. Materials science plays an important role in the sustainable supply of energy, water, products, services, transportation, buildings, and public infrastructure. The Energy and Environment Symposium encouraged an approach toward the role of materials science in sustainable development and provided a medium for technically based, interdisciplinary discussions. Topics included materials for alternative energy sources, materials designed for enhanced recyclability, and objective application of economic, sociological, and governmental models that enable materials research and technological developments.

In a Soft Materials and Biomaterials Symposium talk, Koon Gee Neoh, from the National University of Singapore, discussed the devastating problem of bacterial biofilm formation on implanted medical devices, such as catheters. These bacteria can also harbor on hospital surfaces. Neoh has developed strategies to coat surfaces with antimicrobial materials using UV or heat-induced graft polymerization, thiol-linking, and cross-linking. She uses quaternized chitosan as a bactericidal material to kill adherent bacteria on hospital surfaces. The desired result is a reduction in the patients' risk of infection during hospital stays.

Andrew Minor discussed dramatic improvements in *in situ* transmission electron microscopy (TEM) mechanical testing in a Characterization and Modeling of Materials Symposium presentation. The true value of TEM lies in studying structure and defects with high spatial resolution. Minor and his collaborators at the National Center for Electron Microscopy have developed a technique to locally capture strain during *in situ* mechanical testing. The basis of their work is the direct, rapid collection of 2D electron diffraction patterns from a nano-focused beam (nanobeam electron diffraction) at each point in a raster-scanned image. This is different from typical TEM experiments, as instead of choosing a bright- or dark-field imaging mode, all information is collected simultaneously and can be filtered during post-processing. No longer is it necessary to maintain perfect zone axis alignment, allowing strain maps to be captured over sample areas and completely through a defect with 1 nm resolution.

In an EP4 Symposium presentation, Daniel Chung, University of New South Wales, discussed how solar cells made of multi-crystalline silicon (mc-Si) have recently proven to have more to offer in terms of efficiency consecutively lowering the cost of solar power. As the cell design improves, the quality of the mc-Si becomes more critical, putting pressure on impurity control in the making of silicon for solar cells. Chung described how a solar-cell in-line tool based on photoluminescence imaging is capable of fast and reliable

quantification of a wide range of electronic material and device parameters.

Recognitions

Chong-Min Wang (Pacific Northwest National Laboratory) received the 2015 *Journal of Materials Research* Paper of the Year Award for his article, "*In situ* transmission electron microscopy and spectroscopy studies of rechargeable batteries under dynamic operating conditions: A retrospective and perspective view."

MRS acknowledges the Jiang Family Foundation and MTI Corporation for their support of the MRS Postdoctoral Awards presented to **Babak Anasori**, Drexel University, and **Shinbuhm Lee**, Oak Ridge National Laboratory. MRS President Kristi S. Anseth recognized the Mid-Career Researcher awardee, **Hongjie Dai** (Standford University), Outstanding Young Investigators **Dino Di Carlo**, University of California, Los Angeles, and **Timothy J. White**, Air Force Research Laboratory; and Innovation in Materials Characterization Award recipients **Niels de Jonge** (INM–Leibniz Institute for New Materials), **Frances M. Ross** (IBM T.J. Watson Research Center), and **Chong-Min Wang** (Pacific Northwest National Laboratory).

Plenary Session featuring the Fred Kavli Distinguished Lectureship in Materials Science and Symposium X presentations

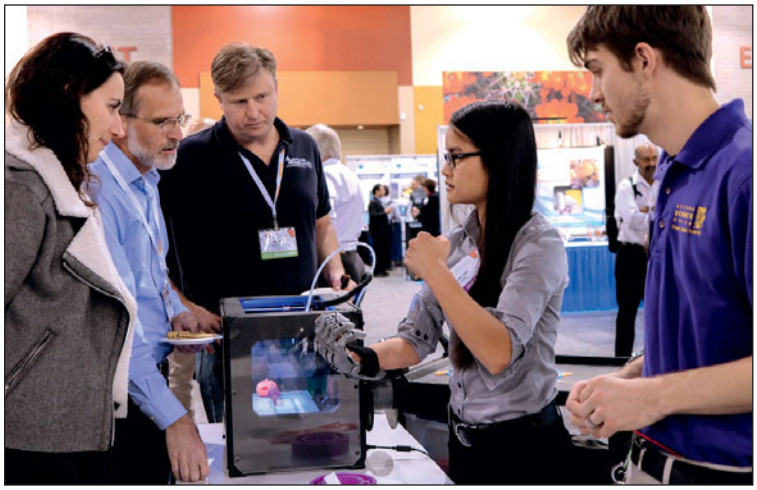
At Tuesday's plenary session, **Cato T. Laurencin** of the University of Connecticut discussed his work on regenerative engineering in the context of materials science and engineering. Laurencin studies musculoskeletal injuries from the viewpoint of scientific and clinical research.

Laurencin was inspired to enter this area of research in the 1980s after a talk by Y.C. Fung, who coined the term "tissue engineering" at a National Science Foundation workshop. Laurencin said the future of tissue engineering lies in regenerative engineering using biomaterials. This "convergence" of advanced materials science, stem cell science, physics, developmental biology, and clinical translation lead to the regeneration of complex tissues, organs, or organ systems. From a materials science perspective, most research in this "convergence" area focuses on nanoscale interactions. In particular, nanoscale surface architecture can strongly influence cellular events at the cell/materials interface because cells are highly sensitive to their physical surroundings.

For the Symposium X: Frontiers of Materials Research presentations that started on Tuesday, **Annette Richards**, Cornell University, and **Catherine Oertel**,

The 2016 MRS Fellows

Standing (left to right): Amit Misra, Kristi S. Anseth (MRS president), Timothy Bunning, Joseph Hupp, Thomas Kuech, Peter Norlander, Arumugam Manthiram, and Albert Polman (MRS Awards Committee chair). Sitting: Andrea Carlo Ferrari, Linda Schadler, and Hongyou Fan. Absent: Pulickel Ajayan, Yi Cui, Alexander Efros, Teri Odom, and Ian Robertson.



Oberlin College, explored the nature of how musical sounds are made and materials' roles in the quality of the sounds produced in an organ. To restore and maintain antique instruments, there needs to be an understanding of the properties of historic organ-pipe metal, for example.

Oertel cited several causes for organ-pipe corrosion, but organic acids, acetic acid in particular, emitted from the wood of organ cases were significant corrosive agents for lead-rich pipes. The collaboration made field observations of conditions in historic organ cases a basis for designing laboratory experiments to study the role of alloy composition and humidity in the susceptibility of pipes to organic acid attack. In short-term (one-month) experiments, they found that at 95% relative humidity, acetic-acid attack on lead–tin alloys increased with increasing tin content, in contrast to observations at lower humidities. This information has led to strategies, such as using different woods and providing ventilation and sensors, to keep acid release and humidity under control.

On Thursday, **Gerbrand Ceder**, University of California, Berkeley, discussed the Materials Project (MP), a US Department of Energy-funded, multi-institutional collaboration launched in late 2011 and headquartered at the Lawrence Berkeley National Laboratory. It aims to provide the capability to query properties for novel compounds upon request, information to be used in selecting materials for whatever application the requestor has in mind. Acknowledging that the most basic properties (analogous to genes) are not necessarily the ones useful for materials selection, Ceder said that the MP approach is to invest in basic property calculations that can be used toward obtaining multiple higher-order properties. For example, elastic tensors lead to a variety of properties, including elasticity, thermal transport, dislocations, and free energy. There are more than 66,000 compounds in the system, about which there is some information and almost 17,000 users. Ceder concluded that the *ab initio* prediction of materials properties is accelerating, and one may expect a fairly complete compound genome within the decade.

On Friday, **John Spence** of Arizona State University provided a detailed examination of the issues involved in achieving today's frontier of "movies" of materials and biological systems with atomic spatial resolution and femtosecond temporal resolution. Spence has a long career in electron microscopy to which he has more recently added x-ray imaging at synchrotron radiation sources and x-ray lasers. He started by discussing electron imaging with fast detectors,

2016 MRS Spring Meeting Poster Awards

Tuesday Poster Awards

- *Solar Absorbing Materials with Enhanced Thermal Stability*
  Lizzie Caldwell, University of California, San Diego
- *Halide-Assisted Atmospheric Pressure Growth of Large WSe_2 and WS_2 Monolayer Crystals*
  Shisheng Li, National University of Singapore
- *Performance and Morphology of Novel Naphthalene Diimide-Based Small Molecule Acceptors for Organic Photovoltaic Applications*
  Kira Rundel, Monash University
- *Backscattered Scanning Electron Microscopy Domain Imaging of Ferroelectric Films*
  David A. Scrymgeour, Sandia National Laboratories
- *Particle-on-Film Gap Plasmons on Antireflective ZnO Nanocone Arrays as Ultrasensitive SERS Sensors*
  Youngoh Lee, Ulsan National Institute of Science and Technology

Wednesday Poster Awards

- *Electrospun Carbon Nanofibers with Surface Attached Zero Valent Iron Nanoparticles (ZVINPs@ECNFs) for Cr (VI) Remediation in Ground and Waste Water*
  Nikhil Reddy Mucha, North Carolina A&T State University
- *Plasmon Gap-Mode Resonance for Large-Area Chemical Detection*
  Matthew Rozin, University of California, San Diego
- *Temperature and Electron Energy Dependent Evolution of Dislocation Loops in Yttria-Stabilized Zirconia*
  AKM Saiful Islam Bhuian, Kyushu University, Bangladesh Atomic Energy Commission
- In Situ *Raman Spectroscopy of the Charge-Density-Wave Phase Transitions in IT-TaS_2 Thin Films*
  Guanxiong Liu, University of California, Riverside
- *Determination of Atomic Structure of Detonation Nanodiamonds Using Simulated and Experimental Aberration-Corrected TEM Imaging at Low Voltage*
  Shery Chang, Arizona State University

Thursday Poster Awards

- *Functionalized Graphene Oxide Wrapped Silica Particles for a Sensitive Impedimetric Dengue Biosensor*
  Seon-Ah Jin, Purdue University
- *Copper-Indium-Selenide Quantum Dot Solar Cells Exceeding 8% Photoconversion Efficiency*
  Jiwoong Yang, Institute for Basic Science, Seoul National University
- De Novo *Design of Mechanically Active MOFs*
  Charles A. Manion, Oregon State University
- *High Voc n-Si Heterojunctions with p-type Transparent Highly Conductive $(CuS)_x$:$(ZnS)_{1-x}$ Prepared by Chemical Bath Deposition*
  Xiaojie Xu, Fudan University, Lawrence Berkeley National Laboratory
- *Four Dimensional* In Situ *Study of Fatigue Crack Initiation and Growth from Corrosion Pits in 7075 Aluminum Alloys*
  Tyler Jaros Stannard, Arizona State University

and then turned to x-rays. Spence closed with a description of a new project that has begun at Arizona State University to build a compact x-ray light source that fits in one room and will cost USD$6 million. The basic idea is to use a laser beam directed antiparallel to an electron beam. The effect is that of an undulator with a period equal to the laser wavelength, 1 μm rather than the 1 cm typical in magnetic undulators. To get the same x-ray wavelength, the electron beam can be correspondingly smaller (25 MeV rather than 1 GeV), thus shrinking the size and cost of the device dramatically.

Highlights

Former US Secretary of Energy and Nobel laureate **Steven Chu** of Stanford University opened this Meeting's Technology Innovation Forum. Chu is the William R. Kenan, Jr., Professor of Physics and Professor of Molecular and Cellular Physiology in the medical school at Stanford University. He was the 12th US Secretary of Energy from January 2009 until the end of April 2013.

As the Secretary of Energy, Chu launched the Advanced Research Projects Agency-Energy (ARPA-E) and the Energy Innovation Hubs. He set up the funding and research systems of these programs by relying on what he had learned at AT&T Bell Laboratories. At ARPA-E, the managers are active scientists. They make their funding decisions in days rather than in years, and they have a work culture of animated discussions. ARPA-E was established to fund high-risk, high-impact energy projects.

Similarly, the Energy Innovation Hubs are designed to eliminate hierarchical control in order to empower managers to hire the best researchers and give them freedom to work. These Hubs plan for what Chu called a "10-year horizon" from research to prototype. The mission of national laboratories, Chu said, is to do very good research for the public good. The method to accomplish this, he said, is to "get the best people, empower them, and let them go charge."

At the second edition of MRS' Innovation in Materials Science, or iMatSci, **Stephen Forrest** of the University of Michigan gave the keynote address. Having co-founded or been a founding participant in numerous companies, Forrest was well positioned to assess what he called the "innovation economic ecosystem" that elicits successful startup companies.

Forrest said, "Your technology is not nearly as important as your market." He emphasized the importance of using every available resource, including the need for academics to partner with industry, and for industry to collaborate with many partners in order to remain competitive. The keynote address was followed by a panel discussion on venture funding.

Dianne Chong addressed the Women in Materials Science & Engineering Breakfast on Wednesday

Graduate Students Receive Gold and Silver Awards

Graduate Student Awards were announced March 29 at the 2016 MRS Spring Meeting in Phoenix.

Gold Award Recipients: Sitting (left to right): Qianqian Lin, The University of Queensland; Hanze Ying, University of Illinois at Urbana-Champaign; Mathieu Grisolia, Centre National de la Recherche Scientifique/Thales; Standing (left to right): Kristi Anseth (MRS president); Peter Dieme, Wake Forest University; Lei Zhang, The Pennsylvania State University; Chia-Hao Chuang, Massachusetts Institute of Technology; Yuchuan Shao, University of Nebraska–Lincoln; Albert Polman (chair, MRS Awards Committee).

Silver Award Recipients: Sitting: Kasra Sardashti, University of California, San Diego; Kristi Anseth (MRS president); Elena Liang, University of California, Irvine; Yifei Yu, North Carolina State University; Standing (left to right): Won Jun Jo, Massachusetts Institute of Technology; Nuri Oh, University of Illinois at Urbana-Champaign; Hamed Arami, University of Washington; Yoonseob Kim, University of Michigan–Ann Arbor; Steven Naleway, University of California, San Diego; Albert Polman (chair, MRS Awards Committee); Amay Bandodkar, University of California, San Diego; Ryan Hufschmid, University of Washington; Kwon-Hyeon Kim, Seoul National University; Jinxing Li, University of California, San Diego; Simiao Niu, Georgia Institute of Technology; Abdon Pena-Francesch, The Pennsylvania State University. Missing: Thomas Lonjaret, École des Mines de Saint-Étienne.

morning, discussing the role innovation plays in stability and change. Chong, who served as the vice president of Boeing Research and Technology said that the definition of "innovation" is often misunderstood. For companies to remain competitive, they need to adapt to changes. They also need an element of stability in order to stay in business.

Within the current competitive climate, companies must make new products and move them into market within a short time frame. One way to do this is to license out products to manufacturers and the market that is ready to use them, Chong said. Furthermore, critical to getting a product "ready" for market is to form partnerships with other companies. For example, various parts of a particular Boeing airplane can be made up of numerous composites that have been developed by as many as a dozen different companies. This is what Chong refers to as innovation in a business model.

Frances Colón, the Deputy Science and Technology Advisor to the Secretary of State at the US Department of State, gave a presentation on the current topics in materials science and policy forum. The forum is sponsored by the MRS Government Affairs Committee. Colón described the mission of her office as working to augment scientific literacy not only in the State Department, but across the government; to use science as a confidence-building tool in diplomacy; and to identify scientific and technical trends in the service of the department.

Colón is also one of the US leaders working on normalizing relations with Cuba, and was one of the first government representatives in over 50 years to meet with the science and health ministries in the island nation. Not only is she working on joint environmental protection issues with Cuba, she is also working on joint (US–Cuba) efforts to collaborate in the biotech sector.

Many presentations from the 2016 MRS Spring Meeting are available through MRS OnDemand® video capture as well as news coverage of the Meeting on MRS TV and *Meeting Scene*®. Further information can be accessed at www.mrs.org/spring2016.

Science as Art Winners

Congratulations to the Science as Art first place winners: **Xin Yin**, University of Wisconsin–Madison, for "Seeking the Light"; **Alexander Labuda**, Asylum Research; and **Christian Pester**, University of California, Santa Barbara, for "Selective Swelling."

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