Tobin J. Marks to Receive 2009 Von Hippel Award

The 2009 Von Hippel Award, the Materials Research Society's highest honor, will be presented to Tobin J. Marks, Vladimir N. Ipatieff Professor of Chemistry and Professor of Materials Science and Engineering at Northwestern University. Marks is being recognized for advancing "materials science across a spectrum from self assembly to crystal growth, encompassing organic electronic, photonic, and photovoltaic materials, and oxide dielectrics, conductors, and superconductors." Marks will accept the honor during the awards ceremony at the 2009 MRS Fall Meeting in Boston, where he will then present his award lecture, "Molecule-Based Organic and Hybrid Inorganic/Organic Electronics and Opto-Electronics."

Tobin J. Marks

Marks research has had an indelible impact in important areas of materials chemistry, with seminal achievements in self-assembled soft matter photonics and electronics, oxide thin films, and catalytic polymer synthesis. His basic discoveries have enabled more cost-effective and energy-efficient solar cells, flexible and transparent printable transistors, advanced high-speed optical communications, organic light-emitting diodes for displays and lighting, and cleaner, stronger, lighter-weight, more recyclable plastics from sustainable feedstocks.

In the burgeoning area of printed electronics, Marks recently achieved two major breakthroughs which should make low-cost (e.g., for developing countries) devices such as displays, computers, cell phones, medical sensors, and product identification tags a reality. The first advance was the rational design and creation of broad new families of tunable, environmentally stable *n*-type organic conductors having record electron mobilities, thereby proving there was no fundamental barrier to *n*-type organic semiconductivity and enabling the first organic complementary metal oxide semiconductor circuits. The second advance addresses the large operating voltages and trapped interfacial charge hindering the performance of most organic transistors. Marks's group devised robust, structurally well-defined, and tailorable self-assembled nanodielectrics (SANDs) as high-κ gate dielectrics that enable sub-1 V organic transistor operation. SANDs are deposited from solution at room temperature, and variants can be printed using conventional printing techniques. His group showed that SANDs can also be applied to plastic substrates to realize flexible organic electronics on plastics, and most recently, are applicable to many inorganic semiconductors (e.g., carbon nanotubes, oxide nanowires, oxide thin films, and GaAs), enabling significant enhancements in transistor performance. Completely transparent transistors ("invisible electronics") were one recent outcome, which should make transparent displays (e.g., on automotive windscreens, and surgeons' and assembly workers' visors) a reality. Several of these technologies form the basis for start-up companies that have spun out of this work.

Catalysis is emerging (or reemerging) as a central theme in materials science, and Marks has been a major contributor to one of the most significant advances in catalysis accomplished in the last decade, namely, the development of single-site catalysts for olefin polymerization. He worked out many of the details of the influence of cocatalyst anion coordination on these catalysts, and his work was prominent among those studies that pointed to the generation of metallocene catalysts and related species that are now attracting widespread industrial attention, including a major production site in Brazil to produce sustainable polyolefins from sugar cane ethanol on a world scale.

In the area of soft matter photonic materials, Marks and his co-workers created new classes of nonlinear optical (NLO) materials in which the covalent attachment of organic chromophores to specific polymers is exploited as a key tool for controlling architecture. Subsequently, he expanded this concept by introducing additional chemical functionality that enabled him to both orient and then covalently lock the chromophores into structures that had high and stable NLO responses. More generally, Marks has also demonstrated that silicon-based chemistry, which previously had been used to make self-assembled monolayers, could form the basis of a general approach to assemble and covalently lock a wide range of chromophores into designed structures exhibiting significant NLO properties. This led to theoretical work on formulation, testing, and application of accurate, robust theoretical techniques for guiding chromophore experimental design. In a culmination of this work, Marks revolutionized the design rules for organic electro-optic chromophores by showing that simple twisting of the π-electron system increases the response by 20-fold. Recently, Marks showed that his self-assembly approach can be employed to precisely position covalently interlocked assemblies of charge-transporting and emissive building molecular blocks. The result is a series of robust, efficient, self-assembled organic light-emitting diodes (OLEDs) as well as nano-OLEDs in which detailed probing of structure-charge transport-recombination-emission relationships is now possible at molecular scales.

Marks has also been very effective in the design of molecules that act as precursors in metalorganic chemical vapor deposition. This problem is another one in materials-by-design, and it relies on his extensive background in the technically difficult field of organometallic synthesis to make the precursors. One of his crowning achievements was his recent report of high organic bulk-heterojunction solar cell efficiency achieved by depositing nanoscopic hole-transporting/electron blocking oxide layers on the solar cell anodes.

Marks received his BS degree from the University of Maryland in 1966 and his PhD degree from the Massachusetts Institute of Technology in 1971. He has over 940 publications and over 90 patents.

In 2009, Marks was named an MRS Fellow. Among his numerous awards and honors, he received the U.S. National Medal of Science (2005), and the Spanish Principe de Asturias Prize for Technical and Scientific Research (2008). He is a Fellow of the American Academy of Arts and Sciences, a member of the U.S. National Academy of Sciences, a Fellow of the U.K. Royal Society of Chemistry, a member of the Leopoldina German National Academy of Natural Sciences, and an Honorary Fellow of the Chemical Research Society of India. Most recently, Marks received the 2009 Herman Pines Catalysis Award from the Catalysis Society of Chicago and the 2009 Nelson W. Taylor Award in Materials Research from the Pennsylvania State University.

Among his numerous professional services, Marks most recently co-authored the National Academy of Sciences–

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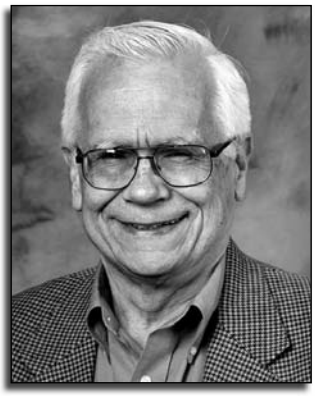
National Research Council Benchmarking Report on Chemical Research and the Department of Energy–Basic Energy Sciences "Grand Research Challenges" report. He serves as an editor of the American Chemical Society's journal, *Organometallics*, and has served as chair of the ACS Division of Inorganic Chemistry.

The MRS Von Hippel Award includes a $10,000 cash prize, honorary membership in MRS, and a unique trophy—a mounted ruby laser crystal, symbolizing the many-faceted nature of materials research. The award recognizes those qualities most prized by materials scientists and engineers—brilliance and originality of intellect, combined with vision that transcends the boundaries of conventional scientific disciplines, as exemplified by the life of Arthur von Hippel (http://vonhippel.mrs.org).

Edward J. Kramer Selected for 2009 David Turnbull Lectureship

The Materials Research Society's David Turnbull Lectureship recognizes the career of a scientist who has made outstanding contributions to understanding materials phenomena and properties through research, writing, and lecturing, as exemplified by David Turnbull of Harvard University. This year, Edward J. Kramer of the University of California, Santa Barbara, has been selected to deliver the 2009 David Turnbull Lecture. Kramer is cited for "outstanding contributions in bringing insights and understanding to flux pinning in superconductors and to the fundamentals of fracture, diffusion, and interface phenomena in complex polymeric materials through research, teaching, mentoring, writing, and lecturing." He will be presented with the award at the 2009 MRS Fall Meeting in Boston, where he will deliver his award lecture, "Phase Transitions in Thin Block Copolymer Films," on Dec. 2 at 12:15 p.m. in the Grand Ballroom of the Sheraton Boston Hotel.



Edward J. Kramer

In the 1970s, Kramer became a pioneering and strong advocate for inclusion of the investigation of the structure/processing and properties of polymers as an important area within the field of materials science. Kramer's principal contributions to the scientific knowledge in polymeric materials are influential with major developments in the fundamental understanding of fracture, diffusion, interfacial, and thin film properties. He pioneered the use of new physical techniques such as holographic interferometry, small angle x-ray scattering, and quantitative transmission electron microscopy to investigate the microscopic aspects of crazing which controls the fracture behavior of glassy polymers. Kramer's assessment of crazing—bundles of elongated polymer that bridge and stabilize a developing crack—remains the textbook explanation today.

He defined the field of surface wetting in polymer blends. Here again Kramer exploited evolving sophisticated experimental techniques to solve complicated problems. Ion beam spectrometry and neutron reflectivity were deftly applied to extract quantitative information regarding the composition profile of specific polymers in a polymer blend in proximity to a surface. This led to a plethora of important activities dealing with phase separation dynamics, including surface-induced spinodal decomposition.

More than a decade ago, Kramer showed the fracture toughness created by bridging polymer–polymer interfaces with block copolymers. Clever experimentation coupled with meticulous analysis followed by insightful theory left the scientific community with fundamental yet practical knowledge regarding the melding together of dissimilar polymers.

In recent years, Kramer has continued to innovate and discover. One example, his work on the dispersion of nanoparticles in block copolymers, produced the unanticipated finding that small particles, endowed with adsorbed polymers, can act like surfactants. Another recent contribution demonstrates that chain architecture in multiblock copolymers can be adjusted to control the orientation of cylindrical microdomains in the vicinity of a free surface.

His group's current research focuses on structured polymer thin films, surfaces, and interfaces using a variety of depth profiling, x-ray scattering, spectroscopy, and microscopic imaging methods. Applications include ordered block copolymer thin films for 20 nm lithography, block copolymers by multiple hydrogen bonding of end groups, and polymer-coated inorganic nanoparticles as surfactants at polymer interfaces.

After obtaining a PhD degree in metallurgy and materials science at Carnegie Mellon University in 1967, Kramer joined the faculty at Cornell University, where he was appointed assistant professor in 1967, associate professor in 1972, and professor in 1979. In 1988, he was appointed the Samuel B. Eckert Professor of Materials Science and Engineering at Cornell; in 1997, Kramer moved to UCSB as professor of materials and professor of chemical engineering.

Kramer is an Editor-in-Chief of *Materials Science and Technology* (18 volumes, published by VCH) and of the *Encyclopedia of Materials: Science and Technology* (11 volumes, published by Elsevier). His honors include Fellow of the American Association for the Advancement of Science, the American Physical Society, and the Materials Research Society and member of the U.S. National Academy of Engineering; the High Polymer Physics Prize of the American Physical Society (1985); the U.S. Senior Scientist Award of the Alexander von Humboldt-Stiftung (1987); the John Simon Guggenheim Fellowship (1988); the Swinburne Award of the Institute of Materials (UK) (1996); Docteur honoris causa, Ecole Polytechnique Federale de Lausanne (1995); the Polymeer Technologie Nederland Medema Award of the Dutch Polymer Society (2007); and the American Chemical Society Polymer Materials Science and Engineering, Cooperative Research Award (2008).

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Gerbrand Ceder Named 2009 MRS Medalist

The Materials Research Society has named Gerbrand Ceder of Massachusetts Institute of Technology (MIT) as the 2009 MRS Medalist for "pioneering the high-impact field of first-principles thermodynamics of batteries materials and for the development of high-power density Li battery compounds." Ceder will be recognized during the awards ceremony at the 2009 MRS Fall Meeting in Boston, where he will also give an award talk on "The Opportunities and Challenges for First Principles Materials Design and Applications to Li Battery Materials." Ceder will give his presentation on Dec. 1 at 5:10 p.m. in Room 200 of the Hynes Convention Center.

Gerbrand Ceder

Ceder's seminal contributions have made first-principles methods a recognized tool in battery materials development, deepened understanding of fundamental thermodynamic and kinetic properties of battery cathode materials, and have led to the development of novel Li battery compounds of commercial importance. Beginning his career as an alloy theorist, Ceder combined computational first-principles statistical mechanics with experiment to attain a fundamental understanding of new and poorly characterized materials phenomena, with a particular interest in the lithium transition metal oxides used as electrodes in Li-ion batteries. As he delved further into the battery scene, Ceder demonstrated the ability of first-principles electronic structure methods to predict measurable thermodynamic properties such as average open-cell voltages.

In a comprehensive study of cathode materials $LiFePO_4$, Ceder demonstrated that the Li^+ diffusion pathway in this material was one-dimensional, which challenged conventional thought and created a framework with which to explain the mechanisms for intercalation/deintercalation in this material. He has later shown that the various surfaces of $LiFePO_4$ are associated with different intercalation potentials and that this has a dramatic impact on the mechanism of intercalation. This study represents one of the first systematic investigations of the effect of surface structure on electrode function.

Computer-designed modifications of crystal structures have led to new classes of Li-based electrode materials, such as Li-Co-Al and Li-Ni-Mn oxides, which show enhanced properties compared to those of the traditional $LiCoO_2$ compound, though much still remains to be done as new avenues need to be explored.

Ceder received a PhD degree in materials science from the University of California at Berkeley (1991). He then joined the faculty at the Massachusetts Institute of Technology, where he is now the R.P. Simmons Professor of Materials Science and Engineering. Ceder holds five current or pending U.S. patents and has published over 220 scientific articles. Ceder has received the Battery Research Award from the Electrochemical Society; the Career Award from the National Science Foundation; and the Robert Lansing Hardy Award from The Metals, Minerals and Materials Society for "exceptional promise for a successful career." He has also received three awards from the graduate students at MIT for best teaching. He is the founder of Computational Modeling Consultants. MRS

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