Richard H. Friend to receive 2015 Von Hippel Award for materials phenomena and device concepts

The 2015 Von Hippel Award, the Materials Research Society's (MRS) highest honor, will be presented to Richard H. Friend, Optoelectronics Group, Cavendish Laboratory at the University of Cambridge. Friend is being recognized "for pioneering research on highly original materials phenomena and device concepts, enabled by polymeric semiconducting materials, and imprinting an indelible influence on contemporary materials science and the new field of plastic electronics." Friend will present his award talk at the 2015 MRS Fall Meeting in Boston on December 2, at 6:30 p.m., in the Grand Ballroom of the Sheraton Boston Hotel.

Friend's research has had a major scientific and technological impact on important areas of contemporary materials science, with the centerpiece being his pioneering research on the materials physics of highly original device concepts based on polymeric semiconductors. His work has changed how materials scientists, chemists, physicists, and device engineers think about the properties and technology prospects of "plastic electronics."

In the mid-1980s, Friend initiated a research program in the Cavendish Laboratory at the University of Cambridge to investigate the electronic properties of so-called "conducting polymers." Chemically doped π-conjugated polymers such as polyacetylene had been shown to behave as metallic conductors, and this work was later recognized by the Chemistry Nobel Prize awarded to Heeger, MacDiarmid, and Shirakawa in 2000. However, with remarkable insight, Friend realized that far more interesting and technologically useful science would lie in the use of such macromolecules as semiconductors, particularly in functioning diodes and transistors. Thus, in 1988, Friend and his student Jeremy Burroughes showed for the first time that polyacetylene, prepared by a synthetic route developed by James Feast at the University of Durham, could demonstrate clean operation as a true field-effect transistor.

In 1990, Friend and his group published a paper in *Nature* showing that other polymers, coming from a new collaboration with Andrew Holmes and his student Paul Burn in the Cambridge Chemistry Department, could function as light-emitting diodes. The paper proved to be seminal, attracting more than 8000 citations, and placing it in the top 20 most-cited papers in this journal. Friend, Burroughes, and Donal Bradley filed a patent ahead of the *Nature* letter, and this proved to be extremely valuable, leading to the founding of the successful nearby spin-off company, Cambridge Display Technology Ltd.

Friend assembled and led a very talented Optoelectronics Group in the Cavendish Laboratory at Cambridge. Their goal was to explore and develop the many basic science challenges that can be accessed through polymer semiconductor devices. In an amazingly short period of time, they conceived, fabricated, and demonstrated a number of "firsts" including:

- 1995—The bulk heterojunction organic solar cell (also developed independently by Heeger at the University of California–Santa Barbara);
- 2000—Inkjet printed organic transistor circuitry;
- 2006—Light-emitting polymer transistors.

Friend's work on organic transistors included important new insights into the relationship between semiconductor microstructure, processing, and carrier mobility—necessary to optimize organic transistor performance—and a detailed new understanding of how the semiconducting material interacts with the proximate gate dielectric. This successful work led to the founding of another Cambridge spin-off company, Plastic Logic Ltd.

More recently, Friend's group has focused on the understanding-based development of high-efficiency polymer solar cells. Through studies of the relationship between polymer architecture, processing, morphology, and carrier dynamics, they have established the basic principles needed to create practical, low-cost plastic solar energy materials and devices. They have also shown that the fission of photogenerated spin-singlet excitons can produce pairs of spin-triplet excitons that can be harvested in solar-cell structures that can, in principle, exceed the Shockley–Queisser power-conversion efficiency limit. In addition to this university-centered research, Friend was involved in the founding of the Cambridge spin-off company Eight19 Ltd., which is commercializing printed organic solar-cell technologies. One focus of the company is to provide cheap, clean, off-grid power for people in remote locations.

What is especially remarkable in all of the previous examples is that Friend's work transcends fundamental science alone, and also enables technologies such as more cost-effective and energy-efficient solar cells, flexible and transparent printable transistors for portable information processing and sensing, advanced high-speed optical communications, and organic light-emitting diodes for displays and energy-efficient indoor lighting.

Friend has approximately 800 publications and numerous awards, including election to the US National Academy of Engineering as a Foreign Associate (2013), the International Medal for Materials Science and Technology, MRS of India (2013), the Harvey Prize of the Technion/Israel Institute of Technology (2011), and Laureate, the Millennium Prize of the Finnish Academy of Technology (2010).

The MRS Von Hippel Award includes a $10,000 cash prize, honorary lifetime 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 disciplines, as exemplified by the life of Arthur von Hippel (http://vonhippel.mrs.org).

Jacob Klein selected for 2015 David Turnbull Lectureship Award

The Materials Research Society's (MRS) David Turnbull Lectureship Award 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 the late David Turnbull of Harvard University. This year, Jacob Klein, Department of Materials and Interfaces, Weizmann Institute of Science, Rehovot, Israel, has been selected to give the 2015 Turnbull Lectureship. Klein is cited "for discoveries which transformed our understanding of soft matter and interfaces, through sustained research, inspirational lecturing, and academic leadership." He will be presented with the award at the 2015 MRS Fall Meeting in Boston.

Klein has made landmark discoveries in polymer physics, in the understanding and control of surface forces, and in elucidating friction and lubrication in aqueous systems. He first studied polymer dynamics, and subsequently, the properties of polymer interfaces, surfaces, and wetting effects. In parallel, Klein focused on the behavior of confined simple and complex fluids, and on forces between surfaces, including steric interactions, nanotribology, and biological lubrication. His work is characterized by studying nature as directly as possible at a microscopic level, often developing, for this purpose, novel experimental approaches and designing state-of-the-art experimental approaches (including infrared microdensitometry and nuclear reaction analysis for polymer dynamics studies, and uniquely sensitive self-designed surface force balances for studying steric forces, confinement effects, and nanotribology). Klein has recently been expanding his basic studies to the biomedical area, with potential impact for alleviation of widespread lubrication-related diseases, such as osteoarthritis.

Klein's major achievements include the first experimental demonstration of reptation (*Nature* 1978) (snake-like motion of entangled polymers), using a novel, self-designed diffusion-measuring technique (*Nature* 1975, *Nature* 1977), together with the theoretical analysis of the onset of reptation and the idea of tube renewal. His findings—extended over the following decade by further discoveries on dynamics of entangled polymers (*Nature* 1983, *Nature* 1986, *Science* 1990)—firmly underpinned our molecular understanding of the rheology of entangled polymers. An additional major achievement was to first measure molecular attraction and repulsion mediated by polymers at surfaces (*Nature* 1980, 1982, 1984, 1988)—years before the advent of atomic force microscopy. Such forces underlie the steric stabilization of colloidal dispersions in myriad natural and synthetic systems. These findings became classic textbook material and played a major role in underpinning the modern understanding of dynamics of entangled polymers and of polymers at surfaces. More recent achievements by Klein include the discovery of confinement-induced phase transitions in liquids (*Science* 1995); the remarkable entropy-based lubrication that can be achieved by polymer brushes (*Nature* 1991, *Nature* 1994); and in particular, the discovery of the hydration lubrication effect (*Nature* 2001, *Science* 2002, *Nature* 2003, *Nature* 2006, *Science* 2009a), which underlies most lubrication processes in biology. Although these achievements are of a very basic nature, the effects they relate to are important in a much wider context of materials science, from the rheology of polymer melts and properties of colloidal dispersions, to tertiary oil recovery, and to more efficient tissue engineering and biomedical devices, such as prosthetic implants (*Science* 2009b).

Some 70 graduate students and postdocs received their training at Klein's labs (at the University of Cambridge, the Weizmann Institute, and the University of Oxford), of whom 26 are currently in tenured faculty positions in leading universities in Israel, Europe, China, and North America, including several who have achieved their own high level of distinction. In Israel, he was one of the pioneers in soft matter research, establishing (in the early 1980s) the first seminar and lecture series in soft matter and interfacial phenomena, and was later a founder of the Department of Materials and Interfaces at the Weizmann Institute. His awards include the Tribology Gold Medal (2012), the Royal Society of Chemistry Soft Matter and Biophysics Prize (2011), the Israel Chemical Society Prize (2010), and the American Physical Society High Polymer Physics Prize (1995). He is a Fellow of the Royal Society of Chemistry, the Institute of Physics (UK), the American Physical Society, and the European Academy.