NSF Tipsheet
National Science Foundation • Office of Legislative and Public Affairs

News Media Tip - November 5, 2001

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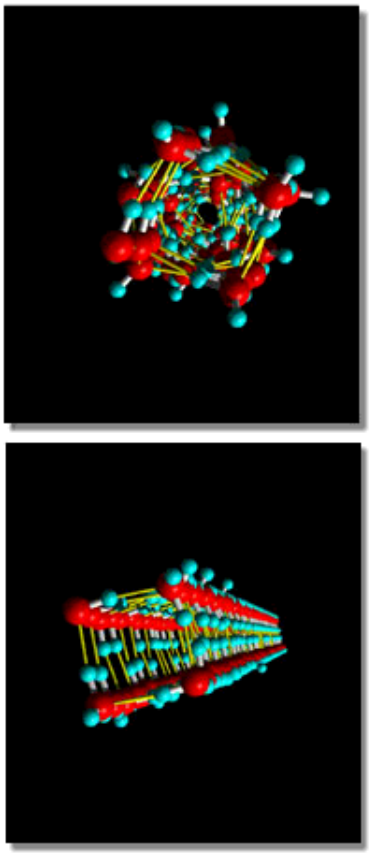
Scientists Predict New Structures for Water Ice

A research team partially funded by the National Science Foundation (NSF) predicts that water frozen within minute carbon tubes will form previously unknown crystal structures. The insight into how water behaves on a nanometer (one billionth of a meter) scale may affect the next generation of nanoelectronic devices, biochips, and studies of how water shapes proteins.



The above images show how water may crystallize within a carbon nanotube. The large spheres are oxygen atoms, small

Using computer modeling and thermodynamic analyses, researcher Xiao Cheng Zeng, of the University of Nebraska-Lincoln, and his colleagues in Japan and the United States, simulated the crystallization of ice within the confined space of a carbon nanotube. Allowed to grow only lengthwise, slight increases in tube diameter resulted in four new tubular ice structures: square (the smallest), pentagonal, hexagonal, and heptagonal (the largest). The researchers also predicted that the nearly one-dimensional environment could yield a solid-liquid "critical point," a condition beyond which the liquid and solid phases of water would merge into one supercritical phase. That condition had only been previously seen -- in any substance -- at transitions between liquids and gasses.

Because the findings show how water operates within

tiny, confined pores, future studies may help reveal how water interferes with carbon-nanotube semiconductors. The findings may also guide research to shrink current microtube devices, such as machines that deposit DNA onto biochips. Water is also critical in binding proteins together and helping them to maintain their shape. Understanding the role of water at the scale of protein molecules will help researchers understand the structures and properties of these biological building blocks. **[Josh Chamot]**

large spheres are oxygen atoms, small spheres are hydrogen atoms, short bars are covalent bonds within individual water molecules, and long bars are hydrogen bonds between separate water molecules. The image on the top shows a disordered array of water molecules as they would appear if confined within a 1.11 nanometer carbon nanotube. The image on the bottom shows the same molecules after being frozen within the tube, yielding an elongate ice tube with a square cross-section. The cross-section consists of four water molecules, with the oxygen atoms positioned at each corner.

Graphic credit: Dr. Xiao Cheng Zeng of the University of Nebraska-Lincoln

Arecibo Named a Historic Engineering Landmark

Two nationally prominent professional organizations have designated NSF's Arecibo Observatory in Puerto Rico as a landmark in the history of engineering.

Photo credit: courtesy of the NAIC-Arecibo Observatory, a facility of the NSF, and David Parker/Science Photo Library.

The American Society of Mechanical Engineers recently named Arecibo a Historical Mechanical Engineering Landmark. The Institute of Electrical and Electronics Engineers named the observatory a Milestone in Electrical Engineering. Joseph Bordogna, NSF's deputy director, accepted the joint honors at the observatory on November 3.

The massive radio antenna, which boasts a receiver dish 305 meters (1000 feet) wide, is the world's largest radio astronomy facility. Designed by William Gordon, formerly of Cornell University, its construction and operation led to electrical engineering advances in antenna design, signal processing and electronic instrumentation.

In mechanical engineering, Arecibo produced advances in antenna suspension and drive systems. The drive system positions the enormous antenna with millimeter precision.

Arecibo has produced discoveries about Earth's ionosphere and astronomical objects such as planets outside of our solar system, pulsars and near-Earth asteroids. **[Amber Jones]**

For more information about Arecibo, see: www.naic.edu