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U.S. Leadership in Materials R&D Faces Stiff Overseas Competition

Growing competition from burgeoning materials research and development (R&D) centers around the world could weaken the long-standing leadership position of the United States in this area, according to a report from the National Academies' National Research Council (NRC). Sponsored by the Department of Defense (DoD) and conducted under the auspices of the NRC's National Materials Advisory Board, the report calls for the federal government to define a national strategy to ensure that future needs for materials R&D can be met and the United States can retain its world leadership.

The NRC appointed the Committee on Globalization of Materials Research and Development in December 2003 to assess the status and potential impact of globalization on the U.S. materials science and engineering R&D enterprise. Materials R&D is "the key building block of most advanced technologies," the report said, contributing to human health and development, national security, enhanced global communications, and electronics, among other applications. "As long as [it] remains vital for U.S. industrial and economic activity...the nation will need to understand well the drivers for and consequences of the globalization of [materials] R&D."

Although the committee found that the United States remains a world leader in most major materials-related research subfields, globalization of materials science and engineering R&D "is happening, and it's irreversible," said Peter Bridenbaugh, retired executive vice president of Alcoa Inc. and chair of the committee. "Although this increased global activity may help our nation develop new materials, it is also possible that a country which has not traditionally been

an ally of the U.S. may decide not to share a new and critical technology developed within its borders."

Available economic data to date have been limited, but thus far globalization has had a limited impact on the U.S. economy, the study found. However, the report noted disturbing trends that could put the country's leadership position at risk in the mid- to long term. Most notably, U.S. industry and government are investing heavily in offshore research and manufacturing facilities, in central Europe and Asia in particular, while domestic investment is declining. This is occurring at the same time that other governments—including China, Japan, India, and the European Union—are increasing investment in building their own materials R&D infrastructure, especially laboratory facilities and education.

The U.S. educational system has historically depended on increasing numbers of non-U.S. students coming to the country to earn advanced degrees, and a fairly high percentage of those finding jobs in the States. This helped offset the declining numbers of U.S. students interested in pursuing advanced degrees in materials science, a trend which has continued. But the number of non-U.S. students choosing to study and work in the United States is declining now as well. In China alone, there is an increasing number of scientists with PhD degrees, as well as high-level science jobs available for them. The Organisation for Economic Cooperation and Development—a forum of democratic countries that addresses the economic, social, and governance challenges of globalization—reports that in 2000, the share of students in China graduating with engineering degrees was about 40%; in the United States, that number is only 5%.

Among the report's other findings was that the United States is beginning to lose

its materials-related pilot scale capability—a vital component that enables a material to move from concept into process and product development. This is critical not just to the U.S. economy, but for national security as well, since the development of new materials is a major component of innovative defense technologies, said the committee. Lightweight but tough materials for protective clothing, self-healing materials, anti-corrosion and fire-retardant materials, and materials to build embedded sensors and integrated antennas are among those needed to meet 21st century defense needs, according to the report.

"From a security point of view, we have been fortunate to retain a one- to two-generation lead over our competitors in DoD-related technology," Bridenbaugh said, but he warns that this competitive edge could be seriously eroded as overseas competition increases.

As its primary recommendation, the committee's report called for the United States to develop a broad strategy to maximize the benefits to the country both economically and from a national security standpoint. This will require coordinating the efforts and existing programs and infrastructure of all the various stakeholders in the U.S. materials science R&D enterprise. Such coordination would most likely rely on leadership from the executive branch.

"An increasing number of very smart people are concentrated offshore and they are capable of doing very competitive materials-related R&D," said Bridenbaugh. "We must maintain access to that knowledge."

To ensure this access, the United States must "become one of the most active players in international materials R&D teams and ensure that knowledge generated by foreign R&D is absorbed into domestic programs," the report said. Universities and federal agencies—among them the DoD, the National Science Foundation, the Department of Energy, and the National Aeronautics and Space Administration—should participate in international collaborations in materials R&D. They should also find ways to encourage more U.S. students to pursue careers in science and engineering. Non-U.S. students and researchers should in return be encouraged to participate in U.S. projects. The committee also said that export controls, visa requirements, and other regulatory requirements should not become so restrictive that U.S. participation in international collaboration is significantly impeded.

Bridenbaugh acknowledges that in the post-September 11 climate, and in the

Nobel Peace Prize Awarded to IAEA and Director General

The Nobel Peace Prize for 2005 has been awarded to the International Atomic Energy Agency (IAEA) and to its director general, Mohamed ElBaradei, for their work for a safer and more peaceful world. The Prize was announced on October 7 and will be presented at a ceremony in Oslo, Norway, on December 10.

"The Norwegian Nobel Committee has decided that the Nobel Peace Prize for 2005 is to be shared, in two equal parts, between the International Atomic Energy Agency (IAEA) and its director general, Mohamed ElBaradei, for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy for peaceful purposes is used in the safest possible way," the announcement said.

During a press conference at IAEA headquarters in Vienna, ElBaradei said that he felt "gratitude, pride, and hope" at sharing the prestigious award with the organization he leads.

He said, "The Prize strengthens my resolve to fulfill both aspects of the IAEA mandate—ensuring the benefits of nuclear energy in the service of humankind, and working towards a world free of nuclear weapons."

wake of the devastation wrought by Hurricane Katrina along the U.S. Gulf Coast earlier this fall, it may be difficult to convince those in leadership of the urgency of the matter. Even the committee had trouble quantifying the economic risks of this globalization, simply because there was not sufficient data on economic trends in materials R&D worldwide to assess how the United States is performing in comparison. Yet the signs of potential future erosion are there, and the issue

needs to be addressed now before it is too late, said the committee.

"It's not going to be devastating next week, it's going to be a slow erosion over a long period of time," said Bridenbaugh. "We must address this now, at the national and federal level. The issue is too important to our future."

JENNIFER OUELLETTE

U.S., India Work toward Global Partnership

On July 18, U.S. and Indian leaders issued a joint statement resolving to establish a "global partnership" between the two countries through increased cooperation on economic issues, energy and the environment, democracy and development, nonproliferation and security, and high technology and space. Of special interest to many in the U.S. Congress was the statement's assertion that "as a responsible state with advanced nuclear technology, India should acquire the same benefits and advantages as other such states," and President George Bush's statement that he would work on achieving "full civilian nuclear energy cooperation with India." Such cooperation would require changes in both U.S. law and Nuclear Suppliers Group guidelines. This passage is widely viewed as representing de facto recognition of India as a nuclear weapons state and a reversal of more than three decades of U.S. nonproliferation policy.

During a luncheon in Washington, D.C., in Indian Prime Minister Manmohan Singh's honor, U.S. Secretary of State Condoleezza Rice said, "Today [July 18] the president had an opportunity to tell the prime minister that we value greatly India as an international partner, as a country whose rise economically, politically, we welcome."

Prime Minister Singh responded, "Our vision of relations with the United States is a long-term and strategic one, based on shared values and commitments."

On September 8, the U.S. House of Representatives Committee on International Relations, chaired by Henry J. Hyde (R-Ill.), held an oversight hearing to examine nuclear and security issues announced in July. Robert G. Joseph, undersecretary for arms control and international security, in

his remarks prepared for the committee, specified that through the joint statement, India has agreed to take significant steps to prevent proliferation, including the placement of its civilian nuclear facilities under the safeguards of the International Atomic Energy Agency (IAEA). IAEA Director General Mohamed ElBaradei, in a statement released in July, has welcomed the U.S.–India agreement to embark on full civil nuclear energy cooperation and to work to enhance nuclear nonproliferation and security.

ElBaradei said that India's intention to identify and place all of its civilian nuclear facilities under IAEA safeguards and to sign and adhere to an additional protocol with respect to civilian nuclear facilities is a welcome development. He has also been urging all countries using nuclear energy to apply the highest safety standards possible.

"Making advanced civil nuclear technology available to all countries will contribute to the enhancement of nuclear safety and security," he said.

Also addressing the House Committee on International Relations in September was the undersecretary for political affairs, R. Nicholas Burns. Burns delineated other initiatives highlighted during Singh's visit in July, including energy and environment and science and technology. He said the U.S.–India Energy Dialogue, established in May prior to Singh's visit, promotes increased trade and investment in the energy sector, specifically focused on oil and natural gas, electric power, coal and clean coal technology, energy efficiency, new and renewable energy technologies, and civil nuclear energy.

"It is our hope," said Burns, "that these efforts in their totality will not only produce the power that India needs, but help safeguard the environment by encouraging cleaner, more efficient, affordable, and diversified energy technologies."

Burns also said, "In conjunction with the prime minister's visit, the U.S. and India agreed to sign a Science and Technology Framework Agreement. It will build on the U.S.–India High-Technology Cooperation Group, to provide for joint research and training and the establishment of public–private partnerships." □

India Institutes "Indira Gandhi Scholars"

In a major initiative for the education of women, the government of India has determined that girls who are the only child will be eligible for free education in grades 6–12, announced the Ministry of Human Resource Development in September.

The Ministry identified Indira Gandhi as the most distinguished "single girl child" in India's history. Gandhi achieved greatness and played a historic role in shaping the world, said the Ministry. "To perpetuate Indiraji's memory and make her a source of inspiration for our girls, it has been decided that all female students at the college/university level, who are single girl children, will be called 'Indira Gandhi Scholars' and would receive recognition and support throughout their educational careers," said the Ministry.

Under the government's initiative, the Central Board of Secondary Education (CBSE) will offer 500 scholarships a year, 350 for female engineering students and 150 for female medical students. The scholarships will be based on the top ranks received by students in the entrance exams conducted by CBSE. In addition, the University Grants Commission (UGC) will implement two post-graduate scholarship schemes.

The Ministry announced, "Promotion of women's education has been one of the cornerstones of our educational policy. Unfortunately, girls still face discrimination in our society....New initiatives have, therefore, become necessary to give the girl child her due, and to empower her for a life of equality and dignity."

According to the Ministry, the scholarships being instituted by CBSE and UGC, once fully operational, will benefit about 11,000 students in any given year.

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