

# Materials News

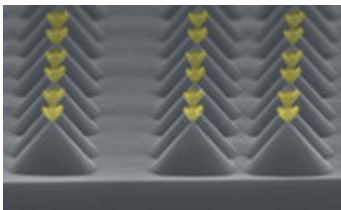
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### [Lighting a fire under hard drives](#) (ScienceNOW)

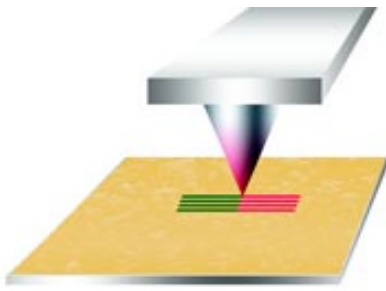


*Credit: Stanciu et al., Physical Review Letters*

Ultra-rapid pulses of polarized light fired from lasers, new tests show, can outperform conventional magnetic data writers by as much as two orders of magnitude. Researchers used laser light to write data to a magnetic hard drive at very high speeds. The technique works because the photons transmitted by the laser actually carry angular momentum, allowing them to interact with the hard drive. Also, each laser pulse heats a tiny space on the disk just enough to make changing its polarity--thereby storing a bit of data--a little easier.

[*All-Optical Magnetic Recording with Circularly Polarized Light*, *Phys. Rev. Lett.* **99**, 047601 (2007)]  
(September 12, 2007)

### [Thermochemical nanolithography used to draw nanoscale features quickly](#) (Georgia Tech)



Credit: Georgia Tech

A new technique for nanolithography has been developed that is extremely fast and capable of being used in a range of environments including air (outside a vacuum) and liquids. Researchers have demonstrated the technique, known as thermochemical nanolithography, as a proof of concept. The technique is surprisingly simple. Using an atomic force microscope, the researchers heat a silicon tip and run it over a thin polymer film. The heat from the tip induces a chemical reaction at the surface of the film. This reaction changes the film's chemical reactivity and transforms it from a hydrophobic substance to a hydrophilic one that can stick to other molecules. The technique is extremely fast and can write at speeds faster than millimeters per second.

[To be published in [Nano Letters](#)  
(September 11, 2007)]

### Biodegradable polymers replace viruses to deliver genes

(MIT)



Credit: MIT - Jordan Green

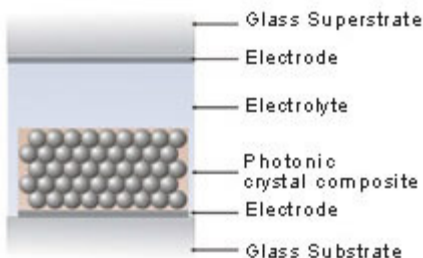
In work that could lead to safe and effective techniques for gene therapy, researchers have found a way to fine-tune the ability of biodegradable polymers to deliver genes. The effort focuses on creating gene carriers from synthetic, non-viral materials. The scientists focused on three poly (beta-amino esters), or chains of alternating amine and diacrylate groups, which had shown potential as gene carriers. They hoped to make the polymers even more efficient by modifying the very ends of the chains. When mixed together, these polymers can spontaneously assemble with DNA to form nanoparticles. The polymer-DNA nanoparticle can act in some ways like an artificial virus and deliver functional DNA when injected into or near the targeted tissue.

[[Combinatorial Modification of Degradable Polymers Enables Transfection of Human Cells Comparable to Adenovirus](#), *Advanced Materials*,  
Published Online: 6 Sep 2007]

(September 11, 2007)

### Electronic-paper formed using photonic ink

(Technology Review)



Credit: Nature Photonics

Scientists have used photonic crystals to create a novel type of flexible electronic-paper display. Unlike other such devices, the photonic-crystal display is the first with pixels that can be individually tuned to any color. The new P-Ink works by controlling the spacing between photonic crystals, which affects the wavelengths of light they reflect. Each pixel in a display consists of hundreds of silica spheres. Each of these photonic crystals is about 200 nanometers in diameter and embedded in a spongelike electroactive polymer.

[*Photonic-crystal full-colour displays*, *Nature Photonics* 1 , 468 - 472 (2007)]

(September 7, 2007)

### Probe maps individual atoms in semiconductor

(Royal Society of Chemistry)

Troublesome clusters of dopant atoms have been 'seen' for the first time. Researchers have drawn up the first 3D maps of the individual atoms in a semiconductor. They used atom probe tomography (APT) to locate individual atoms of dopant, in this case arsenic, in silicon. They were able to show that the arsenic atoms were forming spheroidal clusters around defects in the silicon.

[*Imaging of Arsenic Cottrell Atmospheres Around Silicon Defects by Three-Dimensional Atom Probe Tomography*, *Science* 7 September 2007:

Vol. 317. no. 5843, pp. 1370 - 1374]

(September 7, 2007)

### Improved e-jet printing provides higher resolution, more versatility

(University of Illinois)

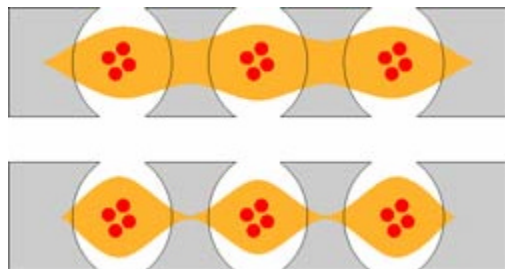
Unlike conventional ink-jet printers, which use heat or mechanical vibrations to launch liquid droplets through a nozzle, e-jet printing uses electric fields to pull the fluid out. Although the concept of electric-field induced flow is not new, a research team has now exploited this phenomenon using nanoscale nozzles and precision control of electric fields to achieve unprecedented levels of resolution. The new e-jet printing head consists of a gold-coated microcapillary nozzle (with a diameter as small as 300 nanometers) mounted on a computer-controlled mechanical support. An organic, Teflon-like coating on the gold ensures the ink flows cleanly out the nozzle toward the target. Tiny droplets of ink eject onto a moving substrate to produce printed patterns. Lines with widths as narrow as 700 nanometers, and dots as small as 250 nanometers, can be achieved in this fashion.

[*High-resolution electrohydrodynamic jet printing*, *Nature Materials*, Published online: 5 August 2007 | doi:10.1038/nmat1974]

(September 7, 2007)

### Photons could impersonate electrons

(Physical Review Focus)



Credit: M. Hartmann, Imperial College, London

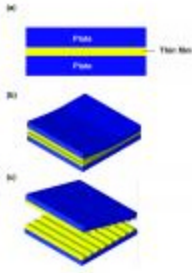
Photons ordinarily pass through one another, but they can sometimes affect each other through atom intermediaries. A research team has now proposed a way to make such atom-induced interactions ten times stronger than ever thought possible. The scheme might allow researchers to make strange new kinds of matter made entirely of light and to use them in probing the physics of quantum liquids and solids more closely than ever before.

[*Strong Photon Nonlinearities and Photonic Mott Insulators*, *Phys. Rev. Lett.* **99** , 103601 (2007)]

(September 6, 2007)

### Low-cost recipe for patterning microchips

(Eurekalert/Princeton University)



Credit: Stephen Chou/Princeton University

A simple, low-cost technique to form nanoscale grooves on microchips has been developed that results in the self-formation of periodic lines, or gratings, separated by as few as 60 nanometers on microchips. The process is called fracture-induced structuring. First, a thin polymer film is painted onto a rigid plate, such as a silicon wafer. Then, a second plate is placed on top, creating a polymer sandwich that is heated to ensure adhesion. Finally, the two plates are pried apart. As the film fractures, it automatically breaks into two complementary sets of nanoscale gratings, one on each plate. The distance between the lines, called the period, is four times the film thickness.

[[Self-formation of sub-60-nm half-pitch gratings with large areas through fracturing](#), *Nature Nanotechnology* 2, 545 - 548 (2007)]  
(September 5, 2007)

### DNA used as a template for nanolithography

(Small)

DNA is looked upon as a promising building block for fabricating microelectronic circuits from the bottom up. Now a team of researchers propose the marriage of DNA self-assembly with standard microfabrication and lithography tools to form features such as nanochannels, nanowires, and nanoscale trenches. They have developed a method to use DNA molecules as templates to define patterns on substrates. The researchers deposit metal films over DNA molecules aligned on a substrate. The DNA molecules essentially act as nanostencils to define sub-10-nm-sized patterns on the substrate. The researchers call this process "DNA shadow nanolithography" because the metal film is deposited at an angle and the shadow cast by the DNA molecules defines the dimensions of the features on the substrate.

[[DNA Shadow Nanolithography](#), *Small*, Volume 3, Issue 9, Pages 1534 - 1538]  
(September 5, 2007)

### Diamond stabilization of ice at human body temperature

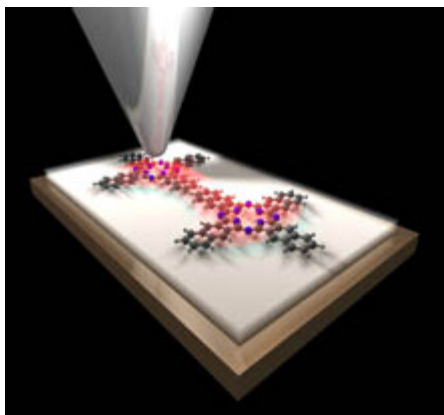
(Physics World)

Computer simulations have been used in a new study to show that diamond surfaces implanted with sodium atoms can sustain very thin layers of ice at temperatures up to 37°C. The ice covering could help to make artificial medical implants more compatible inside the human body. In thin diamond coatings, by encouraging dipole interactions with the surface, the sodium layer would allow a layer of water over 2 nm thick to stay frozen on the surface, thus providing a biologically-compatible shield from the diamond beneath.

[[Diamond stabilization of ice multilayers at human body temperature](#), *Phys. Rev. E* 76, 020501(R) (2007)]  
(September 5, 2007)

### New type of molecular switch does not alter shape

(Technology Review)

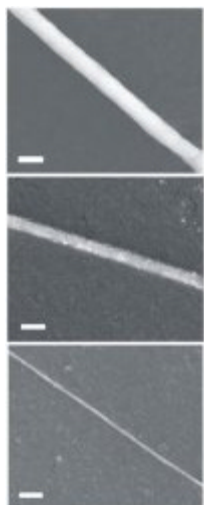


Credit: IBM Zurich Research Laboratory

Scientists have created a novel molecular switch that is able to turn on and off without altering its shape. Researchers have been working to use individual molecules as electronic switches. Such efforts have so far involved molecular processes that in some way deform the geometric shape of the molecule. The problem is that changing the molecule's shape makes it difficult to link them together as switches. In the new work, the scientists have exploited the atomic changes that take place at the center of a molecular cage, which does not alter the molecule's overall structure.

[[Current-Induced Hydrogen Tautomerization and Conductance Switching of Naphthalocyanine Molecules](#), *Science* 31 August 2007: Vol. 317. no. 5842, pp. 1203 - 1206]  
(September 4, 2007)

#### Directed electrochemical nanowire assembly allows diameter-tunable nanowires (NanotechWeb)



Credit: Oklahoma State University

Most techniques for controlling nanowire diameter require two processing stages: one to grow the nanowire and another to make the connection with the host device. Scientists now claim that they can complete the task in a single step and are using the method to probe intracellular signalling pathways. Dubbed directed electrochemical nanowire assembly (DENA), the new process involves passing an alternating voltage between sharp electrodes immersed in concentrated salt solution. The waveform induces electrochemical deposition between the two electrical contacts and gives rise to a perfectly formed nanowire. To control the diameter of the nanowire, researchers simply dial up the appropriate frequency on a signal generator connected to the setup's voltage amplifier – the higher the frequency, the smaller the diameter.

[[Directed growth of diameter-tunable nanowires](#), *Nanotechnology* 18 365302]  
(September 4, 2007)

#### Spallation neutron source sets record (Associated Press)

The Spallation Neutron Source (SNS) facility at Oak Ridge, Tennessee, though still powering up, has established a new mark as the world's most powerful accelerator-based source of neutrons for scientific research. The Laboratory announced Thursday that the SNS's neutron beam reached 183 kilowatts on Aug. 11, surpassing the 163-kilowatt record held by the ISIS facility at Rutherford Appleton Laboratory near Oxford, England. Although the capacity of the ISIS facility is being doubled, Oak Ridge officials said their accelerator is designed to produce up to 10 times more neutrons than now.  
(August 31, 2007)

### Smallest-ever polymer crystals prepared

(Nature)

The smallest-ever polymer crystals have been prepared. Their surprising shape provides crucial evidence that might help explain how polymers crystallize. A research team has described the preparation of uniform-sized, single-crystal nanoparticles made from polyethylene, using a nickel-catalysed process that allows the polymer to be made in water. Under these conditions, nanoparticles of a uniform size form as soon as the polymerization reaction begins, and then quickly crystallize. The reaction is performed at 15 °C, which is more than 100 °C lower than the melting point of polyethylene; this is the lowest temperature at which anyone has been able to crystallize the polymer, including those using the freeze-drying experiments.

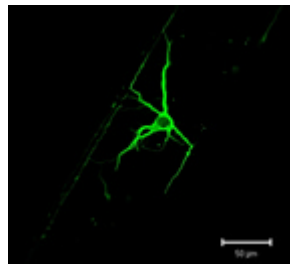
[*Materials science: Polymer crystals downsized*, *Nature* 448, 1006-1007 (30 August 2007);

*Single Lamella Nanoparticles of Polyethylene*, *Nano Lett.*, 7 (7), 2024 -2029, 2007]

(August 31, 2007)

### Microfluidic chambers advance the science of growing neurons

(University of Illinois)



Credit: University of Illinois

Researchers have developed a method for culturing mammalian neurons in chambers not much larger than the neurons themselves. The new approach extends the lifespan of the neurons at very low densities, an essential step toward developing a method for studying the growth and behavior of individual brain cells. The work included scaling down the size of the fluid-filled chambers of a molded gel of polydimethylsiloxane (PDMS) used to hold the cells as well as increasing the purity of the material used to form the chambers. A combination of techniques enabled the research team to grow postnatal primary hippocampal neurons from rats for up to 11 days at extremely low densities, compared to a previous maximum of two days at most.

[*Microfluidic devices for culturing primary mammalian neurons at low densities*, *Lab Chip*, 2007, 7, 987 - 994]

(August 31, 2007)

### Nanocomposite magnets warm up to get stronger

(NanotechWeb)

Researchers have developed a warm compaction technique to make small, powerful bulk permanent magnets out of iron-platinum nanoparticles. Unlike hot pressing, warm compaction takes place at modest temperatures, where metallic powders are chemically stable and no excessive grain growth occurs. Best magnets are produced at temperatures of about 600°C. A (BH)<sub>max</sub> of up to 16.3 MGOe can be reached, which is 25% higher than the value for conventional single-phase isotropic FePt magnets. Moreover, the samples have a density that is 95% of the theoretical density allowed for these materials, which makes them the densest bulk FePt magnets ever made with a nanoscale grain size.

[*Bulk FePt-based nanocomposite magnets with enhanced exchange coupling*, *J. Appl. Phys.* 102, 023908 (2007)]

(August 30, 2007)

### Nanowire coating for bone implants, stents

(Science Daily/Univ. Arkansas)

Researchers have found a simple, inexpensive way to create a nanowire coating on the surface of biocompatible titanium that can be used to create more effective surfaces for hip replacement, dental reconstruction and vascular stenting. Further, the material can easily be sterilized using ultraviolet light and water or using ethanol, making it useful in hospital settings and meat-processing plants. The researchers used an alkali and heat to create titanium oxide-based ceramic nanowires that coat the surface of a titanium medical device. They could control the length, the height, the pore openings and the pore volumes within the nanowire scaffolds by varying the time, temperature and alkali concentration in the reaction.

(August 29, 2007)

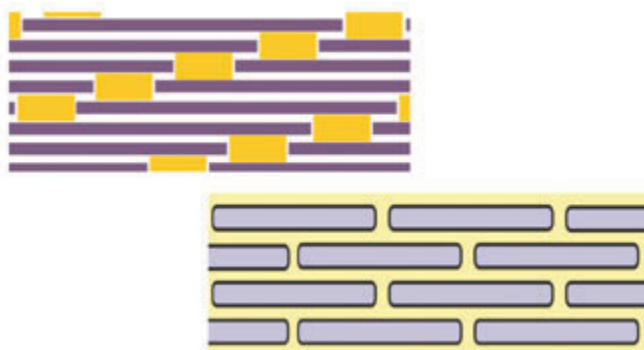
### Nanoscale device measures cellular forces

(Univ. Pennsylvania)

Researchers have designed a nanoscale system to observe and measure how individual cells react to external forces. By combining microfabricated cantilevers and magnetic nanowire technology to create independent, nanoscale sensors, the study showed that cells respond to outside forces and demonstrated a dynamic biological relationship between cells and their environment. The study also revealed that cells sense force at a single adhesion point that leads not to a local response but to a remote response from the cell's internal forces.

(August 29, 2007)

## Strength and toughness of bone probed at an atomistic level (MIT)



Credit: Markus Buehler

New research reveals for the first time the role of bone's atomistic structure in a toughening mechanism that incorporates two previously proposed theories. This combination mechanism allows for the sacrifice of a small piece of bone in order to save the whole, helps explain why bone tolerates small cracks, and seems to be adapted specifically to accommodate bone's need for continuous rebuilding from the inside out. [[Molecular nanomechanics of nascent bone: fibrillar toughening by mineralization](#), *Nanotechnology* 18 (2007) 295102] (August 29, 2007)

## Spin properties of individual atoms measured (Physics News Update)

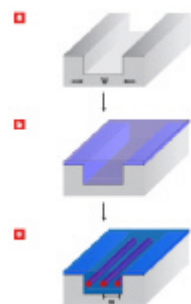
The spin properties of individual atoms added to a metal surface have been measured. Nanometer-sized triangular islands of cobalt were first formed on top of a copper crystal. The cobalt is ferromagnetic, which means that the spins of the cobalt atoms in the islands all line up together. Additional magnetic atoms sprinkled on top of the islands (adatoms) have spins that interact magnetically with the underlying cobalt, causing the adatom spins to either align or anti-align with the underlying island spins. Thus when a small amount of iron atoms (chromium atoms were also used) are dropped onto the islands they immediately become oriented (polarized) by contact with a cobalt island.

[[View image](#)]

[[Observing Spin Polarization of Individual Magnetic Adatoms](#), *Phys. Rev. Lett.* 99, 067202 (2007)]

(August 28, 2007)

## Polymers help build nanowire arrays (NanotechWeb)



Credit: Nature Nanotechnology

A method of using block co-polymers to pattern ordered metallic nanowire arrays on silicon has been developed. The process produces sub-20 nm elements and is compatible with existing silicon-based fabrication techniques. The researchers used the block co-polymer polystyrene-poly(2-vinylpyridine), or PS-P2VP, to pattern arrays of lines about 15 nm across that are around 36 nm apart. The material separates out to produce rods of P2VP embedded in a PS matrix when heated at 230°C for 24 hours. The rods self-assemble to form ordered structures that align along a pre-patterned trench, which is then divided into smaller features. The team has demonstrated arrays of gold, platinum and palladium wires.

[[Assembly of aligned linear metallic patterns on silicon](#), *Nature Nanotechnology* 2, 500 - 506 (2007)]

(August 28, 2007)

## Molecular level chirality switching using a laser (Royal Society of Chemistry)

Scientists are a step closer to the precise control of chirality at the molecular level thanks to a quantum chemical study. They have shown that a pre-oriented achiral molecule, possessing no chirality at all, could be selectively switched into both its left- and right-handed chiral forms using a finely-tuned sequence of laser pulses.

[[Laser-operated chiral molecular switch: quantum simulations for the controlled transformation between achiral and chiral atropisomers](#), *Phys.*

### High-speed pulses of laser light generated on silicon (Eurekalert)

Scientists have claimed to have built the world's first "mode-locked silicon evanescent laser." Mode-locked evanescent lasers can deliver stable short pulses of laser light that are useful for many optical applications. They previously created laser light from electrical current on silicon by placing a layer of indium phosphide (InP) above the silicon. In this new study, electrically-pumped lasers emitting 40 billion pulses of light per second were demonstrated, built on the hybrid silicon platform developed the year prior.

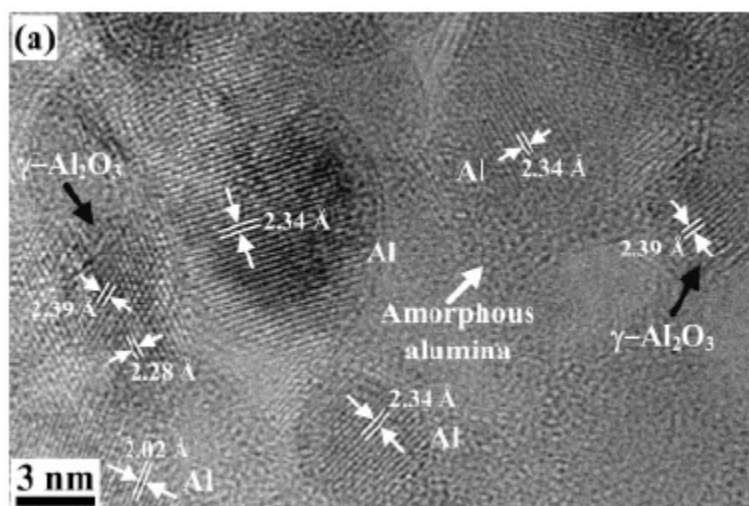
[*Mode-Locked Silicon Evanescent Lasers*, *Optics Express*, Vol. 15, Issue 18, 2007]  
(August 22, 2007)

### Superconducting interface formed between insulating oxides (Cornell University)

A superconducting phase has been created at the atomic interface of two oxides by exposing them to the extremely cold temperature of 200 millikelvin. The two oxides, lanthanum aluminate and strontium titanate, are ordinarily good insulators, but at their interface, the scientists were able to create a superconducting phase.

[*Superconducting Interfaces Between Insulating Oxides*, *Science*, Published Online August 2, 2007, DOI: 10.1126/science.1146006]  
(August 22, 2007)

### High strength ultrafine grained and nanostructured aluminum formed (NanotechWeb)



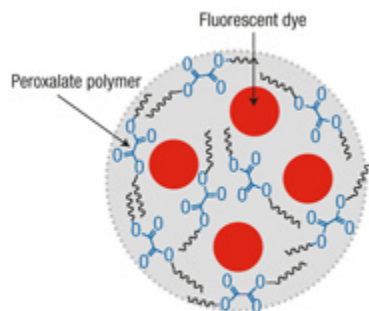
Credit: *Appl. Phys. Lett.*

A new high-strength material consisting of ultrafine nanograins of aluminium has been developed using a technique called ECAP (equal channel angular processing). The final material is truly nanocrystalline because it contains grains about 5 to 10 nm in size. It is a composite containing aluminium and aluminium oxide in both crystalline and amorphous forms, which gives the material its exceptional hardness of 2285 MPa and high strength of 740 MPa. In contrast, the strongest commercially available Al alloys have strengths between 600 and 650 MPa.

[*High strength ultrafine/nanostructured aluminum produced by back pressure equal channel angular processing*, *Appl. Phys. Lett.* 91, 031901 (2007)]  
(August 21, 2007)

### Polymer nanoparticle could help detect many diseases early (Georgia Tech)



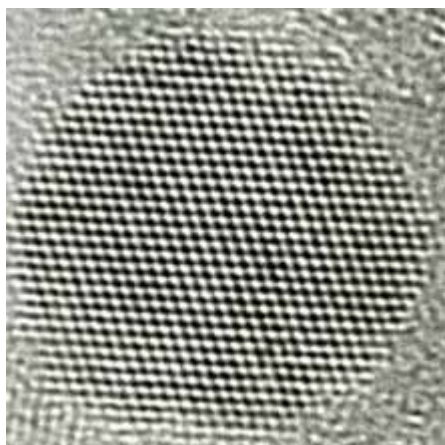


Credit: Georgia Tech

A polymer nanoparticle capable of detecting and imaging trace amounts of hydrogen peroxide in animals has been developed. The nanoparticles, thought to be completely nontoxic, could some day be used as a simple, all-purpose diagnostic tool to detect the earliest stages of any disease that involves chronic inflammation — everything from cancer and Alzheimer's to heart disease and arthritis. The nanoparticle is made of peroxalate esters and a fluorescent dye (pentacene) is encapsulated into the polymer. When the nanoparticles bump into hydrogen peroxide, they excite the dye, which then emits photons (or light) that can be detected. Hydrogen peroxide is thought to be over-produced by cells at the early stages of most diseases.

[*In vivo imaging of hydrogen peroxide with chemiluminescent nanoparticles*, *Nature Materials*, Published online: 19 August 2007] (August 20, 2007)

### Silicon nanocrystals for superefficient solar cells (Technology Review)



Credit: Arthur Nozik, National Renewable Energy Laboratory

A typical solar cell generates only one electron per photon of incoming sunlight. Some materials are thought to produce multiple electrons per photon, but for the first time, the same effect has been seen in silicon. Researchers showed that silicon nanocrystals can produce two or three electrons per photon of high-energy sunlight. The effect, they say, could lead to a new type of solar cell that is both cheap and more than twice as efficient as today's typical photovoltaics.

(August 16, 2007)

### Nanotubes guide phonons with ease (PhysicsWeb)

Tiny nanotubes made of carbon or boron nitride can act as phonon waveguides and retain their excellent heat transmission properties even when they are severely distorted, according to a new study. The researchers believe that the discovery could lead to the development of communications systems that use phonons to transmit information along nanotubes - in much the same way as light is used to carry data through optical fibers.

[*Nanotube Phonon Waveguide*, *Phys. Rev. Lett.* 99, 045901 (2007)] (August 16, 2007)

### Twisting time for AFM (NanotechWeb)

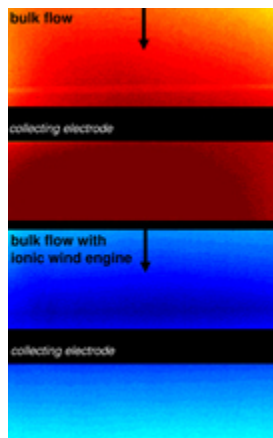
A new atomic force microscope (AFM) that can measure the mechanical properties of a material a thousand times faster than conventional AFMs has been developed by researchers. The new AFM measures the twisting, or torsional, vibrations from the AFM cantilever. This is possible

because the AFM tip is placed at one side of the cantilever, which is quite different to traditional devices where it is placed at the centre. [*An atomic force microscope tip designed to measure time-varying nanomechanical forces*, *Nature Nanotechnology* 2, 507 - 514 (2007)] (August 16, 2007)

### Storing power in a sheet of paper (Eurekalert/Rensselaer Polytechnic Institute)

A new energy storage device that could be mistaken for a simple sheet of paper has been developed. Infused with aligned carbon nanotubes, the nanoengineered battery is lightweight, flexible and geared toward meeting the design requirements of future electronics and implantable medical equipment. The device withstands extreme temperatures, is completely integrated, can be printed like paper, and can function as both a battery and a supercapacitor. It can also be partly powered by human blood or sweat. (August 14, 2007)

### "Ionic wind engines" used to cool computer chips (Purdue University)



Credit: Purdue University

A new technology using tiny "ionic wind engines" that might dramatically improve computer chip cooling. The method increased the "heat-transfer coefficient" by as much as 250 percent. The experimental cooling device, which was fabricated on top of a mock computer chip, works by generating ions using electrodes placed near one another and creating an "ionic" wind. (August 14, 2007)

### Rewritable holographic memory using a genetically engineered microbial protein (Technology Review)

By using lasers to etch data onto fragments of a microbial protein, researchers may have demonstrated a way to produce rewritable holographic memory. They based their holographic storage system on reengineered versions of proteins produced by bacteria-like organisms commonly found in salt marshes. Simply shining blue light on the proteins erases any data stored in them. The technology exploits an evolutionary adaptation of the microbe *Halobacterium salinarum*, which produces a light-sensitive membrane protein when concentrations of oxygen get too low. (August 13, 2007)

### Gold nanoparticles in suspension deposited directly (Science Daily/Northwestern Univ.)

Researchers have demonstrated the ability of a third-generation nanofountain probe (NFP) to directly deposit gold nanoparticles, 15 nanometers in diameter, onto silicon substrates. Such a direct-write method of deposition provides better control over resultant patterns and simplifies the process of fabricating functional structures, as compared to conventional photolithographic or microstamping techniques. The NFP is a cantilevered probe chip that can be mounted on commercial atomic force microscopy (AFM) equipment. On-chip reservoirs hold liquid inks such as the nanoparticle solution, which are delivered through enclosed channels to ring-shaped apertured tips.

[*Direct Deposition and Assembly of Gold Colloidal Particles Using a Nanofountain Probe*, *Langmuir*, 23 ( 17 ), 9120 - 9123 , 2007] (August 13, 2007)

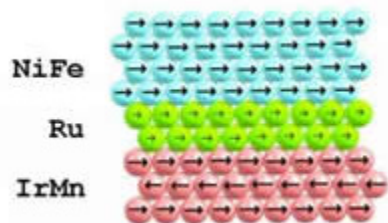
### Ultrafast laser spectrometer measures heat flow through molecules (University of Illinois)

Researchers have developed an ultrafast thermal measurement technique capable of exploring heat transport in extended molecules fastened at one end to a metal surface. To study heat flow through long-chain hydrocarbon molecules anchored to a gold substrate, the researchers used an ultrafast laser spectrometer technique with picosecond time resolution. First, the flash from a femtosecond laser heated the substrate to about 800 degrees Celsius in one picosecond. This heat flowed quickly into the base of the hydrocarbon molecules and through the chains. When heat reached the methyl groups at the ends of the chains, which were originally lined up in order, they began to shake and twist. An extremely sensitive

form of coherent vibrational spectroscopy was used to probe this disordering. The researchers' study showed how the familiar concepts of heat transport do not apply at the level of individual molecules.  
(August 9, 2007)

### Nano-layer of ruthenium stabilizes magnetic sensors

(Science Daily/NIST)



Credit: NIST

A layer of ruthenium just a few atoms thick can be used to fine-tune the sensitivity and enhance the reliability of magnetic sensors according to new tests. The nonmagnetic metal acts as a buffer between active layers of sensor materials, offering a simple means of customizing field instruments such as compasses, and stabilizing the magnetization in a given direction in devices such as computer hard-disk readers.

[[Permanent-magnet-free stabilization and sensitivity tailoring of magnetoresistive field sensors](#), *J. Appl. Phys.* **102**, 033904 (2007)]

(August 9, 2007)

### Laser flips magnetic bit without any help

(Physics World)

A new study is the first to flip the value of a magnetic memory bit by firing a very short pulse of circularly-polarized laser light at it. Unlike other magneto-optic data storage systems, no external magnetic field was required to flip the bit, which meant that its value could be changed about 50 thousand times faster than the fastest conventional memory. The result could lead to the development of low-cost and ultrafast all-optical magnetic hard disk drives

[[All-Optical Magnetic Recording with Circularly Polarized Light](#), *Phys. Rev. Lett.* **99**, 047601 (2007)]

(August 9, 2007)

### PEG coatings for improved intraocular lens performance

(American Chemical Society)

A newly developed method for coating the intraocular lenses (IOLs) used in millions of cataract surgery procedures may prevent a common complication of cataract surgery. Researchers have reported a method for applying a polyethylene glycol coating to IOLs. In laboratory experiments, they showed that the coating reduced accumulation of a protein film and adhesion of cells responsible for formation of secondary cataracts. The coating did not affect the optical properties of the lens.

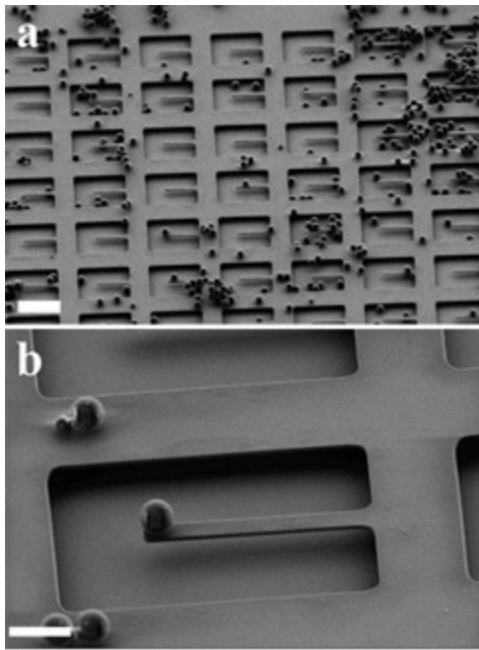
[[Improved Performances of Intraocular Lenses by Poly\(ethylene glycol\)](#) *Chemical Coatings, Biomacromolecules*, ASAP Article, Web Release

Date: July 4, 2007]

(August 8, 2007)

### Side-to-side shaking of nanoresonators throws off impurities

(Cornell University)



Credit: Rob Ilic/Cornell NanoScale Facility

Tiny vibrating silicon resonators are of intense interest in nanotechnology circles for their potential ability to detect bacteria, viruses, DNA and other biological molecules. Researchers have now demonstrated a way to make these resonators vibrate in-plane and have shown that this can serve a vital function: shaking off extraneous stuff that isn't supposed to be detected. The in-plane motion was created by hitting the base of the cantilever with a laser pulsed at the resonant frequency of the cantilever's in-plane vibration, which is different from the resonant frequency of its vibration perpendicular to the plane.

[[Nano Letters](#)]

(August 8, 2007)

#### Gold nanoparticle nanowires assembled by growing fungi

([Advanced Materials](#))

A recent study has demonstrated the self-organisation of colloidal gold onto growing fungi forming a few micron sized gold wires on the fungi. Thus a living fungus was used to actively organize pre-synthesized gold nanoparticles over its hyphae constructing potentially useful microstructures while absorbing nutrients from the colloidal medium in order to grow. This self organization is driven by fungal physiology of absorption of un-reacted precursors from the reduction reaction for synthesis of gold nanoparticles, as nutrients. The fungi get coated by tiny gold particles (about one thousandth of the fungal filament thickness) while consuming the food in the solution similar to how nature assembles organs. By using simple treatments after the formation of the wires, the fungi inside the wires can be removed leading to the formation of gold tubes or gold tapes, a few microns in width, difficult to fabricate otherwise. This is the first report of the use of microorganisms as 'active' templates, avoiding the need for complex DNA/protein chemistry to interface nanoparticles onto biological surfaces.

[[Nutrition-Driven Assembly of Colloidal Nanoparticles: Growing Fungi Assemble Gold Nanoparticles as Microwires](#), *Advanced Materials*, Volume 19, Issue 1, Pages 77 - 81 Published Online: 12 Dec 2006]

(August 7, 2007)

#### Wrinkles reveal elastic properties of a thin film

([University of Massachusetts, Amherst](#))



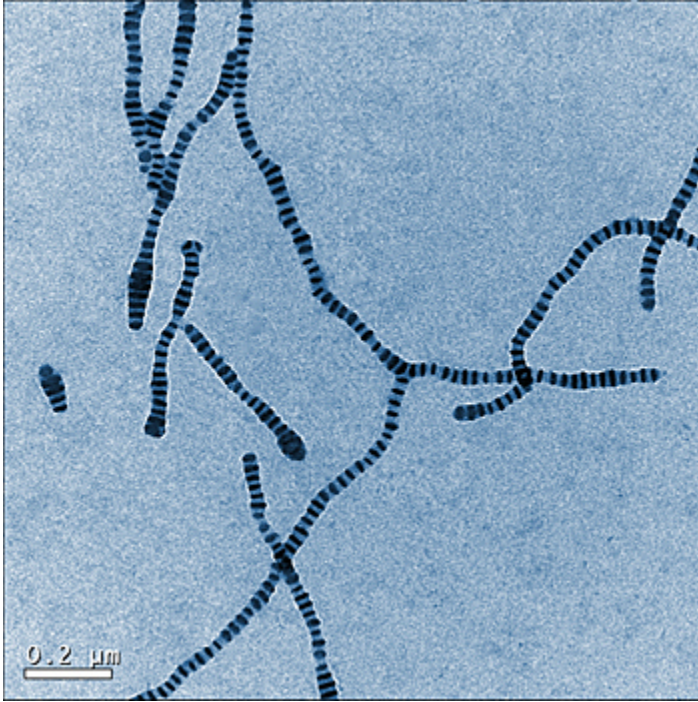
Credit: Univ. Massachusetts, Amherst

The thickness and elasticity of a thin film can be calculated by counting and measuring the wrinkles that form when a force is applied to the film, according to a new report. The study sheds light on how thin films behave and have implications for understanding the behavior of many materials, from membranes in water purification systems to the artificial skins used in treatment of severe burns. The researchers floated ultrathin sheets, or films of polystyrene in a Petri dish of water. With each polystyrene film they induced wrinkles, either by adding a drop of water or a solid disc to the

center of the film, or poking it with a sharp point. The work represents an exciting leap forward, because the wrinkling of films under capillary forces is relatively unexplored. Moreover, the study shows that the film's properties can be elucidated directly on a fluid surface, using no more than a dish of fluid and a low-magnification microscope.

[[Capillary Wrinkling of Floating Thin Polymer Films](#), *Science* 3 August 2007: Vol. 317. no. 5838, pp. 650 - 653; [Perspectives: Materials Science: Exploiting Wrinkle Formation](#), *Science* 3 August 2007: Vol. 317. no. 5838, pp. 605 - 606] (August 6, 2007)

### **Block co-polymers self-assemble to form nanoscale structures** (University of Delaware)



Credit: Univ. Delaware

Block copolymers were coaxed to self-assemble forming various nanoscale structures, in a new study. The researchers used a tri-block copolymer composed of polyacrylic acid, polymethylacrylate, and polystyrene introduced into a solution of tetrahydrofuran and water, and organic diamines. The technique relied on divalent organic counter ions and solvent mixtures to drive the organization of the block copolymers down specific pathways into snake-like, one-dimensional structures. The study demonstrates exquisite control over the resultant cylindrical nanostructures.

[[Block Copolymer Assembly via Kinetic Control](#), *Science* 3 August 2007: Vol. 317. no. 5838, pp. 647 - 650] (August 6, 2007)

### **Focusing light through an opaque lens** (Physics News Update)

Scientists have demonstrated focusing a beam of light by sending it through an opaque medium. Normally an opaque substance, such as milk or paint, will only scatter light waves. But by carefully sculpting the incoming laser beam—processing tiny portions of the forward-moving wavefront—the researchers were able to focus the beam to an intensity 1000 times brighter than for the normal diffuse transmission at that same point previously.

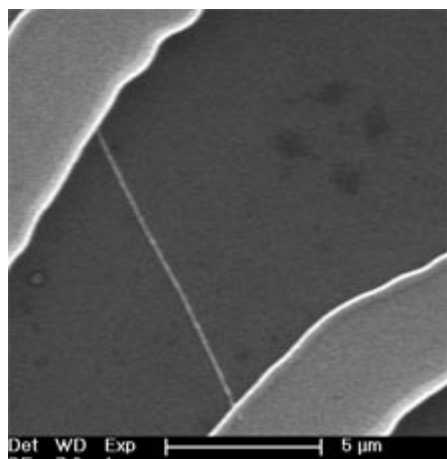
[[View animation](#)] (August 6, 2007)

### **Rubber finger probes sense of touch** (New Scientist)

An artificial finger that can gauge a raft of tactile characteristics for materials is being developed. Researchers are building a life-size silicone rubber finger. To get the measure of how rough or smooth a material is, they place a sample on a pressure-sensitive platform and allow an attached motor to "stroke" the finger across it. Software then compares the sideways pressure that the platform feels with the sideways force applied to the finger. This gives a reading for friction or roughness. At the same time, the software gauges how much downwards force the material absorbs by comparing the force applied by the finger with the force felt by the platform. Softer materials absorb more force. Meanwhile, a sensor at the finger's tip measures temperature.

(August 2, 2007)

### **Indium nitride nanowire infrared LED demonstrated** (Technology Review)



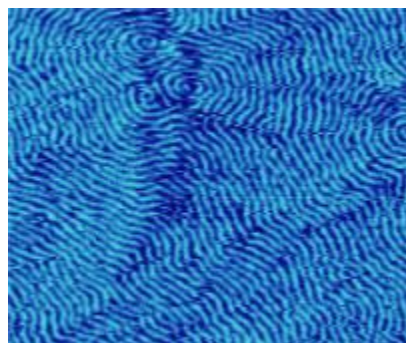
Credit: IBM Research

A new way to convert electricity into light in nanowire-based light-emitting devices (LEDs) has been demonstrated by IBM researchers. They have built an LED resembling a transistor that consists of an indium-nitride nanowire stretched between two electrodes on top of a silicon substrate. The nanowire is about 100 nanometers wide and spans a distance of less than 10 micrometers. When the researchers apply a current to the nanowire, it emits light. While nanowires that emit light have been made before, the new devices rely on different physical mechanisms that are simpler; as a result, the nanowire LED could be more efficient and have improved performance. (August 2, 2007)

#### "Doping" demonstrated in molecular electronics (Weizmann Institute of Science)

Researchers have reported the first successful implementation of doping in the field of molecular electronics. They showed that such doping or 'contamination' is possible, after they succeeded in purifying the molecular layer to such an extent that the remaining impurities did not affect the system's electrical behavior. They were able to dope 'clean' monolayers of Si-CH<sub>2</sub>(CH<sub>2</sub>)<sub>12</sub>CH<sub>3</sub>/Hg molecular junctions by irradiating the surface with UV light or weak electron beams, changing chemical bonds between the carbon atoms that make up the molecular layer. [*Effect of Doping on Electronic Transport through Molecular Monolayer Junctions*, *J. Am. Chem. Soc.*, **129** ( 24 ), 7494 - 7495 , 2007] (August 1, 2007)

#### Using a magnet to tune a magnet (Eureka!ert/University College London)



Credit: Y-A. Soh and G. Aeppli

A new method to switch a material's magnetic properties from 'hard' to 'soft' and back again has been found. Hard magnets, sometimes called 'permanent' magnets, have fixed or 'pinned' domain walls which mean the material stays magnetised for a long time. Soft magnets have moveable domain walls that can be easily flipped. These materials exhibit impermanent magnetic properties. The research shows how a magnet can be 'tuned' by subjecting it to a second magnetic field, perpendicular to the original. This method could lead to new ways of controlling electromagnetic devices. [*A ferromagnet in a continuously tunable random field*, *Nature* **448** , 567-570 (2 August 2007)] (August 1, 2007)

#### Potato chip flavoring boosts longevity of concrete (American Chemical Society)

The ingredient that helps give "salt & vinegar" potato chips that tangy snap is the key to a new waterproof coating for protecting concrete from water damage. In a new report, researchers describe the use of sodium acetate as an inexpensive and environmentally friendly concrete sealant. In laboratory studies using freshly made concrete, the researchers showed that sodium acetate seeps into pores in concrete and then hardens and crystallizes upon exposure to water. The resultant swelling blocks entry of additional moisture thereby significantly reducing water permeability and

increasing service life.

[*Crystallization Technology for Reducing Water Permeability into Concrete*, *Ind. Eng. Chem. Res.*, 46 (16), 5463-5467, 2007]  
(August 1, 2007)

### **New aerogels could clean contaminated water, purify hydrogen for fuel cells**

(Argonne National Lab)

Scientists have created and characterized new porous semiconducting aerogels. Submerging a fraction of a gram of the aerogel in a solution of mercury-contaminated water removed more than 99.99 percent of the heavy metal. The researchers believe that these gels can be used not only for this kind of environmental cleanup but also to remove impurities from hydrogen gas that could damage the catalysts in potential hydrogen fuel cells. The aerogels, which are fashioned from chalcogenides are expected to be able to separate out the impurities from hydrogen gas much as they did the mercury from the water: by acting as a kind of sieve or selectively permeable membrane.

[*Porous Semiconducting Gels and Aerogels from Chalcogenide Clusters*, *Science* 27 July 2007: Vol. 317. no. 5837, pp. 490 - 493]  
(July 31, 2007)

### **Nanotech clay armor creates fire resistant latex emulsion paints**

(Univ. Warwick)

Latex emulsion paints have relied on the addition of soaps or similar materials to overcome the polymer parts of the paint's aversion to water, stabilize the paint, and make it work. Researchers have now found a way of replacing the soap used to stabilize latex emulsion paints with nanoscale clay armor that can create a much more hard wearing and fire resistant paint. They found a simple way to individually coat the polymer particles used in such paints with a series of nanosized Laponite clay discs. The discs effectively create an armored layer on the individual polymer latex particles in the paint. The clay discs are 1 nm thick by 25 nm in diameter.

[*Pickering Miniemulsion Polymerization Using Laponite Clay as a Stabilizer*, *Langmuir*, 23 (16), 8316-8322, 2007, Web Release Date: June 29, 2007]

(July 30, 2007)

### **Graphene senses individual molecules of toxic gases**

(Eurekalert)

Researchers have used graphene to create sensors that can detect just a single molecule of a toxic gas. Graphene was shown to be extremely sensitive to the presence of minute amounts of gases such as alcohol vapour or extremely toxic carbon monoxide. This sensitivity was unexpected and seems to contradict the common belief that graphene is extremely chemically inert. Gas molecules are adsorbed on graphene without disrupting its structure. They only add or take away electrons from graphene, which results in notable changes in its electrical conductance.

[*Detection of individual gas molecules adsorbed on graphene*, *Nature Materials*, Published online: 29 July 2007 | doi :10.1038/nmat1967]

(July 30, 2007)

### **Striped nanorods feel the strain**

(Royal Society of Chemistry)

Stripy nanorods containing evenly spaced quantum dots have been prepared using strain forces. This is the first time that strain has been used to construct a '1D superlattice' of this sort without the need to fix the particles to a solid surface, creating free-standing particles. The team took nanorods less than 5nm across made of pure semiconductor cadmium sulfide. They then swapped some of the cadmium atoms for silver. This cation exchange created random islands of Ag<sub>2</sub>S within the CdS rod. The spacing between the atoms is different in these regions, so strain arises where they meet. Eventually the silver dots grew into stripes, trapping layers of cadmium atoms.

[*Science*, 2007, 317, 355 (DOI: 10.1126/science.1142593)]

(July 27, 2007)

### **Cheap polymer opal could fight fake currency**

(New Scientist)

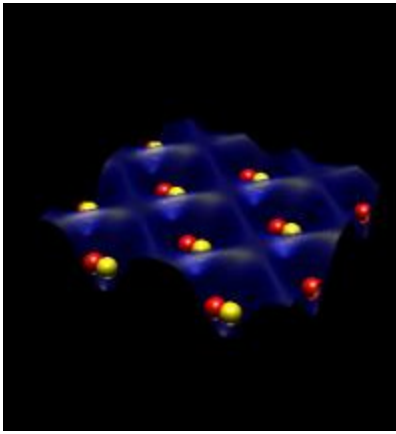
Butterfly wings and opals have already inspired the creation of make-up and paints with the same flickering, iridescent colors. These qualities spring from photonic crystals, whose atoms sit in a three-dimensional repeating pattern, similar to a stack of egg boxes. This structure blocks certain wavelengths of light at some viewing angles, while other wavelengths zip through. As a result, the crystals change color, or shimmer, as the viewer's perspective changes. Not only that, when flexible photonic crystals are stretched, the spacing between the "egg holes" changes, causing further color variation. A research team has now developed a photonic crystal film that shimmers from virtually every angle. Not only that, it can be mass-produced cheaply because it's partly self-assembling. The films could be used on banknotes to prevent counterfeiting.

[*Nanoparticle-tuned structural color from polymer opals*, *Optics Express*, Vol. 15, Issue 15, pp. 9553-9561]

(July 27, 2007)

### **Thousands of atoms swap spins with partners simultaneously**

(Eurekalert/NIST)



Credit: NIST

Scientists have induced thousands of atoms trapped by laser beams to swap spins with partners simultaneously. The repeated exchanges, lasting a total of just 10 milliseconds, might someday carry out logic operations in quantum computers, which theoretically could quickly solve certain problems that today's best supercomputers could not solve in years. The atomic dance advances prospects for the use of neutral atoms as quantum bits (qubits) for storing and processing data in quantum computers. Neutral atoms are among about a dozen systems being evaluated around the world as qubits.

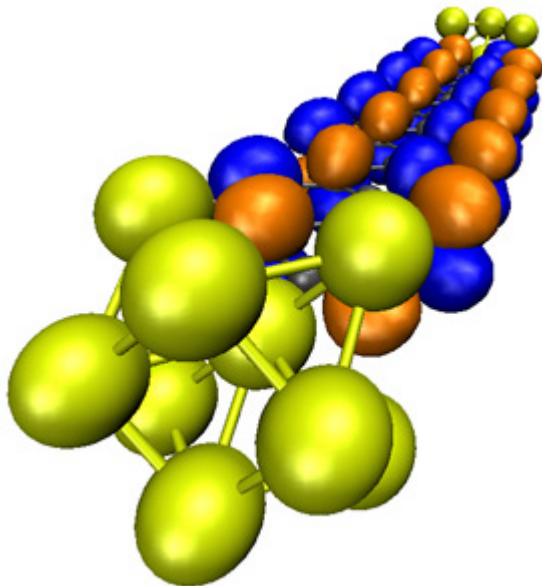
[[Controlled exchange interaction between pairs of neutral atoms in an optical lattice](#), *Nature* **448**, 452-456 (26 July 2007)]  
(July 26, 2007)

#### Unique quantum effect found in Si nanocrystals (National Renewable Energy Laboratory)

A new and important effect called Multiple Exciton Generation (MEG) has been shown to occur efficiently in silicon nanocrystals. MEG results in the formation of more than one electron per absorbed photon. Until this discovery, MEG had been reported over the past two years to occur only in quantum dots of semiconductor materials that are not presently used in commercial solar cells, and which contained environmentally harmful materials such as lead. The new result opens the door to the potential application of MEG for greatly enhancing the conversion efficiency of solar cells based on silicon because more of the sun's energy is converted to electricity.

[[Multiple Exciton Generation in Colloidal Silicon Nanocrystals](#), *Nano Lett.* **2007**, ASAP Web Release Date: 24-Jul-2007]  
(July 26, 2007)

#### Key discovery a step towards graphene nanoelectronics (Rensselaer Polytechnic Institute)



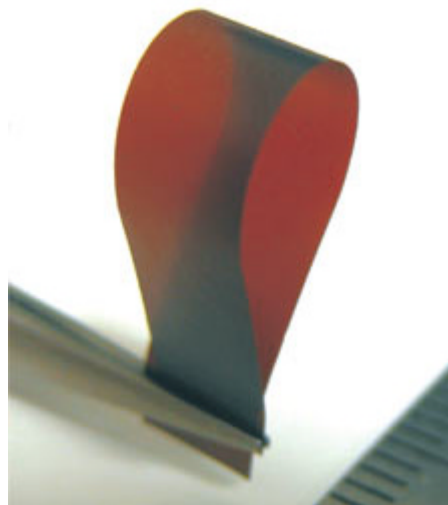
Credit: Philip Shemella, RPI

Researchers have been working to elucidate how graphene's extremely efficient conductive properties can be exploited for use in nanoelectronics. After running dozens of robust computer simulations, the group has demonstrated for the first time that the length, as well as the width, of graphene directly impacts the material's conduction properties.

[[Energy gaps in zero-dimensional graphene nanoribbons](#), *Appl. Phys. Lett.* **91**, 042101 (2007)]  
(July 26, 2007)



## Ultrastrong paper from graphene (Technology Review)



Credit: Dmitriy Dikin, Northwestern Univ.

Researchers have used graphene layers to create a strong, flexible, and lightweight paperlike material. The new material is made of overlapping layers of graphene, one-atom-thick sheets of carbon atoms arranged in honeycomb-like hexagons. In contrast, graphite, which becomes powdery under pressure, is made of graphene sheets stacked one on top of the other. The material could be used as electrolytes or hydrogen storage materials in fuel cells, electrodes in supercapacitors and batteries, and super-thin chemical filters. It could also be mixed with polymers or metals to make materials for use in aircraft fuselages, cars, and buildings. Right now, water molecules hold together the individual 10-nanometer-thick graphene flakes to create the micrometers-thick graphene paper. By using other chemicals as glues, the researchers could make ultrastrong paperlike materials with various properties.

[[Preparation and characterization of graphene oxide paper](#), *Nature* **448**, 457-460 (26 July 2007)]  
(July 25, 2007)

## Pt nanocubes yield better shaped crystals (NanotechWeb)

Controlling the morphology of nanocrystals is important because many of their physical and chemical properties are highly shape-dependent. Most research so far has focused on heterostructures made on chalcogenide interfaces, yet controlling the shape of individual binary metallic nanoparticles has not received much attention. Researchers have now used highly faceted cubic platinum nanocrystals as nucleation seeds to direct the overgrowth of a lattice-matched palladium-based compound in solution. The platinum cubes measured around 13 nm along each face and have only (100) surface planes. The Pd undergoes conformal growth on the surface of these seeds to produce Pt/Pd bimetallic core-shell structures.

[[Shaping binary metal nanocrystals through epitaxial seeded growth](#), *Nature Materials*  
Published online: 8 July 2007 | doi :10.1038/nmat1957]  
(July 25, 2007)

## A window into glass formation (Physical Review Focus)



Credit: E. Weeks, Emory Univ.

Researchers have wondered whether glass is just a very viscous liquid, or whether it is a liquid that goes through some kind of phase transition as it cools and solidifies. Using tiny beads suspended in a liquid as a stand-in for the atoms or molecules in a real glass, a team reports that sandwiching the beads between two plates slows them down dramatically, mimicking the cooling of a liquid into a glass. The results strengthen the idea that at least some glasses form when their constituents lock together over long distances in a kind of phase transition.

[[Colloidal Glass Transition Observed in Confinement](#), *Phys. Rev. Lett.* **99**, 025702 (2007)]  
(July 25, 2007)

## Novel hydrogels for repairing, regenerating human tissue (University of Delaware)

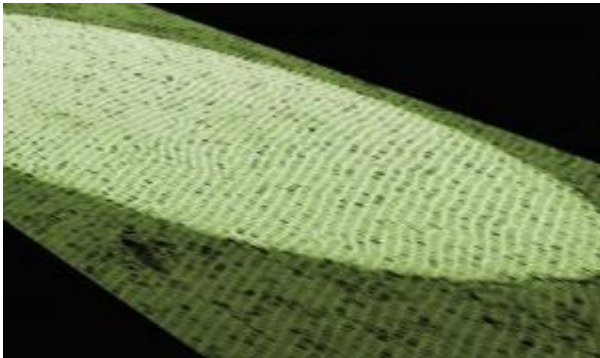


Credit: Joel Schneider (right) and Darrin Pochan, Univ. Delaware

A novel biomaterial with surprising antibacterial properties has been invented that can be injected as a low-viscosity gel into a wound where it rigidifies nearly on contact--opening the door to the possibility of delivering a targeted payload of cells and antibiotics to repair the damaged tissue. The basis of these hydrogels is "MAX1," a self-assembling peptide that the scientists designed six years ago.

[[Controlling hydrogelation kinetics by peptide design for three-dimensional encapsulation and injectable delivery of cells](#), *PNAS*, May 8, 2007, vol. 104, no. 19, 7791-7796 ]  
(July 23, 2007)

#### **Unexpected strength of nanothin sheet of material** (Science Daily)



Credit: Klara Mueggenburg and Heinrich Jaeger, Univ. Chicago

Researchers have discovered the surprising strength of a sheet of nanoparticles that measures just 50 atoms in thickness. The experimental material consisted of gold particles separated by organic "bumpers" to keep them from coming into direct contact. The research team suspended this array of nanoparticles in a solution, then spread the solution across a small chip of silicon. When the solution dried, it left behind a blanket of nanoparticles that drape themselves over holes in the chip, each hole measuring hundreds of nanoparticles in diameter. When probed with the tip of an atomic force microscope, the sheet was found to be a robust, resilient membrane.

[[Elastic membranes of close-packed nanoparticle arrays](#), *Nature Materials*, Published online: 22 July 2007]  
(July 23, 2007)

#### **Spontaneous separation of charged sand grains** (Physics News Update)

A new study has shown how two populations of sand grains mixed together and held in a hopper will, when shaken out into a beaker, spontaneously segregate themselves, all because of static electrical interactions. This phenomenon, the opposite of mixing, might have practical uses in the powder industry.

(July 20, 2007)

#### **Single photon switches the state of a light beam** (New Scientist)

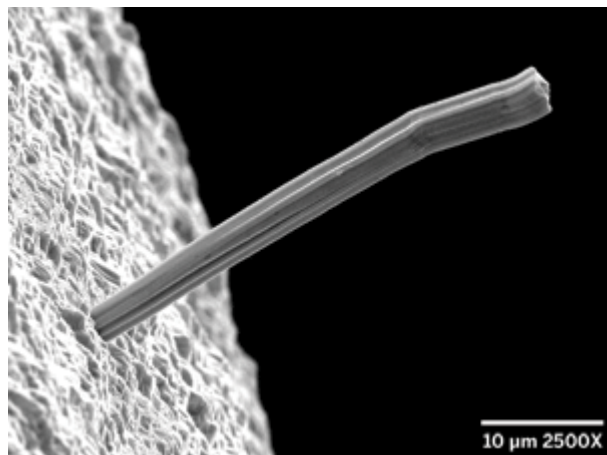
Researchers have devised a light-based transistor made of semiconducting nanowires that could be a key building block of machines that are hundreds of times faster than today's supercomputers.

Until now, optical transistors, in which one beam of light controls the state of another, have required large bursts of photons to switch states, making them unfeasibly power-hungry. The researchers have come up with a technique that uses a single photon to switch the state of a light beam.

(July 20, 2007)

### Stopping the tin whisker stalkers

(Chemical & Engineering News)



Credit: Peter Bush, SUNY, Buffalo.

Just as a tiny blood clot can fell a seemingly hale human, a tin "whisker" can bring an electronic device to its knees. Electrical shorts caused by growth of these needlelike metal crystals have knocked out guided missiles and communication satellites, shut down a nuclear power plant, and caused heart pacemakers to fail. Many technological failures for which causes haven't been found could be due to undetected tin whiskers. Researchers are now attempting to suppress filaments that sprout from tin coatings in lead-free electronic equipment.

(July 19, 2007)

### 'Crystals-as-Genes' hypothesis tested

(Royal Society of Chemistry)

Nearly three decades ago, Graham Cairns-Smith proposed that the first genetic systems must have been more primitive than the sophisticated chemistries of DNA and RNA. He argued that crystals, particularly clay minerals, have the capacity to act as primitive genes. His idea was that imperfect crystals can act as genes by transferring information from one crystal to another by means of their imperfections. Screw dislocations, for instance, are often replicated through crystal growth, so the arrangement of these dislocations in a crystal can be considered a store of information. This so-called 'crystals-as-genes' hypothesis has never been put to the test, until now. Researchers have designed the first experiment to examine the idea that crystals can act as a source of transferable information, using crystals of potassium hydrogen phthalate.

[[Test of Cairns-Smith's crystals-as-genes hypothesis](#), *Faraday Discuss.*, 2007, DOI: 10.1039/b616612c]

(July 19, 2007)

### Supersolidity and screw dislocation core

(Physical Review Focus)

The strange quantum phenomenon known as supersolidity occurs when atoms flow without friction through a solid block of helium, possibly along a network of defects extending through an otherwise perfect crystal. In a new report, physicists find such a flow in computer simulations even when the atoms that make up the defects form a regular pattern, unlike the disorderly arrangement used in previous calculations. The results open a new way of understanding this extraordinary state of matter, which has properties of both solids and liquids.

[[Luttinger Liquid in the Core of a Screw Dislocation in Helium-4](#), *Phys. Rev. Lett.* (to be published)]

(July 19, 2007)

### First "heat transistor" unveiled

(PhysicsWeb)

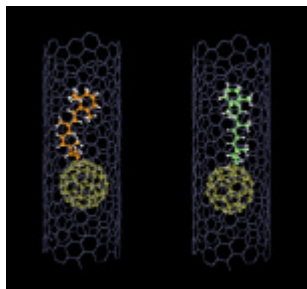
Researchers have built the world's first "heat transistor" in which the flow of heat between two electrodes is controlled by a voltage applied to a third lead. The flow can be increased, decreased or even switched off by changing the voltage -- in much the same way as electrical current is controlled in a conventional transistor. While the heat flux of the device is too small for most practical applications, the researchers believe that it could help physicists gain a better understanding of heat flow in very small systems such as conventional electronic refrigerators.

[[Heat Transistor: Demonstration of Gate-Controlled Electronic Refrigeration](#), *Phys. Rev. Lett.* 99, 027203 (2007)]

(July 18, 2007)

### Vision molecules change shape inside nanotubes

(NanotechWeb)



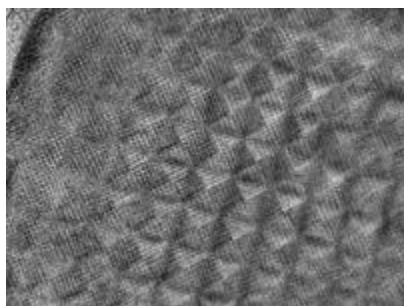
Credit: K Suenaga, AIST, Japan

High-resolution images of shape changes in retinal – a molecule important for vision – may help us to understand how we see, according to a new report. Using TEM, researchers imaged a single retinal molecule by attaching it to a carbon-60 molecule trapped inside a carbon nanotube. When retinal molecules are stimulated by light, they change shape – going from being bent (cis) to straight (trans). This shape change triggers a cascade of biochemical reactions that ultimately results in an electrical impulse being sent along the optic nerve, so allowing us to see. To investigate this mechanism, a single retinal molecule was attached to a carbon fullerene molecule so that the hybrid Ret-C60 could be placed into a single-walled carbon nanotube. In this way, the nanotube acts as a sample holder.

[[Imaging the dynamic behaviour of individual retinal chromophores confined inside carbon nanotubes](#), *Nature Nanotechnology* 2 , 422 - 425 (2007)]  
(July 18, 2007)

### Natural 'workbench' for nanoscale construction

(Eurekalert/Univ. Pennsylvania)



Credit: University of Pennsylvania

Researchers have taken a step toward simplifying the creation of nanostructures by identifying the first inorganic material to phase separate with near-perfect order at the nanometer scale. The finding provides an atomically tuneable nanocomposite "workbench" that is cheap and easy to produce and provides a super-lattice foundation potentially suitable for building nanostructures. The material used was an ionically- conductive, crystalline ceramic (Nd<sub>2/3-x</sub>Li<sub>3x</sub>)TiO<sub>3</sub>.

[[Nano-chessboard superlattices formed by spontaneous phase separation in oxides](#), *Nature Materials* Published online: 24 June 2007]  
(July 18, 2007)

### New particle explains odd behavior in cuprate superconductors

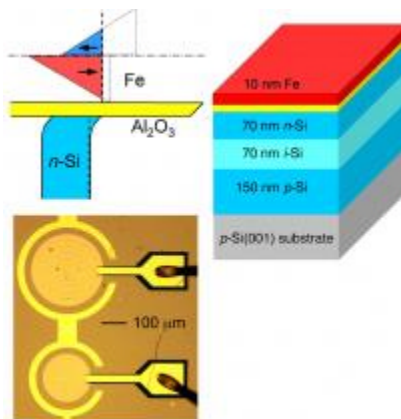
(University of Illinois)

New fundamental particles are not found only using large particle accelerators. They also can be found hiding in plain pieces of ceramic, as per a new report. The newly formulated particle is a boson and has a charge of 2e, but does not consist of two electrons. Rather, the particle arises from the strong, repulsive interactions between electrons, and provides another piece of the high-temperature superconductivity puzzle. Twenty-one years ago, superconductivity at high temperatures was discovered in copper-oxide ceramics (cuprates). Existing explanations of superconductivity proved inadequate. The new boson is not formed from the elementary excitations – that is, electrons and ions. Instead, the particle emerges as a remnant of the strong interactions between electrons in the normal state.

(July 17, 2007)

### Efficient electrical spin injection into silicon demonstrated

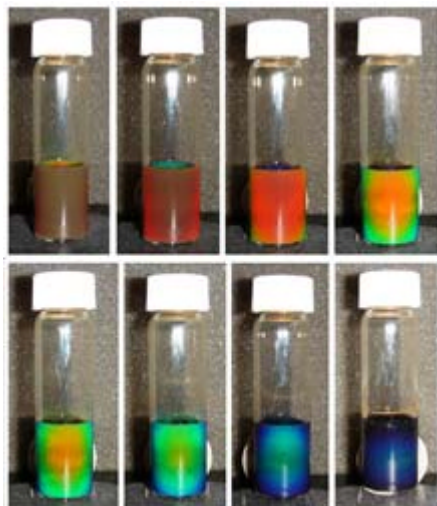
(Eurekalert/Naval Research Laboratory)



Credit: Naval Research Laboratory

Scientists have efficiently injected a current of spin-polarized electrons from a ferromagnetic metal contact into silicon, producing a large electron spin polarization in the silicon. This demonstration is a key enabling step for developing devices which rely on electron spin rather than electron charge for semiconductor spintronics, and is expected to provide higher performance with lower power consumption and heat dissipation. [*Electrical spin injection into silicon from a ferromagnetic metal/tunnel barrier contact*, *Nature Physics*, August 2007] (July 17, 2007)

### Nanomaterial solution changes color with magnetic field strength (Technology Review)



Credit: Yin laboratory, University of California, Riverside

A nanomaterial solution can take on any color of the rainbow, simply by the scientists changing the distance between the material and a magnet. It could be used in sensors or, encapsulated in microcapsules, in rewritable posters or other large color displays. A high-temperature method was used to synthesize nanoscale, crystalline particles of magnetite. Each particle was made about 10 nm in diameter. The 10 nm particles group together to form uniformly sized spherical clusters, each about 120 nanometers across. By coating these clusters with an electrically charged surfactant, the researchers cause the clusters to repel each other. When researchers use a magnet to counteract the repellent forces, the clusters rearrange and move closer together, changing the color of the light they reflect. (July 17, 2007)

### Architecture of "Mother-of Pearl" revealed (Physical Review Focus)



Credit: G. De Stasio et al., *Am. J. Sci.* 305, 673 (2005)

Researchers have revealed new details of the microscopic architecture of mother-of-pearl, or nacre. Using an x-ray technique, the team determined the orientation of the crystalline structure within the calcium carbonate "bricks" that make up the material. They found that adjacent bricks can have different crystal orientations, even though their faces are parallel and stack neatly together. The team proposes a mechanism for nacre growth and says that improved understanding of the nacre structure could provide inspiration for new types of engineered materials. [*Architecture of Columnar Nacre, and Implications for Its Formation Mechanism*, *Phys. Rev. Lett.* **98**, 268102 (2007)] (July 16, 2007)

#### **Nanoparticles make cancer cells magnetic** (New Scientist)

Turning cancer cells into mini magnets by using nanoparticles could make biopsies so sensitive and efficient that there will be no need to repeat these invasive tests. The idea is to use magnetic iron oxide nanoparticles encased in a biocompatible material. These in turn can be coated with antibodies that bind to chemicals found only in cancerous cells. When injected into the body, thousands of the particles stick to cancer cells, turning them into miniature magnets. The cells can then be drawn towards magnets encased in the tip of a biopsy needle. [*Magnetic needles and superparamagnetic cells*, *Phys. Med. Biol.* 52, 2007, 4009-4025] (July 16, 2007)

#### **Higher efficiency "tandem" organic solar cell developed** (University of California, Santa Barbara)

Scientists have create a new "tandem" organic solar cell with increased efficiency. Tandem cells are comprised of two multilayered parts that work together to gather a wider range of the spectrum of solar radiation — at both shorter and longer wavelengths. The result is a 6.5% efficiency which is the highest level achieved for solar cells made from organic materials. The researchers believe that additional improvements will yield efficiencies sufficiently high for commercial products. [*Efficient Tandem Polymer Solar Cells Fabricated by All-Solution Processing*, *Science*, 13 July 2007, 222-225] (July 13, 2007)

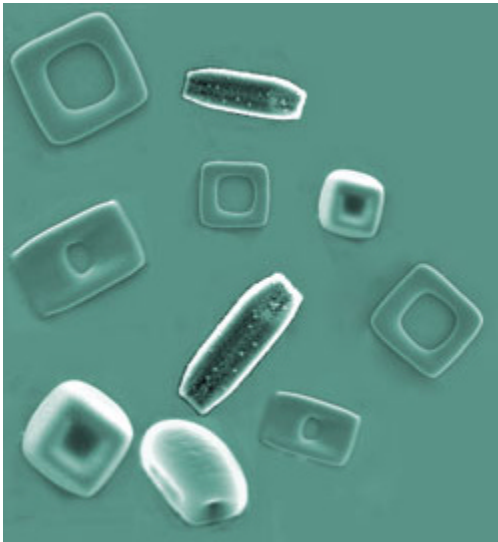
#### **Semiconductor membrane mimics biological behavior of ion channels** (University of Illinois)

A semiconductor membrane has been designed that could offer more flexibility and better electrical performance than biological membranes. Built from thin silicon layers doped with different impurities, the solid-state membrane could also be used in applications such as single-molecule detection, protein filtering and DNA sequencing. By creating nanopores in the membrane, it was used to separate charged species as well as regulate the flow of charged molecules and ions, thereby mimicking the operation of biological ion channels. (July 13, 2007)

#### **Graphene p-n junction unveiled** (PhysicsWeb)

Scientists have created a locally-gated p-n junction in graphene, which is a 2D sheet of carbon just one atom thick. The charge density in the device is controlled by applying voltages to electrodes that are attached to the surface of the material. The fabrication technique could open the door to practical graphene transistors that could be much smaller and more efficient than today's silicon-based devices. [*Quantum Hall Effect in a Gate-Controlled p-n Junction of Graphene*, *Science*, Published Online June 28, 2007, DOI: 10.1126/science.1144657] (June 29, 2007)

#### **Stop-flow lithography for custom designed polymeric particles** (Royal Society of Chemistry)

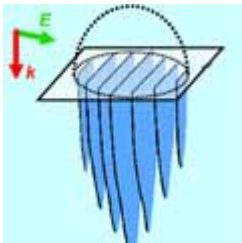


Credit: Dendukuri et al.

A microfluidic device technique called stop-flow lithography (SFL), for making custom designed polymeric particles with complex geometric shapes, has been developed. A unique feature of the new method is that the particles formed are not just spherical - it can make a wide range of shapes. SFL also allows the formation of particles in biocompatible and easily functionalised materials that are not typically amenable to photolithographic methods.

[[Stop-flow lithography in a microfluidic device](#), *Lab Chip*, 2007, 7, 818 - 828]  
(June 29, 2007)

#### Femtosecond laser pulses create periodic planar nanocracks in glass (SPIE)



Credit: Simova et al., NRC-Canada

Femtosecond laser pulses with focused intensity above the ionization threshold initially deposit energy homogeneously in fused silica. After many exposures this homogeneity can vanish, producing beautifully arrayed nanometer-thick planar cracks throughout the focal volume. These are oriented perpendicular to the laser polarization and have a periodicity approximately half that of the laser wavelength in the medium. These nanocracks have the largest aspect ratios of any nanostructures created in a pure material using light, and can be placed and replaced inside glass with unprecedented control. This allows them to be used in a variety of biophotonic and data storage applications as well as in the study of material fatigue.

(June 28, 2007)

#### Tunable nanowire nonlinear optical probe developed (PhysicsWeb)

A new type of microscopy that uses a nanowire to image objects with a resolution less than the wavelength of the probing light has been devised. The technique was used to image a glass plate covered with gold lines just nm in width. The researchers used nanowires made from potassium niobate. The technique could potentially be used to study biological samples in water.

[[Tunable nanowire nonlinear optical probe](#), *Nature* **447**, 1098-1101 (28 June 2007)]  
(June 28, 2007)

#### Advance in organic semiconductor processing (EurekaAlert/Carnegie Mellon Univ.)

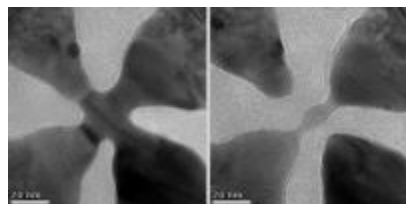
The adage that a little grease goes a long way toward making a tool work better may soon hold true for plastic electronics as well. Researchers have found that grease can make some innovative plastics vastly better electrical conductors. The work outlines a chemical process that could become widely adopted to produce the next generation of tiny switches for transistors in radio frequency identification tags, flexible screen displays, and debit or key cards. The new process involves adding a little grease in two ways. The first step involves chemically combining an inherently conducting polymer (ICP) with a grease-like chemical. The second step involves depositing this hybrid block copolymer onto a greased

platform.

[[High Field-Effect Mobilities for Diblock Copolymers of Poly\(3-hexylthiophene\) and Poly\(methyl acrylate\)](#), *Advanced Materials*, Published Online: 25 Jun 2007]  
(June 27, 2007)

### Electron beam 'carves' the world's smallest devices

(Eurekalert/Univ. Pennsylvania)



Credit: Univ. Penn.

A new technique has been used to craft some of the tiniest metal nanostructures ever created, none larger than 10 nanometers. The technique employs transmission electron beam ablation lithography, or TEAL, to "carve" nanostructures from thin sheets of gold, silver, aluminum and other metals. TEAL provides a dependable method for producing quality versions of microscopic devices, which are studied for their novel mechanical properties and their potential use in next-generation sensors and electronics. The method also permits simultaneous, real-time atomic imaging of the devices as they are made.

[[Sub-10 nm Device Fabrication in a Transmission Electron Microscope](#), *Nano Lett.*, 2007, 7(5) pp 1329 - 1337]  
(June 27, 2007)

### Multiferroicity induced by spin-density waves

(Physical Review Focus)

Scientists have proposed a less exotic mechanism by which a material could become multiferroic compared to currently understood mechanisms. Their theory was motivated by recent perplexing experiments, where materials called rare-earth manganites became multiferroic at low temperatures, even though they do not have a helical magnetic pattern, observed in present multiferroics. The materials form so-called spin-density waves, where the spins of the atoms organize into sheets alternately pointing in opposite directions. The researchers argue that this magnetic order alone can generate a macroscopic electric field.

[[Multiferroicity Induced by Dislocated Spin-Density Waves](#), *Phys. Rev. Lett.* 98, 257602 (2007)]  
(June 25, 2007)

### Metal nanoparticles lend glimmer to medieval artefacts

(NanotechWeb)

Luster is a glaze decoration first produced at the end of the 9th century. Lusters made during medieval times show a broad range of colors; those made in the Middle East at this time are shiny. A team of researchers has now shown that this metallic shine comes from the copper/silver nanoparticles present in the glaze. Moreover, the researchers found that the luster layer formed in lead-rich glasses is thinner (around 250 nm thick) and richer in Cu and Ag. This means the metal nanoparticles are more densely packed in the layer, which leads to more light being reflected.

[[Metallic and nonmetallic shine in luster: An elastic ion backscattering study](#), *J. Appl. Phys.* 101, 103518 (2007)]  
(June 25, 2007)

### Nanospheres leave cancer no place to hide

(New Scientist)

Gold-coated glass "nanoshells" can reveal the location of tumors and then destroy them minutes later in a burst of heat when irradiated with a near-infrared laser. The team has shown how to tweak the size of the nanoshells so that they scatter some of the radiation while using the rest for heating. This means any cancer sites will "light up" under low-intensity infrared, so they can then be zapped with the laser.

(June 22, 2007)

### High-performing room-temperature nanolaser demonstrated

(Eurekalert)

Researchers have built a highly efficient room-temperature nanometer-scale laser that produces stable, continuous streams of near-infrared laser light. The overall device has a width of several microns, while the part of the device that actually produces laser light has dimensions at the nanometer scale in all directions. The laser uses only a microwatt of power, one of the smallest operating powers ever achieved. This nanolaser design should be useful in future miniaturized circuits containing optical devices.

[[Room temperature continuous wave operation and controlled spontaneous emission in ultrasmall photonic crystal nanolaser](#), *Optics Express*, Vol. 15, Issue 12, pp. 7506-7514]  
(June 21, 2007)



### Smallest piece of ice reveals its true nature (Eurekalert/Univ. College London)

Scientists have combined experimental observations with theoretical modelling to reveal with unprecedented resolution the structures of the smallest pieces of ice that form on hydrophobic metal surfaces. The results provide information about the process of ice nucleation at a molecular level and take science a significant step closer to understanding the mysterious process through which ice forms around microscopic dust particles in the upper atmosphere. Because this is the basis of cloud formation, knowing how different particles promote ice formation is crucial for climate change models.

[*Ice nanoclusters at hydrophobic metal surfaces*, *Nature Materials*, Published online: 17 June 2007 | doi:10.1038/nmat1940] (June 21, 2007)

### New optical device stores light (Technology Review)

A newly developed microscopic device for storing light could help free up bottlenecks in optical communications and computing. The new device relies on an optically controlled "gate" that can be opened and closed to trap and release light. The researchers used a very fast, 1.5-picosecond pulse of light to open and close the entryway. The device includes two parallel silicon tracks, each 560 nanometers wide. Between these two tracks, and nearly touching them, are two silicon rings spaced a fraction of the width of a hair apart.

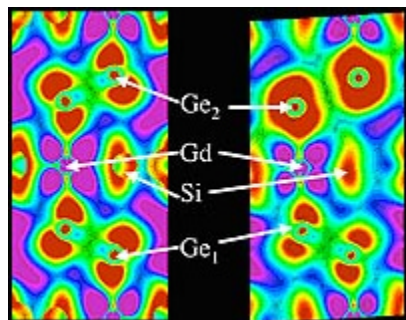
(June 21, 2007)

### Nanotube adhesive sticks better than a gecko's foot (Rensselaer Polytechnic Institute)

Researchers have created synthetic "gecko tape" with four times the sticking power of the real thing. They have described a process for making polymer surfaces covered with carbon nanotube hairs. The nanotubes imitate the thousands of microscopic hairs on a gecko's footpad, which form weak bonds with whatever surface the creature touches, allowing it to "unstick" itself simply by shifting its foot. They have developed a prototype flexible patch that can stick and unstick repeatedly with properties better than the natural gecko foot. They fashioned their material into an adhesive tape that can be used on a wide variety of surfaces, including Teflon.

[*Carbon nanotube-based synthetic gecko tapes*, *PNAS*, published June 19, 2007, 10.1073/pnas.0703505104] (June 20, 2007)

### Giant magnetocaloric materials could have large impact on the environment (Argonne National Lab)



Credit: Y. Lee and B. Harmon, Ames Lab

Materials that change temperature in magnetic fields could lead to new refrigeration technologies that reduce the use of greenhouse gases. Magnetic refrigeration is a clean technology that uses magnetic fields to manipulate the degree of ordering (or entropy) of electronic or nuclear magnetic dipoles in order to reduce a material's temperature and allow the material to serve as a refrigerant. New materials for refrigeration based on gadolinium-germanium-silicon alloys display a giant magnetocaloric effect due to unusual coupling between the material's magnetism and chemical structure. Magnetic refrigeration does not rely on hydrofluorocarbons (HFCs) used in conventional refrigeration systems.

(June 20, 2007)

### Stretching a molecule helps it conduct (Royal Society of Chemistry)

Researchers have shown that the conductance of a molecule fluctuates as it is stretched. Many researchers believe that a molecule's conformation, or structure, influences its electron transporting properties. This effect has now been experimentally measured.

[*The effect of molecular conformation on single molecule conductance: measurements of -conjugated oligoaryls by STM break junction*, *Chem. Commun.*, 2007, DOI: 10.1039/b705521h] (June 19, 2007)

### Strong polarizability of water explained (Physical Review Focus)

Water is very sensitive to an electric field. The field strongly "polarizes" water, lining up the charges in the molecules. Researchers have now used a new calculation scheme to explain this large electric response. The results shed light on how water polarizes at short distances--the range relevant for the charged pieces of a protein molecule packed tightly among water molecules in biological cells.

[*Dipolar Correlations and the Dielectric Permittivity of Water*, *Phys. Rev. Lett.* **98** (2007) 247401]

(June 19, 2007)

### **In Nature, proteins sweep up nanoparticles**

([Bio.com](#))

Scientists have discovered a world in which bacteria emit proteins that sweep up metal nanoparticles into immobile clumps. Their finding may lead to innovative ways to remediate subsurface metal toxins. The research reveals that the proteins travel far from the microbes that produce them, and then amass metal nanoparticles into piles that are too large to be swept away by underground currents. Precisely how and why the bacteria undertake this bit of housecleaning remains a mystery, but it suggests that proteins could play a key role in bioremediation strategies designed to trap harmful metals such as arsenic, lead, uranium, and plutonium.

[*Extracellular Proteins Limit the Dispersal of Biogenic Nanoparticles*, *Science* 15 June 2007,

Vol. 316, no. 5831, pp. 1600 - 1603]

(June 18, 2007)

### **'Off-the-shelf' vascular grafts developed**

([Eurekalert/Univ. Pittsburgh](#))

Researchers have engineered artificial blood vessels from muscle-derived stem cells (MDSCs) and a biodegradable polymer that exhibit extensive remodeling and remain free of blockages when grafted into rats. The results of their study have potentially significant implications for the treatment of heart and kidney diseases, where there is a critical need for new sources of blood vessels for vascular grafts. They developed its vascular graft by "bulk seeding," or spraying, MDSCs inside a biodegradable porous, tubular polyester urethane scaffold using a rotational vacuum seeding device.

(June 18, 2007)

### **Magnetic nanoribbons toughen up with Co**

([NanotechWeb](#))

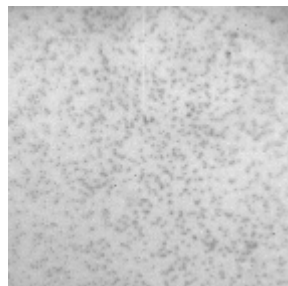
Nanocrystalline magnetic alloys, such as the iron-based "Finemet" and "Nanoperm", are usually made with melt-spun amorphous precursor ribbons that are annealed above the primary crystallization temperature. This results in a microstructure consisting of iron-rich nanocrystallites embedded in an amorphous matrix. Although they have excellent soft magnetic properties, the ribbons become brittle after the crystallization step. It has now been shown that cobalt-rich magnetic alloys are more than twice as tough as the Finemet and Nanoperm alloys after annealing, while keeping their good magnetic properties.

[*Nanocrystalline soft magnetic ribbons with high relative strain at fracture*, *Appl. Phys. Lett.* **90**, 212508 (2007)]

(June 18, 2007)

### **Imploding bubbles mix fluids on a chip**

([Royal Society of Chemistry](#))



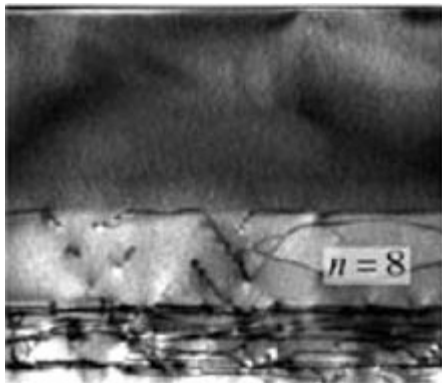
Credit: *Claus-Dieter Ohl*

Fluids travelling through micro channels could be mixed together by being whipped into a laser-induced froth, according to researchers. Their technique may provide a simple way to control chemical reactions in a lab-on-a-chip, doing away with the need for pumps, valves, or complicated channel patterning. They have exploited the well-known phenomenon of controlled cavitation, putting to good use the shockwaves created by collapsing bubbles. Focusing a pulsed nanosecond laser into any fluid creates a short-lived plasma bubble which quickly expands and implodes, causing turbulence around it.

(June 15, 2007)

### **New ultraefficient photovoltaics use "metamorphic" materials**

([Technology Review](#))



Credit: NREL

A solar cell more than twice as efficient as typical rooftop solar panels has been developed. The new cell employs new "metamorphic" materials and is designed for photovoltaic systems that use lenses and mirrors to concentrate the sun's rays onto small, high-efficiency solar cells, thereby requiring far less semiconductor material than conventional solar panels.

(June 15, 2007)

### Imperfect Earth's inner core

(Science)

Earth's solid-iron inner core has a low rigidity as indicated by the anomalously low velocities of shear waves as compared to shear wave velocities measured in iron alloys. Recent molecular dynamics simulations show that crystal defects could reduce the inner core's rigidity. The researchers conclude that the low rigidity of the Earth's inner core arises from viscous grain boundaries and high diffusion within iron crystals at high temperature.

[*Origin of the Low Rigidity of the Earth's Inner Core*, *Science* 15 June 2007, Vol. 316. No. 5831, pp. 1603 - 1605]

(June 15, 2007)

### NMR gets seriously small

(PhysicsWeb)

Researchers have made a breakthrough in nuclear magnetic resonance (NMR) spectroscopy that allows the technique to be used effectively on nanoliter-sized solid samples for the first time. The new method involves the use of two coils -- one stationary and one rotating at up to 70 kHz -- and allows the highly-sensitive magic angle spinning (MAS) NMR technique to be applied to tiny samples. The approach could eventually be used to study chemical processes in a single biological cell.

[*High-resolution, high-sensitivity NMR of nanolitre anisotropic samples by coil spinning*, *Nature* **447**, 694-697 (7 June 2007)]

(June 14, 2007)

### Force, not light, used to image cell receptors

(MIT)

Researchers have found a way to glimpse interactions between molecules on the surface of a cell. By measuring the force generated by these cell surface interactions, they were able to image and measure the rate at which individual molecules join and separate from receptors on the cell surface. These interactions are not visible with traditional light microscopy. They used a technique called functionalized force imaging, which could allow researchers to better understand the strength and rates of interactions between molecular ligands outside the cell and the molecular receptors on the cell surface.

[*Chemomechanical mapping of ligand-receptor binding kinetics on cells*, *PNAS*, June 5, 2007, vol. 104, no. 23, 9609-9614]

(June 14, 2007)

### Genetic secrets of black widow spider silk unraveled

(Eurekalert)

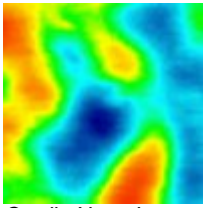
Scientists have identified the genes, and determined the DNA sequences, for two key proteins in the "dragline silk" of the black widow spider -- an advance that may lead to a variety of new materials for industrial, medical and military uses. The black widow spider's dragline silk is a standout compared to other spider silks because of its superior strength and extensibility, a combination which enables black widow dragline silk to absorb enormous amounts of energy. These properties suggest that synthetically-produced silk might find applications as diverse as lightweight super-strong body armor, components of medical devices and high-tech athletic attire.

[*Blueprint for a High-Performance Biomaterial: Full-Length Spider Dragline Silk Genes*, *PLoS ONE* 2(6): e514. doi:10.1371/journal.pone.0000514]

(June 13, 2007)

### Spectrometer reveals nano-morphology

(NanotechWeb)



Credit: Nano Lett.

Understanding the morphology of organic semiconductors is essential for designers looking to squeeze the most out of "plastic electronics". Researchers have developed an absorption spectrometer that can pinpoint variations in the local composition of polymeric or other optoelectronic materials with a spatial resolution of 100 nm, and in a relatively short time.

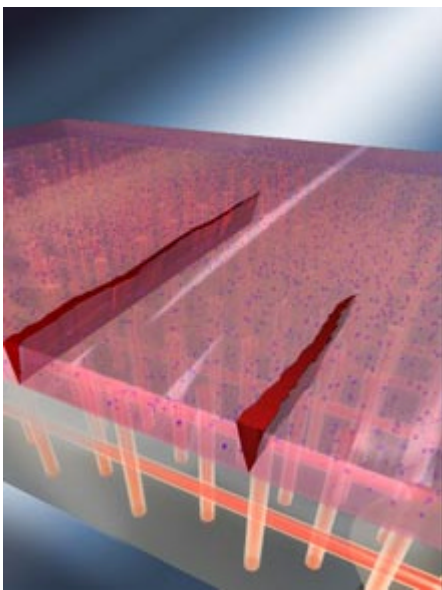
[*Structural Phase Contrast in Polycrystalline Organic Semiconductor Films Observed by Broadband Near-Field Optical Spectroscopy*, *Nano Lett.*, 7 ( 4 ), 998 - 1002 , 2007 ]  
(June 13, 2007)

#### **Zinc tweaked to get many model compounds** (Ames Laboratory)

Researchers have discovered a new family of zinc compounds that can be tuned, or manipulated, to take on some of the physical properties and behavior of other materials, ranging from plain old copper to more exotic elements like palladium, to even more complex electronic and magnetic compounds that are on the edge of becoming magnetic (or even superconducting). The unique aspect of the  $RT_2Zn_{20}$  (R=rare earth, T=transition metal, Zn=zinc) compounds' properties lies in the fact that they display extraordinary tunability, even though they are over 85 percent zinc.

[*Nearly ferromagnetic Fermi-liquid behaviour in  $YFe_2Zn_{20}$  and the associated high-temperature ferromagnetism of  $GdFe_2Zn_{20}$* , *Nature Physics*]  
(June 12, 2007)

#### **Polymer material mimics human skin, heals itself** (Technology Review)



Credit: J. Hanlon, Univ. of Illinois

Researchers have developed a polymer material that can heal itself repeatedly when it cracks. Also, this is the first time anyone has made a material that can repair itself multiple times without any external intervention. The new material mimics human skin. It is a significant advance toward self-healing medical implants and self-repairing materials for use in airplanes and spacecraft. It could also be used for cooling microprocessors and electronic circuits, and it could pave the way toward plastic coatings that regenerate themselves.

(June 11, 2007)

#### **Silicon nanowires upgrade data-storage technology** (Eurekalert)

Scientists have fabricated a memory device that combines silicon nanowires with a higher-end type of non-volatile memory that is similar to flash, a layered structure known as semiconductor-oxide-nitride-oxide-semiconductor (SONOS) technology. Their hybrid structure may be more reliable than other nanowire-based memory devices recently built and more easily integrated into commercial applications.

[*Silicon nanowire on oxide/nitride/oxide for memory application*, *Nanotechnology* 18 (2007) 235204]  
(June 11, 2007)

### Nature of disordered packing of hard spheres

(Physical Review Focus)

If equal-sized marbles are carefully stacked in a box, they will fill about 74% of its volume. But if they are dumped in, they won't fill up more than about 64%, no matter how much the box is jiggled. Researchers have measured this "random close packing" limit but can't explain it. Now a research team reports that the limit occurs when virtually all marbles form into distorted pyramid shapes called quasiregular tetrahedra. The work clarifies how simple components--or the molecules in non-crystalline solids--can get stuck in arrangements that are locally convenient but less than ideal for the whole group.

[*Polytetrahedral Nature of the Dense Disordered Packings of Hard Spheres*, *Phys. Rev. Lett.* 98, 235504 (issue of 8 June 2007) ]  
(June 11, 2007)

### Magnetic nanoparticles used for diagnosis and treatment of cancer

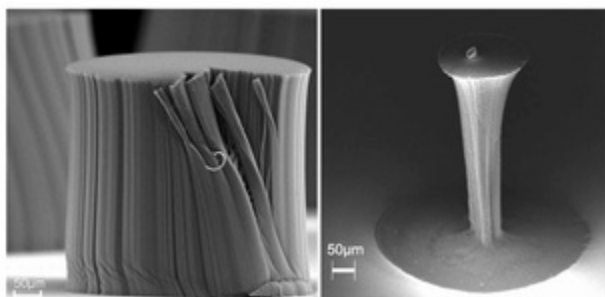
(Royal Society of Chemistry)

A proof-of-concept method has been developed for cancer detection and treatment. Researchers have made magnetic nanoparticles that can both detect breast cancer cells and deliver drugs to them. They combined iron nanocrystals and a biodegradable polymer to create the nanoparticles. An anticancer drug, doxorubicin, was encapsulated inside the nanoparticles, and the antibody Herceptin, used to target breast cancer cells, was bound to their surface.

[*Antibody conjugated magnetic PLGA nanoparticles for diagnosis and treatment of breast cancer*, *J. Mater. Chem.* , 2007, DOI: 10.1039/b702538f]  
(June 7, 2007)

### Compacting carbon nanotubes into dense bundles

(Rensselaer Polytechnic Institute)



Credit: James Lu/RPI

A new method of compacting carbon nanotubes into dense bundles has been demonstrated. These tightly packed bundles are efficient conductors and could one day replace copper as the primary interconnects used on computer chips and even hasten the transition to next-generation 3-D stacked chips.

(June 7, 2007)

### Ultralong nanobelts for wiring nanoelectric devices

(American Chemical Society)

In the realm of nanotechnology, linking nanoscale units into structures 100 microns long (the width of a human hair) seems like a world-class achievement. Scientists are now reporting for the first time the fabrication of "ultralong nanobelts" that are about a millimeter long. This will enable easier construction of integrated nanoelectronic devices, which usually require "long" lengths of wire to connect electrodes and other electronic components.

[*Ultralong Nanobelts Self-Assembled from an Asymmetric Perylene Tetracarboxylic Diimide*, *J. Am. Chem. Soc.*, **129** ( 23 ), 7234 - 7235 , 2007]  
(June 6, 2007)

### Aligning carbon nanotubes, nanowires over large areas

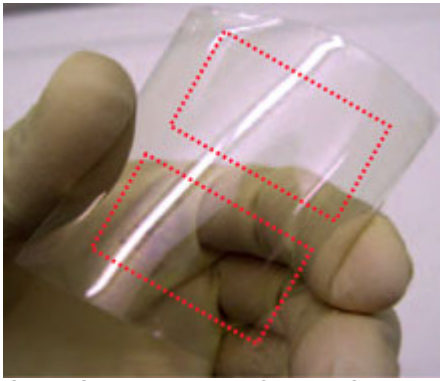
(NanotechWeb)

A simple technique has been developed to align carbon nanotubes and nanowires over large areas – by suspending these materials in a polymer and blowing bubbles from the suspension. The bubbles, which grow to 25 cm in diameter and 30 cm in height, contain regularly spaced nanowires or nanotubes all pointing in the same direction. The method could prove useful for applications that require large-scale arrays of nano- or opto-electronic devices such as sensors and displays.

[*Large-area blown bubble films of aligned nanowires and carbon nanotubes*, *Nature Nanotechnology* 2 , 372 - 377 (2007)]  
(June 6, 2007)

### Transparent transistors made from nanowires

(Technology Review)



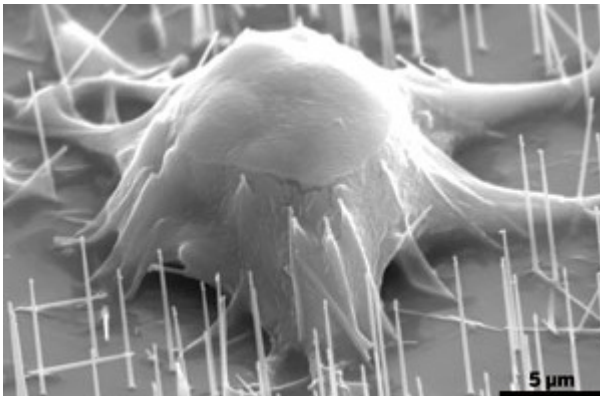
Credit: Sanghyun Ju and Chulwoo Son, Purdue University

Researchers have made flexible, see-through transistors using zinc-oxide and indium-oxide nanowires. By contrast, the amorphous or polycrystalline silicon transistors used in current displays are not transparent. The new transistors also perform better than their silicon counterparts and are easier to fabricate on flexible plastic.  
(June 6, 2007)

#### **Big particles are secret to crack-free paint** (PhysicsWeb)

The frustrating cracks that appear on newly painted surfaces could soon be a thing of the past. Physicists have calculated how the properties of paint, such as the size of the constituent particles, affect its ability to stay smooth while drying, which could help manufacturers to develop more effective crack-free paints.  
[*Cracking in Drying Colloidal Films*, Phys. Rev. Lett. **98**, 218302 (2007)]  
(June 4, 2007)

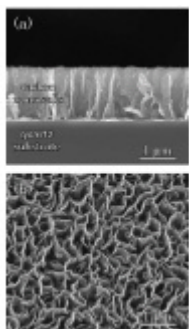
#### **Interfacing Si nanowires with mammalian cells** (Chemical & Engineering News)



Credit: J. Am. Chem. Soc.

Researchers have grown mammalian cells on arrays of silicon nanowires, each about 3–6  $\mu\text{m}$  long and less than 100 nm in diameter. As the cells settle out of the culture medium onto the bed of nanowires, the wires penetrate the cells without damaging them and without the application of any external force. The cells survive and proliferate, even after being impaled on the wires. This can be used to place foreign molecules into cells.  
[*Interfacing silicon nanowires with mammalian cells*, J. Am. Chem. Soc., DOI: 10.1021/ja071456k]  
(June 4, 2007)

#### **Nanowalls contain tiny domains** (NanotechWeb)



Credit: *Appl. Phys. Lett.*

The carbon nanowall (CNW) is a promising new form of two-dimensional carbon discovered in 2002. Because of their large surface area, CNWs are good candidate materials for a wide range of applications. A new study now shows that a CNW is made up of tiny nanographite domains. The result confirms that the material is highly "graphitized", which means that it should have unique physical properties not present in other graphite-based materials.

[[Nanographite domains in carbon nanowalls](#), *J. Appl. Phys.* 101, 094306 (2007)]  
(May 30, 2007)

#### **Direct interconnections between nanowires and human cells** (American Chemical Society)

Scientists have reported an advance toward one of the futuristic goals in nanobiology and nanomedicine — developing technology for “wiring” together individual cells and connecting cells via nanowires to external sensors and other devices. They report what they term is the first demonstration of a direct nanowire connection to individual mammalian cells without the use of force that can damage or kill cells. They connected human embryonic kidney cells and mouse embryonic stem cells to silicon nanowires, using an approach in which the wires penetrated into cells naturally as the cells grew in cultures.

[[Interfacing Silicon Nanowires with Mammalian Cells](#), *J. Am. Chem. Soc.*, ASAP Article, Web Release Date: May 22, 2007]  
(May 30, 2007)

#### **Quasicrystals: Somewhere between order and disorder** (Science Daily)

Two mathematicians have offered a key proof in the study of quasicrystals. The work focuses on a popular model mathematicians use to study quasicrystals. The research, which was 10 years in the making, proves that quasicrystals in the model are not electrical conductors and sheds light on a little-understood corner of materials science.

[[Jour. American Math. Society](#)]  
(May 24, 2007)

#### **Improved fluorescent sensor material detects explosives more effectively** (American Chemical Society)

Present fluorescent-based sensors signal the presence of explosives by losing their glow. Such existing devices, however, have serious limitations. A new fluorescent film, made from nanofibrils, senses the presence of vapors from TNT and a related explosives compound with greater effectiveness than existing materials. After sensing the compounds and losing its fluorescence, the material recovered its ability to fluoresce repeatedly during the tests.

[[Detection of Explosives with a Fluorescent Nanofibril Film](#), *J. Am. Chem. Soc.*, ASAP Article, Web Release Date: May 15, 2007]  
(May 23, 2007)

#### **Super-stable surface nanobubbles** (Physical Review Focus)

An air bubble can survive on the side of a glass of water for a long time, but shrink that bubble to the nanoscale, and the overwhelming force of surface tension should prevent it from ever forming. Yet researchers have been observing them for several years. Now, a team reports that nanobubbles can withstand shock waves exerting wide swings in pressure, a sign of what they call superstability. Aside from any impact on solving the riddle, the results suggest that tiny bubbles could be useful pieces of nanotechnology, perhaps serving to protect delicate machinery in future biochemical devices.

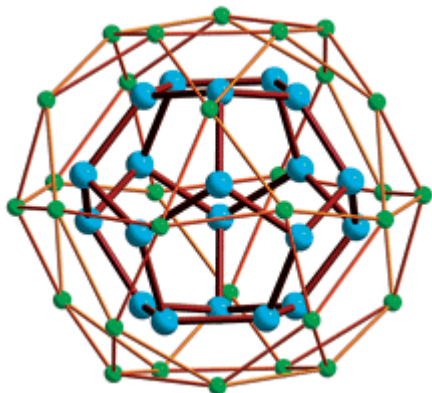
[[Superstability of Surface Nanobubbles](#), *Phys. Rev. Lett.* 98, 204502 (issue of 18 May 2007)]  
(May 22, 2007)

#### **Inverse woodpile structure has extremely large photonic band gap** (University of Illinois)

In a new study, researchers have described the fabrication and optical properties of a germanium "inverse woodpile structure"; a structure with one of the widest photonic band gaps ever reported. When stacking firewood, pieces should be placed close enough to permit passage of a

mouse, but not of a cat chasing the mouse. Now, if the woodpile were built with all of these mouse passageways packed with ice, and the wood carefully removed, then this is the latest photonic structure built by the researchers.  
(May 22, 2007)

### Highly symmetric cage molecule boasts intriguing magnetic properties (Chemical & Engineering News)



Credit: Zhiping Zheng

A complex metal cage structure with arresting symmetries has emerged from three simple ingredients. Although its beauty stands out, the molecule also has shown some intriguing magnetic properties. In the synthesis,  $\text{La}(\text{NO}_3)_3$ ,  $\text{Ni}(\text{NO}_3)_2$ , and iminodiacetic acid (IDA) were combined in an aqueous solution, the mixture was sealed in a Teflon-coated stainless steel container, and subjected to a roughly weeklong program of heating and slow cooling. Crystallographic analysis revealed a stunning architecture: a pair of nested, cagelike metal spheres bridged by IDA.  
[*A Keplerae Magnetic Cluster Featuring an Icosidodecahedron of Ni(II) Ions Encapsulating a Dodecahedron of La(III) Ions*, *J. Am. Chem. Soc.*, ASAP Article 10.1021/ja0726198 S0002-7863(07)02619-4, Web Release Date: May 11, 2007]  
(May 21, 2007)

### Nanocomposite labeled cancer cells can be targeted, destroyed using lasers (Eurekalert)

A nanocomposite particle can be constructed so that it has a mix of properties that would not otherwise happen in nature. By combining an organic matrix with metallic clusters that can absorb light, it is possible to incorporate such particles into cells and then destroy those targeted cells with a laser. These are called Composite NanoDevices (CNDs) which are an emerging class of hybrid nanoparticulate materials. The study focused on the creation and characterization of a dendrimer nanocomposite (DNC) matrix containing silver clusters that can be used to target and destroy melanoma cancer cells.  
(May 21, 2007)

### Electrons hold their spin in silicon (PhysicsWeb)

Researchers claim to have injected spin-polarized electrons into silicon for the first time. In their tiny device, electrons were made to flow from a ferromagnetic alloy into a piece of silicon, where they traveled for a distance of about 10  $\mu\text{m}$  without losing their polarization. The team was also able to rotate the electron spins as they travel through the silicon and finally extract the electrons and measure their polarization.  
[*Electronic measurement and control of spin transport in silicon*, *Nature* **447**, 295-298 (17 May 2007)]  
(May 18, 2007)

### Growing particles from the inside out (Royal Society of Chemistry)

Gold particles have been grown inside silica nanoshells in an inside out approach to synthesis. Coating silica onto metal nanoparticles is a known method of stabilising and functionalising nanoparticles, however, the new technique takes a reverse approach, using hollow silica particles as nanoreactors to grow gold particles. The scientists added a gold precursor and a reducing compound to the silica's cavity to form silica coated gold nanocomposites. The size of the nanocomposites can be controlled by tailoring the cavity size of the silica reactors.  
[*Au-silica nanoparticles by reverse synthesis of cores in hollow silica shells*, *Chem. Commun.*, 2007, 2031]  
(May 17, 2007)

### Porous nanoparticles deliver chemicals into plants (NanotechWeb)

Even though nanoparticles have been used to deliver DNA, drugs and other molecules into animal cells, this is not so easy to do in plants because of their cell walls, which act as barriers. Now, researchers have succeeded in overcoming this problem by using silica nanoparticles with a



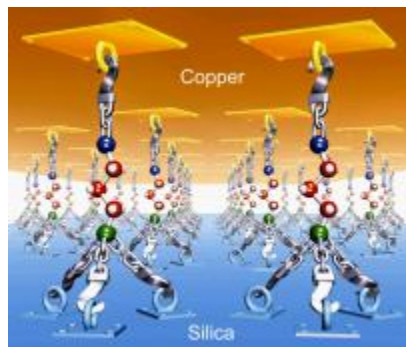
honeycomb shape. The nanoparticles have pores measuring just 3 nm across and can transport DNA and chemicals into isolated cells and intact leaves. The breakthrough result could find applications in plant biotechnology and might even be used to improve crops in the future.

[[Mesoporous silica nanoparticles deliver DNA and chemicals into plants](#), *Nature Nanotechnology* 2, 295 - 300 (2007)]

(May 17, 2007)

### Inexpensive 'nanoglue' can bond nearly anything together

(Eurekalert/RPI)



Credit: Rensselaer Polytechnic Institute/G. Ramanath

A new method to bond materials that do not normally stick together has been developed. The team's adhesive, which is based on self-assembling nanoscale chains, could impact everything from next-generation computer chip manufacturing to energy production. Less than a nanometer – or one billionth of a meter – thick, the nanoglue is inexpensive to make and can withstand temperatures far higher than what was previously envisioned. In fact, the adhesive's molecular bonds strengthen when exposed to heat, and the nanolayers continue to strengthen up to temperatures as high as 700 degrees Celsius.

[[Annealing-induced interfacial toughening using a molecular nanolayer](#), *Nature* **447**, 299-302 (17 May 2007)]

(May 17, 2007)

### First example of a polymer quasicrystal

(Physical Review Focus)



Credit: *Phys. Rev. Lett.* **98**, 195502 (2007)

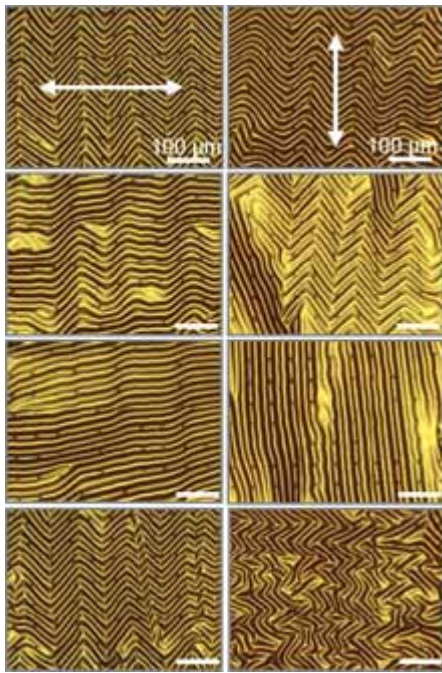
Quasicrystals are curious structures that aren't completely random but also never quite repeat themselves the way crystal structures do. They have been seen in metals and a few other materials. Now the first example of a polymer quasicrystal has been reported. This was observed in a three-component polymer system composed of polyisoprene, polystyrene, and poly(2-vinylpyridine) which forms a star-shaped terpolymer, and a polystyrene homopolymer blend. The spacing between the polymer structures is 100 times larger than between atoms, so it's difficult to apply the quantum mechanical theories from previous quasicrystals to this new type. The larger size also means that these new structures could be used as photonic crystals.

[[Polymeric Quasicrystal: Mesoscopic Quasicrystalline Tiling in ABC Star Polymers](#), *Phys. Rev. Lett.* 98, 195502 (issue of 11 May 2007) ]

(May 16, 2007)

### Two-dimensional stretchable Si demonstrated

(Technology Review)



Credit: John A Rogers, Univ. Illinois

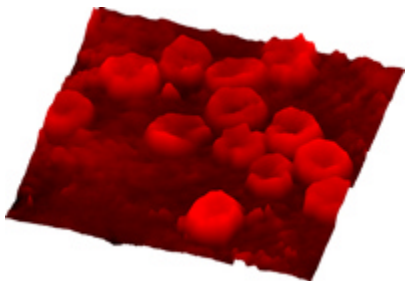
Stretchable Si can be useful for a host of other applications, such as wearable electronics and bendable computers. A research group has previously shown that silicon can stretch in one dimension, like a rubber band. Now, the same group has developed sheets of silicon that can stretch in two dimensions as well, which could make it possible to put electronics on spheres and surfaces with complicated shapes. The team has also made functional diodes out of the two-dimensional stretchy silicon.

[[Biaxially Stretchable "Wavy" Silicon Nanomembranes](#), *Nano Lett.*, ASAP Article 10.1021/nl0706244 S1530-6984(07)00624-8, Web Release Date: May 8, 2007]

(May 16, 2007)

### Quantitative phase imaging monitors living cells

(SPIE)



Credit: Gabriel Popescu, MIT

An imaging technique called quantitative phase imaging (QPI) allows high-resolution observations of the stiffness of living cells and could eventually lead to enhanced treatment and diagnostics for conditions such as malaria, sickle-cell anemia, and cancer. QPI enables monitoring of living cells during time intervals from milliseconds to days. For instance, it reveals every vibration of red-blood-cell membranes. That, in turn, makes it possible to infer the elasticity of the cells, which is crucial for their function.

[[Optical measurement of cell membrane tension](#), *Phys. Rev. Lett.* 97, pp. 218101, 2006]

(May 16, 2007)

### Tunable superhydrophobic/superhydrophilic wetting transition on surfaces

(Eurekalert)

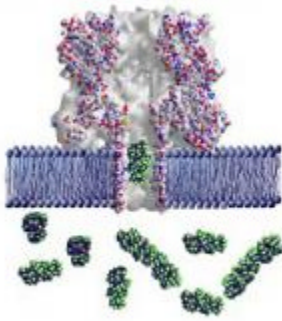
Researchers have devised a convenient way to construct test surfaces with a variable affinity for water, so that the same surface can range from superhydrophilic to superhydrophobic, and everything in between. The technique, based on ultraviolet light and photosensitive materials, mimics one of nature's cleverest feats of surface chemistry demonstrated by the *Stenocara* beetle of Africa's Namib Desert.

[[UVO-tunable superhydrophobic to superhydrophilic wetting transition on biomimetic nanostructured surfaces](#), *Langmuir* 2007, 23, 2608-2614]

(May 14, 2007)

### Nanoscale pores can be tiny analysis labs

(Eurekalert)

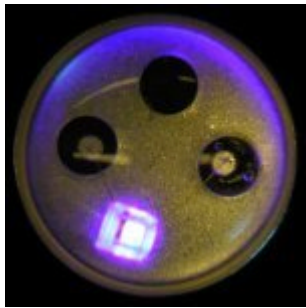


Credit: NIST

A research team has shown for the first time that a single nanometer-scale pore in a thin membrane can be used to accurately detect and sort different-sized polymer chains (a model for biomolecules) that pass through or block the channel. The "single-molecule mass spectrometry" system described in a recent paper is a non-destructive technique that in principle can measure one molecule at a time in a space small enough to fit on a single microchip device.

[[Single-molecule mass spectrometry in solution using a solitary nanopore](#), *Proc. Natl. Acad. Sci. USA*, 10.1073/pnas.0611085104] (May 14, 2007)

### Massive power boost for non-polar GaN LEDs (Compound Semiconductor)

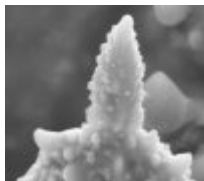


Credit: University of California, Santa Barbara

Thanks to improved substrate material, a research team working on non-polar GaN has produced a blue-violet LED with record output power and an external quantum efficiency of 41 percent at a very high drive current. They have fabricated an LED with the highest efficiency and output power ever reported. The device is an InGaN multi-quantum-well structure with an output power of 28 mW and a peak wavelength of 402 nm when driven at 20 mA - equivalent to an external quantum efficiency of 45.4 percent. Crucially, that impressive conversion efficiency was maintained at much higher currents, with the device emitting 250 mW when driven at 200 mA.

[[Improved electroluminescence on nonpolar m-plane InGaN/GaN quantum wells LEDs](#), *physica status solidi - Rapid Research Letters*, Volume 1, Issue 3, Pages 125 - 127] (May 10, 2007)

### Germanium nanospikes by femtosecond laser irradiation (NanotechWeb)

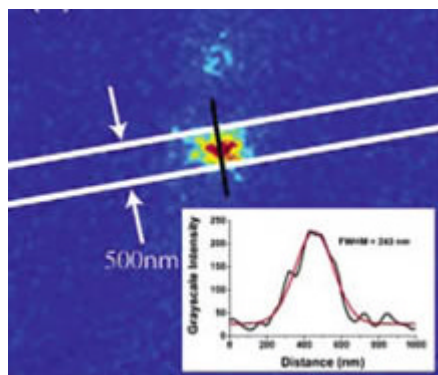


Credit: University of Virginia

Laser-textured germanium could lead to a new breed of high-performance photodetectors, solar cells and electron emitters. Researchers exposed chipped portions of a Ge wafer to 1.4 mJ pulses of 800 nm emission from a Ti:sapphire laser. SEM images revealed a surface covered with conical structures with a base diameter of about 5  $\mu\text{m}$ , a height of 10–15  $\mu\text{m}$  and a tip diameter of just 100 nm. Tips could be sharpened further by a brief chemical-etching process lasting just 10 seconds and yielding a tip radius of approximately 10 nm.

[[Spontaneous formation of nanospiked microstructures in germanium by femtosecond laser irradiation](#), 2007 *Nanotechnology* 18 195302] (May 10, 2007)

### Nanometer-scale light sources demonstrated (Technology Review)



Credit: Craighead Research Group, Cornell University

By depositing narrow light-emitting fibers on a silicon substrate patterned with gold electrodes, researchers at Cornell University have created extremely small light sources with dimensions of only a few hundred nanometers. The fibers are made of a polymer, containing ruthenium-based molecules, which light up when exposed to an electric field. Electrospinning was used to lay down the fibers directly on the substrate. Because the method is relatively simple, the light sources should be easy to integrate into lab-on-a-chip devices, where light can be used to detect chemical and biological molecules, such as drugs and proteins, which could be tagged with fluorescent dyes or might absorb a portion of the light. And because the fibers are made of polymers, they could find use in flexible displays.  
(May 9, 2007)

### Porous silicon for photodynamic therapy (Royal Society of Chemistry)

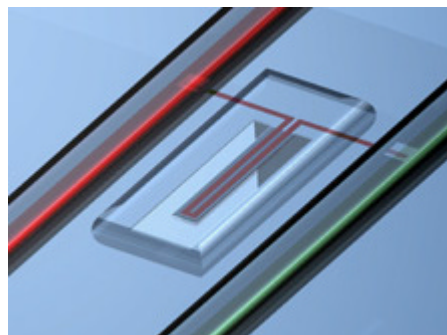
A porous silicon nanobomb has been developed that heats up with near-infrared irradiation and could cause cancer cells in the body to explode. Recent research into a new kind of photodynamic therapy has concentrated on using single-walled carbon nanotubes, combined with near-infrared light, to generate heat to kill cancer cells. In a new study, researchers have substituted the carbon nanotubes with a porous silicon nanomaterial, which they claim can generate as much heat as the carbon nanotubes, with the added bonus of producing much smaller amounts of reactive oxygen species.

[[The properties of porous silicon as a therapeutic agent via the new photodynamic therapy](#), *J. Mater. Chem.* , 2007 DOI: [10.1039/b700892a](#) ]  
(May 8, 2007)

### 'Layered-layered' materials for rechargeable lithium batteries (EurekAlert/Argonne National Lab.)

A new approach has been developed to increase the capacity and stability of rechargeable lithium-ion batteries. The technology is based on a new material for the positive electrode that is comprised of a unique nano-crystalline, layered-composite structure. The two-component "composite" structure includes an active component that provides for charge storage embedded in an inactive component that stabilizes the structure.  
(May 8, 2007)

### Ultrasensitive method for weighing living cells (Technology Review)



Courtesy: Thomas Burg, MIT

An extremely sensitive biomolecule detector that can measure the weight of single living cells has been demonstrated. The new biodetector could provide, among other applications, a practical and cheap way to count particular types of cells in, say, a blood sample. The heart of the detector is a tiny, vibrating, silicon cantilever. Inside it, a U-shaped microchannel allows fluids containing cells to flow. As cells travel through the cantilever, their added mass alters the speed at which the cantilever vibrates.

[[Weighing of biomolecules, single cells and single nanoparticles in fluid](#), *Nature* **446** , 1066-1069 (26 April 2007)]  
(May 7, 2007)

### Speckles expose magnet's noisy secrets

(PhysicsWeb)

Scientists have long been able to measure the tiny thermal fluctuations in the magnetization of ferromagnetic materials like iron, but measuring similar "noise" from antiferromagnetic materials like chromium has proved far harder. Now, researchers have been able to measure these fluctuations in an antiferromagnet for the first time and they find that these occur at surprisingly low temperatures. This means that it could be difficult to use antiferromagnets in certain data-storage and spintronic devices.

[*Direct measurement of antiferromagnetic domain fluctuations*, *Nature* **447**, 68-71 (3 May 2007)]

(April 7, 2007)

### Electron nanodiffraction sets new record

(NanotechWeb)

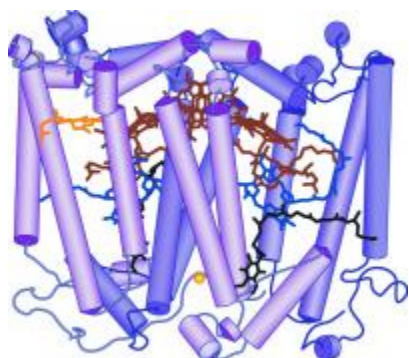
A new electron microscope technique has been developed that is able to produce diffraction patterns from areas of material just 10 nm in diameter with unprecedented precision. The method also allows the size of the diffracting area to be carefully "tuned" to the features of interest in a particular material, which allows the surrounding material to be excluded for the first time.

[*Electron nanodiffraction using sharply focused parallel probes*, *Appl. Phys. Lett.* **90**, 151104 (2007)]

(May 7, 2007)

### Scientists offer new view of photosynthesis

(EurekaAlert)



Credit: Arizona State Univ.

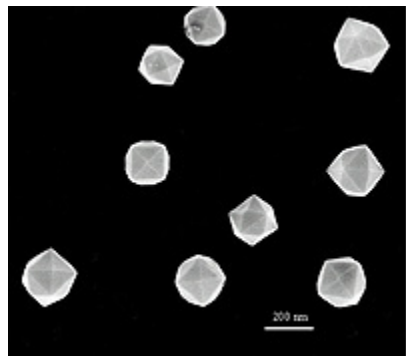
During the remarkable cascade of events of photosynthesis, plants approach the pinnacle of stinginess by scavenging nearly every photon of available light energy to produce food. Yet after many years of careful research into its exact mechanisms, some key questions remain about this fundamental biological process that supports all life on earth. Now, a research team has come up with a new insight into the mechanism of photosynthesis, which involves the orchestrated movement of proteins on the timescale of a millionth of a millionth of a second. This allows plants or bacteria to harness light energy efficiently even when conditions aren't optimal. The answers may be good news for organic solar cell technology, a low cost alternative to traditional silicon solar cells.

[*Protein Dynamics Control the Kinetics of Initial Electron Transfer in Photosynthesis*, *Science* 4 May 2007: Vol. 316. no. 5825, pp. 747 - 750 ]

(May 4, 2007)

### Tetrahexahedral platinum nanocrystals boost catalytic activity

(Georgia Tech.)



Credit: Georgia Tech

A research team has produced a new form of the industrially-important metal platinum: 24-facet nanocrystals whose catalytic activity per unit area can be as much as four times higher than existing commercial platinum catalysts. The new platinum nanocrystals, whose "tetrahedral" structure had not previously been reported in the metal, could improve the efficiency of chemical processes such as those used to catalyze fuel oxidation and produce hydrogen for fuel cells.

[*Synthesis of Tetrahedral Platinum Nanocrystals with High-Index Facets and High Electro-Oxidation Activity*, *Science* 4 May 2007: Vol. 316. no. 5825, pp. 732 - 735]  
(May 4, 2007)

#### Quantum dot recipe may lead to cheaper solar panels (Eurekalert/Rice Univ.)

Researchers have revealed a breakthrough method for producing quantum dots, a discovery that could clear the way for better, cheaper solar energy panels. They describe a new chemical method for making four-legged cadmium selenide quantum dots, called tetrapods, which previous research has shown to be particularly effective at converting sunlight into electrical energy. The technique produces same-sized particles, in which more than 90 percent are tetrapods.

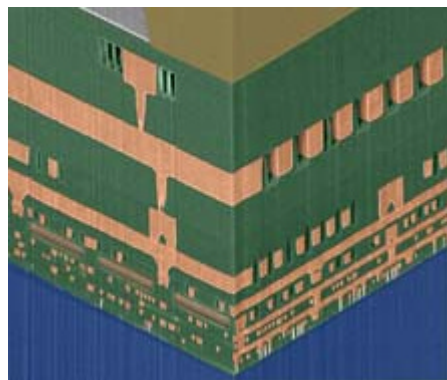
[*Shape-Controlled Synthesis of CdSe Tetrapods Using Cationic Surfactant Ligands*, *Small*, Published Online: 30 Apr 2007]  
(May 3, 2007)

#### Sensitive, selective mercury sensor (Chemical & Engineering News)

A new colorimetric method provides a simple and sensitive way to detect mercury in aqueous samples. The advance may form the basis of an instrument-free procedure for monitoring mercury levels in lakes and rivers and may lead to similar types of detection methods for other metals. The method detects Hg<sup>2+</sup> ions at concentrations as low as 100 nM (20 ppb) in aqueous samples. Based on DNA-functionalized gold nanoparticles, the procedure is highly selective and, unlike other Hg<sup>2+</sup> detection methods, does not require organic solvents or cosolvents.

[*A Gold-Nanoparticle-Based Real-Time Colorimetric Screening Method for Endonuclease Activity and Inhibition*, *Angew. Chem. Int. Ed.*, Volume 46, Issue 19, Pages 3468 - 3470]  
(May 3, 2007)

#### Self-assembly to make faster chips (Technology Review)



Courtesy: IBM

IBM researchers have taken a step toward using self-assembly in making future microprocessors. The company has announced a novel process that uses self-assembly techniques to create air gaps that insulate wires in microprocessors. Early results show that these air-gap insulators can increase the speed of a chip by 35 percent or allow it to consume 15 percent less power than chips without the air-gap insulator. The company expects that the new process will be implemented in semiconductor facilities by 2009.  
(May 3, 2007)



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