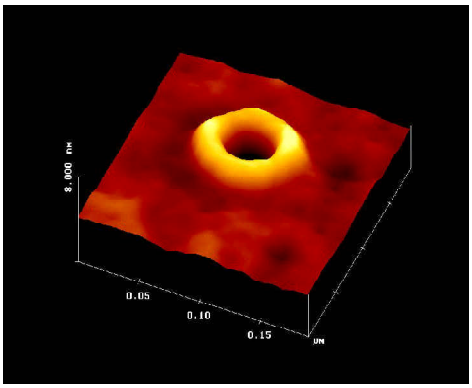
Science.

Technology.

Innovation.

The Nano Revolution

Contributing to a small new world



Formed by a collection of nano-dots, each so small that about 100,000 of them would fit on the head of a pin, these metal oxide nano-rings built themselves or "self assembled." They have unique electronic properties that can be changed by adjusting the material size, composition and how they interact with the surface material. At Pacific Northwest National Laboratory, researchers are investigating the potential use of nano-rings and nano-dots for generating hydrogen on demand for energy applications.

In 1959, future Nobel Prize winner Richard Feynman predicted the revolution of nanoscience and nanotechnology with the words, "There is plenty of room at the bottom." Today, more than 40 years later, this significant new area of science and technology is finally moving into the spotlight.

Nanoscience and nanotechnology bring a new dimension to solving environmental problems, advancing medicine, and reaching new heights in technical achievements. When system dimensions approach the range of one billionth of a meter, or a nanometer, many useful properties emerge. Researchers are exploring how to build materials with these properties "from the bottom up," in a way similar to nature.

The ability to precisely combine and manipulate single atoms and molecules presents tremendous opportunities to address a wide range of society's critical challenges. For example, this new knowledge will revolutionize

- disease detection and treatment
- energy production
- computer efficiency
- environmental cleanup
- food safety
- materials and manufacturing

In the midst of the revolution

The federal government recognized the potential beneficial impacts that nanoscience and technology can bring to society and dedicated $497 million to a National Nanotechnology Initiative in the 2001 fiscal year.

Researchers at the U.S. Department of Energy's Pacific Northwest National Laboratory are helping pave the way for this revolution. We are contributing scientific and technical resources to the nation's knowledge and understanding of the phenomena that occur on the nanoscale. In October 2000, PNNL formed its own Nanoscience and Technology Initiative to concentrate our capabilities and further the contributions we can make in this area.

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

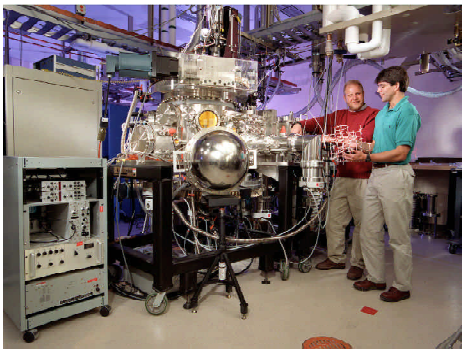
Our researchers have access to the world-class resources of the William R. Wiley Environmental Molecular Sciences Laboratory, a DOE national user facility with leading-edge instrumentation and equipment.

PNNL is committed to moving science out of the laboratory through new applications and products. As our scientists, engineers and technologists discover new properties and how they can be applied, they are pressing these gains in nanoscience forward for use in new devices and systems.

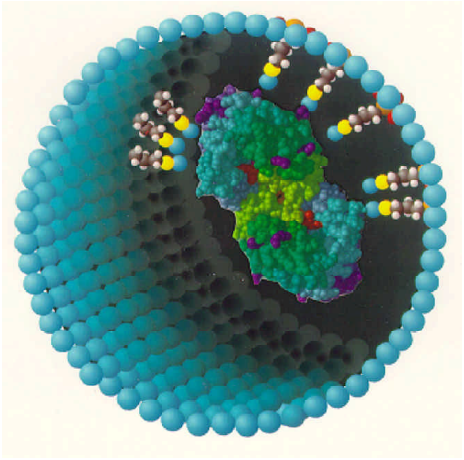
PNNL's contributions

Taking an approach that encompasses a network of technical disciplines, PNNL's Nanoscience and Technology Initiative is focused specifically on these four areas:

- **Nanosynthesis**—creating materials with tailored nanoscale features. For example, our researchers are growing nanoscale magnetic semiconducting oxides that could be used in next-generation computing systems



This equipment, used to create nano-structures and learn more about their properties, is among the resources available at the Environmental Molecular Sciences Laboratory, a U.S. Department of Energy national user facility operated by Pacific Northwest National Laboratory.



Researchers at Pacific Northwest National Laboratory are exploring how clusters of enzymes attached or immobilized in nanosized pores can be used in chemical threat detection and abatement and for medical applications.

- **Characterizing materials on the nanoscale**—analyzing and building an understanding of features on the nanoscale, how they can be manipulated and how they might be useful.
- **Nanobiology**—applying nanoscience to biologic applications. For example, we are conducting research to understand the properties of individual biomolecules and their function in living cells.
- **Theory, modeling and computation**—using high-performance computers to guide the design, creation and testing of nanoscale systems, supporting and advancing experimental efforts.

Joining forces

We know that collaboration and teamwork are essential to addressing the complex technical challenges facing society. At PNNL, we welcome the opportunity to partner with other laboratories, universities and industry. Researchers at the University of Washington and PNNL have been collaborating on nanotechnology research to investigate the proteins that affect mineral levels in bones, teeth and kidney stones.

In April 2001, the signing of a formal agreement between UW and PNNL officially created the Joint Institute for Nanoscience and Nanotechnology. Through this "virtual" institute, both organizations can leverage their knowledge and equipment to complement and strengthen their capabilities.

The Joint Institute allows students enrolled in UW's nanotechnology doctoral program and professors to conduct research at PNNL, giving them access to the Laboratory's unique equipment and instrumentation. The agreement also gives the university the opportunity to bring on PNNL scientists as university faculty.

For more information contact:

Don Baer
Pacific Northwest National Laboratory
P.O. Box 999
Richland, WA 99352
Phone: 509-376-1609
E-mail: don.baer@pnl.gov

Loni Peurrung
Phone: 509-373-0201
E-mail: loni.peurrung@pnl.gov

David Brenchley
Phone: 509-375-6515
E-mail: dr.b@pnl.gov

Please see our website:
http://www.pnl.gov/nano/

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