

TMS Considers MSE Study at Symposium Honoring Morris Cohen

During its Fall Meeting in Orlando, Florida, The Metallurgical Society (TMS) held a symposium to honor Morris Cohen (See "Metals Societies Honor Morris Cohen" in this issue.) The two half-day sessions held October 7 and 8 featured an opening address by Prof. Cohen and presentations by representatives of the Materials Science and Engineering Study (MSE) commissioned by the National Academies of Sciences and Engineering (NAS/NAE) at the request of the National Research Council. The sessions were organized by the TMS Governmental, Energy, and Minerals Committee and chaired by the two MSE Study Chairs, Merton Flemings (Massachusetts Institute of Technology) and Praveen Chaudhari (IBM).

Cohen's Address

After brief introductory remarks by Flemings, Prof. Cohen of MIT reviewed materials science and engineering history since the COSMAT study sponsored by NAS over a decade ago. Prof. Cohen's remarks placed the study of materials within the contexts of the disciplines of science and engineering, and of today's societal and economic realities. Enumerating the five most important resources of mankind today, he included "materials" among those of living space, food, energy and knowledge. He went further to demonstrate that materials science and engineering (MSE) is really a dynamic partnership between basic science and societal needs and experience, with information flowing from these extremes to the mixture called MSE, where structure, property, performance and processing relationships are researched and developed. The unique blending of scientific knowledge and empirical knowledge makes MSE a central function of technical progress today, he said, and pointed out that such a relationship [of MSE to basic science and to society]



P. Chaudhari, MSE Study Chair.



M. Flemings, MSE Study Chair (left), and Morris Cohen (MIT).

necessarily causes it to be multidisciplinary.

He expounded on the science and engineering disciplines which collaborate in the pursuit of MSE and pointed to the microcosm of this phenomenon represented by metallurgy. Metallurgy was first considered to be multidisciplinary, including, for example, physics, chemistry, chemical engineering and mechanical engineering. It has evolved to where it is considered a single discipline. Cohen questioned the future of MSE—i.e., would it also evolve to being viewed as a single discipline. He drew an analogy to medicine, which is considered a single discipline and rests on a basic common medical curriculum, but at the advanced level is made up of a wide variety of disparate specialties.

Cohen remarked that the term "multidisciplinary" came into vogue following World War II and that the advent of block grants to interdisciplinary centers, beginning with DARPA's (Defense Advanced Research Projects Agency) interdisciplinary laboratories, marked the beginning of local administration of such funds, without individual projects specified by sponsoring agencies. Cohen further noted that the COSMAT study was the first sponsored by NAS/NAE which involved both science and engineering disciplines. One of the results of the study published in 1974 was the recognition that the panels could not establish a boundary between materials science and materials engineering, and the conclusion that the reference must be to one field—MSE.

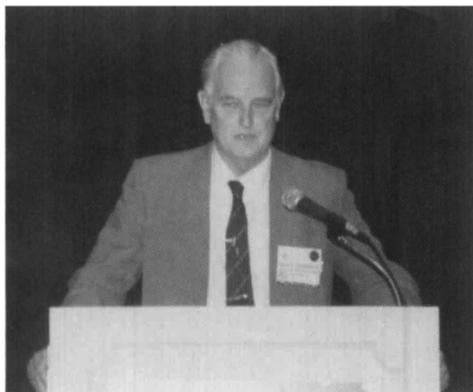
MSE Study Chair M. Flemings provided

an overview of the current MSE Study, indicating that its five panels are now complete with about 100 panel members actively pursuing their tasks. (See list of chairs and panelists on previous page.) He pointed out that, after considerable deliberation, the definition of "materials science and engineering" remains essentially that used by the COSMAT study over a decade ago, except that the phrase "synthesis" has been added to processing, structure, properties and performance of materials.

MSE Study Panel 1

Describing the mission and status of Panel 1 on Materials Research Opportunities and Needs, Flemings listed several areas in which small workshops will be held, including synthesis, processing, characterization, performance, disordered materials, deliberately structured materials, electronic/photonic materials, structural materials, biomaterials, and computation in MSE. These areas will concentrate on questions and answers regarding research opportunities. Panel 1 subgroups will investigate the following eight industrial needs areas: aerospace, automotive, biomaterial, chemical, communications, electronic, energy, and metals needs. In addition, a separate subgroup of Panel 1 will investigate the federal role in three issues: (1) the transfer of research to mission-related products and procedures, (2) the need for new materials in areas such as defense, and (3) an identification of the barriers to obtaining new materials for the federal sector.

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A. Chynoweth (Bell Communications Research), Chair of MSE Study Panel 2.

MSE Study Panel 2

Alan Chynoweth, Chair of Panel 2 on Exploitation of MSE Technology for National Welfare, then described that panel's mission. He pointed out that "something is not working as well as it should in the innovation process" and that this issue must be addressed because it is essential to U.S. economic strength. Chynoweth, from Bell Communications Research, is well qualified to provide an overview in this area. Noting that technology transfer is central to linkages within the R&D network, he named four readily identifiable links: (1) traditional publications, meetings, and conferences; (2) accidental serendipitous interactions which often depend on such mundane factors as the design of the building housing the researchers; (3) deliberate mechanisms for information transfer; and (4) other generally weak links between R&D manufacturers and marketers. He identified scientific curiosity and engineering needs as *internal forces* which act positively. One internal force which inhibits progress he characterized as the "not-invented-here" syndrome, referring to attitudes within the institution and the individual. He then listed 28 *external forces* which impact the linkages in R&D and indicated that there were several omissions he had noticed. These external forces ranged from political issues such as national pride to trends in industry such as multinational corporations to issues of education, export constraints, national policy, public ignorance of R&D, competition, regulatory agencies, government subsidies, environmental questions, and many more.

Chynoweth cited the need to identify those nodes in the process where a "critical mass" of effort needs to be applied. Such nodes he said, include, on the local level, the materials research laboratories at universities; at the interfacial level, the industry, university or government-industry joint consortia; and at the collective level, consortia among industries and new kinds of entities such as Bell Communications Research with seven operating companies involved in its ownership and direction. He

also cited the need for a long-range vision and the need to have that vision articulated by government without governmental attempts to direct its implementation. He challenged professional societies particularly, saying that "they might be more visible/audible rather than making self-serving noises concerning their own little part of the action."

Indicating that research and development need added momentum, Chynoweth explained that "momentum" is defined as a mass times a time derivative of position, and concluded that a "critical mass" is needed with the proper direction and the proper speed of implementation in order to make progress.

MSE Study Panel 3

Lyle Schwartz of the National Bureau of Standards and Chair of Panel No. 3 on International Cooperation and Competition in MSE detailed the panel's mission and activities. Its mission, he said, includes a quantitative assessment of international MSE activity, determination of the differences and similarities to MSE in the United States, comparison of U.S. national MSE policies and strategies with those abroad, and an assessment of the role of MSE in industrial competition, particularly in relation to multinational entities. The panel is taking three approaches, he continued, first probing the existing literature for statistics and program information. Second, the panel is circulating a questionnaire to a representative set of foreign countries which pursue MSE. Third, the panel will consider case studies on the intent and scope of research in particular cases covering such areas as structural materials in commercial aircraft, steel manufacturing, information/communication materials, ceramic heat engines, engineering plastics, and possibly zeolites as catalysts. Panel 3 will also study features of technology transfer in the foreign country context.

Schwartz noted that the United States has experienced difficulty in "harvesting information" from international competitors. This is apparently becoming more



L. Schwartz (NBS), Chair of MSE Study Panel 3.

difficult now than in the past. Citing statistical evidence for this trend, he said that over the past decade travel by U.S. scientists to foreign meetings has decreased 45%. During the following discussion with the audience, it was suggested that the countries to be surveyed include those regarded as "supplier nations" even though they don't explicitly pursue MSE, and that environmental issues relevant to a worldwide materials cycle might be included in this panel's charter.



T. Loucks (Norton Company), Chair of MSE Study Panel 4.

MSE Study Panel 4

Chair Terry Loucks of the Norton Company said that the task of Panel 4 on Research Resources in MSE is to assess present resources (both physical and human) available to MSE and to forecast future requirements. This panel, he said, is particularly interested in building a consensus around these issues and in providing opportunities for all constituencies to be heard. Remarking that "more and more people are calling themselves materials scientists and engineers, not all the time, but certainly at funding time," Loucks said he expects a good deal of interest because the results of this panel's survey may impact the next federal budget. Panel 4 has been subdivided into subpanels—federal research laboratories, large research facilities, intermediate scale research facilities, individual principal investigators, advanced instrumentation, structural materials, and electronic materials—all actively garnering information.

MSE Study Panel 5

Panel 5 Chair Professor I.M. Bernstein of Carnegie-Mellon University was the final speaker. In explaining the goals of Panel 5 on Education in MSE, Bernstein presented statistics on trends over the past several years for students from various disciplines entering materials-related fields and graduating at different degree levels. This issue is complex because the boundary between the discipline and the materials categorization is not clear. For example, he said, those working in polymers have stopped calling themselves chemists and starting

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I.M. Bernstein (Carnegie-Mellon University), Chair of MSE Study Panel 5.

calling themselves materials scientists to some extent.

Bernstein identified four task categories which the panel will pursue. The first

involves a study of the disciplines which offer materials programs, and will include a study of the pool of students and their demographics, including students coming from abroad. In addition, a forecast of the need for the educational product, i.e., students in academia, industry, government or nonprofit laboratories, will be attempted. A second task, called "future directions of education in MSE," deals with issues such as curricula, accreditation, engineering/science "tilt," and similar ones. The third task is to identify the needs and opportunities for increasing interdisciplinarity in MSE education. Bernstein commented that this seems easier in graduate research than in the undergraduate schools. The fourth task is to examine the needs and opportunities in lifelong or continuing education. Following Bernstein's presentation a member of the audience observed that the Panel 5

members seemed to over-represent universities and under-represent the education's customer, which is industry.

The spokesman for each panel solicited audience input and announced a desire for suggestions and comments from as wide a spectrum of materials science and engineering constituencies as possible. The time scale tentatively set for each panel would produce rough drafts of the panel reports in April 1987. A forum to discuss the MSE Study is currently being planned for March 1987 at NAS/NAE.

Another opportunity for the materials community to provide input for and hear about progress concerning the MSE Study is during the Materials Research Society's Forum on the Materials Science and Engineering Study at the 1986 MRS Fall Meeting in Boston. A report on the MRS Forum will be published in the next issue of the BULLETIN.

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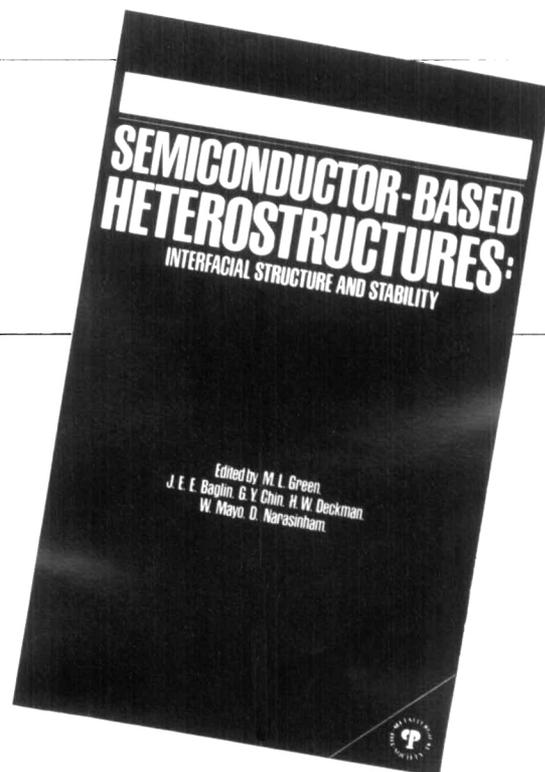
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