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Materials Research in the FY 2015 Budget

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HIGHLIGHTS

In contrast to previous years, the Administration's budget would not continue to place physical science R&D on a path of growth in FY 2015 for the National Science Foundation, Department of Energy Office of Science, National Institute of Standards and Technology, and Department of Defense Basic Research. Proposed materials research budgets vary considerably by percent increases in the FY 2015 department and agency budgets but generally follow the overall trends for each agency this year. Comparisons are provided in reference to enacted FY 2014 budgets:

– ***National Science Foundation*** – Overall 1.2 percent increase for the Foundation, while the NSF Division of Materials Research (DMR) within the Mathematical and Physical Sciences Directorate would increase by only 0.3 percent;

– ***Department of Energy Office of Science*** – Overall 0.9 percent increase for R&D, while Basic Energy Sciences (BES) would receive a 5.5 percent increase, and Materials Sciences and Engineering (MSE) within BES would receive a proposed increase of 6.6 percent;

– ***Department of Defense*** – Overall 6.9 percent decrease for basic research accounts. Defense Advanced Research Projects Agency (DARPA) would increase by 4.9 percent in all defense research science programs;

– ***Department of Commerce National Institute of Standards and Technology*** – Scientific and Technical Research and Services would receive an overall 3.4 percent increase.

INTRODUCTION

Materials research is a broad, interdisciplinary field supported by funding from a number of federal departments and agencies. Materials research is conducted in universities, government laboratories, and industry.

Table 1. Materials Science in the FY 2015 Budget
(budget authority in millions of dollars)

	FY 2014 Enacted	**FY 2015 Budget**	Change FY 14-15 Amount	Change FY 14-15 Percent
National Science Foundation	7,172	**7,255**	83	1.2%
Math and Physical Sci	1,300	**1,296**	-4	-0.3%
Materials Research	*298*	***299***	*1*	*0.3%*
National Nanotech Initiative	411	**412**	2	0.4%
Department of Energy				
Office of Science	5,066	**5,111**	45	0.9%
Basic Energy Sci	*1,712*	***1,807***	*95*	*5.5%*
Mat Sci and Eng	*363*	***387***	*24*	*6.6%*
Chem, Geo, and Bio Sci	*316*	***316***	*0*	*0.0%*
Office of EERE	1,901	**2,322**	421	22.1%
ARPA-E	280	**325**	45	16.1%
National Nanotech Initiative	303	**343**	40	13.1%
Department of Defense				
Basic Research	2,167	**2,018**	-149	-6.9%
Applied Research	4,641	**4,457**	-184	-4.0%
DARPA	2,779	**2,915**	136	4.9%
Defense Research Sci	*365*	***362***	*-3*	*-0.8%*
Materials & Bio	*167*	***160***	*-7*	*-4.2%*
Electronics Tech	*233*	***179***	*-54*	*-23.2%*
National Nanotech Initiative	176	**144**	-32	-18.1%
Nat'l Institute of Standards and Tech				
Science & Tech Res and Serv	597	**617**	20	3.4%
National Nanotech Initiative	98	**83**	-15	-15.5%
National Institutes of Health				
Bio Imaging and Bio Eng	326	**329**	3	0.8%
National Nanotech Initiative	442	**442**	0	0.0%

Source: Agency budget justifications and other budget documents.
Figures rounded to nearest million. Changes calculated from unrounded figures.
*includes non-R&D components

Materials scientists and engineers conduct research that results in fundamental breakthroughs in electronics, energy systems, aerospace, biomedical devices, nanotechnology, transportation, and advanced computation and communication technologies. Federal materials research programs support scientific research, state-of-the-art facilities, and analytical techniques, as well as programs that advance innovation and train the next generation of materials scientists and engineers.

NATIONAL SCIENCE FOUNDATION (NSF)

Materials research funding at NSF is focused primarily in the Mathematical and Physical Sciences (MPS) Directorate, under the Division of Materials Research (DMR). The MPS Directorate would decrease by $4 million in FY 2015 to $1.3 billion, a decrease of 0.3 percent below FY 2014. Funding for materials research and condensed-matter science in DMR would increase by $1 million in FY 2015 to $299 million, an increase of 0.3 percent over FY 2014.

Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS) decreases by $7.8 million to a total of $37.2 million with a specific focus on Designing Materials to Revolutionize and Engineer our Future (DMREF) program to design and synthesize materials by integrating theory, computation, experimentation, and data mining. These programs are a direct response to the Administration's Materials Genome Initiative (MGI). DMREF funding in FY 2015 is proposed at $11.0 million, a decrease of $9.0 million from FY 2014.

Materials Centers in the FY 2015 proposed budget for MPS Division of Materials Research is equivalent to FY 2014 funding and would support 18 centers. These new and on-going centers are interdisciplinary programs for increasing materials research and educating students.

The DMR FY 2015 request includes other Foundation focus areas in which advanced materials are key. These include the Sustainable Chemistry, Engineering, and Materials (SusChEM) effort under the NSF-wide Science, Engineering, and Education for Sustainability (SEES) program area, including critical minerals and materials.

DMR proposes a new midscale research infrastructure program, Materials Innovation Platforms (MIP), and will continue a research commitment in clean energy technologies. Much of this funding is in the

form of individual investigator awards, but MPS also makes larger awards that include centers, institutes, and multi-user facilities.

Programs impacting materials research are also found in two other Divisions of MPS – Chemistry and Physics – and in NSF's Engineering Directorate (ENG). Proposed funding levels for these programs are similar to last year, with no growth.

DEPARTMENT OF ENERGY (DOE)

DOE supports fundamental and applied materials research that seeks to achieve discoveries in a wide range of global energy and national security challenge areas. The DOE budget emphasizes the importance and priority of materials, chemistry, and biology by design.

The Office of Science (SC) is the largest federal sponsor of basic research in the physical sciences. In FY 2015, funding for Materials Science and Engineering (MSE) would rise to $386.6 million, an increase of 6.6 percent over FY 2014. Basic Energy Sciences (BES) is projected to grow by 5.5 percent within an overall SC budget limited to 0.9 percent growth for R&D over FY 2014. BES is the largest of the program areas within the Office of Science, due mainly to stewardship of national user facilities. Within non-facility-based research programs of BES, the MSE Division includes materials discovery, design, and synthesis; condensed matter and materials physics; and scattering and instrumentation sciences. A new activity on computational materials sciences is planned to support integrated theoretical modeling and experimental research to develop codes and software for predictive design of functional materials.

The Department of Energy oversees seventeen national laboratories through SC and the National Nuclear Security Administration (NNSA). BES program operates the Scientific User Facilities (SUF) Division, with large national user research facilities that provide researcher access to expensive and rare instrumentation, including synchrotron and neutron sources, nanoscience centers, and smaller user facilities for materials preparation and electron microscopy. The FY 2015 budget would provide funding for these facilities with benefits to materials research at a level of $964.9 million, an increase of 3.6 percent over FY 2014. BES operates five Nanoscale Science Research Centers within SUF at national laboratories and, through their user programs, supports a wide range of individual programs on nanoscience.

BES also manages the Energy Frontier Research Centers (EFRCs), which are multi-investigator and multidisciplinary centers that pursue projects of high priority to energy research. The scientific directions for these centers cut across materials science and engineering, chemical sciences, geosciences, and biosciences.

DOE supports applied materials research for energy technologies through a number of programs in the Office of Energy Efficiency and Renewable Energy (EERE), and directed materials research for national security through the NNSA's Weapons Activities account, within the Science and Engineering programs. The Advanced Manufacturing Office in EERE focuses on materials technologies and production techniques that have broad applications for energy-intensive manufacturing methods. The Advanced Research Projects Agency-Energy (ARPA-E) is a source of funding for high-risk, high-payoff materials research projects. In addition, DOE has continued to manage Energy Innovation Hubs, including the Critical Materials Hub at Ames Laboratory as well as a multi-team Batteries and Energy Storage Hub led by Argonne Laboratory.

DEPARTMENT OF DEFENSE (DOD)

DOD funds materials research through the Army, Navy, and Air Force research organizations, and through defense-wide agencies that support the entire department such as the Defense Advanced Research Projects Agency (DARPA).

Basic research ("6.1" in the military classification system; see Chapter 5) for all DOD agencies would decrease in FY 2015 by 6.9 percent to $2.0 billion compared to FY 2014. Applied research ("6.2") would decrease by 4.0 percent to $4.5 billion. The proposed decreases in military service science and technology budgets vary, but the overall downward trend is a real concern for all FY 2015 defense budgets.

Materials science and technology programs are dependent on the individual defense agency mission. Army basic research ("6.1") would decrease by 2.8% in FY 2015 compared to FY 2014. The Navy and Air Force basic research accounts would decrease by 6.9 and 13.4 percent respectively. DARPA funding in the Defense Science Office for basic research would decrease by 0.8 percent to $362 million in FY 2015. Applied research within DARPA Materials and Biological Technology would decrease by 4.7 percent to $160 million, and Electronics

Technology would decrease by 23.2 percent to $179 million. In addition, programs in the Microelectronics Technology Office also support the materials science community. Initiatives in electronics, engineering biology, and information technology are all area in which materials research continues to play an important role in advancing new technologies.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST's Scientific and Technical Research and Services R&D budget is proposed to increase by $20 million to $617 million, which is 3.4 percent above FY 2014 funding. NIST develops measurements, standards, and data needed to advance the development of metals, ceramics, polymers, nanomaterials, biomaterials, electronics, and semiconductor materials that are critical to national needs related to commerce. The budget emphasizes manufacturing technologies, network infrastructure, and support for the MGI program and data standards.

OTHER AGENCIES

Three other agencies also provide support for materials science: the National Aeronautics and Space Administration (NASA), the National Institutes of Health (NIH), and the Department of Homeland Security (DHS). These agencies do not separately report materials science budget line items. NASA's Science and Aeronautics directorates both include programs that support materials research. Within NIH, the National Institute of Biomedical Imaging and Bioengineering (NIBIB) is an important funding agency for materials research with an emphasis on health-related science and applications. At DHS, the Science and Technology Directorate conducts applied research on programs that impact materials science. The overall agency budgets for R&D are analyzed in their respective chapters.

NATIONAL NANOTECHNOLOGY INITIATIVE (NNI)

Federal investment in the cross-cutting National Nanotechnology Initiative (NNI) would remain at the same level compared to FY 2014, at $1.54 billion. NNI agencies focus on research in materials, devices, and systems that exploit the unique physical, chemical, and biological properties that emerge in materials at the nanoscale. NNI programs by agency and specific signature initiatives are outlined in Chapter 23.