Restructuring of Materials Science Discussed at Solid State Sciences Committee/Washington Materials Forum

The joint Solid State Sciences Committee/Washington Materials Forum, held in the National Academy of Sciences Auditorium in Washington, DC, Tuesday and Wednesday, May 4–5, 1993, was a sequel to the joint Forum held the previous spring. The meeting was co-sponsored by the Materials Research Society, American Physical Society, American Chemical Society, American Ceramics Society, American Vacuum Society, ASM International, The Metals, Mining, and Materials Society, Society of Photo-Optical Instrumentation Engineers, Society of Hybrid Microelectronics, Mineralogical Society of America, Federation of Materials Societies, the Electrochemical Society, Inc., and the American Institute of Chemical Engineers.

The Forum brought together materials scientists and engineers, and leading policymakers from industry, government, and universities to address the restructuring of materials science and engineering in the United States. The first day of this stimulating forum was devoted to discussions about activities of government agencies with major roles in U.S. materials science and engineering, along with discussions of technology transfer and technology co-development from the federal labs and consortia. The second day emphasized needs relating to the semiconductor and aircraft industries and the role of universities.

The meeting opened with a keynote address by Sen. Jeff Bingaman, followed by presentations from representatives of government agencies involved in materials science and technology: Lyle Schwartz (NIST), William Harris (NSF), Will Happer (DOE), Lee Buchanan (ARPA), and Daniel Goldin (NASA). The roles of the national labs, consortia, and government policy were addressed by Al Narath (Sandia National Labs), Craig Fields (MCC), and Donald Kash (George Mason University). On the second day, industrial issues were addressed by industry representatives, including Tommy George (Motorola), Jim McGroddy (IBM), William Brinkman (AT&T Bell Labs), Don Lovall (Boeing), Jim Williams (General Electric), Roland Haitz (Hewlett-Packard), and John McTague (Ford Motor Co.). Following a panel discussion with Dan Arvizu (Sandia National Labs), Bill Appleton (Oak Ridge National Lab), and

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Roger Lewis, DOE, two speakers—Venky Naranamurti (UC–Santa Barbara) and Ray Orbach (UC–Riverside)—addressed the role of universities.

Several important points emerged in the presentations and ensuing discussions. Participants noted that the nation is experiencing a major paradigm shift in the manner in which research will be performed in the future. While many people had previously noted the need for this shift, the required change in the approach to partnering—which U.S. industry is undergoing to address threats from subsidized offshore competition from other nations—has never been as evident as it is now. The walls between companies are fading. To be responsive to customers, industrial firms must team up wherever they can for precompetitive, generic technology development, while competing vigorously against their own "partners" for market share. It is further evident that industry is becoming even more multinational. Partnerships with foreign companies and increased offshore presence from Asia to Europe are necessary for entering local markets. Industry will not be able to compete in domestic markets unless it can be competitive in global markets—against the strongest companies.

Facing major and increasing pressures from the international marketplace, industry is leading the change in this new era. Industry after industry has been forced to restructure. The ethic of "quality," emphasizing continuous improvement, has become the industry watchword. Research is also being restructured to be more responsive to and focus more sharply on activities that will lead to improved products. This change is bringing with it an increasing emphasis on processing and synthesis.

Many of the speakers emphasized that responding to these market-driven imperatives will require major changes on the part of government agencies, national labs, and universities. In addition to expanding the number of partnerships among government, universities, and industry, increased interlaboratory and interagency cooperation is necessary. During the Forum, several concerns surfaced about the ability of these institutions to respond adequately. For example, it was noted that the culture of government agencies and federal laboratories, which have been driven by government needs rather than commercial needs, must change to permit industry-led response. A case in point is the cooperative research and development agreement (CRADA) process for working with Department of Energy laboratories: Although some improvement has been evident over the two-year life of the program, the "red tape" associated with using this process is onerous and must be reduced. Further, the federal labs must recognize that industry has to set the speed and direction of joint activities and that they—the labs—must be responsive to such industry-mandated needs. The multiplicity of government agencies and federal labs means that coordination among the diverse government agencies responsible for materials science and engineering must occur rapidly to provide "used-friendly" support for the commercial sector without adding layers of bureaucracy that impede effective interactions; industry is pleading for less bureaucracy, not more.

Research universities must re-examine the size and mission of their doctoral programs relative to the number of PhDs they supply to the nation. Surveys by the Divisions of Materials Physics and Condensed Matter Physics of the American Physical Society reveal that the nation is presently producing, by a factor of two, more PhDs in materials-related areas than can be employed in their specialties. The stringent restructuring which the nation's industries are undergoing can only make this oversupply problem more severe in the future.

An intriguing aspect of the meeting was the fact that there was little discussion about the need for discovering new materials or improving existing materials. It was as if the participants assumed that the advances provided in the past by materials research would continue, despite the change in emphasis that many of these participants felt was necessary for addressing the economic issues facing U.S. industry.

Finally, it appears that the traditional "disciplinary" approach to training scientists and engineers—in which university faculty train specialists designed to perpetuate the research of their college's or department's discipline—must change. The strengths of interdisciplinary training must be exploited to produce graduates prepared to respond to the new requirements facing industry as it marshals its forces to restore the United States to a position of leadership in the global economy.

Major changes are required on all fronts, not only in performance, but also in philosophy and approach. And these changes must be made rapidly if the nation is to maintain its strong position in the international economy. It is not clear how rapidly the required transitions can be made by the entrenched establishment, but it is clear that these changes must be made quickly if that establishment wishes to make a contribution to what is arguably the most important problem facing the nation today. □

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