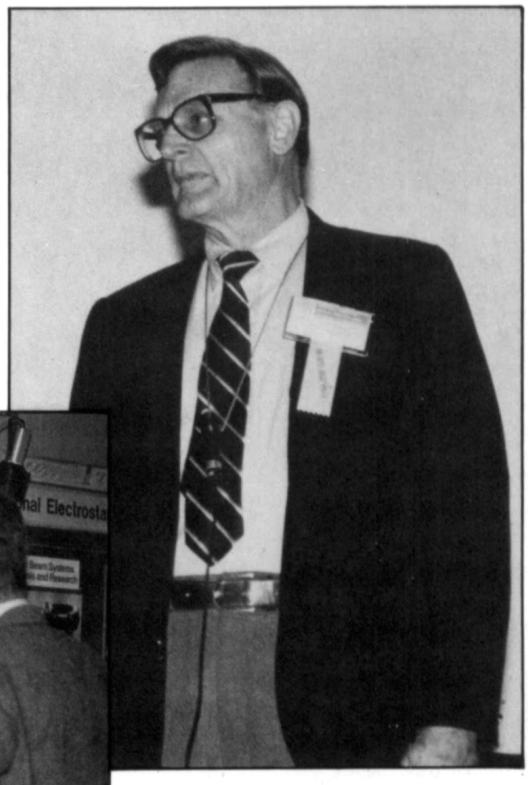
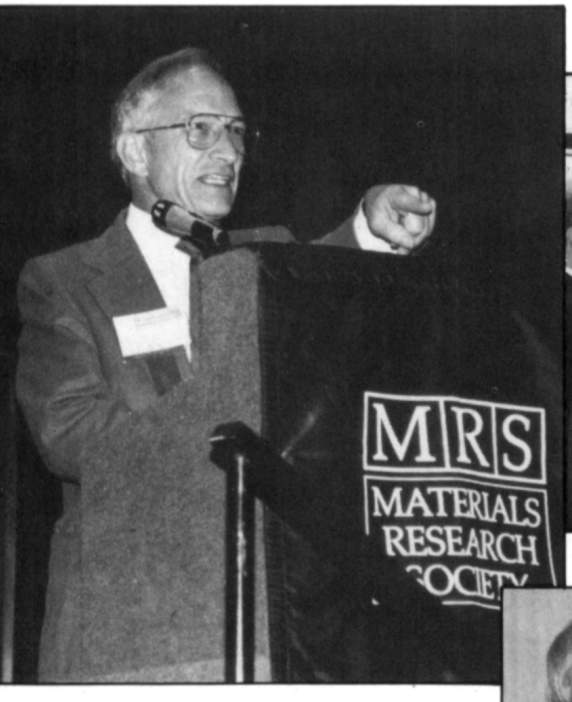
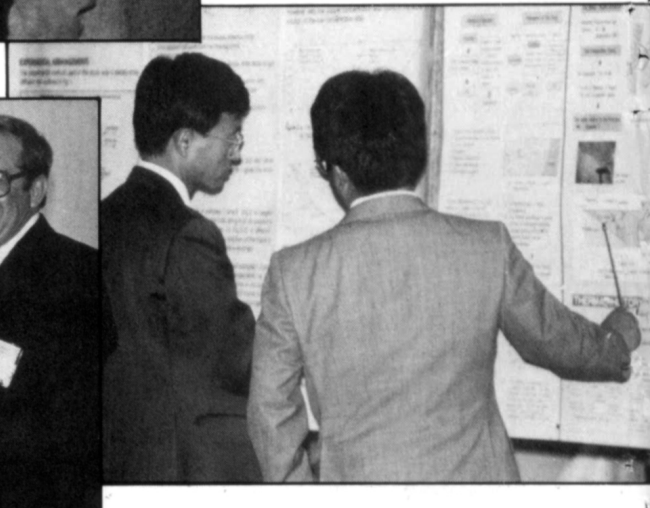
Boston Meeting Attracts Worldwide Audience

3,900 Discuss Broad Mix of Topics







https://doi.org/10.1557/S0883769400060474 Published online by Cambridge University Press

Opposite Page—Top left: Plenary speaker Robert Noyce speaks frankly about the technical challenge facing the U.S. semiconductor industry. **Top center:** Participants continue their discussions at the equipment exhibit. **Top right:** Von Hippel Award recipient John B. Goodenough discusses the "Molecular Engineering of Oxides." **Center left:** G.G. Bentini (left), CNR-LAMEL, Italy, accepts a plaque commemorating the establishment of the International Materials Research Committee from C.W. White. Forty-six scientists from 12 countries attended the inaugural meeting of the IMRC, hosted by MRS on November 30, 1989. An article on the inaugural meeting will be published in the March issue of the *MRS Bulletin*. **Center right:** Poster sessions continue to offer an excellent opportunity for in-depth discussions. **Bottom:** Panelists and participants discuss strategies for implementing the MS&E Study's recommendations during a special session at the Fall Meeting. See the article by Paul Peercy on p. 6 of the January 1990 *MRS Bulletin*.

This Page—Top: 1989 MRS President R.P.H. Chang (right) congratulates the Fall Meeting Chairs (L to R) Robert Nemanich, James Mikkelsen Jr. and Gary McVacy **Bottom:** Graduate Student Award Recipients. See the article on p. 61.

Participants at the 1989 MRS Fall Meeting in Boston found a strong core of familiar subjects intermixed with topics not previously covered at MRS meetings. Superconductivity, fractals, nuclear waste management, and a broad mix of forefront semiconductor and electronics topics received the enthusiastic attention of approximately 3,900 attendees, as did such areas as optical fibers, polymer-based molecular composites, multifunctional materials, neutron scattering, materials synthesis using biological processes, and more. The stimulating array of 24 technical symposia and some 2,400 oral and poster papers was organized by Meeting Chairs Gary L. McVay of Pacific Northwest Laboratories, Robert J. Nemanich of North Carolina State University, and James C. Mikkelsen Jr. of Xerox with the volunteer help of 75 symposium organizers.

Live video broadcasts of two symposia allowed attendees to remain in one hotel while viewing ongoing presentations in the other. The symposia participating in this venture were those on High Temperature Superconductors and on Diamond, Boron Nitride, Silicon Carbide and Related Wide Bandgap Semiconductors. In another first-time venture, a 90-minute segment of Symposium X—Frontiers in Materials Research was broadcast as a live, interactive videoconference through the PBS and National Technical University satellite services.

Complementing the symposia were 22 short courses scheduled throughout the week. Several poster sessions, a major equipment exhibit, and a job placement center offered attendees additional opportunities for interaction.

The plenary speaker was Robert N. Noyce, co-inventor of the integrated circuit, president and CEO of Sematech, and vice chairman of Intel Corporation. He spoke frankly to a packed international audience about what he calls "the considerable technical challenge" the United States

faces since it lost its place to Japan as the world's leading supplier of semiconductors. The mission of Sematech, a consortium of 14 high-tech companies and the U.S. Department of Defense, is to restore U.S. leadership. The text of Noyce's address will be published in an upcoming issue of the *MRS Bulletin*.

John Baglin, chair of the MRS Awards Committee presented the Von Hippel Award, the highest honor of the Materials Research Society, to Prof. John B. Goodenough, holder of the Virginia H. Cockrell Centennial Chair of Engineering at the University of Texas at Austin. Goodenough was honored for "his distinguished contributions to the field of solid state sciences, where his insights, ideas, knowledge and research have consistently drawn together the basic concepts of physics and chemistry in the conquest of wide-ranging fundamental topics." Goodenough's address on "Molecular Engineering of Oxides" will be published in an upcoming issue of the *MRS Bulletin*.

Also honored during the awards ceremonies were 13 graduate students. See "Graduate Student Award Winners Honored at Fall Meeting" on p. 61.

The following summaries written by the symposium organizers provide a closer look at some of the topical highlights from this meeting. Additional symposium summaries will be published in the March issue of the *MRS Bulletin*. For more details readers are encouraged to order MRS Symposium Proceedings or Extended Abstracts volumes from the MRS Publications Department. (See the complete list on p. 55.) In the few instances where proceedings will not be published, readers should contact one of the symposium organizers for further details.

Beam-Solid Interactions: Physical Phenomena (Symposium A)

MRS Symposium Proceedings, Vol. 157

Organizers: *Peter Borgesen (Cornell University), James A. Knapp (Sandia National Laboratories), Ray A. Zuhr (Oak Ridge National Laboratory).*

Support: *Corning Cornell Ceramics Initiative, IBM Corporation, National Electrostatics Corporation, Oak Ridge National Laboratory.*

More than 180 papers were presented during this latest symposium in the series on beam-solid interactions. Included were both fundamental and applied studies of the interaction of ion, laser, and electron beams with matter, with emphasis on the physical aspects of these interactions. Sessions were organized on ion-assisted deposition, ion-induced growth, buried layers, modeling and fundamental studies, and beam-induced modification of deposition of metals, ceramics, superconductors, and semiconductors.

The session on ion-assisted deposition included invited presentations on surface modification, deposition and synthesis (J.J. Cuomo, IBM); ion-assisted MBE (E. Chason, SNL); and a historical perspective on ion beam deposition by one of the first groups to work in this area (K. Miyake, Hitachi). The session on ion beam mixing covered phase formation (J. Bottiger, Aarhus, and W.L. Johnson, Caltech) and a new perspective on critical temperatures for radiation-enhanced diffusion and phase formation during ion mixing (F. Saris, FOM). Work on ion beam modification of superconductors was highlighted by one of the leaders in this area (O. Meyer, Karlsruhe), while new results on the properties of amorphous alumina were reported by one of the principal groups in the ion beam modification of ceramics (C.J. McHargue, ORNL). Considerable new work on the ion beam modification of semiconductors was presented, including results on the amorphous-to-crystalline phase transitions in silicon (J.S. Williams, RMIT), and mechanical measurements of stress and plastic flow in ion-bombarded silicon (C.A. Volkert, Bell). The final day of the symposium began with a session on fast thermal processing. Leading off was a summary of the latest transient conductance measurements (M.O. Thompson, Cornell), and freezing rates at large undercooling in silicon (A. Polman, FOM). The substantial number of people who remained for the final session on ion beam modification of metals were rewarded with excellent presentations on the martensitic transformation in ion implanted stainless steels (E. Johnson, Copenhagen) and the effects of ion implantation on the single-crystal alloy Ni_3Al.

Because so many papers were submitted this year, about half were presented during the two evening poster sessions. The sessions were extremely well received, with animated discussions continuing beyond the scheduled closing time.

In the last few years this symposium has become truly international, with more than 40% of this year's contributed papers coming from outside the United States. This year 21 different countries were represented, including Argentina, Australia, Brazil, India, Korea, Japan, and China.

Atomic-Scale Structure of Interfaces (Symposium C)

MRS Symposium Proceedings, Vol. 159

Organizers: *R.D. Bringans (Xerox Palo Alto Research Center), R.M. Feenstra (IBM T.J. Watson Research Center), J.M. Gibson (AT&T Bell Laboratories).*

Support: *Office of Naval Research.*

Surface superstructures are commonly observed by many methods, but interfacial superstructures are less common and more difficult to observe. Several talks in this symposium addressed the issue of studying buried interfaces. The use of grazing incidence x-ray diffraction to directly observe interfacial superstructures was described by K. Akimoto (NEC). A boron $\sqrt{3} \times \sqrt{3}$ structure was observed on both amorphous and crystalline silicon (111), capped with crystalline silicon (111). This study is complementary to recent surface studies of the B $\sqrt{3} \times \sqrt{3}$ system, and is particularly interesting in terms of forming a δ-doped B layer.

Several novel techniques for observing atomic scale surface topography were presented. E. Bauer (Clausthal) described low energy electron microscopy (LEEM), which can readily image atomic-scale structures such as steps and regions of varying reconstruction on a surface. Dynamic studies are possible with LEEM, and examples were presented of step growth on Si(100), and the 7x7 to 1x1 phase transition on the Si(111) surface.

The heteroepitaxial growth of semiconductors was examined by many different methods. One notable result was presented by R. Tromp (IBM), who described the role of a surface active species ("surfactant") to control the epitaxial growth process. Using an arsenic monolayer in the Si(OO1)/Ge/Si system resulted in layer by layer growth, due to the inhibition of Ge out-diffusion by the presence of the low surface energy arsenic species.

Layered Structures-Heteroepitaxy, Superlattices, Strain and Metastability (Symposium D)

MRS Symposium Proceedings, Vol. 160

Organizers: *Leo J. Schowalter (Rensselaer Polytechnic Institute), Brian W. Dodson (Sandia National Laboratories), Jack E. Cunningham (AT&T Bell Laboratories), Fred H. Pollak (Brooklyn College of SUNY).*

Support: *Aixtron, Inc.; ASTeX, Inc.; Blake Industries, Inc.; EPI Systems Division - Chorus Corporation; Emcore, Inc.; Instruments SA (Riber); MDC Vacuum Products Corporation; VG Semicon Ltd.; Varian, Inc.*

This symposium focused on heteroepitaxial growth dynamics, optical characterization techniques, and superlattices of both crystalline and noncrystalline solids. The issue of strain control and stability of the layered structures was both a unifying theme and a major topic. The five-day symposium featured 10 oral presentation sessions, an evening poster session, and a successful evening session during which six manufacturing representatives made

presentations on "Future Developments in Epitaxial Techniques and Equipment."

The technical sessions considered the following topics: heteroepitaxy of metals, semiconductors, and insulators; metallic superlattices; general topics in strained layer epitaxy; epitaxial growth of III-V semiconductors; small angle x-ray characterization and amorphous layers; and optical characterization of strained layers, quantum wells, superlattices, and other epitaxial layers.

Excellent presentations were given by 13 invited speakers: J.M. Ballingall (GE), F. Capasso (AT&T), P.I. Cohen (University of Minnesota), C.P. Flynn (University of Illinois), O.J. Glembochi (NRL), J.P. Harbison (Bell Communications Research), R. Hull (AT&T), S. Iyer (IBM), J. Kakalios (University of Minnesota), U.K. Mishra (North Carolina State), T.P. Pearsall (AT&T), P.D. Persans (Rensselaer) and J.Y. Tsao (Sandia).

Despite an expanded format with 155 technical presentations, the high level of interest in this symposium forced us to reject many excellent papers that did not fit this year's theme. Overflow attendance at some sessions necessitated use of a closed-circuit TV.

Neutron Scattering for Materials Science (Symposium J)

MRS Symposium Proceedings, Vol. 166

Organizers: *S.M. Shapiro (Brookhaven National Laboratory), S.C. Moss (University of Houston), J.D. Jorgensen (Argonne National Laboratory).*

Support: *Argonne National Laboratory, Army Research Office, Brookhaven National Laboratory, Los Alamos National Laboratory; National Institute for Standards and Technology, Oak Ridge National Laboratory.*

Seventy-eight papers, including 11 invited overview talks, were presented on an impressive range of topics. These included studies of superconductors (where neutron powder diffraction methods have been crucial for oxygen site location); small-angle polymer studies; elastic and inelastic investigations of structural phase transformations in solids; quasielastic diffusion measurements; studies of catalyst reactions at surfaces; nondestructive light-element depth profiling (where remarkable accuracy on boron-implanted silicon has been achieved); residual stress measurements (on, for example, massive train rails); theory, structure and phase relations in alloys; and the structure and dynamics of disordered solids and liquids. In particular, there were extended sessions on alloys, residual stress, and the structure and dynamics of polymers and gels, where fractal and fracton concepts were invoked in a stimulating discussion of recent small-angle neutron scattering data. The variety of neutron methods displayed was also impressive, utilizing both steady-state reactors and the newer pulsed sources whose timed structure and high-energy neutron distribution present many exciting options for materials research. It was clear that neutron scattering has truly come of age in materials science as an essential tool and that a large user community is increasingly availing itself of the national facilities for both fundamental and (nondestructive) applied research.

Advanced Electronic Packaging Materials (Symposium K)

MRS Symposium Proceedings, Vol. 167

Organizers: *C-Y. Li (Cornell University), C.J. Chen (IBM T.J. Watson Research Center), J.P. Partridge (IBM T.J. Watson Research Center), A. Barfknecht (Conductus, Inc.).*

Support: *National Science Foundation.*

Seventeen invited papers from the United States and Japan, in conjunction with 44 submitted papers, addressed areas mentioned in Robert Noyce's Plenary Address where the U.S. semiconductor industry is facing tough competition. The session started with D. Eastman (IBM) and S. Prough (Intel) giving an overview of trends and challenges for industry in electronic packaging. Invited presentations by K. Kimbara (NEC) on the polyimide-ceramic substrate for the NEC supercomputer and H. Hiramoto (Toray) on photosensitive polyimides emphasized the impressive advances recently made in these fields and highlighted the extent of Japanese participation in this interdisciplinary field.

A session devoted exclusively to optoelectronic packages, featuring invited speakers only (from MIT, Princeton, IBM, AT&T, and Dupont), focused on optical waveguide fabrication, optical interconnects for multiprocessor networks, photonic integrated circuits, and optical switches. Presentations in the polymers session included an invited paper by S. Stupp (Illinois) on liquid crystal polymers, followed by contributed papers on topics such as new polymers, environmental effects, diffusion, etc.

The potential of low dielectric constant composites was explored in depth in invited talks from T. Srinivasan (Penn State) on nanocomposites, G. Arjavalingham (IBM) on a new measurement technique for dielectric constant and J. Kim (IBM) on polymer-metal interfaces.

Another session covered the latest studies on aluminum nitride, and the session on metallization and interconnects spanned topics ranging from electroless plating to solder joints and metallization of semiconductors.

The symposium was well attended with enthusiastic audience participation showing that although electronic packaging is a technology-oriented field, the fundamental materials science is apparently of great interest to MRS members and the advanced materials community.

High Temperature Superconductors: Fundamental Properties and Novel Materials Processing (Symposium M)

MRS Symposium Proceedings, Vol. 169

Organizers: *J. Narayan (North Carolina State University), P. Chu (University of Houston), L. Schneemeyer (AT&T Bell Laboratories), D. Christen (Oak Ridge National Laboratory).*

Support: *Oak Ridge National Laboratory through the High-Temperature Superconductivity Pilot Center of the Department of Energy.*

The size and scope of this symposium reflected the important fundamental and technological challenges these remarkable new materials have provided. Notable progress in materials properties has occurred in the area of thin films. As T.H. Geballe (Stanford University) noted, researchers have achieved the growth of YBCO films of such quality by a number of deposition techniques that more detailed examination of film characteristics is now necessary to determine preparation techniques best matched to the applications being considered. Researchers are beginning to evaluate YBCO films for device applications. P. Mankiewich (Boston University) described promising behavior for YBCO films in strip line tests and in resonator configurations. The study of bulk materials also enjoys sustained interest and shows significant progress in our understanding of these fascinating materials. Papers on neutron and proton irradiation experiments (AT&T Bell Laboratories group) and on proton irradiation experiments (IBM group), on single-crystal YBCO, demonstrate that effective flux pinning centers can be introduced which result in significant intragranular Jc's at 77 K. Finally, progress in synthesizing new superconducting phases and in the understanding of the chemistry, physics and processing behavior of the oxide superconducting phases was presented throughout the five days of the symposium.

Polymer-Based Molecular Composites (Symposium O)

MRS Symposium Proceedings, Vol. 171

Organizers: *D.W. Schaefer (Sandia National*

Laboratories), J.E. Mark (University of Cincinnati).

Support: *Allied-Signal, Inc.; Army Research Office; Dow Chemical Company; Dow Corning Corporation; E.I. duPont de Nemours & Co., Inc.; IBM Corporation; The Proctor & Gamble Company; Rhone-Poulenc, Inc.; Union Carbide Corporation.*

This symposium was devoted to multicomponent polymer materials, in which phase separation controls material properties. It has long been recognized that few polymers are compatible, making the polymeric analogue of substitutional alloys very rare. Although one session of the symposium was devoted to such alloys ("blends"), the majority of papers considered microphase separated systems. These materials include block copolymers, polymer-modified ceramics, and toughened elastomers containing precipitated glassy phases. Several interesting new routes to microphase separated materials were also presented, including infusion of microcellular foams and catalytic hydrogenation of olefins. The session on rod/flexible systems demonstrated that the long-time goal of molecularly dispersed composites has not been realized. Nevertheless, microphase separated coil/rod systems can yield substantially enhanced properties.

Scientific Basis for Nuclear Waste Management XIII (Symposium U)

MRS Symposium Proceedings, Vol. 176

Organizers: *V.M. Oversby (Lawrence Livermore National Laboratory), P.W. Brown (Pennsylvania State University).*

Support: *U.S. Department of Energy.*

The 13th symposium in this series featured approximately 100 papers covering a wide range of topics, including cementitious materials, glass waste forms, spent fuel performance characteristics, waste package container materials, performance assessment, near field studies, and natural analog studies.

A special effort was made to encourage presentations on cement-based materials, which are used as low level waste forms and as engineered barrier materials. Presentations focused on the durability and leachability of cementitious materials, with consideration of mechanisms and kinetics of attack by aggressive solution species. Concrete pore structures and permeability received considerable attention. Phase formation studies of grouts, including microstructural development, and the relationship of phase assemblage to durability was discussed in a number of papers.

A special joint session was held with Symposium T (Fractal Aspects of Materials). The purpose of this session was to educate our group on the concept of fractals and to tell the fractal group about some of the waste management problems that might be amenable to fractal analysis. The joint session was well attended and seems to have achieved its purpose.

One of the sessions on glass waste form performance featured a series of papers on different models for extrapolation of laboratory data to geologic repository time scales. The session was opened by an invited paper by Alex Navrotsky, who set the scene by discussing the thermodynamic properties of glasses that determine their long-term durability.

Fly Ash and Coal Conversion By-Products: Characterization, Utilization and Disposal VI (Symposium W)

MRS Symposium Proceedings, Vol. 178

Organizers: *R.L. Day (University of Calgary), F.P. Glasser (University of Aberdeen).*

Support: *Electric Power Research Institute; Gas Research Institute; Iowa Fly Ash Affiliates; Mining & Mineral Resources Research Institute; Ortech International; Western Fly Ash Research, Development and Data Center.*

The fairly small scale of this year's symposium was used advantageously to extend each presentation to 20 minutes with 10 minutes for discussion (Invited papers were 30 minutes long with a 15-minute discussion period). As in the past, the papers encompassed both the fundamental and practical aspects of the properties and uses of fly ash and coal-conversion by-products.

Improvements in sophisticated experimental and theoretical characterization techniques for the mineralogical and chemical analyses of fly ashes and slags were discussed; progress in this area is essential to the better understanding of the complexity of individual minerals and how they react and interact in the cement-fly ash-water system.

Variability in the chemical, physical, mineralogical and thermal properties of ashes and other by-products were introduced. Several trends and relationships were proposed in order to describe and predict such variations; the effect of variability on the behavior of engineering materials was an important theme.

Discussion also centered on the implications of (1) chemical and mineralogical properties—especially the presence of sulfates, chlorides and magnesium bearing compounds, and (2) porosity and particle size distribution, on the role of ash and other by-products in increasing the durability of materials (especially concrete). Several examinations touched on the leaching characteristics of fly ash. Studies of the presence of trace elements and minor compounds and their effect on performance and evaluation were also highlighted.

Other presentations examined the use of fly ash in engineering materials such as concrete and the substructure material for roads. Two of the invited speakers concentrated on the practical aspects of using fly ash in engineering. Examinations of various techniques to produce end-products containing fly ash and to store fly ash were also presented.

Frontiers of Materials Research (Symposium X)

Organizer: *Rustum Roy (Pennsylvania State University).*

For the first time, Symposium X organized an experimental live television satellite broadcast which originated from the meeting site on Monday, November 27. Produced in cooperation with the Materials Education Council, the 90-minute program featured five presentations on exciting advances in materials research: "New Steels by Design" (Gregory Olson), "Diamond Schottky Diodes Based on Growth of Thick (>100 microns) B-Doped Homoepitaxial Films" (Andrezj Badzian), "Materials Synthesis Utilizing Biological Processes" (Mark Bednarski), "Liquid Crystalline Materials for Polymers with Anisotropic Ultrastructures" (George Attard), and "Pulsed UV-Laser Processing for Ultra-High Speed Device Technology" (Thomas Sigmon). The broadcast was received by academic and industrial sites around the country through PBS Adult Learning Satellite Services and the National Technological University.

The regular Symposium X noon sessions (Tuesday through Thursday) consisted of authoritative review talks of a tutorial nature designed for the nonspecialist. The texts are subsequently published in the *Journal of Materials Education* as a teaching aid to materials students and faculty worldwide. Particularly well received were two topics which seldom get much exposure at MRS meetings: "Advances in Zeolites and Other Microporous Materials" (David Vaughan) and "Synthetic Metals: A Novel Role for Inorganic Polymers" (Alan MacDiarmid). MRS