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### Additional Funding, Basic Research Critical to Achieving Hydrogen Economy

The Department of Energy (DOE) is ramping up efforts to foster the development of a new hydrogen economy with several new funding programs announced over the summer. The programs include funding for basic and applied research in hydrogen storage as well as related efforts in fuel-cell technology and hydrogen production.

Proposals are currently being evaluated by the DOE Office of Science. In July, DOE Secretary of Energy Spencer Abraham announced the selection of 13 firms and educational institutions in 12 states to receive \$75 million to fund new research in advanced fuel-cell technology for vehicles, buildings, and other applications, along with an additional \$21 million awarded to 11 firms and universities in eight states for the development of hydrogen storage, production, and sensor technologies. There is also a new DOE program to establish virtual Centers of Excellence in metal hydrides, carbon, and chemical hydrogen storage, to be led by the national laboratories, with universities and industries offering proposals for research in new and innovative materials, compressed and liquid hydrogen, and both on-board and off-board hydrogen storage technologies.

The as-yet-unrealized potential of hydrogen was highlighted by President Bush in his 2003 State of the Union address when he announced his Hydrogen Fuel Initiative, proposing \$1.2 billion over five years in research funding to develop clean, hydrogen-powered cars. It complements the President's existing FreedomCAR initiative, aimed at developing technologies needed for mass production of safe and affordable hydrogen-powered fuel-cell vehicles.

The potential benefits of transforming the nation's transportation fleet from a near-total reliance on petroleum to a

steadily increasing use of clean-burning hydrogen include dramatically reducing U.S. dependence on imported oil, reducing carbon emissions from energy production and consumption, and increasing the reliability and efficiency of electricity generation. But the issue extends beyond national borders, as evidenced by the U.S. and European Union's agreement, announced in June, to collaborate on accelerating the development of the hydrogen economy.

Fundamental materials research and development (R&D) is especially critical to the realization of the future large-scale use of hydrogen as an energy carrier, according to a report from the DOE Office of Science released in August. It summarized the findings of the department's Basic Energy Sciences Workshop on Hydrogen Production, Storage and Use, which convened in May. "Implementing the hydrogen economy represents perhaps one of the most fundamental and wide-ranging influences on the social fabric of our times," the report concluded, comparing the task at hand to the deployment of the fossil fuel economy in the late 19th and early 20th centuries and the development of electric power generation and distribution in the mid- and late 20th century.

Making the stated goals a reality will take not just further R&D on existing technology, but some fundamental research, particularly in materials science.

"There is a huge gap between where we are now and where we need to be in terms of the knowledge base for the hydrogen economy, and simple incremental advances in the present technology cannot bridge it," said Mildred Dresselhaus (Massachusetts Institute of Technology), who chaired the workshop and previously served as director of the Office of Science. "Some very radical ideas are needed to advance the field, and that points to basic research."

Among the many challenges is providing sufficient and cost-effective means to produce usable hydrogen, whether it be from fossil fuels (which would require carbon sequestration); some form of solar hydrogen, biological, and biomimetic systems; nuclear energy; or thermal energy. Storage is another critical challenge, particularly for transportation applications. Metal hydrides may represent ideal storage systems, yet of the numerous available hydrides, none have met all of the requirements for hydrogen storage applications. And today's fuel-cell technology is still far from sufficient to meet the demanding requirements of the hydrogen initiative.

According to George Crabtree (Argonne National Laboratory), associate chair of the workshop, the field of catalysis is particu-

larly ripe for significant and dramatic developments, such as the ability to fabricate catalysts like platinum at the nanoscale, giving them exciting new properties.

"When you go to the nanoscale, the chemistry and physics change, so we'll be able to get enhanced performance of catalytic centers," said Michelle Buchanan (Oak Ridge National Laboratory), also an associate chair of the workshop, adding that the concept has already been proven with studies of gold at the nanoscale.

While there has been a great deal of R&D in fuel-cell technology in the last decade, much of it has used the same materials (namely, platinum) that have been used since the fuel cell was invented in 1839.

"The R&D has progressed to the point where major advances are not likely to come from just engineering changes," said Cornell University's Frank DiSalvo, who co-chaired the workshop panel on fuel cells. "It's going to require new materials to be discovered and then implemented into the technology."

For example, an ideal anode would be able to take in gasoline directly and use it without putting it through a reformer.

"Right now, no one has an idea of what kind of material would do that, if one even exists," said DiSalvo. "There are entire classes of promising materials that have yet to be explored, but fuel-cell researchers have not been talking to materials scientists, and vice versa. We would like to nucleate that discussion and get these people together."

DiSalvo believes there has not been enough research to date on better alternatives to platinum metal, nor has there been sufficient communication between the various disciplines that could affect that research, such as in solid-state chemistry and materials, and among scientists with expertise in surface science, nanotechnology, and theory and simulation. DiSalvo is currently director of a materials research center at Cornell, funded by the National Science Foundation, that practices this approach in other areas of materials science, and he believes the same model should be applied to enable the hydrogen economy. Buchanan believes initiatives like the DOE's nanoscience centers provide other useful collaborative models. ORNL is currently constructing a Center for Nanophase Materials as part of that program.

While universities typically foster individual and group research efforts, the national laboratories can play an important role in promoting multidisciplinary collaboration and technology transfer. Most of the national laboratories already

#### South Africa Accepts Applications for Evaluation and Rating

South African researchers in all disciplines are invited to apply online for evaluation and rating with the National Research Foundation's Evaluation Centre at Web site <http://submissions.nrf.ac.za>. **The application deadline is February 27, 2004.** To find out more about the Evaluation Centre, access Web site [www.nrf.ac.za/evaluation](http://www.nrf.ac.za/evaluation).

have mechanisms in place with the industrial sector to help turn promising research results into cost-competitive practical technologies for the hydrogen economy.

"You need research on a broad front for the hydrogen economy to be realized, with lots of different players involved in the research," said Crabtree. "The U.S. research establishment is very decentralized and tends to progress in a massively parallel way. It needs to be much more broadly based throughout the universities, national labs, and industry."

"It's a huge undertaking, at least equivalent to landing a man on the moon, and it will require the cooperation, collaboration, and interaction on everybody's part," said DiSalvo of the challenges ahead. It will also require a great deal of funding over a period of 15–30 years, considerably more than the \$1.2 billion allocated by the DOE for this fiscal year.

"The amount of money needed to get where we need to be for the hydrogen economy is considerable, but the time scale is also long because the problem won't be solved overnight," said Dresselhaus.

JENNIFER OUELLETTE

### Korea, China Hold Science-Technology Ministers' Meeting

Park Ho-koon, Korea's minister of science and technology, met with his Chinese counterpart, Xu Guanhua, in Beijing on September 13 and discussed the follow-up measures agreed upon during Korean president Roh Moo-hyun's visit to China in July for greater scientific cooperation, the Korean Ministry of Science and Technology (MOST) reported.

The ministers' discussion focused on joint projects to develop advanced technologies and commercially apply them. Among the projects discussed were the

opening of a Korea–China nano joint research center; the launching of science and technology ministers' meetings among Korea, China, and Japan; the establishment of a Northeast Asian Cooperation Program for Science and Technology; the opening of a Korea–China science and technology cooperation center at Tsinghua University in Beijing; a possible Korean investment of \$4.2 million (a government–civilian fund) in venture companies working with Chinese firms; and the formation of a Korea–China investment fund for technology development.

### New Zealand Explores Possible S&T Collaborations with the European Union

New Zealand's Ministry of Research, Science & Technology (MoRST) has in the past year taken action to explore ways to strengthen New Zealand researchers' links with their European counterparts. Several initiatives have been undertaken by the ministry, based on suggestions made last summer by a New Zealand delegation to the Research Directorate-General (RDG) of the European Commission (EC), suggestions from the New Zealand embassy in Brussels, activities arising from MoRST's global links strategy, and a report to the New Zealand Cabinet by Minister of Research, Science, and Technology Pete Hodgson.

MoRST has taken steps to establish the position of a Science and Technology counselor based in the New Zealand embassy in Brussels. The Ministry anticipates the selection by the end of the year, with the successful candidate in place by the end of March 2004. The delegation that visited Brussels last summer highly recommended such a position. According to the position description for the coun-

selor's work, key tasks include: establishing and enhancing key relationships within the EU's research and innovation sectors; ensuring New Zealand researchers and businesses are aware of, and gain access to, funding opportunities provided through the European 6th Research Framework Programme (FP6); and ensuring that the New Zealand government is informed of all significant developments within the EU's research and innovation systems.

Another initiative proposed by the delegation was the registration of leading New Zealand researchers as FP6 project evaluators. The RDG expressed concern that while the EC has a large pool of evaluators, most are from the EU. With the increasing number and multinational nature of proposals, the EC is experiencing increasing difficulty finding evaluators who have no conflicts of interest. Working with the administrators of the Marsden Fund (a government research fund supporting "blue skies" research) and the New Zealand Embassy in Brussels, MoRST was able to provide details of over 80 Marsden Fund Principal Investigators to the RDG for consideration as evaluators.

Information on further opportunities and initiatives can be accessed through the MoRST Web site at [www.morst.govt.nz](http://www.morst.govt.nz).

### CAS, Shanghai Strengthen S&T Cooperation

President of the Chinese Academy of Sciences (CAS) Lu Yongxiang and the mayor of Shanghai, Han Zheng, attended the signing ceremony for the agreement of science and technology cooperation between CAS and the Shanghai Municipality on September 15 in Shanghai. The document sets new objectives for multi-directional, multilevel CAS–Shanghai cooperation, including a collaboration to promote the establishment of the Shanghai Synchrotron Radiation Facility, which they have jointly proposed to the central government. CAS and the Shanghai Municipality clarified their intent to further explore the cooperative possibilities in additional projects, including the establishment of a deep-ultraviolet free electron laser facility. □

### COHMAG Solicits Input for Report on High Magnetic Field Science

The Committee on Opportunities in High Magnetic Field Science (COHMAG), commissioned by the U.S. National Research Council, has issued a call for information and opinions from researchers in this area of study. COHMAG's mission is to produce a report on the facilities available to scientists worldwide for doing experiments at high magnetic fields (i.e., at fields above 12 T), the current state of the many scientific disciplines that use high-field magnets, the scientific opportunities these fields present, and the prospects for advances in related technologies. COHMAG can be contacted by e-mail at [cohmag@nas.edu](mailto:cohmag@nas.edu).

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