FSMRL joins DOE Solar America Initiative

A proposal led by FSMRL researcher John Rogers (MatSE) with co-PIs Ralph Nuzzo (Chemistry) and Jennifer Lewis (MatSE) has been selected for funding through the DOE Solar America Initiative. As part of the DOE EERE “Next Generation Photovoltaic Devices & Processes” program, the MRL team will develop a low-cost concentrator PV from automated printing and the interconnection of a large number of microcells with built-in optics. The Solar America Initiative is an effort aimed at accelerating the development of solar energy technology with a primary goal of making solar power cost-competitive with conventional sources of electricity by the year 2015.

Schweizer awarded 2008 APS Polymer Physics Prize

FSMRL researcher Kenneth Schweizer (MatSE) has been recognized as the 2008 recipient of the Polymer Physics Prize of the American Physical Society, the highest honor in physical polymer science in the United States. The award citation reads: “For outstanding theoretical contributions to the fundamental understanding of the structure and dynamics in polymer melts, polymer blends, polymer-particle composites, and glasses”. The APS Polymer Physics Prize is awarded annually to recognize outstanding accomplishment and excellence of contributions in polymer physics research. The prize consists of a monetary award and a certificate citing the contributions made by the recipient. Established in 1960, it is currently supported by the General Electric Company.

His research is supported by the DOE/BES Division of Materials Sciences and Engineering through the FSMRL Materials Research Cluster (MRC) on Programming Function via Soft Materials.

Zuo shows that electron diffraction pattern can yield sub-Angstrom resolution

The ultimate challenge for materials characterization is to determine 3D atomic structure of complex functional materials lacking the periodicity of a crystal. One promising approach is based on sub-Å resolution electron imaging. The high resolution allows an examination of the atomic structure at different orientations. The resolution of as-recorded electron images in a microscope is limited by the chromatic aberration. Dennis Gabor proposed in 1947 to use electron diffraction patterns to overcome the microscope resolution limit. While wavefront reconstruction in off-axis holography has been highly successful, Gabor’s original goal of improving electron microscope resolution remains unfulfilled. In a

The FSMRL gratefully acknowledges financial support from the DOE/BES Division of Materials Sciences and Engineering.
Each quarter, Advances introduces the researchers involved in the FSMRL and highlights their recent accomplishments. Together, we are transforming fundamental scientific discoveries into technological advances in the areas of photonics, flexible electronics, superconductor devices, and energy materials (e.g., catalysts, fuel cells, and photovoltaics).

I hope that you enjoy learning more about the Frederick Seitz Materials Research Laboratory and our impact on the scientific community and society as a whole.

Jennifer A. Lewis
FSMRL Director

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**Electron diffraction patterns yield sub-Angstrom resolution (from p.1)**

Simulation study of experiment, FSMRL researcher Jianmin Zuo (MatSE) and his group shows that electron diffraction pattern can be used to achieve sub-Å resolution imaging for small Au nanoclusters. By incorporating electron dynamic scattering effects in their simulation, they were able study the limit of the electron diffraction technique. Furthermore, they developed new algorithm to improve the accuracy and reliability of reconstruction. Their work represents significant progress towards atomic resolution imaging of three-dimensional structures of nanoclusters. Their work appeared in Ultramicroscopy, a journal dedicated to the advancement of new microscopy techniques, and was highlighted on the cover of the November 2007 issue.

This research is partially supported by the DOE/BES Division of Materials Sciences and Engineering.

**Improved e-jet printing provides higher resolution and more versatility**

By combining electrically induced fluid flow with nanoscale nozzles, FSMRL researcher John Rogers and his collaborators have established new benchmarks for precision control and resolution in electrohydrodynamic jet-printing processes. This type of e-jet printing could be used for large-area circuits, displays, photovoltaic modules and related devices, as well as other wide-ranging application possibilities in security, biotechnology and photonics.

Unlike conventional ink-jet printers, which use heat or mechanical vibrations to launch liquid droplets through a nozzle, e-jet printing uses electric fields to pull the fluid out. Although the concept of electric-field induced flow is not new, the way the research team, led by Rogers, has exploited this phenomenon with nanoscale nozzles and precision control of electric fields to achieve an unprecedented level of resolution is an important advance. Lines with widths as narrow as 700 nm, and dots as small as 250 nm, can be produced by this approach. As a demonstration of electronic device fabrication by e-jet printing, thin-film transistors that use aligned arrays of single-walled carbon nanotubes as the semiconductor and e-jet-printed source and drain electrodes were printed on flexible plastic substrates. The transistors were fully operational, with properties comparable to similar devices fabricated with conventional photolithographic methods. Their work appeared in the October 2007 issue of *Nature Materials*.

This research is supported by the NSF Center for Nanoscale Chemical Electrical Mechanical Manufacturing Systems, and utilized the FSMRL Central Facilities. These facilities are partially supported by the DOE/BES Division of Materials Sciences and Engineering.

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**Other Highlights**

**Paul Braun** participated in the Tenth Annual Japanese-American Kavli Frontiers of Science Symposium held in Kanagawa, Japan on December 1st-3rd, 2007. The Kavli Japanese-American Frontiers of Science symposia are sponsored by the U.S. National Academy of Sciences and the Japan Society for the Promotion of Science, and are designed to bring together a select group of exceptional young scientists to focus on current cutting-edge research.

**Steve Burdin**, a member of the MRL Central Facilities staff, volunteered numerous hours to help build the solar home “elementhouse” for the University of Illinois’ entry in the DOE 2007 Solar Decathlon Competition. The Solar Decathlon is an international competition involving 20 university student teams, who designed, built, and operated highly energy-efficient, fully solar-powered houses that incorporate building integrated photovoltaics (BIPV). The houses were on display on the National Mall in Washington D.C. during October 3rd-22nd, 2007. The Illinois team placed 9th overall in this competition, and were the only team to win two of the ten individual competitions.