

MS&E Agenda Made Public at SSSC Forum

Another milestone for the materials community was passed on February 27, 1991. At the annual forum of the Solid State Sciences Committee (SSSC) of the National Research Council (NRC), a report titled *A National Agenda in Materials Science and Engineering: Implementing the MS&E Report* was unveiled to the public. A month earlier the report was presented to the Office of Science and Technology Policy (OSTP) and the federal agencies. This document comes one and a half years after the comprehensive study of the MS&E field was released by the NRC in October 1989.* In a scant 52 pages, the new report collates the conclusions of four regional meetings held in the east, southeast, midwest, and west from March through September around the U.S. in 1990 to plan implementation of the earlier study's recommendations.**

A National Agenda in Materials Science and Engineering identifies the need for a better strategic planning mechanism for MS&E, emphasizes the need for more effective collaboration among government laboratories, universities, and industry, and notes that MS&E education needs more attention. Six specific technical areas are given highest priority for early and strong support. These areas are (1) information and communications, (2) transportation, (3) energy, (4) health, (5) environment, and (6) the MS&E field itself. The last in the list refers to the need to sustain a leadership position so that the new complex materials of the future for introduction into the other five areas will be ready when the time comes. The report describes each area and estimates the necessary annual funding increments to achieve the desired goals. The total cost amounts to \$1.25B annually over what is now spent on materials R&D. Copies of this report are available through the Materials Research Society.

Two hours of the morning session on



D. Allan Bromley, assistant to the president for science and technology and director of OSTP, addresses the attendees of the SSSC Forum.

February 27 were devoted to a description of the report by B.R. Appleton, chairman of the SSSC and principal coordinator of the report, followed by a panel discussion with chairpersons of the Regional Meeting steering committees and the earlier NRC Study, as well as associate director for industrial technology in the OSTP, William O. Phillips.

Before the report itself was presented in the main auditorium of the National Academy building in Washington, DC, where the Forum was held, presentations were given by Senator Albert Gore (D-TN) and by D. Allan Bromley, assistant to the president for science and technology and director of OSTP.

Gore showed his appreciation for the importance and status of the field of materials science saying, "We have built our industrialized civilization by exploiting the properties of matter...the age of serendipity...is

giving way to the age of massive organized search." He placed his remarks in the context of growing competition from overseas and a decline in technical education in the United States. Saying that "global well-being, taken as a whole, will reflect the progress in your field," he placed particular emphasis on the need for new manufacturing technologies and for a new level of computing power interconnected by a nationwide communications network.

Recognizing that the approach to R&D outside the United States differs from the domestic one, Gore said "we need to reexamine our methods and perhaps do some soul searching...[but] should not abandon what reflects our fundamental character. [We] can certainly find ways to adapt what's unique about our approach to the [new challenges]."

In Gore's discussion about high-performance computing and a nationwide fiber-optic communications network, he posited that "computer science joins the other two ways of creating knowledge—inductive and deductive reasoning," and proposed that the definition of "infrastructure" be broadened to include the national network of "superhighways" for our binary-coded digitized knowledge.

Bromley's remarks focused more directly on materials. He labeled the NRC's MS&E Study as a "watershed" and "landmark" document which "has unified the field as never before." He repeated the observation he has made in earlier interviews that "MS&E has been an orphan science in Washington and at some universities due to its breadth [i.e., with no comfortable fit to agencies or departments]" He said it was "time to focus attention in the field and attempt to get some coherence in our approach." For 1992, Bromley noted the current materials initiative at NSF. He also indicated that the High Performance Computing Initiative, which was one of three initiatives OSTP put forth for next year, will involve an MS&E component. Bromley explained the roles of various bodies which participate in the initiative planning process. On the purely federal side (restricted by law to have only government employees on the roster) is the Federal Coordinating Council on Science, Engineering and Technology (FCCSET) which consists of Cabinet-level and agency-head members. With members of this rank, Bromley as-

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Panel members at the SSSC Forum discuss the role of materials science in the context of the national agenda: (left to right) R. Abbaschian, G. Rosenblatt, I.M. Bernstein, G. Parshall, M. Flemings, P. Chaudhari, W. Phillips, J. Williams, B. Appleton, P. Eisenberger (at podium).

**Materials Science and Engineering for the 1990s: Maintaining Competitiveness in the Age of Materials* (National Academy Press, Washington, DC, 1989), see *MRS Bulletin XIV* (10) (1989) p. 27.

**See *MRS Bulletin XV* (12) 1990 p. 15.

Washington Materials Forum Explores Superconductivity, Microelectronics Issues

The first Washington Materials Forum was held February 28 - March 1, 1991 in conjunction with the February 27 Solid State Sciences Committee (SSSC) Forum of the National Research Council. The Materials Forum was coordinated by the Materials Research Society and sponsored by eight materials-related societies—MRS, ACerS, ASM, APS, ACS, AVS, TMS, and FMS. More than 200 persons attended. This event led the Materials Research Society into new territory: coordination of technical society meetings with a policy-oriented meeting. Through its multisociety sponsorship, this meeting also enhanced unity in the diverse materials science and engineering community.

The Materials Forum opened with a plenary session on "Industrial Competitiveness and Consortia" following the SSSC Forum afternoon session talks on consortia in MS&E (see "MS&E Agenda Made Public at SSSC Forum" elsewhere in this issue). The plenary session explored the role of consortia in two areas: silicon-based microelectronics technology and high temperature superconductivity.

In the opening talk of the plenary session, W.F. Brinkman, executive director of research, Physics Division, AT&T Bell Laboratories, discussed materials-related needs for microelectronics of the future. He emphasized the central role that silicon-based microelectronics will play, and illustrated the materials and processing advances required in the fabrication of future generations of integrated circuits. T.E. Seidel of Sematech then detailed activities at Sematech and enumerated the changes—technical, political, and

financial—needed to restore the U.S. semiconductor industry to a competitive position in the international arena.

Regarding superconductivity, D.W. McCall, director of the Chemical Research Laboratory at AT&T Bell Laboratories and chairman of the President's Commission on Superconductivity, reviewed efforts in the United States. Contrasting industrial funding for superconductivity research in the United States and Japan, he said research efforts in the two countries are comparable, but the ratio of industry to government funding in Japan is 2 to 1, compared with 1 to 2 in the United States.

R.W. Ralston, of MIT Lincoln Laboratories and a director of the DARPA-funded Consortium for Superconducting Electronics (founded by AT&T Bell Laboratories, IBM, MIT, and MIT Lincoln Laboratories), considered the future of semiconducting electronics. He noted that selected devices based on high temperature superconductors have performance superior to that of conventional devices, and are beginning to be developed for niche markets. However, the future for wide-spread microelectronics applications of high temperature superconducting devices was not certain and would require a major, long-term research effort, he said.

The afternoon session also focused on consortia and future technologies in the silicon and high temperature superconductivity areas. W.C. Holten reviewed Semiconductor Research Corporation's programs in silicon microelectronics research, and R. San Martin discussed the success of the Department of Energy pilot centers at the national laboratories in im-

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MRS Office of Public Affairs Hosts Forum Reception

Brown Addresses Attendees

Two coordinated events, the Spring Forum of the Solid State Sciences Committee (SSSC) and the Washington Materials Forum running from February 27 through March 1, 1991, provided an excellent opportunity for the newly established MRS Office of Public Affairs in Washington, DC to host a reception for Forum attendees and for friends from the agencies, the Congress and the press. It was held at the Mayflower Hotel on the evening of February 28. More than a cocktail party, the reception also had a topic for discussion and a speaker. The topic, "Professional Societies: Obligations and Opportunities in MS&E," recognized the increasing unity in the MS&E field as exemplified in many ways, including the multisociety sponsorship of the Washington Materials Forum itself. The guest speaker was Congressman George E. Brown Jr. (D-CA), the new chairman of the House Science, Space and Technology Committee. (Brown's remarks are published in this issue's Material Matters section.)

Brief remarks by Jim Roberto, MRS president, and Elton Kaufmann, chairman of the MRS Subcommittee on Public Affairs, concerning cooperation among the materials societies, emphasized that the societies taken together are a formidable and under-utilized resource which spans all disciplinary and institutional boundaries within the field. These remarks were reinforced by Brown, who called on MRS and the community as a whole to help in the pursuit of a national program in materials science and engineering. Guests were asked to contribute suggestions on possible new modes of involvement and cooperation for professional societies, which directly represent the scientists and engineers of the materials community. Suggestions can be sent to: Ronald L. Kelley, MRS Office of Public Affairs, 2000 Florida Ave. NW, Third Floor, Washington, DC 20009. The suggestions will be distributed to all interested materials societies.

MRS Office of Public Affairs
Washington, DC



Organizers of the reception hosted by the MRS Office of Public Affairs gather with Congressman George E. Brown Jr. (far left) at the Washington Materials Forum. From left to right: Brown, John B. Ballance, Ronald L. Kelley, James B. Roberto, Elton N. Kaufmann, Jim Turner.

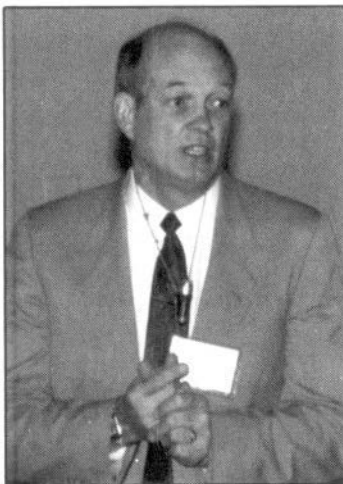
Washington Materials Forum Explores Superconductivity, Microelectronics Issues

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proving industry-government laboratory interactions and technology transfer. Looking to the future, R.W. Hill evaluated x-ray lithography, and S.A. Wolf discussed the devices to be flown in the upcoming High Temperature Superconducting Space Experiment (HTSSE) and the plans for HTSSE-2 and HTSSE-3 flights. A highlight of the afternoon session was the poster exhibit, presented by some 20 university, industry, and national laboratories consortia and centers. The posters summarized technical activities and interactions, and offered the Materials Forum attendees in-depth discussions with representatives from these centers and consortia.

Highlighting the meeting was an appearance by Representative George E. Brown Jr., chairman of the House Science, Space and Technology Committee, at an MRS reception on Thursday evening. Brown's remarks on science policy issues were warmly received by the participants, and are the subject of this issue's Material Matters.

The Washington Materials Forum con-



William F. Brinkman, AT&T Bell Laboratories, addresses attendees of the Washington Materials Forum. His talk, "Electronic Materials for Future Devices," was one of eight talks highlighting industrial competitiveness and consortia.

cluded Friday with parallel technical sessions on "High Tc Superconducting Films for Electronic Applications" and "The Science behind Semiconductor Processing: Advances in Plasma and CVD Research," describing advances in these areas. These well-attended sessions featured lively discussion and interactions at the invited talks and poster sessions.

In summary, the combined treatment of policy issues and associated technical information offered by the coordinated Washington Materials Forum and the SSSC Forum provided an excellent opportunity for the Washington community to learn about recent technical accomplishments, and for the technical community to learn about current science policy and funding issues. It also afforded technical attendees the opportunity to discuss funding and policy issues with representatives from government funding agencies.

Paul S. Peercy
Conference Committee Chairman
Washington Materials Forum

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sured, "decisions made, stay made." Under FCCSET is a Committee on Industry and Technology which includes a subcommittee on materials (COMAT). It is up through this line that an MS&E initiative for 1993 will rise. According to Bromley it will be strongly influenced by the (private) reports of the NRC and by the President's Council of Advisors on Science and Technology (PCAST) on which leading experts serve who are not government employed. Bromley said he was confident that MS&E will receive the "same treatment" for the 1993 budget year in the FCCSET process as did the initiatives that made it into the 1992 proposal to Congress.

Bromley delivered a strong message to the SSSC Forum concerning the strategy for U.S. science in general. He said that "the big versus little science debate is counterproductive." More counterproductive are loud complaints by young and old at universities about inadequate funding. "For heaven's sake," he said, "focus on the untold opportunities which could have tremendous payback...which we are not pursuing for lack of funds, rather than focus

on [the] entitlement impression [i.e.], some sort of right to federal funding because 'I have defined myself as a scientist or engineer.'" This last critique was a clear slap, not at the laudable goals, but at the method employed by Leon Lederman, president-elect of AAAS to advocate increased funding for science.

SSSC Forum tradition has been to devote the afternoon session to a few leading edge topics in condensed matter science. As a departure this year, the SSSC program coordinated with the Washington Materials Forum, a jointly organized meeting sponsored by several materials societies and scheduled for the two days following the SSSC meeting (see related article in this section). A smooth transition was achieved by offering four afternoon talks on "Consortia in MS&E" to close the SSSC event and devote the following day of the satellited meeting to similar topics of consortia and government-industry-university cooperation. SSSC speakers were S. Hecker (Los Alamos) on DOE Superconductivity Pilot Centers, T. Hasty (Sematech) on Sematech, E. Miller

(NCMS) on the National Center for Manufacturing Sciences, and H.K. Bowen (MIT) on a University-Industry Manufacturing Initiative. These four versions of consortia were quite different in detail. The Pilot Centers were experiments in cooperative, cost-shared research between DOE laboratories and industry. Sematech is a government and industry supported multi-industry membership organization with its own R&D facility. NCMS subcontracts out all R&D to the best laboratory, whether member or not. The MIT program, dubbed the "Leaders for Manufacturing Program," involves industry collaboration to provide students experience which will combine the technical and "MBA" perspectives needed by the manufacturing enterprise. The speakers presented clear evidence of success for all of the above algorithms.

By the time of the 1992 SSSC Forum, the character and extent of the MS&E initiative in the president's 1993 budget proposal will be clear.

MRS Office of Public Affairs
Washington, DC

Excerpts from *A National Agenda in Materials Science and Engineering* Implementing the MS&E Report

Recommended Initiatives

Information/Communication

Miniaturization of Electronic Devices: The technical goal is to produce integrated circuit electronic devices "at and beyond the scaling limit," that is, devices where active elements and interconnects are so dense and whose minimum feature sizes are so small that new physical principles must be utilized in their design. The broader goal is to address human needs in information, communication, and control. Fabrication will require progress at the most advanced levels of synthesis and processing, and also the development of novel instrumentation; design will require understanding at the quantum mechanical level and learning to predict and control the performance of large assemblies of very small elements.

Transportation

Designing and Manufacturing of and with Structural Materials: The technical goal is to better integrate structural materials into design philosophies to simultaneously optimize both their performance and manufacturability. A broader human factors goal is to address environmental constraints and safety needs in transportation, particularly in the automotive and aerospace industries.

Energy

Advanced Materials for Energy Conversion and Conservation: The technical goals are the integrated development of advanced materials and manufacturing techniques to improve energy conversion and conservation technologies and the development of new materials needed in future energy technologies. The broader goals are to provide materials that significantly improve energy conversion and utilization technologies in a cost effective and environmentally acceptable manner. Achieving these goals will require progress in the design, synthesis, and processing of high-temperature metallic alloys, ceramics and composites, and in the development and understanding of advanced processing and surface modification techniques.

Health

Biocompatible Materials: The technical goal is to develop biocompatible materials for a wide variety of medical applications. The broader goal is to address human needs for health maintenance and medical care at reduced costs. Developments in synthesis, processing, and performance will be essential. Progress also will require research in biomaterials and surface science.

Environment

Environmentally Benign Materials: The technical goal is to design materials that are indefinitely recyclable and that can be manufactured without generating environmentally harmful waste products. The broader goal, strongly endorsed at the regional meetings, is to alleviate the growing tension between human needs for goods and services and the need for a clean environment.

Maintaining Leadership in Materials Research

Complex Materials: The goal is to maintain U.S. strength in advanced materials research. The selected areas are materials with novel properties and unusually complex atomic structures such as high-temperature superconductors, artificially structured electronic materials, biomolecular materials, and structural materials. The broader goal is to assure that the U.S. retains a competitive edge as advanced materials are developed for technological applications. Progress will require new techniques for synthesis and processing at the atomic and molecular levels as well as new scientific instrumentation.

Implementing the Agenda

Goal-Oriented Planning and Implementation

A major conclusion from the regional meetings was the need to establish a strategic, goal-oriented planning process that intimately involves participants from the three major components of the MS&E community—industry, universities, and government laboratories—in selecting and implementing new initiatives and in establishing clear national goals. OSTP and/or the funding agencies should play an enabling role in convening the MS&E community for strategic planning and for monitoring the implementation of selected initiatives.

Increased Industry, University, Government Laboratory Cooperation

All the regional meetings specifically addressed the importance of increased R&D cooperation among industry, universities, and government laboratories as a means to shorten the time from discovery to commercialization and to leverage scarce resources.

Improved Communications: Encourage improved communications among all levels of the three R&D organizations by streamlining the interaction process, establishing

national information retrieval systems, and establishing industry nodes on the National Research and Education Network as part of the High Performance Computing and Communication initiative.

Exchange Programs: Establish a prestigious Presidential Visitors Program to encourage personnel exchanges and to initiate joint R&D programs among industry, university, and government laboratory scientists and engineers.

Improved Modes of Support: The importance of diversity in MS&E should be recognized when identifying the most effective modes of support. Both strengthening of conventional modes, especially support for individual investigators, and experimentation with newer modes, such as distributed centers, are essential. Distributed centers or consortia are innovative concepts for assessment, identification, and implementation of MS&E initiatives. In particular, these offer the possibility of providing regional/national coordination of initiatives that share common goals, and of establishing efficient programs that share equipment, expertise, and costs.

Education

A critical need for the initiatives recommended in this report is well-trained personnel. If these initiatives are to have lasting effects, adequate resources must be devoted to the training of skilled scientists and engineers.

College and University Curriculum: Resources should be allocated for the development of new materials curricula, at both the undergraduate and graduate levels. Emphasis should be placed on the development of integrated materials curricula in fundamental aspects of synthesis and processing.

Instructional Laboratory Equipment: The federal, state, and private sectors should substantially increase their support for instructional laboratory equipment. Furthermore, transfer of surplus laboratory equipment from federal laboratories and industries to universities should be expanded. The sharing of expensive equipment between institutions should also be encouraged.

Development of Advanced Educational Materials: Resources should be made available to support innovative techniques, such as team writing of textbooks or the development of computer software, for producing advanced educational material for materials science and engineering.