

## NNI Workshop Charts Progress and Future Challenges

In its first two years of existence, the National Nanotechnology Initiative (NNI) has more than doubled its initial funding level and reached several key technical objectives ahead of schedule, according to featured speakers at a conference held in Arlington, Va., April 29 through May 1. Leading experts and officials from government agencies and research centers around the country discussed progress in nanoscale research and development (R&D) to date, potential applications, and business opportunities, and reported on recent discoveries and future NNI research priorities.

First deployed under the Clinton administration, NNI has received broad bipartisan support in Congress, due in large part to the long-term societal implications of such research in terms of potential applications. In fact, nanotechnology is already having a major impact on the commercial marketplace. For instance, giant-magneto-resistance materials are now routinely used in magnetic-storage applications, and the use of nanoparticles in drug delivery systems and to reinforce polymer materials is becoming equally commonplace. For example, scientists at Rutgers University are developing and commercializing a new class of polymer blends containing functional nanoparticles, building on their earlier work on plastic lumber applications, now in use by several New Jersey-based companies.

These early successes are expected to help launch future applications in nanotechnology. The strong support is reflected in the federal funding levels for NNI, which continue to rise. From a starting budget of \$270 million in its first year, NNI's budget increased to \$422 million in FY2001 and \$604.4 million in FY2002. The Bush White House has continued the Clinton administration's support of the initiative with a requested R&D budget for FY2003 of \$710.2 million, a smaller increase than in past years, but still strong in light of the recent economic decline. The National Science Foundation (NSF) would receive the largest piece of the budgetary pie, with a requested \$221 million, followed by the Department of Defense (DoD) with \$201 million and the Department of Energy (DOE) with \$139.3 million.

Equally important to the program's success has been the acceptance of NNI's

vision by the scientific community, professional societies, and the general public.

"The NNI has raised the flag of nanotechnology as a megatrend in science and engineering, both in the U.S. and abroad, and there is almost no S&E field not touched yet by nanotechnology," said conference chair Mihail C. Roco, a senior advisor at NSF and chair of the National Science and Technology Council's Subcommittee on Nanoscale Science, Engineering, and Technology (NSET), who delivered the keynote address. Industry has been just as eager to embrace the trend, investing equivalent R&D amounts—compared with federal funding—in hopes of capitalizing on the commercial promise of nanotechnology. Nonetheless, Roco believes there is a need for a coherent 5–10-year program to ensure continuity in the nanotechnology research enterprise, and a draft bill to that effect is currently being prepared in Congress, spearheaded by Sen. Joseph Lieberman (D-Conn.).

Roco also referred to heavy investment internationally in nanotechnology. Japan invested an estimated \$465 million in 2001 and \$650 million in 2002. Western Europe will spend an estimated \$400 million on nanotechnology R&D this year, with Australia, Canada, China, Eastern Europe, the former Soviet Union, Israel, Korea, Singapore, and Taiwan combined spending an additional \$500 million.

Judging by the progress presented at the workshop, the investment is paying off. Several key developments have been achieved sooner than expected, boding well for the future of nanotechnology, particularly when combined with progress made in reducing the time to development of commercial prototypes by at least a factor of two for several key applications. For instance, scientists are now able to engineer materials with atomic and molecular precision by using proteins, viruses, and other biosystems and assemble molecular-scale nanodevices. The past year has also seen innovative new concepts for the large-scale production of carbon nanotubes. Last September, Mitsubishi announced plans for the mass production of the structures, expected to reach 1500 tons a year by 2004, which will reduce prices to 10–100 times lower than the current prices. A French company called Nanoledge is also reaching large-scale production of carbon nanotubes.

Encouraged by the progress, Roco outlined a new set of grand challenges for

FY2002–2003, most notably the need for improving manufacturing capabilities at the nanoscale, envisioning "a new world of products with a high degree of control at the nanoscale and integrated along scales." There is also a pressing need for high-performance, low-cost, standardized instruments and tools for measurement, manipulation, and analysis at the nanoscale. International cooperation and collaboration will be key for precompetitive R&D, most notably for single-molecule and single-cell research, the development of tools and standards, and the education and training of the future technical workforce that will be required if nanotechnology advancement continues apace.

One of the original grand challenges is national security, which has been refocused for FY2003 and beyond to reflect the changed national priorities in light of last year's attacks on New York City and Washington, D.C.: developing nanotechnology for the detection of and protection from explosives. Nanoscale R&D is a top priority at DoD, which funds programs to develop such innovations as nanoengineered fabrics for masks and protective clothing—including multifunctional, adaptable "smart" materials and nanoengineered functional materials built into soldiers' uniforms—and decontamination equipment such as high-surface-area adsorbents, nanopowders, and nanoreactors for chemical- or biological-agent detection and destruction. Ultimately, said Clifford Lau, associate director for corporate programs at the Office of Naval Research, "nanotechnology will prove to be more important than the invention of gunpowder," in terms of its revolutionary impact on warfare and national security.

JENNIFER OUELETTE

### House Passes Bill to Put NSF on Doubling Track

The House of Representatives has passed a bill by a vote of 397 to 25, on June 5, that would authorize the first three years of a five-year doubling of the budget of the National Science Foundation (NSF): H.R. 4664, the "Investing in America's Future Act." The bill and its summary, as it was introduced by the House Science Committee, can be found at the committee's Website: [www.house.gov/science](http://www.house.gov/science). The bill now moves to the Senate for consideration.

**FOR WASHINGTON NEWS POLICY AFFECTING MATERIALS RESEARCH . . .**

**. . . access the Materials Research Society Web site: [www.mrs.org/pa/](http://www.mrs.org/pa/)**