An analysis of public policy issues and how they affect MRS members and the materials community...

EC-NSF Workshop on Materials Recommends Pilot Areas for International Cooperation

A workshop on Materials for Future Technologies, sponsored by the European Commission (EC) and the U.S. National Science Foundation (NSF) was held December 12–14, 1996 in Leuven, Belgium.* Workshop participants identified specific areas for fruitful U.S.-European cooperation in materials research. At the end of the meeting the group recommended steps that the NSF and EC should take to develop increased cooperation. The governments of both the European Union (EU) and the United States (US) support increased interaction between the US and the EU in scientific areas in the face of increasing globalization of the economy and the concomitant challenges that this poses for research, technology, and economic competitiveness. Challenges are associated with such international cooperation because of differing political systems and cultures. Materials research is a logical area for some of the earliest interactions because of its inherent interdisciplinarity and crossing of traditional boundaries, as well as the significant amount of funding devoted to the area by both partners.

The workshop explored research opportunities for development of new and improved technologies in six areas: Information/Communication, Transportation, Energy, Environment and Packaging, and Civil Infrastructure. A plenary talk was given in each area by a prominent representative from the industrial sector. These talks focused on the scientific and engineering horizons, barriers, and challenges for advancing materials contributions to the technology under consideration.

While the topics spanned from materials perceived to be "high tech" such as electronic and photonic materials to "commodities" such as plastics and concrete (which may nevertheless be produced by very modern and complex technology), a number of themes linked all of the groups. A very large infrastructure is associated with each technological area—either that needed to produce the product (e.g., semiconductor fab facilities which now cost in excess of $1B to build), or the sheer amount of material already in use by society (e.g., over $6T of concrete in roads in the US). The magnitude of the investment in the infrastructure for each area imposes considerable conservatism on the industry making use of it, ranging from the extreme reluctance on the part of semiconductor manufacturers to introduce new materials into their production lines to the legitimate safety concerns surrounding the introduction of new materials and processes into automobiles, airplanes, and civil structures. Cost is a major driver in all of the industries considered, so that technically superior materials and processes will not be incorporated into an industrial process unless it can be done in a cost-effective manner.

Six parallel sessions, one in each technology area, built on the plenary talks. These groups debated a number of questions including (1) Where is long-term research needed? (2) What are the proper roles of the various sectors (government, university, and industry)? (3) What role(s) should NSF and the EC play? (4) What are the opportunities for inter-institutional and international cooperation? How can this be accomplished?

Several themes emerged from the discussion groups leading to the identification of four pilot thematic areas for international cooperation. (1) Looking at current industrial practices, continuous materials and processing understanding and improvement is needed. This would include, but not be limited to, a science-based approach to aging and reliability involving an appropriate mix of theory and experiment; life cycle engineering including simulations of the complex interrelationships between diverse materials properties at length scales ranging from the atomic to the macroscopic; and failure mode analysis for function improvement, including the development of nondestructive testing and evaluation techniques. (2) All of the technological areas have a need for improved interface science, ranging from the fundamental understanding of the structure and behavior of interfaces to their control. (3) Social responsibility demands the development of environmentally benign materials and processes in all areas of technology. (4) Long-term research on materials and processes for technologies of the future is needed, which would include smart materials, structures, processes, multifunctional materials, and hybrids (at all length scales).

Any international cooperation in these areas must have several attributes. Each group or institution participating in the collaboration should have strengths that complement those of the other participants. There should be the potential for long-term impact of the work. Multidisciplinarity is a term that is traditionally associated with materials research, but in this case, it should be stretched even further. For example, researchers working in different technological areas on related problems (e.g., sensors, materials development, and cost-effective materials processes) should have strong communication and interaction. Each cooperative agreement should involve academic and government researchers with at least one industry as a full partner. Each arrangement should have a strong educational component, likely involving the exchange of personnel (especially students) among the participating institutions. Students of diverse backgrounds should be prepared to participate in the global economy as a result of these arrangements. Each collaboration should also contribute in other ways to the societal infrastructure.

Several mechanisms were identified that could promote long-term international cooperation. The cooperation should be funded by a separately identified program, not just as a possibility covered under existing programs. Collaborations could be launched by means of workshops, whose product would be a proposal for more substantive interaction. Centers already funded separately by NSF (e.g., Science and Technology Centers, Engineering Research Centers, or Materials Research Science and Engineering Centers) could collaborate with their counterparts in the EU. "Virtual" centers could be formed around a task (e.g., standards development) spread over a number of locations. Interactions could take the form of "round robins" in which the participants sample exchanges to qualify techniques, establish materials properties, or qualify computer simulation codes. Small projects involving several researchers from a small number of institutions should be possible, as should short, dedicated projects that involve a short visit of one researcher to another institution for a particular task. International cooperation could lead to the possibility of sharing databases or of developing them jointly. Major facilities (such as synchrotrons and neutron sources) could serve as a focal point for fostering international cooperation. The full workshop report will be prepared for submission to the EC and NSF by the Spring of 1997.

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* Workshop Chairs were Praveen Chaudhari (IBM), Mark B. Ketchen (IBM), Venkatesh Narayanamurti (University of California—Santa Barbara), James C. Williams (General Electric), Horst Czichos (BAM—Berlin); Bertrand Escaig (Laboratoire de Structure et Proprietes de l-Etat Solide); and J-P. Celis (University of Leuven).

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