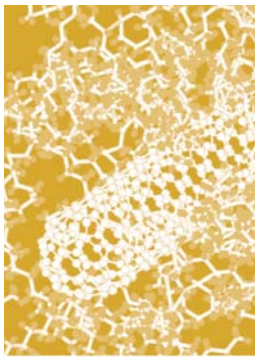
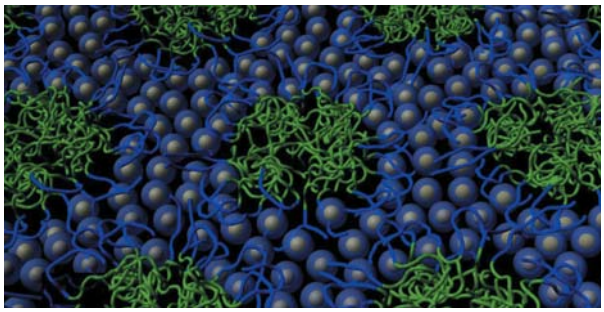


EMERGING TECHNOLOGY

Coated nanoparticles self-assemble into complex parts

A method to self-assemble metals into complex configurations with structural details about 100 times smaller than a bacterial cell by guiding metal particles into the correct form with soft polymers has reportedly been developed by researchers at Cornell University, Ithaca, N.Y.



First, metal nanoparticles measuring about two nanometers in diameter, are coated with an organic material known as a ligand. The jacketed metal atoms are then put in a solution containing block co-polymers, a kind of nano-scaffolding material. The ligands allow for the metal nanoparticles to be dissolved in such a solution.

A block co-polymer is made up of two different long chains, or blocks, of molecules linked together to form a predictable pattern. In the experiment, ligand-coated platinum nanoparticles (shown as blue and gray balls) were nestled among the block co-polymers (shown as blue and green strands). The result was a platinum structure with uniform hexagonal pores, each on the order of 10 nm across, a much larger diameter than previous attempts have been able to produce. Platinum is the best available catalyst for fuel cells, and a spacious pore structure allows fuel to flow through and react over a larger surface area.

For more information: Ulrich B. Wiesner, Cornell University, Ithaca, NY 14853; tel: 607/255-3487; ubw1@cornell.edu; www.cornell.edu.

Permeable glass microspheres feature Ångstrom-scale pores

Porous glass microballoons whose thin outer walls contain interconnected porosity have reportedly been developed by scientists at the Savannah River National Laboratory, Aiken, S.C. The spheres are 2 to 100 microns in diameter, and the wall porosity can be produced and varied on a scale of 100 to 3000 Ångstroms. Hydrogen or other reactive gases can then enter the microspheres through the pores, creating a relatively safe, contained, solid-state storage system.

Called porous wall-hollow glass microspheres (PW-HGM), the porosity can be altered and controlled in various ways that allow the spheres to filter mixed gas streams within a system. In addition, their mechanical properties can be altered so they flow like a liquid. This suggests that it would be compatible with an existing infrastructure that currently transports, stores, and distributes liquids, such as the existing gasoline distribution and retail network.

For more information: Steve Wach, Savannah River National Laboratory, Savannah River Site, Aiken, SC 29808; tel: 803/725-3020; www.srnl.doe.gov.

Nanostructures built of magnetic materials

A process to build complex, three-dimensional nanoscale structures of magnetic materials such as nickel or nickel-iron alloys via techniques compatible with standard semiconductor manufacturing has reportedly been developed at the National Institute of Standards and Technology, Gaithersburg, Md. The process is a variation of a technique called "Damascene metallization," which builds complex three-dimensional copper interconnects across multiple layers in advanced, large-scale integrated circuits.

Named after the ancient art of creating designs with metal-in-metal inlays, the process involves etching complex patterns of horizontal trenches and vertical "vias" in the surface of the wafer, then filling them with copper by an electroplating process.

The high aspect-ratio features may range from tens of nanometers to hundreds of microns in width. Once filled, the surface of the disk is ground and polished down to remove the excess copper, leaving behind the trench and via pattern.

The new process makes it feasible to create complex

BRIEFS

ASTM's online edition of the **ASTM Dictionary of Engineering Science and Technology** provides 76,000 terms contained in more than 12,000 ASTM standards. The definition of each term was written by technical experts in their field. www.astm.org.

Entegris Inc. introduces a broad portfolio of substrate handling and contamination control product lines for photovoltaic fabs. These products enable the productivity, performance and technology of solar cell-making operations through advanced materials science expertise. www.entegris.com

Northwestern University researchers have reportedly developed transistors based on a CVD dielectric material called a self-assembled nanodielectric (SAND). It has been lifted into outer space on the space shuttle Endeavour and attached to the outside of the International Space Station for radiation testing. www.northwestern.edu

Pacific Northwest National Laboratory researchers have developed the Multi-Scale Materials Integrated Processing Method, the only integrated, single-step materials fabrication method that generates nano- to macro-sized materials with identical chemistry characteristics.
www.pnl.gov

SolFocus solar arrays generate more power than conventional solar panels but use just one-thousandth as much expensive semiconductor material. Curved mirrors focus sunlight onto one-square-centimeter solar cells, concentrating the light 500 times and improving efficiency.
www.solfocus.com

Thermo Fisher Scientific Inc. has been awarded an R&D 100 Award for the handheld Thermo Scientific Niton XL3t XRF analyzer. It was selected as one of the 100 most technologically significant products introduced into the marketplace over the past year.
www.thermofisher.com

three-dimensional MEMS devices such as inductors and actuators that combine magnetic alloys with nonmagnetic metallizations such as copper interconnects on existing production systems.

For more information: T. P. Moffat, National Institute of Standards and Technology, 100 Bureau Drive, Gaithersburg, MD 20899; tel: 301/975-2143; Thomas.moffat@nist.gov; www.nist.gov.

Carbon nanotube film is better catalyst than platinum

A film of carbon nanotubes may be able to replace two of the layers normally in a solar cell, with improved performance at a lower cost, say researchers at the Santa Fe Institute, Santa Fe, N.M., in collaboration with others at Michigan State University, Ann Arbor, and Columbia University, New York. The scientists found that adding defects gives the nanotubes the properties needed.

Currently, these solar cells, called dye-sensitized solar cells, have a transparent film made of an oxide that is applied to glass and conducts electricity. In addition, a separate film made of platinum acts as a catalyst to speed the chemical reactions.

However, the oxide films cannot easily be applied to flexible materials: they function much better on a rigid and heat resistant substrate such as glass. In addition, expensive equipment is necessary to create the platinum films.

Therefore, the team decided to make a single layer of carbon nanotubes that could carry out the functions of both the oxide and platinum layers. Previous theory had suggested that materials may function better as catalysts when they have tiny defects, providing sites for chemicals to attach. So the researchers tried exposing the carbon nanotubes to ozone, which roughs them up a bit. Very thin films, they found, became dramatically better catalysts, with more than ten-fold improvement, very close to that of platinum.

For more information: Jessika Trancik, Santa Fe Institute, Santa Fe, NM 87501; tel: 505/946-2794; trancik@santafe.edu; http://www.santafe.edu/~trancik.

Metamaterial absorbs all of the light that strikes it

A highly-engineered metamaterial capable of absorbing all of the light that strikes it has reportedly been designed by a team of scientists from Boston College and Duke University. Tiny geometric surface features capture the electric and magnetic properties of a microwave to the point of total absorption.

"Three things can happen to light when it hits a material," says Boston College physicist Willie J. Padilla. "It can be reflected, as in a mirror. It can be transmitted, as with window glass. Or it can be absorbed and turned into heat. This metamaterial has been engineered to ensure that all light is neither reflected nor transmitted, but is turned completely into heat and absorbed. It shows we can design a metamaterial so that at a specific frequency it can absorb all of the photons that fall onto its surface."

The group used computer simulations based on prior research to design resonators able to couple individually to electric and magnetic fields to absorb all incident radiation. Because its elements can separately absorb the electric and magnetic components of an electromagnetic wave, the "perfect metamaterial absorber" created by the researchers can be highly absorptive over a narrow frequency range.

For more information: Willie J. Padilla, Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA 02467; tel: 617/552-3575; willie.Padilla.1@bc.edu; www2.bc.edu/~padillaw.

The U.S. Department of Energy's National Renewable Energy Laboratory and A123Systems have teamed up to develop safe, less expensive, more powerful and longer lasting batteries for hybrid-electric vehicles. The Laboratory and the battery maker have signed a three-year, Cooperative Research and Development Agreement. By better understanding the thermal behavior of advanced batteries, NREL researchers will help A123Systems engineers design improved thermal management systems, optimize the design of the battery cell, and develop a battery pack that's lighter, cheaper, and more durable. www.doe.nrel.gov