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## Materials News

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#### [Metal-nanoparticle embedded paint shows antimicrobial properties](#)

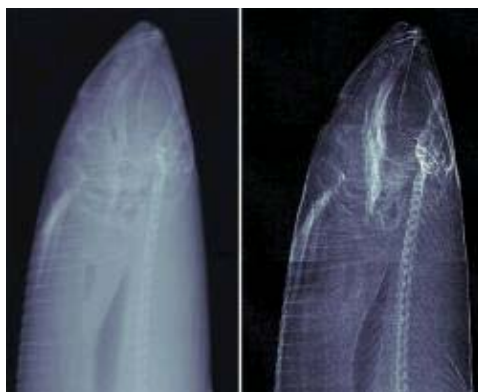
(Nature Materials)

Free radicals generated during the natural drying process of oils and resin paints can be used to reduce silver salts to form nanoparticles embedded in the paints. An environmentally friendly chemistry approach using this method for the synthesis of metal-nanoparticle (MNP)-embedded paint, in a single step, from common household paint has been demonstrated. The coatings show excellent bactericidal activity against human pathogens and bacteria.

[[Silver-nanoparticle-embedded antimicrobial paints based on vegetable oil](#), *Nature Materials*, Published online: 20 January 2008 | doi:10.1038/nmat2099] (January 23, 2008)

#### [Dark-field X-rays yield much higher quality images](#)

(New Scientist)



Credit: Franz Pfeiffer (Paul Scherrer Institute)/ *Nature Materials*

A set of simple silicon filters could dramatically improve the quality of X-ray images. Dark-field microscopy improves the contrast of an image by using only scattered light. A new study now shows that the same principle can be applied to X-ray images. This is done by ignoring conventional X-rays passing through an object and only collecting those that scatter off it instead. The team has developed a set of silicon filters that make this possible: radiation that passes straight through an object can be ignored, and rays bent through a tiny angle, as a result of scattering, are collected. The process involves taking four separate images, each with the three filters in a slightly different arrangement. Software then compares each snapshot to produce a final high-contrast picture.

[[Hard-X-ray dark-field imaging using a grating interferometer](#), *Nature Materials*, Published online: 20 January 2008 | doi:10.1038/nmat2096]

(January 23, 2008)

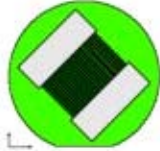
### Scientists find diatom genes involved in silica bioprocessing

(Eurekalert)

Diatoms build their hard cell walls by laying down submicron-sized lines of silica. A research team has reported finding a set of 75 genes specifically involved in silica bioprocessing in the diatom *Thalassiosira pseudonana*. The new data will enable manipulation of the genes responsible for silica production and potentially harness them to produce lines on computer chips. This could vastly increase chip speed, because diatoms are capable of producing lines much smaller than current technology allows. (January 22, 2008)

### Low-cost chip stretches single molecules

(NanotechWeb)

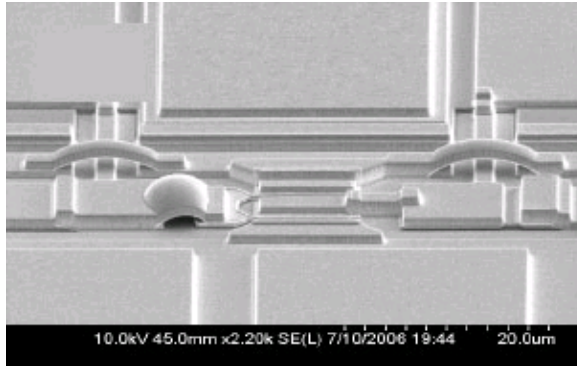


Credit: Univ. of Tokyo

Scientists have successfully generated silicon dioxide nanochannel arrays without the use of nanolithography. Nanofluidic channels are in demand as tools for isolating, manipulating and analyzing DNA and proteins at the single molecule level, but their cost can be high due to manufacturing methods, such as focused ion beam milling and e-beam lithography. Using bulk micromachining – a combination of anisotropic etching in potassium hydroxide solution, local oxidation of silicon and plasma etching of silicon – the team has produced an array of parallel nanogrooves on 100- and 110-orientated silicon wafers. The grooves are covered using a deposition method (or by tilted evaporation) to form enclosed channels. Finally, buffered hydrofluoric acid is applied at the wafer's edge to etch "V" shaped inlets and outlets along either side of the nanoarray. (January 22, 2008)

### 1 THz InP transistor claims speed record

(Semiconductor International)

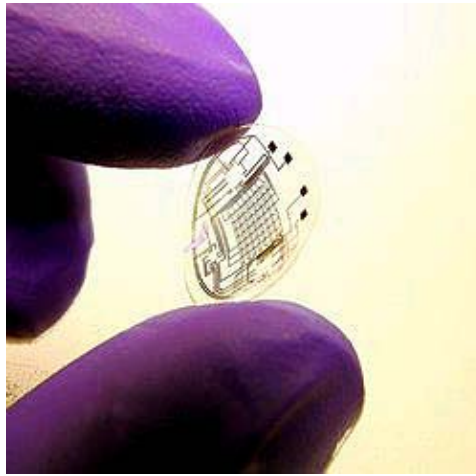


Credit: Northrop Grumman

A new world record for transistor speed with an indium phosphide-based high-electron-mobility transistor (InP HEMT) is being reported. The device has a maximum frequency of operation of >1 THz (1000 GHz). To develop the terahertz Fmax InP HEMT device, researchers employed several process enhancements. One key process enhancement was the reduction of the gate length from 70 to <50 nm. The gate length footprint of the T-shaped gate is ~35 nm, fabricated with electron-beam lithography (EBL) operating at 20 keV. (January 21, 2008)

### Contact lens with integrated electronic circuit, LED demonstrated

(University of Washington)



*Credit: University of Washington*

Research engineers have for the first time used manufacturing techniques at microscopic scales to combine a flexible, biologically safe contact lens with an imprinted electronic circuit and lights. The prototype device contains an electric circuit as well as red light-emitting diodes for a display, though it does not yet light up. The lenses were tested on rabbits for up to 20 minutes and the animals showed no adverse effects. Looking through a completed lens, it would be eventually possible for humans to see what the display is generating superimposed on the world outside. (January 18, 2008)

#### **Materials' crystal properties illuminated by mathematical 'lighthouse'** (Eurekalert/Princeton Univ.)

A deeper fundamental understanding of complex materials may now be possible, thanks to a pair of scientists who have uncovered a new insight into how crystals form. The researchers' findings reveal a previously unknown mathematical relationship between the different arrangements that interacting particles can take while freezing. The findings explore particles' behavior as they attract and repel each other over varying distances. By analyzing this behavior, the scientists were able to conceive a precise mathematical correspondence -- called duality relations -- between possible arrangements of particles. The work will enable the researchers to draw important conclusions about how particles at very low temperatures interact over great distances, a situation that is very difficult to treat theoretically.

[*New Duality Relations for Classical Ground States*, *Phys. Rev. Lett.* 100, 020602 (2008)]

(January 18, 2008)

#### **Uranium ion reacts** (Nature News)

Uranium, the heaviest naturally occurring element, prevalent in nuclear waste, has been forced into a chemical reaction. The chemical achievement won't yet allow researchers to clean uranium out of the environment. But it is big step forwards in understanding how the element works — which might one day lead to uranium 'mops' or even new catalysts for industrial processing. The uranyl ion,  $[\text{UO}_2]^{2+}$ , is the default form that uranium takes in water the environment. The metal-oxygen bonds in this linear molecule are incredibly strong, making the ion very unreactive. got around the ion's stubborn unreactivity by trapping it in the mouth-shaped cavity of a large, 'pacman'-shaped organic molecule. This arrangement slightly bends the usually rigid uranyl molecule, so that the oxygen atom sticking out of the top of the large complex becomes reactive, and grabs silicon-containing groups chucked into the mixture. The oxygen then binds to silicon as well as uranium, forming a strong silicon-oxygen bond.

[*Reduction and selective oxo group silylation of the uranyl dication*, *Nature* 451, 315-317 (17 January 2008)]

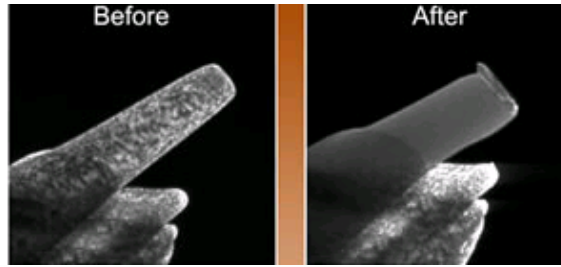
(January 17, 2008)

#### **World's darkest material created using carbon nanotubes (Audio)** (National Public Radio)

The "darkest ever" substance known to science has been created from carbon nanotubes. The researchers involved said it is the closest thing yet to the ideal black material, which absorbs light perfectly at all angles and over all wavelengths. The discovery is expected to have applications in the fields of electronics and solar energy. The material is made of an array of vertically aligned, low-density carbon nanotubes.

[*A Phase Transition Hidden in Higher Dimensions*, *Science* 4 January 2008: Vol. 319. no. 5859, pp. 41 - 42; *Hidden Degrees of Freedom in Aperiodic Materials*, *Science* 4 January 2008: Vol. 319. no. 5859, pp. 69 - 71] (January 4, 2008)

### Mechanical annealing in sub-micron-sized metal crystals (Lawrence Berkeley National Lab)



Credit: Andrew Minor, Lawrence Berkeley National Lab

A new study has used an *In Situ* TEM to record what happens when pillars of nickel with diameters between 150 and 400 nm are compressed under a flat punch made of diamond. The TEM is equipped so that samples can be stressed, measured, and videotaped while being observed under the electron beam. The investigation helped the researchers understand why nanoscale nickel pillars are so strong by allowing them to observe changes in the microstructure of the pillars during deformation — including a never-before-seen process the researchers dubbed "mechanical annealing."

[*Mechanical annealing and source-limited deformation in submicrometre-diameter Ni crystals*, *Nature Materials*, Published online: 23 December 2007; | doi: 10.1038/nmat2085] (January 3, 2008)

### Missing evolutionary link found using tiny fungus crystal (Purdue Univ.)



Credit: Barbara Golden, Purdue University

The crystal structure of a molecule from a primitive fungus has served as a time machine to show researchers more about the evolution of life from the simple to the complex. By studying the three-dimensional version of the fungus protein bound to an RNA molecule, scientists have been able to visualize how life progressed from an early self-replicating molecule that also performed chemical reactions to one in which proteins assumed some of the work. This shows how RNA progressed to share functions with proteins, a critical missing step.

[*Structure of a tyrosyl-tRNA synthetase splicing factor bound to a group I intron RNA*, *Nature* **451**, 94-97 (3 January 2008)] (January 3, 2008)

### A Materials Feast In Boston (Chemical & Engineering News)

Report on the 2007 MRS Fall Meeting. " While most of America thinks of Thanksgiving as a traditional time to indulge, materials scientists know, intellectually speaking, that the real feast arrives the week after the November holiday. That's when the Materials Research Society (MRS) serves up its annual fall meeting, offering materials researchers from around the world a vast repast of science to sample." (January 2, 2008)

### Giant wasp could inspire nanodevices

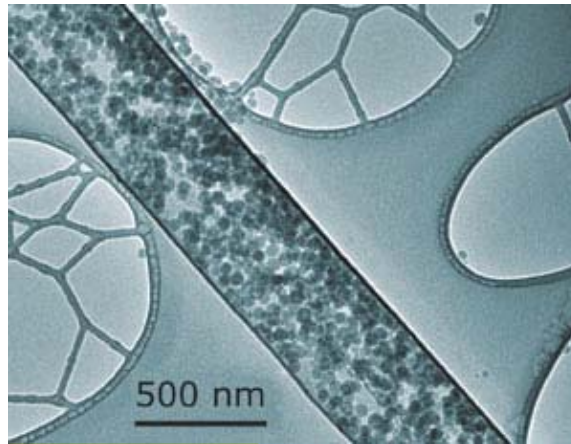
(NanotechWeb)

A giant tropical wasp could help inspire new nano and optical devices thanks to the way that its wings reflect light. Researchers have found that a simple structure – made of a transparent wax layer covering the whole surface of each wing of the wasp – is responsible for the blue-green iridescence observed in these creatures. According to the Authors, the results could be used to inspire nano and optical devices. Depositing layers of optical material on glass is now common and this study gives an example of a similar layer on an opaque material, which could be made of steel or plastic. Indeed such layers could also produce selective reflectance in non-visible electromagnetic ranges, which could provide ultraviolet protection, for instance.

[[Nanomorphology of the blue iridescent wings of a giant tropical wasp, "Megascolia procer javanensis" \(Hymenoptera\)](#), arXiv:0710.2692v1 [physics.optics]]  
(January 2, 2008)

### New method for trapping liquids inside carbon nanotubes

(Royal Society of Chemistry)



Credit: *J. Mater. Chem.*

Researchers have reported a mild new method for trapping liquids and nanoparticles inside carbon nanotubes. In the new technique, water is dragged into nanotubes by a self-sustained diffusion mechanism. A toluene solution of a polymer, in this case polycaprolactone, is then pulled into the nanotubes. As the polymer is insoluble in the water already in the tubes, the polymer gathers at the ends and forms caps. As a result, the water becomes trapped within the nanotubes. Crucially, this takes place under mild conditions, which is where this method holds its advantage.

[[Room-temperature, open-air, wet intercalation of liquids, surfactants, polymers and nanoparticles within nanotubes and microchannels](#), *J. Mater. Chem.*, 2008, DOI: 10.1039/b714541c]  
(January 2, 2008)

### New method for fabrication of graphene transistors

(Eurekalert/Princeton University)

For carbon-based microelectronics, switching from silicon to carbon has not been possible because technologists believed they needed graphene material in the same form as the silicon used to make chips: a single crystal of material eight or 12-inches wide. The largest single-crystal graphene sheets made to date have been no wider than a couple millimeters, not big enough for a single chip. A research team realized that a big graphene wafer is not necessary, as long they could place small crystals of graphene only in the active areas of the chip. They have developed a novel method to achieve this goal and demonstrated it by making high-performance working graphene transistors.

[[Graphene Transistors Fabricated via Transfer-Printing In Device Active-Areas on Large Wafer](#), *Nano Lett.*, 7 (12), 3840 -3844, 2007]  
(December 20, 2007)

### Conduction seen in DNA backbone

(Physics World)

A new study has yielded important new insights into how DNA might behave as an electrical conductor. Using a technique called resonant Auger spectroscopy, a group of Japanese scientists are the first to measure how electrons move through the DNA backbone. They directed a beam of X-rays onto DNA to excite electrons from phosphorus atoms in the backbone of the molecule. If these electrons remain near to