AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE

ISSN 0036-8075
16 MARCH 1990
VOLUME 247
NUMBER 4948

■ **SCIENCE is published weekly on Friday, except the last week in December, and with a supplement in March by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005.** Second-class Non-profit postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Copyright © 1990 by the American Association for the Advancement of Science. The title SCIENCE is a registered trademark of the AAAS. Domestic individual membership and subscription (51 issues): $75. Domestic institutional subscription (51 issues): $120. Foreign postage extra: Canada $46, other (surface mail) $46, air mail via Amsterdam $85. First class, airmail, school-year, and student rates on request. **Single copy sales**: Current issue, $3.50; back issues, $5.00; Biotechnology issue, $6.00 (for postage and handling, add per copy $0.50 U.S., $1.00 all foreign); Guide to Biotechnology Products and Instruments, $18 (for postage and handling add per copy $1.00 U.S., $1.50 Canada, $2.00 other foreign). Bulk rates on request. **Authorization to photocopy** material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by AAAS to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of $1 per copy plus $0.10 per page is paid directly to CCC, 27 Congress Street, Salem, Massachusetts 01970. The identification code for *Science* is 0036-8075/83 $1 + .10. **Change of address:** allow 6 weeks, giving old and new addresses and 11-digit account number. **Postmaster:** Send Form 3579 to *Science*, P.O. Box 1723, Riverton, NJ 08077. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

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COVER Basalt lava erupted from Kilauea Volcano, Hawaii, pours 3 meters from a shallow tube into the Pacific Ocean. The current eruption began in January 1983; the lava produced now covers 70 square kilometers, including 150 acres of new land formed along the seacoast. Analysis of more than 20 years of ground deformation data suggests that Kilauea's magma system is deeper and more extensive than previously thought. See page 1311. [Photographed on 27 November 1989 by J. D. Griggs, U.S. Geological Survey]

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American Association for the Advancement of Science
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Support for Materials Science and Engineering

Activities in materials science and engineering are yielding very important results, and the field will continue to be one of the most fruitful of all of science. Properly supported and implemented, materials science and engineering could make crucial additional contributions to our ability to compete in international trade. But, at least in part due to lack of a serious national commitment, we have lost superiority in the science and engineering of materials. From 1976 to 1987, federal expenditures for nondefense materials science and engineering dropped 23 percent in terms of constant dollars.

Meanwhile, the governments of our major international competitors have targeted advanced materials as a growth area and have developed strong competence in selected areas. The governments have taken a proactive role in deciding which types of materials should be emphasized on the basis of their contribution to enhancing competitiveness.

A recent report of the National Research Council* notes achievements in eight different industries, including aerospace and telecommunications, that have a total work force of 7 million and annual sales totaling $1.4 trillion. In all eight industries advances have come from improved instrumentation, better controls on composition of products, and expanded use of computers in modeling behavior of materials. The report states that "the field of materials science and engineering is entering a period of unprecedented intellectual challenge and productivity. . . . Scientists and engineers have a growing ability to tailor materials from the atomic scale upward to achieve desired functional properties."

Spectacular advances have been achieved in microelectronics. Commercial competition is currently focused on dynamic memory chips having increased circuit density. An exciting frontier arises from ability to create complex, tiny structures using molecular beam epitaxy. By this technique a series of discrete thin layers a few atoms thick can be deposited. Such structures can give rise to novel physical phenomena.

Advances in other types of materials have also been important. For examples, rapid solidification produces metals having excellent combinations of strength, ductility, and corrosion resistance. New processes are yielding improved ceramics. It is now possible to grow diamonds and diamond-like materials at low temperatures and pressures. Tough lightweight polymers of great strength are being produced. Composites of polymers are having increasing roles in high-performance applications. Many new kinds of magnetic materials have been developed, including the neodymium-iron-boron permanent magnets. The list goes on to include superconducting, photonic, and biomaterials.

The report points to several organizational matters that need to be improved. One is a lack of facilities and people capable of synthesizing experimental materials. Earlier we obtained many new materials from Europe for characterization here. They now study such items there. A second deficiency is lack of support for development of new instrumentation. At one time we had a virtual monopoly in pioneering advances in instrumentation. Now practically no federal funds are available to universities for the purpose. Instrument developments in other countries provide special advantages to first users there.

Another concern expressed in the report has to do with education. Most of the people engaged in materials research enter the field with backgrounds in physics and chemistry. Only about 1000 students annually receive bachelor's degrees in materials science and engineering departments. About the same number graduated during the 1970s. This stagnation scarcely reflects the opportunities or importance of the field.

Throughout the report there is frequent mention of the need for better interaction between materials scientists and engineers located at universities and their counterparts in industry and at federal laboratories. The cultures of the institutions differ, but they have much to contribute to each other by way of ideas and knowledge. Periodic human interaction is a far better mechanism for transfer of technology than the literature. It was good to learn that regional meetings designed to promote interaction among materials scientists and engineers are now being organized, with a first one slated for Princeton University on 22 March.—PHILIP H. ABELSON

*National Research Council, *Materials Science and Engineering for the 1990s* (National Academy Press, Washington, DC, 1989).