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

Trends of Major Research Facilities Related to Materials Science and Engineering

Science and technology have always been strongly influenced by materials science and engineering (MS&E) because of materials needed to implement technology and lead science. And although MS&E disciplines are best known as fields of individual investigator science, they have become a significant influence on the development and use of major facilities and vice versa. In this article, I explore some of the trends in MS&E as they relate to major facilities.

In recent years, the design and understanding of new materials often require relating the microscopic properties and interactions of atoms at the atomic level to the macroscopic behavior of the material, and increasingly, this requires the use of some major facility. Also, powerful probes such as synchrotron and neutron sources have opened entirely new areas of investigation to scientists in a broad range of disciplines.

MS&E have also altered user trends at major facilities. Unlike high energy nuclear physics facilities, where a few "big science" experiments are done year round, major facilities for MS&E are used by numerous groups of individuals doing many experiments on many beam lines as an extension of their own laboratory studies. Another trend is the increasing use of the facilities by industry. As little as 10 years ago, most users of Oak Ridge National Laboratory's (ORNL) materials facilities were academic scientists, but now almost one-third of the users are from industry and that fraction is growing. Also, the diversity of disciplines using major facilities is increasing. Ten to 15 years ago, the major use of neutron scattering facilities was for condensed matter studies, but today, new users include chemists, biologists, astronomers, polymer scientists, medical researchers, environmental analysts, nondestructive testers, engineers, and drug and automotive manufacturers just to mention a few.

Much has been written by politicians and policymakers about the necessity of prioritizing major science projects, and although astronomy and high energy physics are often cited as fields which have done this well, it is worth noting that the MS&E disciplines have done an exemplary job. Many reports written in the early 1970s through the 1990s justified the need for facilities in MS&E. Perhaps the best known of these was the National Research Council report *Major Facilities for Materials Research and Related Disciplines*[1] (so-called Seitz-Eastman report for its two well-known co-chairs Frederick Seitz and Dean E. Eastman). This pioneering report made recommendations for the development and construction of facilities in two categories: (1) major new facilities; and (2) new capabilities at existing facilities. The recommendations for construction of major new facilities were (1) a six GeV synchrotron radiation facility; (2) an advanced steady state neutron facility; (3) a one to two GeV synchrotron facility; and (4) a high intensity pulsed neutron facility.

In January 1986 in a memorandum entitled "Secretarial Site Selection Decisions on Specific Energy Research Projects," the Under Secretary of the Department of Energy (DOE) reflected these priorities of the scientific community and sited four specific Energy Research (ER) projects as part of a long-range plan to revitalize the DOE/ER laboratories. This siting memo stated that these "site decisions were made to maintain the technical viability among the Department of Energy laboratories." The facilities and selected sites were (1) Relativistic Heavy Ion Collider, Brookhaven National Laboratory; (2) One to Two GeV Synchrotron Radiation Source, Lawrence Berkeley Laboratory; (3) Six GeV Synchrotron Radiation Source, Argonne National Laboratory; and (4) Advanced Steady State Research Reactor, Oak Ridge National Laboratory. Although the order of these facilities have changed, the DOE/ER has done remarkably well in following through on this long-range revitalization plan and has now completed or started all but one of these facilities.

The remaining uncompleted facility is the research reactor recommended for Oak Ridge National Laboratory. And although design for a new research reactor, the Advanced Neutron Source (ANS), was in both the 1994 and 1995 President's Budgets as a construction line item, it was not approved by Congress either year because of total cost. In response, the DOE replaced it in the FY 1996 budget with a request for design of a lower-cost, accelerator-based spallation neutron source. At this writing, the request remains in the budget and the neutron science community may finally be on its way to acquiring a much needed new neutron source.

Has the return to science and technology been worth the investment in major facilities? Although such questions are difficult to answer, the best indication may come from considering the oldest major facilities, neutron sources, and their impact on science and, thereby, society. The 1994 Nobel Prize in Physics was shared by Clifford Shull for pioneering work he did at the ORNL Graphite Reactor in the early 1950s, and by Bertram Brockhouse for similar studies at a comparable reactor at the Chalk River Nuclear Laboratories in Canada. Their work, which initiated the modern field of neutron scattering, would have been impossible without these first "major" neutron reactor facilities accessible to them at the time. Furthermore, these same facilities and their successors produced the first medical isotopes, initiated radiation damage studies and alloy development, facilitated nuclear power production, supported recent industrial developments, and much more. In the area of science alone, at least eight other Nobel Prizes have been granted between 1950 and 1994 for work done at major neutron facilities. This enviable record for science and technology is a strong testimonial of the synergism between major facilities and MS&E, and the ultimate benefit to society.

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1. *Major Facilities for Materials Research and Related Disciplines.* (National Academy Press, Washington, D.C., 1984).

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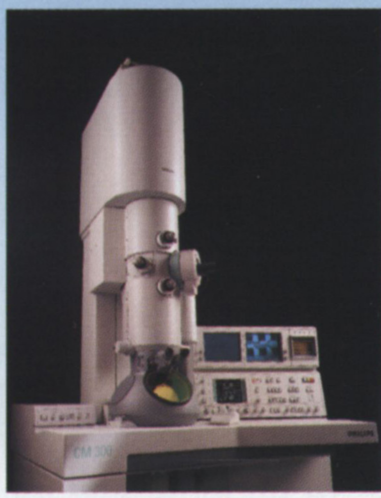

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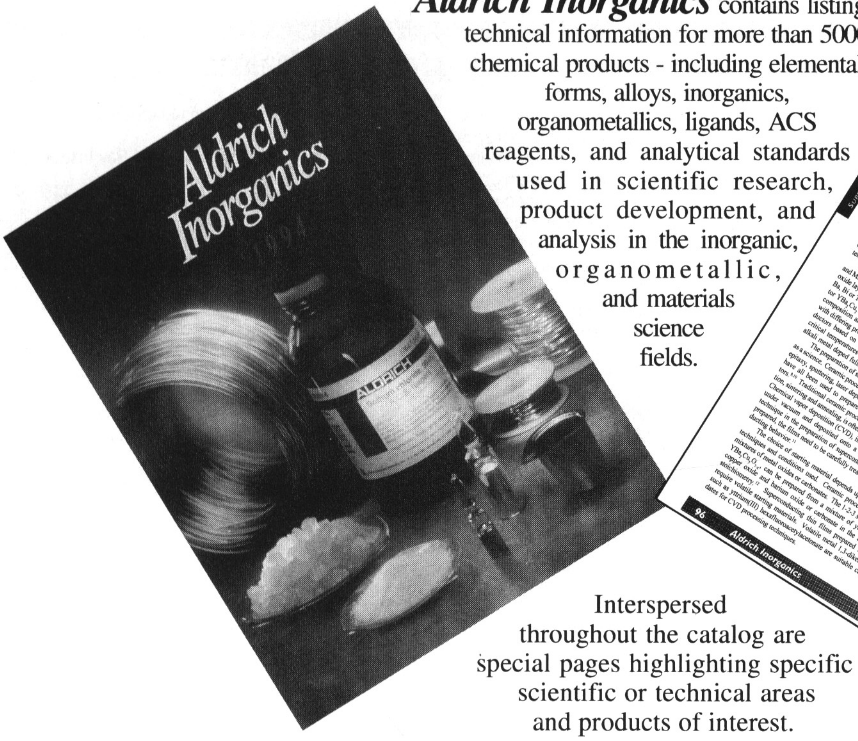

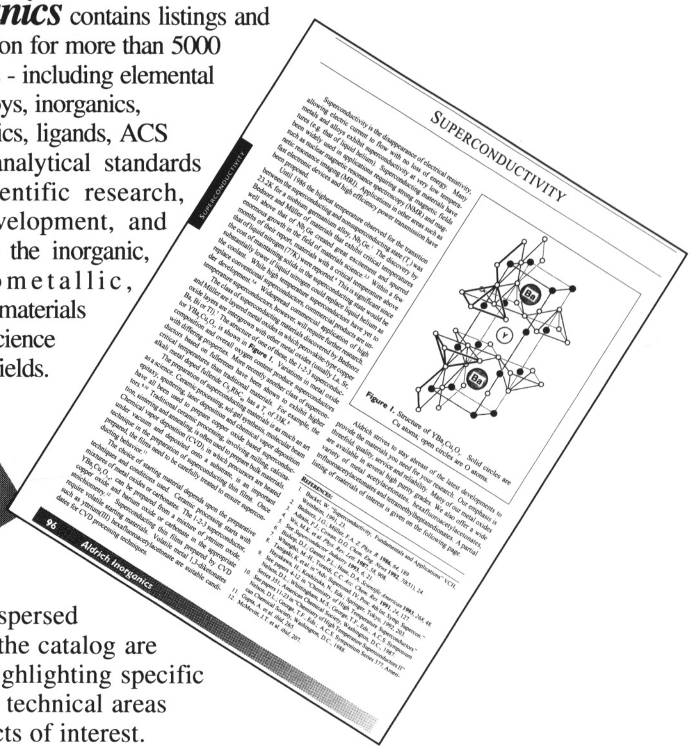

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