Presidential Initiative Proposes $1.8 Billion for Materials R&D

The Bush administration's long-awaited "Materials Initiative" is finally on the table. The initiative proposed for FY 1993, the Advanced Materials and Processing Program (AMPP), represents the first coordinated federal approach to materials science and technology. It is based on a materials R&D crosscutting analysis developed under FCCSET's Committee on Industry and Technology. The multi-year, multi-agency Advanced Materials and Processing Program coordinates and prioritizes research in materials science in 10 agencies.* (Figures 1 and 2 show funding by material class and by agency.) The Initiative draws heavily from the National Research Council's 1989 report, *Materials Science and Engineering for the 1990s: Maintaining Competitiveness in the Age of Materials*,** and the followup report, *A National Agenda in Materials Science and Engineering: Implementing the MS&E Report*.†

The administration's proposed FY 1993 budget includes $1,821.4 million for materials R&D, a 10% increase over the FY 1992 base. Classified programs and some mission-driven activities such as the superconducting supercollider and the national aerospace plane are not included in these budget figures, but the figures do include operating funds for national user facilities that may contribute to areas other than materials science.

The initiative emphasizes four areas: (1) synthesis and processing, which receives the highest priority, followed by (2) theory, modeling, and simulation; (3) materials characterization; and (4) education and human resources. The program also focuses on the interfaces between universities, government laboratories and industry, and on transferring technology from basic research to application through consortia and cooperative research and development agreements (CRADAs).

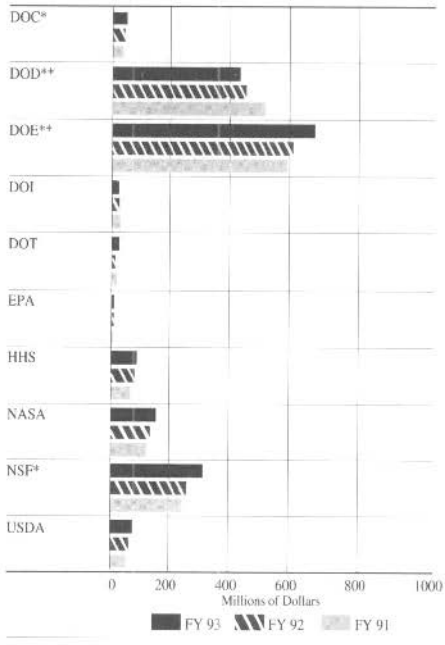

Figure 1. AMPP R&D Funding by Agency.

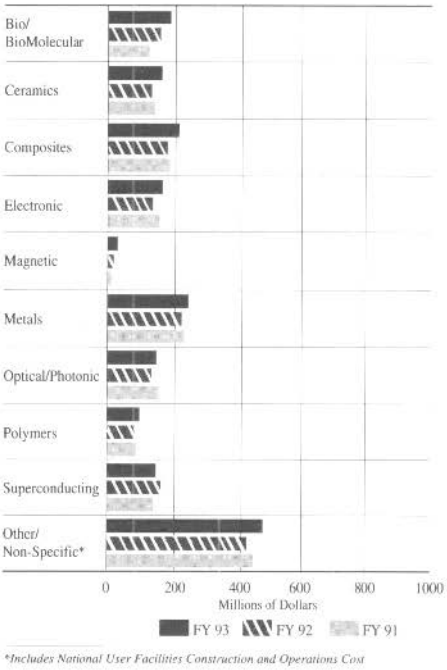

Figure 2. AMPP R&D Funding by Materials Class.

Synthesis and processing funding is proposed to increase by $64.8 million to $747.7 million for 1993. The emphasis within this area is on creating new materials and processes, transferring laboratory achievements to pilot plants, and developing processes that integrate design and manufacturing requirements. Specific targeted areas include process control of advanced ceramic structures via hot-isostatic-pressing and microwave sintering (DOE), university-based programs in synthesis and processing (NSF), construction of starch/microbial biopolymer composites (USDA), "intelligent" processing of materials, with an initial focus on advanced control of injection molding of polymers (DOC), and enhancement of basic understanding to allow computation of phase diagrams for covalently and ionically bonded ceramics (DOE).

Funding for theory, modeling, and simulation is slated to increase by $29.7 million to a total of $253.3 million to capitalize on U.S. leadership in computational techniques for quantitative understanding of complex materials and processes. This subcategory complements activities supported by the Presidential Initiative on High Performance Computing and Communications. Program enhancements call for expanding individual investigator work on theory, modeling, and simulation at universities and initiating large, interdisciplinary groups to address major problems in mathematics and computational modeling relevant to advanced materials and processing (NSF). Also proposed is the use of fundamental theoretical tools to design structural polymers with desirable properties from the atomic scale (DOE).

Materials characterization is proposed to increase by $29.2 million to a total of $503 million. Here the focus is on the interrelationships among structure, composition, properties, and performance, specifically to accelerate the development of atomic-scale characterization techniques and shared facilities (NSF), and to accelerate research on the immunologic response of total joint replacements and bone material interfaces (HHS).

Education and human resources, designated to increase by $5.8 million to a total of $26.9 million, supplements the Presidential Initiative in Math and Science Education. The goal would be to develop an integrated approach to undergraduate

For both figures: FY 1993 figures are the President's budget request, FY 1992 figures are budget authorizations as set by congressional appropriations, and FY 1991 figures are actual expenditures. The figures are from *Advanced Materials and Processing: The Federal Program in Materials Science and Technology*, a supplement to the President's Fiscal Year 1993 budget.

* Departments of Commerce (DOC), Defense (DOD), Energy (DOE), Interior (DOI), Transportation (DOT), and Agriculture (USDA); Environmental Protection Agency (EPA); Health and Human Services (HHS); National Aeronautics and Space Administration (NASA); National Science Foundation (NSF).

** *Materials Science and Engineering for the 1990s: Maintaining Competitiveness in the Age of Materials* (National Academy Press, Washington, DC, 1989); see *MRS Bulletin* **XIV** (10) (1989) p. 27.

† *A National Agenda in Material Science and Engineering: Implementing the MS&E Report* (Materials Research Society, Pittsburgh, PA 1991); see *MRS Bulletin* **XVI** (4) (1991) p. 22.

course and curricula development at intermediate and advanced undergraduate college levels to improve depth and breadth of materials education for majors in physics, chemistry, materials science, biology, mathematics, and engineering (NSF).

The remaining $290.5 million, an increase of $33.3 million, is for national user facilities.

The Industry and Technology Committee's report on the AMPP, a document supplementing the President's budget, also suggests potential materials opportunities that could advance the country in various economic sectors and categories, such as:

Agriculture—advanced natural polymers that are degradable for mulch, sustained-release matrices for pest-control agents, packaging materials;

Defense—electronics and electro-optics; theory, models, and simulations to reduce lab work; intelligent processing;

Energy—photovoltaics, superconducting electric power lines, magnetic materials for motors, nuclear reactor materials;

Environment—aerogels to replace CFCs in foam plastics, advanced sorbents to remove sulfur dioxide and nitrogen oxide emissions, processes to recycle or reuse waste ash from power plants and municipal waste incinerators, biodegradable materials;

Raw materials extraction and production—less expensive titanium, ultra-high-field magnetic separation of minerals from waste rock, biological treatment of surfaces to improve metal extraction, super critical fluids to chemically destroy toxic organic materials in the waste stream, microwave or shock wave energy sources for crushing and grinding;

Health—long lasting, biocompatible implants, artificial organs impregnated with genetically engineered cells for drug delivery, artificial kidney membranes, artificial blood, fabrication of implantable neural prostheses;

Information and Communications—further miniaturization of silicon devices, improved processing of compound semiconductors, and identification and development of superior semiconducting materials;

Infrastructure and Construction—advanced materials, such as steel alloys and high-performance concrete, for roads and bridges, improved fabrication and analysis;

Transportation—advanced metal alloys, polymers, ceramics, and composites to reduce weight and increase efficiency in aircrafts and cars; and

Materials for the Future—nanostructured materials and intelligent materials that respond to environmental stimuli.

The FCCSET Committee on Industry and Technology's 64-page report, *Advanced Materials and Processing: The Federal Program in Materials Science and Technology,* is available from: COMAT, National Institute of Standards and Technology, Room B309 Materials Building, Gaithersburg, MD 20899; Phone (301)975-5655.

Interagency Initiatives Given High Priority in Proposed 1993 Budget

In addition to the Advanced Materials and Processing Initiative, the administration's 1993 budget proposes four other interagency Presidential Initiatives in science and technology developed from FCCSET (Federal Coordinating Council on Science, Engineering, and Technology) crosscuts this year. D. Allan Bromley, Assistant to the President for Science and Technology, presented an overview of these initiatives and other features of the proposed $76.6 billion FY 1993 R&D budget on January 29.

Biotechnology Research

The Biotechnology Research Initiative is a new initiative proposed for 1993. It was developed under FCCSET's Committee on Life Sciences and Health and is largely supported by the National Institute of Health (NIH) within the Heath and Human Services Agency, but also by 11 other agencies. The administration proposes a 7% increase in funding to over $4 billion. This initiative is designed to maintain the U.S. lead in health-related biotechnology research and to expand research in other critical areas such as agriculture, energy, and environment. Programs include: biological sensor technology (DOD), conservation and renewable energy research (DOE), and bioprocessing and applied biotechnology (NSF).

High Performance Computing and Communications

This is the second year proposed for the High Performance Computing and Communications Initiative organized under

MRS Responds to Proposed Materials Initiative

MRS President Slade Cargill sent the following letter expressing the Society's support of the Presidential Initiative on Advanced Materials and Processing to key congressional representatives:

"The Materials Research Society endorses the Advanced Materials and Processing Program (AMPP) as proposed in the President's Fiscal Year 1993 budget. This initiative strengthens the federal commitment to materials research and development (R&D) and represents a significant investment in our future. It underscores the central importance of materials as the basis for critical enabling technologies on which most other technologies depend. It fosters cooperation among universities, industry, and federal laboratories in a coordinated, interagency effort to exploit opportunities in materials R&D to meet significant national goals. It represents a historic, national recognition of materials and the materials community.

"The AMPP follows from a series of comprehensive assessments of the materials field which involved broad participation of materials scientists and engineers from industry, academia, and government. The basic themes were established in the National Research Council's 1989 report, *Materials Science and Engineering for the 1990s: Maintaining Competitiveness in the Age of Materials.* This watershed report documented the importance of advanced materials to quality of life, security, industrial productivity, and economic growth. Subsequently, at the request of the National Research Council and the Office of Science and Technology Policy, four regional meetings were held across the country involving more than 400 participants from industry, academia, and government. The results of these meetings were summarized in the 1991 publication, *A National Agenda in Materials Science and Engineering: Implementing the MS&E Report.*

"These reports provided key input for the preparation of the AMPP by the interagency Committee on Industry and Technology of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). The AMPP represents a coordinated federal approach to materials science and technology based on a crosscutting analysis of materials R&D in 10 agencies. It focuses special attention on synthesis and processing, areas which are critical to the development of new and improved materials, and on bridging the gap between discoveries and applications in advanced materials technologies. The materials community and all segments of society will benefit from this significant positive step in science and technology in the national interest."

FCCSET's Physical, Mathematical, and Engineering Sciences Committee. Slated for a 23% increase to $803 million, this initiative would aim to sustain and extend U.S. leadership in all advanced areas of computing and networking. The goal is to meet, by 1996, the needs of federal research agencies to investigate and understand a wide range of fundamental scientific and engineering problems such as forecasting severe weather events, predicting new superconducting materials, minimizing air pollution, designing better aircraft, designing and packaging new computer chips, and understanding and predicting global change.

Global Change Research

The U.S. Global Change Research Program, proposed for its fourth year, is organized under FCCSET's Earth and Environmental Sciences Committee, and it involves 11 agencies. The administration proposes increasing funding by 24% to $1.37 billion. This initiative is to monitor, understand, and model the entire Earth system to support the needs of policy makers associated with global and regional environmental issues such as ozone depletion and global warming.

Mathematics and Science Education

Not directly in the R&D budget, but relevant, is the Presidential Initiative on Mathematics and Science Education, proposed for its second year. This initiative, developed by FCCSET's Education and Human Resources Committee and included in the education section of the budget, involves 11 agencies. Funding is proposed to increase 7% to $2.1 billion. This initiative sets the highest priority on providing more adequate preparation for precollege education (slated to increase by 18% to $768 million), but would also support undergraduate and graduate education (a 1% increase to $1,231 million), and public science literacy (a 2% increase to $93 million). Funds would go into teacher training, demonstrations of electronic dissemination of learning methods, and computers and scientific equipment.

Other Targeted R&D

In addition to the special interagency initiatives, the Bush administration plans to emphasize a number of key areas such as biomedical research, energy, advanced manufacturing, transportation infrastructure, and space exploration. Funding for these and other R&D areas are summarized in Table I.

The total budget proposed for fiscal year 1993 comes to $76.6 billion for R&D and facilities, up 3% over 1992 appropriations. Civilian R&D is proposed to increase by 7% over 1992 to a total of $30.4 billion. Defense-related R&D would increase by 1% to $43.2 billion. Funding for facilities would decrease by 16% to $2.9 billion.

To compensate for decreased funding on nuclear weapons research, development, and testing, the administration suggests in the budget document that DOE laboratories may gain a larger role in civilian R&D initiatives, including materials research, advanced manufacturing R&D, biotechnology, and space exploration.

The administration also emphasizes the importance of university research, proposing $11.5 billion for such activities, an increase of 5% over 1992. NSF is slated to receive the biggest increase (20%) for R&D funding for academic institutions.

The 1993 proposed budget emphasizes technological advancement by increasing federal investments in high-payoff applied research and development, particularly precompetitive, generic technologies. The budget also emphasizes improving government and industry collaborations through consortia and technology transfer from the federal laboratories to industry through cooperative research and development agreements (CRADAs). □

Table I: Enhancing Research and Development and Expanding the Human Frontier—Highlights.
(Dollar amounts in millions)

Budget Authority	1989 Actual	1992 Enacted	1993 Proposed	Dollar Change: 1992 to 1993	Percent Change: 1992 to 1993
Applied Research:					
†High Performance Computing and Communications	N/A	655	803	+148	+23%
†Advanced Materials and Processing	N/A	1,659	1,821	+162	+10%
†Biotechnology Research	N/A	3,759	4,030	+271	+7%
Energy R&D	397	774	914	+140	+18%
Moving Fusion Energy from Science to Engineering	347	337	360	+23	+7%
Advanced Manufacturing R&D (non-defense)	N/A	252	321	+69	+27%
Transportation R&D	802	1,224	1,433	+209	+17%
Protecting the Public Health	3,482	4,757	4,849	+92	+2%
Expanding R&D at the National Institute of Standards and Technology	159	247	311	+64	+26%
Space Technology	256	273	305	+32	+12%
Basic Research:					
Doubling the NSF Budget by 1994	1,923	2,572	3,026	+454	+18%
Support for Individual Investigators (HHS, NSF, DOE)	5,884	7,273	7,939	+666	+9%
Human Genome Project	N/A	164	175	+11	+7%
Superconducting Super Collider	98	484	650	+166	+34%
†U. S. Global Change Research Program	N/A	1,110	1,372	+262	+24%
Astronomy and Astrophysics	617	836	890	+54	+6%
National Research Initiative (USDA)	N/A	98	150	+52	+53%
Maintaining National Security: Defense R&D:					
Defense	38,031	40,043	40,509	+466	+1%
Energy	2,321	2,668	2,640	-28	-1%
Expanding the Geographic Frontier:					
Improving Access to Space	4,411	5,312	5,412	+100	+2%
Space Exploration	1,433	2,646	2,836*	+190	+7%

From the *Budget of the United States Government Fiscal Year 1993*, (U.S. Government Printing Office, Washington 1992) Part one, p. 87, Table 6-1.

† Presidential initiatives developed from FCCSET interagency crosscuts.
* Includes $2.25 billion for Space Station Freedom.

The MRS BULLETIN welcomes your information on matters of science and your opinion on policy and decision-making issues facing the materials science community.

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