

inside

**European union organizes
for greater role**

**Taking nanotechnology
to market**

**New AML opens
doors to researchers**

Right: Shown here is the United Kingdom's National Physical Laboratory (NPL) in Teddington, Middlesex. It is similar in function to the U.S. National Institute of Standards and Technology's Advanced Measurement Laboratory, Gaithersburg, Maryland.



International Intrigue

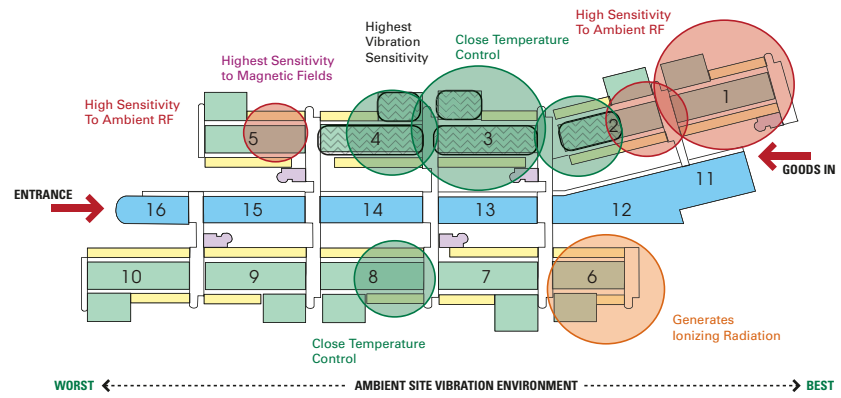
All Eyes on U.S. Nanotechnology

Sparked by the 2001 National Nanotechnology Initiative (NNI), the U.S. multi-agency R&D program is getting top billing in the global scientific community. The national movement to advance this tiny technology is on stage and in the spotlight as the international community observes.

“The U.S. is one of the very few countries taking the lead in nanotechnology research,” said Roger Stewart, HDR senior vice president. “The U.S. government has come forth with tremendous funding and support for this growing science, putting the U.S. on the cutting edge. The rest of the world is very interested in how we’re doing nanotechnology research, as well as building the research infrastructure to support the science.”



Left: View of the "street" between NPL Modules 2 and 12 from the the connecting bridge. **Right:** Scientific criteria of most significance to the building design.



The Department of Energy (DOE) model exemplifies the U.S. government's heavy investment in new user facilities, with five state-of-the-art nanotechnology labs now in various stages of development around the country, according to Ahmad Soueid, HDR senior vice president and principal for nanotechnology. Researchers are invited to submit proposals to conduct research at government-run user facilities. These facilities are available for free if their proposal is accepted and they publish their research results.

"Having the opportunity to work in one of these large, well-funded labs, scientists can perform leading-edge research in facilities specially designed to offer extreme control of temperature, humidity, vibration, and electromagnetics," Soueid said. For other countries, the concept of a laboratory without dedicated scientists is somewhat unusual.

The U.S. has the added advantage of more venture capital flow and companies willing to invest in potentially blockbuster scientific developments, Soueid said.

The European Scene

According to HDR's Bea Sennewald, who heads the company's London office, Europe tends to have smaller, less unified nanotechnology communities due to funding and the political structure of the European Union (E.U.)

"Because the U.S. is a single country, it seems much easier to centralize funding for facilities and get something going," she said. "U.S. politicians may lobby for a lab to be built in their state, but this is a much easier dynamic to work with than countries collaborating to decide which one will ultimately have a facility representing the entire E.U. While the E.U. has a large central fund for supporting research, there is not yet a central funding source for research facilities development."

Currently, each member country is responsible for its own facilities. For example, France is developing a new \$193 million nanotechnology center in Grenoble, and several other

countries (Spain, Italy, Netherlands, and Scandinavian countries) are moving toward developing similar centers, though at a smaller scale, Sennewald said.

"Without immediate payoff, construction of a nanotechnology research facility means a country has to have fairly deep pockets. In the U.K., the Department of Trade and Industry oversees a £90 million nanotechnology initiative with half earmarked for facilities, but it is currently structured to be distributed through several Regional Development Authorities. This will result in many smaller projects, rather than one or two shared central facilities," she said.

This is not to say that countries outside the U.S. are missing on the playing field or that the U.S. has a lead that will last forever. According to Soueid, there is real concern in Europe that, if left unchallenged, the U.S. will gain too much advantage and Europeans won't be able to catch up. They then could lose some of their best researchers and potential products to the U.S., he said.

"Recent years have witnessed a westward migration of scientists across the Atlantic Ocean," Soueid said. "Inadequate facilities and lower pay cause them to look for better career opportunities in the United States. Many of the academic post-doctoral positions in the U.S. are filled with foreign scientists as Americans turn away from such positions in favor of more lucrative industry-based jobs."

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As a result of this growing concern, there is a great deal of effort underway in the E.U. to build collaboration between countries to do the research and to establish funding for the necessary infrastructure.

Big Things Come in Big Labs

With the centralization of resources into a few major labs, the U.S. has the opportunity to develop larger labs with environmental controls and instrumentation found nowhere else, Soueid noted.

The \$235 million Advanced Measurement Laboratory (AML) at the National Institute of Standards and Technology (NIST) is the prime example. Recently finished, this lab is “the most environmentally stable lab in the world,” having specially designed critical spaces with temperature controlled to 0.01 degrees Celsius and vibration criteria requiring a velocity of 0.75µm/s for frequencies between 5 and 100 Hz.” Soueid said. (See information on the back on the new AML.)

“Because of the groundbreaking facility innovations accomplished at NIST, many other countries benchmark NIST and seek advice before beginning their facilities,” Soueid said. One such example is the U.K.’s National Physical Laboratory (NPL) in Teddington, Middlesex. Another is the University of Alberta’s National Institute for Nanotechnology in Canada. Others are the national labs of Mexico, Finland and The Netherlands.

From Research to Commercialization

The U.S. NNI is focused on bringing nanotechnology research to fruit by producing viable commercial products. Some products employing nanotechnology are in the marketplace now. However, according to the National Nanotechnology Coordination Office (NNCO), in its Supplement to the President’s FY 2004 Budget, understanding of the

properties of nanoscale materials and structures is still at a rudimentary level and traditional models for explaining material behavior do not apply at the nanoscale. In order to maximize the development of future innovations, the NNI has devoted a significant investment toward basic research to achieve a fundamental understanding of nanoscale properties and processes.

The NNCO further says that an important mechanism to bring about commercialization of nanotechnology is interaction among industry, academic and government researchers. This partnering and collaboration is encouraged by the NNI through the establishment or support of centers, networks and facilities that are available to researchers from all scientific sectors.

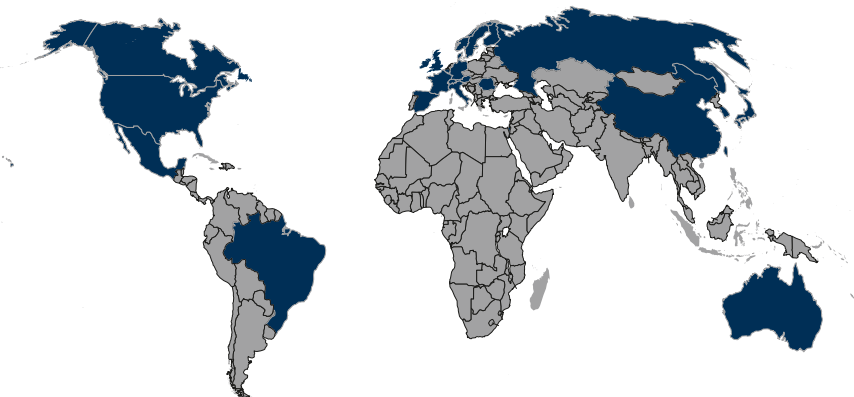
Grand Challenges Foster Knowledge-Sharing

A part of this mission is realized through NNI’s sponsorship of topical workshops for the international community, related to its nine Grand Challenge areas. (See www.nano.gov/html/research/nnigc.html) For example, in January this year, Soueid gave a presentation at the NNI’s Interagency Workshop on Instrumentation and Metrology. More than 200 metrologists from around the world attended, he said.

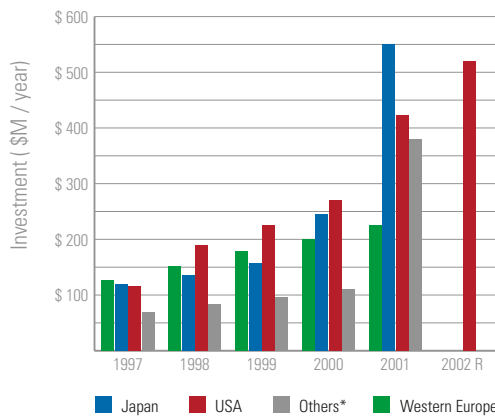
“Through these workshops, information exchange enables us to envision the future of measurements for buildings, a sort of ‘crystal ball’ with a focus on facilities,” he said.

The NNI held its third annual “From Vision to Commercialization” conference March 31 - April 2, 2004, in Washington, D.C. At that three day event, Dr. Mihail C. Roco, senior advisor for nanotechnology with the National Science Foundation, indicated that future NNI conferences will include even more international invitees than in the past, Soueid said.

Currently 30 countries are pursuing nanotechnology research.



Worldwide government funding for nanotechnology R & D (August 2001)



* "Others" include Australia, Canada, China, FSU, Korea, Singapore, Taiwan

Adapted from "International Strategy for Nanotechnology Research and Development," Dr. Mihail C. Roco, senior advisor for nanotechnology, U.S. National Science Foundation



National Institute of Standards and Technology Advanced Measurement Laboratory ...at a Glance

Gaithersburg, Maryland

The most environmentally stable advanced technologies in the world can now be found at the new Advanced Measurement Laboratory (AML) of the National Institute of Standards and Technology (NIST). The new facility in Gaithersburg, Maryland, gives NIST and its partners in U.S. industry access to research and development capabilities unequalled in the world for research in such 21st century applications as nanotechnology, semiconductors, biotechnology, advanced materials, quantum computing and advanced manufacturing.

The new \$235 million building, completed in December 2003 and officially opened in June 2004, features five separate wings with stringent environmental controls on particulate matter, temperature, humidity, vibration and electromagnetic interferences. The design includes:

- 536,500 SF
- One occupiable scientific level in each of the five wings
- 187 instrument lab modules and 151 metrology lab modules featuring:
 - 48 precision temperature control labs (± 0.1 degree C or ± 0.01 degree C)
 - 18 extremely low vibration labs with active or passive isolation systems
 - 33,000-SF clean room, Class 100, upgradeable to Class 10
 - Humidity control with variations of no more than one percent in specialized areas

Research at NIST covers a broad spectrum. Over 100 different types of laboratories were identified during initial AML user interviews. Classifying the spaces into a few general categories helped to establish a modular concept for lab space organization and utility distribution. With this modular approach, space and utility can be readily modified for changing research efforts of the future.