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New Technology, a CD could hold up to one hundred times more information Manipulating light waves, or electromagnetic radiation, has led to many technologies, from cameras to lasers to medical imaging machines that can see inside the human body. Scientists at the University of Michigan have developed a way to make a lens-like device that focuses electromagnetic waves down to the tiniest of points. The breakthrough opens the door to the next generation of technology, said Roberto Merlin, professor of physics at U-M. His research on the discovery will be published online July 12 in Science Express.

Nanotechnology Oversight, EPA The U.S. Environmental Protection Agency released its current thinking on whether a nanoscale material is a “new” or “existing” chemical substance under the Toxic Substances Control Act (TSCA). In the document, TSCA Inventory Status of Nanoscale Substances—General Approach, EPA states that it will maintain its practice of determining whether nanoscale substances qualify as new chemicals under TSCA on a case-by-case basis.

Solid-State Membranes A semiconductor membrane designed by researchers at the University of Illinois could offer more flexibility and better electrical performance than biological membranes. Built from thin silicon layers doped with different impurities, the solid-state membrane also could be used in applications

Nanoscale Propeller with Molecule-Sized Blades

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The ability to pump liquids at the cellular scale opens up exciting possibilities, such as precisely targeting medicines and regulating flow into and out of cells. But designing this molecular machinery has proven difficult.

Now chemists at the University of Illinois at Chicago have created a theoretical blueprint for assembling a nanoscale propeller with molecule-sized blades.

The work is featured in Research Highlights in the July 12 issue of Nature and was described in the June 28 cover story of Physical Review Letters.

Using classical molecular dynamics simulations, Petr Král, assistant professor of chemistry at UIC, and his laboratory coworkers were able to study realistic conditions in this microscopic environment to learn how the tiny propellers pump liquids.

While previous research has looked at how molecular devices rotate in flowing gases, Král and his group are the first to look at molecular propeller pumping of liquids, notably water and oils.

"We want to see what happens when the propellers get to the scale where it's impossible to reduce the size of the blades any more," said Král.

Král's group found that at the molecular level -- unlike at the macro level -- the chemistry of the propeller's blades and their sensitivity to water play a big role in determining whether the propeller pumps efficiently or just spins with little effect. If the blades have a hydrophobic, or water-repelling nature, they pump a lot of water. But if they are hydrophilic -- water-attracting -- they become clogged with water molecules and pump poorly.

"Pumping rates and efficiencies in the hydrophilic and hydrophobic forms can differ by an order of magnitude, which was not expected," he said.

The UIC researchers found that propeller pumping efficiency in liquids is highly sensitive to the size, shape, chemical or biological composition of the blades.

"In principle, we could even attach some biological molecules to the blades and form a propeller that would work only if other molecules bio-compatible with the blades are in the pumped solution," he said.

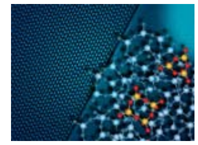
The findings present new factors to consider in developing nanoscale liquid-pumping machines, but Král added that such technology probably won't become reality for several years, given the difficult nature of constructing such ultra-small devices.

Král's laboratory studies how biological systems, like tiny flagella that move bacteria, offer clues for building motors, motile systems and other nanoscale devices in a hybrid environment that combines biological and inorganic chemistry.

"The 21st century will be about hybrid biological and artificial nanoscale systems and their mutual co-evolution," Král predicts. "My group alone is working on about a half-dozen such projects. I'm optimistic about such nanoscale developments."

such as single-molecule detection, protein filtering and DNA sequencing. “By creating nanopores in the membrane, we can use the membrane to separate charged species or regulate the flow of charged molecules and ions, thereby mimicking the operation of biological ion channels,” said lead researcher

Nanostructures, Improved Possibilities For Microelectronics and Membranes Naturally occurring



structures like birds' bones or tree trunks are thought to have evolved over eons to reach the best possible balance between stiffness and density. But in a June paper in Nature Materials, researchers at Sandia National Laboratories and the University of New Mexico (UNM), in conjunction with researchers at Case Western Reserve and Princeton Universities, show that nanoscale materials self-assembled in artificially determined patterns can improve upon nature's designs.

Molecular Switch Research The electronics industry believes that when it comes to circuits, smaller is better -- and many foresee a future where electrical switches and circuits will be as tiny as single molecules. Turning this dream into reality may be a step closer, thanks to a collaboration between chemists at the University of Illinois at Chicago and Japan's RIKEN research institute. The international team successfully formed a single chemical bond on a single molecule, then broke that bond to restore the original molecule -- without disturbing any bonds to adjacent atoms within the molecule.

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