Strange Matter Provides a Behind-the-Scenes Look at Everyday Stuff

The Materials Research Society's interactive *Strange Matter* exhibition recently visited the Dallas Museum of Natural History in Texas and the Cranbrook Institute of Science in Bloomfield Hills, Mich.

From June 4 through September 5, *Strange Matter's* 6000 square feet of hands-on technologies and interactive experiences allowed visitors at the Cranbrook Institute to investigate the structure of materials and their intriguing and remarkable properties. The exhibition captured advanced materials used in high-tech fields such as the space program and cardiac surgery and revealed them in more common places, from shoes and dishes to music CDs, bicycles, and skateboards. Volunteers were on-hand to engage visitors in materials science demonstrations. This local presentation was made possible by Ford Motor Company Fund, Dow, IBEW Local 58, and 3M Foundation.

The smaller version of *Strange Matter* (1700 square feet) was on display at the Dallas Museum from May 21 through September 4. In *Strange Matter*, visitors experienced the science behind everyday stuff while gaining a glimpse of where the future of materials research might go.

"We are thrilled to bring the community an educational and fun exhibition providing visitors a glimpse into the world of materials and the role that material science plays in our daily lives," said Nicole Small, CEO of the Dallas Museum of Natural History, during the exhibition. This local presentation was made possible by Texas Instruments.

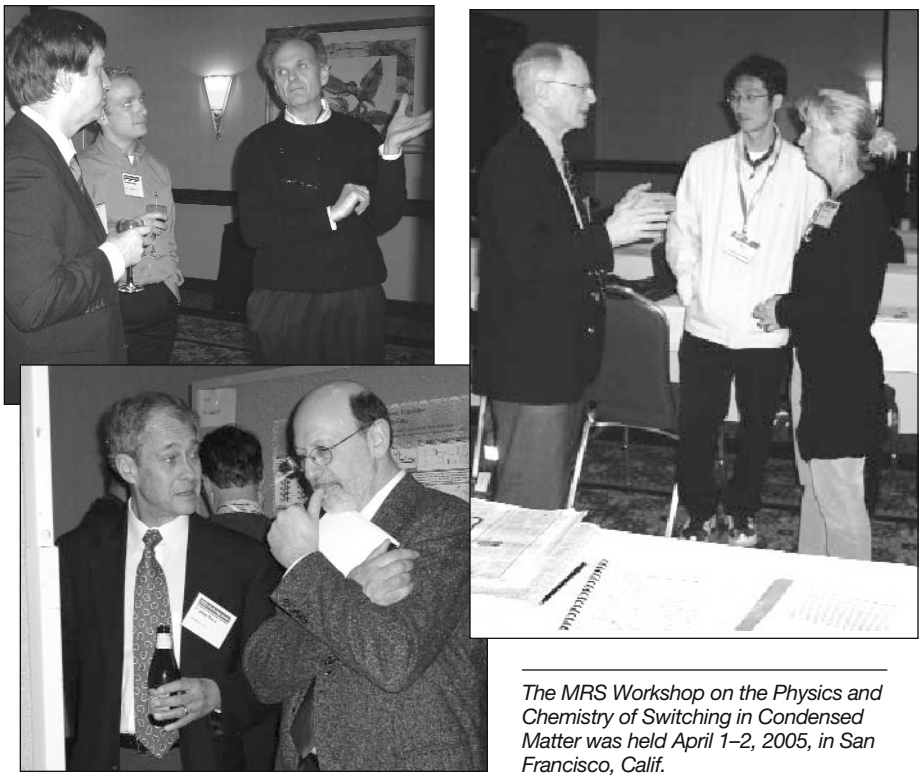
The exhibitions and tour are made possible by the generous support of the National Science Foundation, Alcan, Dow, Ford Motor Company Fund, Intel Innovation in Education, and 3M Foundation. MRS

MRS Workshops Provide Forums for In-Depth Review of Leading Topics

www.mrs.org/meetings/workshops

Since the establishment of the MRS Workshop Series in 1999, the Materials Research Society has produced several workshops as a service for the materials community. Dealing with highly focused and compelling topics, the workshops are designed to enable attendees to explore an in-depth review of important topics over the course of 2–3 days.

This year, the MRS Workshop on the **Physics and Chemistry of Switching in Condensed Matter** was held April 1–2, 2005, in San Francisco, Calif. The members of the organizing committee were **A.H. Edwards**, Air Force Research Laboratory (AFRL) Space Vehicles Directorate; **Arthur J. Epstein**, the Ohio State University; **D. Emin**, University of New Mexico; **Mark Johnson**, Naval Research Laboratory; **Robert Nemanich**, North Carolina State University; **Ramamoorthy Ramesh**, University of California, Berkeley; **Chris Bozada**, AFRL Sensors Directorate; and **Don Dorsey**, AFRL Materials Laboratory. Sessions primarily focused on the amorphous–crystalline transition, such as that found in chalcogenide-based alloys, ferroelectrics, and multiferroic materials; ferromagnetic transitions; and switching in polymers. Specific goals of the workshop were to establish the current limits of understanding of switching mechanisms, including mechanisms for wear-out, and to foster interaction between materials scientists and engineers seeking to exploit these phenomena in microelectronic and optoelectronic devices and subsystems.



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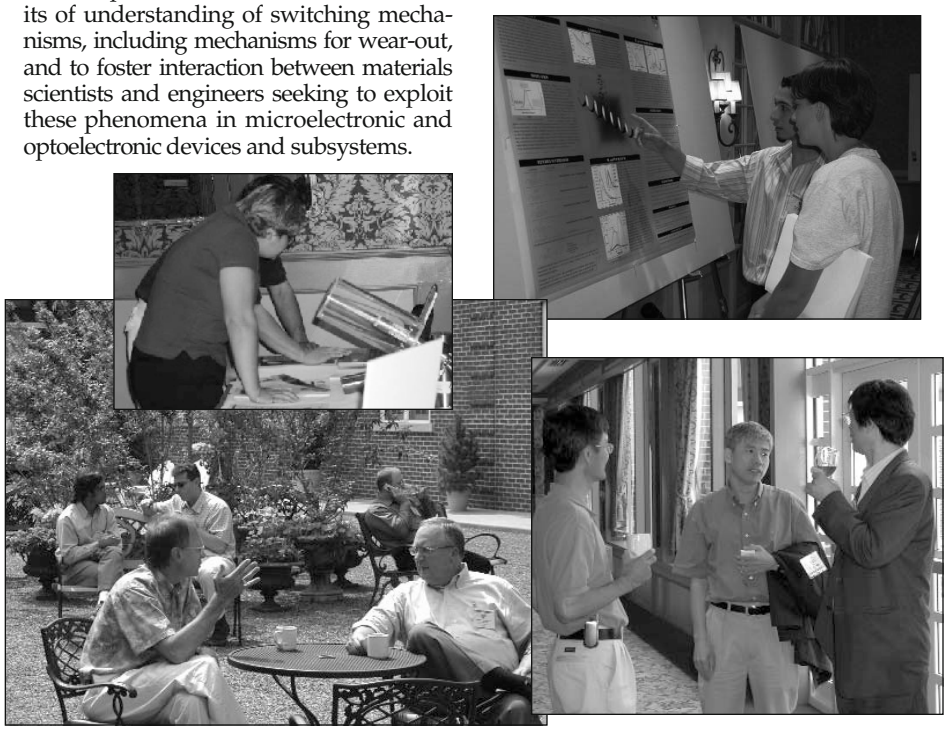


The MRS Workshop on Organic Microelectronics, held jointly with the American Chemical Society and the IEEE Components, Packaging, and Manufacturing Technology Society, was held July 10–13, 2005, in Newport, Rhode Island.

MRS also held a joint workshop with the American Chemical Society (ACS) and the IEEE Components, Packaging, and Manufacturing Technology Society (CPMT) July 10–13, 2005, in Newport, Rhode Island, focused on **Organic Microelectronics**. The workshop was chaired by **George Malliaras**, Cornell University; **Tobin J. Marks**, Northwestern University; and **Henning Sirringhaus**, University of Cambridge. The workshop brought together chemists, materials scientists, physicists, and engineers from both industry and academia in order to build an interdisciplinary community working on applications such as radio frequency identification (RFID), displays, sensors, and photovoltaics while addressing some of the common scientific and manufacturing challenges to help these technologies advance in a more rapid, effective, and economical manner.

For information on future workshops, access the MRS Web site at www.mrs.org/meetings/workshops or contact MRS Member Services, tel. 724-779-3003 or e-mail info@mrs.org. To suggest a topic or volunteer to organize a workshop, contact Patricia Hastings, MRS Director of Meeting Activities, by e-mail at hastings@mrs.org. MRS

MRS Workshop Explores the Diversity of 3D Multifunctional Ceramic Composites

www.mrs.org/meetings/workshops

The MRS Workshop on Three-Dimensional Multifunctional Ceramic Composites was held at the Beckman Institute on the campus of the University of Illinois at Urbana-Champaign (UIUC) October 3–5, 2005. Organized by **Paul V. Braun** of UIUC, **C. Jeffrey Brinker** of the University of New Mexico and Sandia National Laboratories, and **Shanhui Fan** of Stanford University, the workshop reached an audience of about 100 attendees from academic institutions, government laboratories, and private industry. The scientific and technical underpinnings of self-assembly and properties of self-assembled 3D ceramic, composite, and semiconductor structures were emphasized. The technical program consisted of invited presentations from renowned experts, along with selected contributed presentations, posters, and hands-on tutorials given by expert faculty. The topics explored included new developments in 3D photonic crystals, chemical and biological sensors, nanoparticle assemblies, rapid fabrication techniques, active membranes, 3D holographic patterning, and modeling and theory of 3D optical devices.

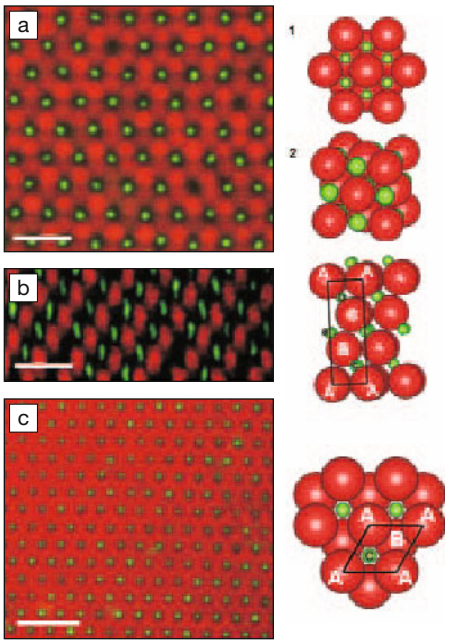


Figure 1. Laser scanning confocal microscope images of binary colloidal crystals formed from charged (red, radius 1.16 μm) and uncharged (green, radius 0.36 μm) poly(methyl methacrylate) (PMMA) particles in an index-matching solvent. (a), (b) NaCl-type crystals. (a) NaCl-type crystal with a hexagonal plane and the unit cell in a hexagonal (1) and a cubic (2) representation. (b) NaCl-type crystal with a plane perpendicular to the hexagonal close-packed layers, showing the ABC-stacking of both the large and small particles. (c) NiAs-type crystal with a superposition of confocal images of 10 layers, and the corresponding model. All scale bars are 8 μm. Reprinted by permission from Nature ***437*** *(2005) p. 235.*

J.A. Rogers (UIUC) opened the workshop with his presentation on the phase mask holographic formation of 3D polymer and inorganic–organic composite microstructures. In this work, he demonstrated that complex 3D microstructures can be formed over large areas in photoresist using only a simple contact phase mask formed from poly(dimethylsiloxane) (PDMS) and fairly incoherent ultraviolet light. This lecture was the first in a number of presentations by speakers demonstrating the formation of photonically active 3D microstructures by self-assembly and directed assembly routes. D. O'Brien (Army Research Laboratory) presented his work on creating large-area photonic crystals through both interferometric lithography and colloidal assembly. Although the defect density in these crystals is higher than for colloidal crystals formed through more complex routes, he noted that good colloidal crystals could be formed through simple spin-coating techniques. In another route to ordered 3D microstructures, he demonstrated the modern 3D microscale example of the bubble raft model.

Formation and characterization of complex 3D micro- and nanostructures were investigated by a number of the presenters. For example, D. Pine (New York University) demonstrated the construction of complex colloidal assemblies through surface-tension-driven aggregation. The resulting colloidal "molecules" have, for example, triangular, tetrahedral, and octahedral symmetries. Pine then explored several routes to combine these colloidal molecules into larger colloidal crystals that may exhibit unique optical properties. As it is well known that fcc colloidal crystals are not ideal for photonic applications, the tetrahedral clusters Pine has created may provide a needed route to colloidal crystals with diamond symmetries. Complex colloidal structures can also be formed through the assembly of mixtures

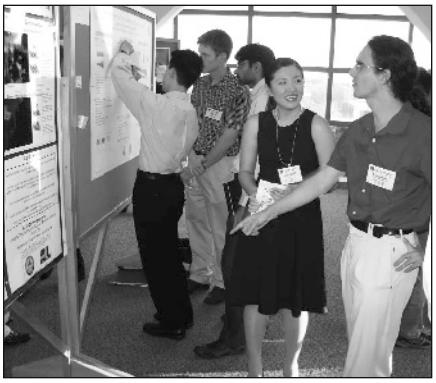
Workshop co-organizers Jeff Brinker (left) of Sandia National Laboratories and Paul Braun of the University of Illinois at Urbana-Champaign enjoy the evening reception at the MRS Workshop on Three-Dimensional Multifunctional Ceramic Composites. Workshop co-organizer Shanhui Fan of Stanford University is not pictured.

of different-sized building blocks. A. van Blaaderen (Utrecht University) and C. Murray (IBM) each showed their routes to creating complex binary colloidal crystals. Van Blaaderen forms his structures from mixtures of micron-sized particles (see Figure 1), while Murray creates binary colloidal crystals from dispersions of inorganic nanoparticles. In both cases, complex structures with unique electrical and optical properties were formed. Although work remains to fully understand the properties and assembly of these binary crystals, these studies suggest that through accurate control of particle size and charge, it should be possible to self-assemble polymer, ceramic, semiconductor, and metal building blocks into metamaterials with all the same symmetries seen in ionic or metallic solids.

One powerful route to the assembly of 3D multifunctional composite structures is the biologically mediated synthesis and assembly of materials. Several presentations on this topic demonstrated that biological macromolecules found in living organisms can be used to direct the formation of composite structures with unique properties. Y. Lu (UIUC) presented his work on using enzymatically active DNA to direct the formation of nanoparticle assemblies, and for the removal of errors from such self-assembled structures. This work is unique, as it represents a new

route to correction of the errors inherent in self-organized media. Along a similar line, J.E. Hutchison (University of Oregon) showed a number of detailed projects where DNA was used to assemble nanoparticles into complex 1D and 2D structures. Biological macromolecules were also demonstrated to be active for directing the mineralization of inorganic materials. R.R. Naik (Air Force Research Laboratory) showed how polypeptide sequences could drive the deposition of silica even under very mild conditions. B.F. Chmelka (University of California, Santa Barbara) presented a number of nuclear magnetic resonance (NMR) and other characterization experiments which provided a deep understanding of the structure of the inorganic pore walls in mesoporous materials formed by a number of routes, both synthetic and biological.

The hands-on tutorials preceding the technical sessions were a unique and important part of this workshop. There have been a number of recent developments in the formation, properties, and modeling of 3D ceramics and composites that are best explored in a hands-on environment. Laboratories on the campus of UIUC were used for a number of the tutorials. The following six tutorials were given by experts in their respective fields: Opal Synthesis, Assembly, and Characterization (Instructor: P.V. Braun); Introduction to Photonic Crystals (Instructor: S. Fan); 3D Holographic Lithography (Instructor: P. Wiltzius, UIUC); Direct-Write Assembly of 3D Structures (Instructor: J.A. Lewis, UIUC); Self-Assembly of Porous and Composite Nanostructures (Instructor: C.J. Brinker); and DNA-Based Assembly and Sensing (Instructor: Y. Lu, UIUC). The tutorials included theory and optical characterization of photonic crystals, the principles and practice of holographic lithography, the fundamentals of ink-based direct-write assembly, self-assembly of highly ordered inorganic and organic mesoporous materials, and the design, synthesis, and characterization of DNA for assembly and sensing of a broad range of analytes.



Margaret Shyr and Florencio García-Santamaría, both of UIUC, discuss Shyr's research at the poster session.

Partial support of the MRS Workshop on Three-Dimensional Multifunctional Ceramic Composites was provided by the Army Research Office and the Beckman Institute at the University of Illinois at Urbana-Champaign.

PAUL BRAUN
Chair and Co-Organizer

MRS Selects Outstanding Symposium Papers

In recognizing proceedings as an important and integral part of Materials Research Society meetings, the chairs of the 2004 MRS Fall Meeting implemented an awards program for the best symposium manuscripts. The chairs—Shefford P. Baker (Cornell University), Julia Hsu (Sandia National Laboratories), Bethanie J.H. Stadler (University of Minnesota), and Richard Vaia (Air Force Research Laboratory)—requested that symposium organizers select the award recipients based solely on the written manuscripts and not on the oral or poster presentations.

Nominations for best papers were made based on both technical content and manuscript quality. No more than 5% from the accepted manuscripts in each proceedings volume could be nominated (Ribbon Award). The best manuscript from among the nominations in each proceedings volume was selected by the organizers to receive the Trophy Award for Best Symposium Proceedings Paper Award. The contact authors received a $100 award in addition to an invitation from the *Journal of Materials Research* to submit an article based on their papers.

Following is a partial list of award recipients; other award recipients were announced in the June and July 2005 issues of *MRS Bulletin*. Papers can be accessed at www.mrs.org/publications/epubs/proceedings/fall2004.

Materials for Hydrogen Storage—2004 (Symposium N) (Proceedings Volume 834)

Trophy Award (Best Paper):
N3.6 **NMR and X-ray Diffraction Studies of Phases in the Destabilized LiH-Si System**
R.C. Bowman Jr., S.-J. Hwang, and C.C. Ahn of the California Institute of Technology, and J.J. Vajo of HRL Laboratories, LLC.

Ribbon Award (Best Paper Nomination):
N4.2 **Discovering the Mechanism of H_2 Adsorption on Aromatic Carbon Nanostructures to Develop Adsorbents for Vehicular Applications**
A.C. Dillon, J.L. Blackburn, P.A. Parilla, Y. Zhao, Y-H. Kim, S.B. Zhang, A.H. Mahan, J.L. Alleman, K.M. Jones, K.E.H. Gilbert, and M.J Heben of the National Renewable Energy Laboratory.

Organic/Inorganic Hybrid Materials (Symposium EE) (Proceedings Volume 847)

Trophy Award (Best Paper):
EE1.1 **From Raspberry-Like to Dumbbell-Like Hybrid Colloids Through Surface-Assisted Nucleation and Growth of Polystyrene Nodules Onto Macromonomer-Modified Silica Nanoparticles**
E. Duguet, S. Reculusa, A. Perro, C. Poncet-Legrand, and S. Ravaine of CNRS, Université Bordeaux, Bordeaux, France; E. Bourgeat-Lami of CPE, CNRS, Villeurbanne, France; and C. Mingotaud of Université Paul Sabatier, CNRS, Toulouse, France.

Ribbon Award (Best Paper Nomination):
EE10.1 **Photo-Induced Optical and Chemical Properties of Polysilane/Inorganic Nano-Hybrids**
K. Matsukawa and Y. Matsuura of Osaka Municipal Technical Research Institute.

Solid-State Chemistry of Inorganic Materials V (Symposium FF) (Proceedings Volume 848)

Trophy Award (Best Paper):
FF3.18 **Magnetic Structure of K_2NiF_4-Type Iron(III) Oxide Halides**
A.L. Hector of the University of South Hampton.

Ribbon Award (Best Paper Nomination):
FF1.1 **Hydrothermal Synthesis of the Deep-UV NLO Material $Sr_2Be_2B_2O_7$**
J.W. Kolis, C.D. McMillen, and T. Franco of Clemson University;

FF1.2 **Crystal Chemistry of Some Organically Templated Metal Fluorides: The Crystal Structure of $[C_2N_2H_{10}]_{0.5}[Y_2F_7]$**
P. Lightfoot and N.F. Stephens of the University of St. Andrews; and

FF3.17 **High Throughput Synthesis of Pigments by Solution Deposition**
S.J. Henderson, A.L. Hector, and M.T. Weller of the University of South Hampton.

Materials Issues in Art and Archaeology VII (Symposium OO) (Proceedings Volume 852)

Trophy Award (Best Paper):
OO7.2 **Understanding Bronze Age Faience in Britain and Ireland**
A. Sheridan of the National Museums of Scotland, K. Eremin of Harvard University Art Museums, and A. Shortland of Cranfield University, U.K.

Ribbon Award (Best Paper Nomination):
OO2.9 **Effects of Water Exposure on the Mechanical Properties of Early Artists' Acrylic Paints**
E. Hagan and A. Murray of Queen's University, Kingston, Canada;

OO8.1 **The Provenance of Ancient Glass through Compositional Analysis**
I.C. Freestone of Cardiff University, U.K.; and

OO8.4 **Recent Case Studies in the Raman Analysis of Ancient Ceramics: Glaze Opacification in Abbasid Pottery, Medici and 18th Century French Porcelains, Iznik and Kûtayha Ottoman Fritwares and an Unexpected Lapis Lazuli Pigment in Lajvardina Wares**
Ph. Colomban of CNRS, Université Pierre & Marie Curie, Thiais, France.

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