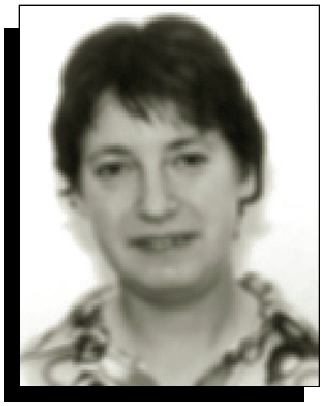
# Frances M. Ross Named Outstanding Young Investigator for Work on *In Situ* Electron Microscopy Techniques

Frances M. Ross, Research Staff Member at the IBM Thomas J. Watson Research Center, is not only this year's Materials Research Society Spring Meeting co-chair, but also the recipient of the 2000 MRS Outstanding Young Investigator Award. Cited for "innovative and powerful experimental studies, based upon development of novel *in situ* electron microscopy techniques, that have provided fundamental new understanding of nucleation, growth, oxidation and etching processes in a wide range of materials systems," Ross continues to lead the materials field with her innovative application of transmission electron microscopy (TEM) to *in situ* materials science experiments. This award recognizes exceptional, interdisciplinary scientific work in materials research by a young scientist or engineer who also displays leadership in the materials area.



Frances M. Ross

Ross' novel development of *in situ* TEM techniques for materials analysis crosses a broad range of materials-related fields, including electrochemistry, interfacial characterization, dislocation dynamics, and thin-film growth. By modifying designs for the specimen, the specimen holder, or the microscope itself, Ross has enhanced understanding of materials phenomena through real-time imaging and quantitative measurements.

During her tenure at the National Electron Microscopy Center at the Lawrence Berkeley National Laboratory (1992–1997), she coordinated development of the *In Situ* Microscope user facility. She used the *in situ* microscope to image domain switching in ferroelectric thin films and also to study the electrochemical etching of porous silicon in the TEM, both projects requiring integration of specimen design with novel specimen holders.

At IBM, which she joined in 1997, Ross is studying the evolution of self-assembled islands, or quantum dots, in systems such as Ge and GeSi on Si and $CoSi_2$ on Si. Understanding the details of the growth of these islands is essential if they are to become components of future microelectronic devices. By using an ultrahigh vacuum TEM equipped with physical and vapor deposition sources, she was able to observe the nucleation and growth of individual islands in real time. The kinetics measured from these experiments were used to derive models for island growth. In the Ge/Si system, where the islands are known to change shape as they grow, she showed that the development of individual islands is dominated by a coarsening process which in turn is strongly influenced by the shape change. This model predicts details of the island size distribution and shows how best to grow islands with desirable characteristics. Further studies demonstrated the mechanism by which the islands change shape.

Ross' first work with the TEM was during her PhD studies at Cambridge University where she developed a Fresnel contrast technique for measuring specimen composition accurately in the TEM. She used this technique to measure composition variations quantitatively across interfaces such as $Si/SiO_2$ and GaAs/AlGaAs. Following graduation in 1989, Ross continued to study the $Si/SiO_2$ interface in a postdoctoral project at AT&T Bell Laboratories. She observed the motion of steps on the Si surface and at the silicon/oxide interface during oxidation and oxygen etching *in situ* in an ultrahigh vacuum TEM. Measurements of surface step dynamics during oxygen etching allowed her to derive a terrace sticking and evaporation model for etching, while her observation that oxidation (to form both thermal and native oxides) occurs by terrace attack, without motion of interface steps, overturned the existing assumption that oxidation occurs preferentially at the interface steps.

In a second project at Bell Labs, Ross used a combination of *in situ* TEM techniques to measure the electrical activity of misfit dislocations in strained GeSi/Si heterostructures. She made high-quality diode devices compatible with TEM specimen dimensions which could be electrically contacted in the microscope. By annealing the diodes *in situ*, Ross was able to introduce misfit dislocations controllably into the *p-n* depletion region. As the dislocations were introduced, she could simultaneously measure the electrical properties of the junction. In this way Ross was able to correlate dislocation density with leakage current and deduce a fundamental physical parameter for device applications: the electron-hole generation current per unit length of dislocation line. The number she measured for this parameter was orders of magnitude higher than predicted by conventional Shockley-Hall-Read statistics, and suggested mechanisms for point defect generation during dislocation motion in strained layer semiconductors.

In her most recent work at IBM, Ross has designed and constructed a wet cell for the TEM in order to study processes at the liquid/solid interface in real time. Exciting applications for this cell include the dynamics of electroplating, corrosion, and etching. The wet cell is significantly thicker than a conventional TEM specimen, so she has equipped the TEM with an energy loss imaging filter in order to improve its imaging capabilities.

Ross has over 70 publications, two patents, and has presented over 15 invited talks. She received the Institute of Physics Charles Vernon Boys Medal in 1999. She is Guest Editor of the June 1994 issue of *MRS Bulletin*, on the theme of materials science in the electron microscope, and has contributed subsequent articles in the May and July 1996 issues.

The Outstanding Young Investigator Award will be presented to Ross during the Awards Ceremony on April 24, 6:00 p.m. at the 2000 MRS Spring Meeting in Salon 7 at the San Francisco Marriott Hotel. She will give her presentation, "Dynamic Studies of Semiconductor Growth Processes Using *In Situ* Electron Microscopy," on April 25 at 11:30 a.m. in Symposium C, Salons 5–6, San Francisco Marriott. MRS

For up-to-date information on the 2000 MRS Spring Meeting, see Web site
www.mrs.org/meetings/

# Arthur Bienenstock to Give Plenary Talk at 2000 MRS Spring Meeting

**Arthur Bienenstock**

Arthur Bienenstock, associate director for science of the White House Office of Science and Technology Policy (OSTP), will give the plenary address at the 2000 MRS Spring Meeting on April 24, 6:00 p.m. in Salon 7 at the San Francisco Marriott Hotel. The title of his talk is "Seeking Balance in the Federal Research Budget." As head of the science division, Bienenstock concentrates on policy and interagency coordination directly related to the health of U.S. basic science, as well as other policy matters which can be informed by basic science.

At OSTP, Bienenstock has sought to gain general recognition of the interdependencies of the sciences and the need for the United States to maintain broad scientific and technological strength. He has also focused on ensuring that the country has a scientific and technological workforce, at all levels, to meet its 21st century needs. Mindful of anticipated demographic changes, he initiated an interagency working group which is seeking to increase the participation of minorities, women, and the disabled community in science and technology. He has led a Task Force on the Government-University Research Partnership aimed at strengthening the relationship, and has championed an Interagency Educational Research Initiative to fund large-scale, interdisciplinary research on teaching and learning.

For the 30 years prior to his coming to OSTP in November, 1997, Bienenstock was on the faculty of Stanford University, at the Stanford Linear Accelerator Center and in the Departments of Materials Science & Engineering and Applied Physics. He served as director of the Stanford Synchrotron Radiation Laboratory (SSRL) from 1978 to 1997, leading SSRL's transition from a scientific project to a major facility. He also served as Stanford's first Faculty Affirmative Action Officer and as Vice Provost for Faculty Affairs.

Prior to that, he was on the faculty of Harvard University's Division of Engineering and Applied Physics (1963–1967). During this period, he maintained an active research group in the general areas of solid-state physics, amorphous materials, and synchrotron radiation. He has published over 100 scientific papers in these areas.

Bienenstock received a BS (1955) and MS (1957) degree from the Polytechnic Institute of Brooklyn. He received his PhD degree from Harvard University in 1962. In addition, he was a recipient of an honorary PhD degree from Polytechnic University in 1997.

In 1968, Bienenstock was the first recipient of the Pittsburgh Diffraction Society's Sidhu Award for his work in x-ray diffraction and crystallography. He received the Distinguished Alumnus Award of the Polytechnic Institute of New York Alumni Association in 1977. He is a fellow of the American Physical Society and the American Association for the Advancement of Science. MRS

# Alan J. Hurd Receives 1999 Woody Award

Alan J. Hurd, manager of the Catalytic and Porous Materials Department at Sandia National Laboratories and adjunct professor of physics at the University of New Mexico, is the recipient of the 1999 Materials Research Society Woody Award. Ronald Gibala, 1999 MRS President, made the presentation to Hurd at the 1999 MRS Fall Meeting in Boston.

The Woody Award recognizes outstanding service and dedication to MRS, as exemplified by its namesake Woody White, 1984 MRS President. The award is bestowed annually by the MRS president to an individual for extraordinary contributions to the Society.

Hurd's service covers tremendous breadth and depth. He has been a task force member or chair three times, including the Materials MicroWorld Task Force currently; a committee or subcommittee chair twice including the Public Outreach Subcommittee currently; a symposium organizer twice, including Symposium GG on When Materials Matter—Analyzing, Predicting, and Preventing Disasters, at the Spring 2000 Meeting; a short course presenter five times; and a member of the *MRS Bulletin* Editorial Board. In 1994, he was a co-chair of the MRS Spring Meeting. At the governance level, he has been a Councillor (1996–1998), and Society Treasurer and member of the Executive Committee (1997–1998).

**Alan J. Hurd**

"The impact of Al Hurd's volunteer efforts for MRS is remarkable," said Gibala. "Each of his activities has been distinguished by unparalleled enthusiasm and incisive accomplishment which reflects his quality as a materials researcher and manager at Sandia."

Gibala said, "An excellent example of Al's contribution is his work with Society finances. After two years as Society Treasurer, he moved seamlessly into the oversight role of budget development for Materials MicroWorld, the major MRS national traveling exhibit to promote public awareness and appreciation of materials research, now under development."

Harry Atwater, 2000 MRS President, enthusiastically endorses Hurd as the Woody Awardee. "Not only has he done many things for MRS and done them well, but his work represents a continuum of quality effort. It's hard to imagine MRS without Al's presence."

Robert Nemanich, 1998 MRS President, concurs. He said, "Al is one of the most innovative volunteers in the Society. He's a 'go-to' person for all of us, and we have truly benefited from his egalitarian perspective."

Al Hurd received his formal education in physics at the Colorado School of Mines and the University of Colorado, where he held a National Science Foundation predoctoral fellowship. In 1981 he went to Brandeis University as a postdoctoral fellow, doing research on liquid crystals and teaching physics. He joined Sandia in 1984 and has held several research and manager positions in the past 15 years. His research interests have included complex fluids and sol-gel ceramics. He has shared three awards from the Department of Energy Basic Energy Sciences (BES) with collaborators for research in these areas. He has served on advisory boards for BES, the National Research Council, several universities, and the Los Alamos Neutron Science Center, for whom he has served in various executive and advisory roles. He is an adjunct professor of physics at the University of New Mexico and a member of its Center for Advanced Studies. A member of MRS since 1985, he is also active in the American Physical Society. MRS

## SECTION NEWS

# New Mexico MRS Section Co-Sponsored Rio Grande Regional Symposium on Advanced Materials

J. Charles Barbour of the New Mexico Section of the Materials Research Society co-chaired the 11th annual Rio Grande Regional Symposium on Advanced Materials (RGRSAM). The Symposium was held in Albuquerque, New Mexico on October 11, 1999. John J. Stephens, Jr. of Albuquerque Chapter of ASM International and Deidre Hirschfeld of the New Mexico Section of the American Ceramics Society also chaired the Symposium. Students and established scientists came together to present their work on composite materials (ceramic, metal); biomaterials; thin-film oxide materials; steels and other metals; polymers; semiconductors; materials for microelectromechanical systems and sensor applications; corrosion of materials; and various techniques for synthesis and processing of materials. The Symposium was divided into four parallel sessions.

A poster session was held in which undergraduate and graduate students and technicians competed for best poster awards. The award recipients were **Erica Corral**—"Processing and Defects in Alumina-Molybdenum Cermets," **Scott Smith**—"Granulation Techniques for Ceramic Powder Compaction," and **John Stuecker**—"Merging Robocasting with Other Processes for the Development of Unique Materials" for first-place; **Sara Vick**—"Aluminum Doping of $LiNiO_2$ Cathode Materials for Lithium Ion Battery Cathode Materials," **Mary Sandstrom**—"Chemical Control of the Orientation in Complex Perovskite Sol-Gel Films Using $La_2Ti_2O_7$," and **Linda McLaughlin**—"An Overview of Our Studies on Hydrous Metal Oxides with Emphasis on Their Use in the Area of Catalysis" for second place; and **Theresa Gutierrez**—"Vacuum Effects on a Micro-Machined Accelerometer with Digital Feedback Control," **Charles Mandeville**—$SiO_2$ Films via Evaporation of SiO with Simultaneous $O_2^+$ Ion Reaction/Bombardment," and **Clay Newton**—"Evaluation of the Strength Distribution and Stress Profiles for a Novel Ion-Exchanged Glass." □