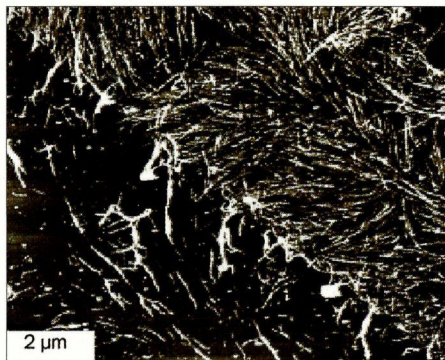


Compiled by Steve Reucroft and John Swain

Carbon nanotubes found to be wiggly when wet

Take a pinch of carbon nanotubes, add a dash of water, and what do you get? The answer, rather surprisingly, is almost anything you want. While most work to date would lead one to think of carbon nanotubes as stiff rods just a few nanometres across, Vladimir Tsukruk and his colleagues at Iowa State University in Ames have found that all this changes when the nanotubes are wet. They become very flexible and will spontaneously bend into interesting forms as they dry. By cycling through many wetting and drying operations, they have found loops, hooks, coils and other shapes. In addition to the obvious interest in bent nanotubes as possible structural components for nano-devices, the expected change in their optical properties in response to bending also makes them possible candidates for sensors.



This image from an atomic force microscope shows part of an individual stripe of carbon nanotubes "woven" into a complex texture.

Further reading

V V Tsukruk, H Ko and S Peleshanko 2004 *Phys. Rev. Lett.* **92** 065502.

MOS structure points way to silicon optics

One of the big hold-ups on the development of optical (as opposed to electronic) circuits has been that there were no clear alternatives to silicon, which never seemed up to the job; certainly there was nothing with comparable fabrication infrastructure in place. However, this may have changed. Ansheng Liu of Intel in Santa Clara, California, and colleagues have shown that a MOS-type capacitor structure placed in a silicon optical waveguide can have its index of refraction varied by an applied voltage. The resulting device can provide phase-shift modulation with a bandwidth of more than 1 GHz, exceeding earlier speed records by a factor of about 50. Such progress, and the obvious ease with which electronics in silicon could be mixed with nascent silicon-optics technology, could lead to amazing devices in future.

Further reading

A Liu *et al.* 2004 *Nature* **427** 615.

Catalyst research takes off

This year is already proving good for research into new catalysts. John Shelnutt and colleagues at Sandia National Laboratories in Albuquerque, New Mexico, have shown that porphyrin molecules embedded in fatty droplets called liposomes can, in the presence of platinum ions and light, form foamy platinum nanostructures. These nanostructures turn out to be amazing catalysts that allow hydrogen atoms to be split off from water by light.

Meanwhile, Gregg Deluga of the University of Minnesota and colleagues have found a way to turn alcohol into hydrogen by simply passing it, together with air and water vapour, over a sequence of two catalysts. The first catalyst, made of rhodium and cerium oxide, makes hydrogen, carbon dioxide and carbon monoxide, and the second, made of platinum and cerium oxide, turns the carbon monoxide and water vapour into carbon dioxide and more hydrogen. The reaction takes place at over 700 °C, but once started it is exothermic so the process warms itself. This is exciting news as it offers a way to convert alcohol –

which is easy to produce commercially in large quantities in a completely renewable and environment-friendly way – into a fuel whose only waste product on burning is pure water.

Finally, a new way has been found to split diatomic nitrogen, which is abundant in the atmosphere but almost inert chemically, into single nitrogen atoms, which can be made into important compounds of industrial and commercial value, such as ammonia. Paul J Chirik of Cornell University and colleagues have developed a novel semi-organic zirconium-based catalyst that does the job at 100 °C and atmospheric pressure. In contrast, the traditional Haber–Bosch process requires high temperatures between 400 and 500 °C and about 400 atmospheres of pressure.

Further reading

Y Song *et al.* 2004 *J. Am. Chem. Soc.*

126 635.

G A Deluga *et al.* 2004 *Science* **303** 993.

J A Pool, E Lobkovsky and P J Chirik 2004 *Nature* **427** 527.

When fermions pair up and condense

A novel state of matter consisting of condensed fermions has been created by Deborah Jin and colleagues, Cindy Regal and Marcus Greiner, at NIST and the University of Colorado. The team showed that when fermionic potassium-40 atoms are held at microkelvin temperatures they pair up into bosons (rather as electrons form Cooper pairs in the BCS theory of superconductivity or He-3 pairs in superfluidity, but with much stronger binding) and then condense, forming a Bose–Einstein condensate, even though they're really fermions. The strength with which the pairing takes place can be tuned with a magnetic field, which makes this a very interesting experimental system. Even more excitingly, the small ratio between the Fermi and condensation temperatures relative to that observed in normal and even high-Tc superconductors could point the way to room-temperature superconductivity.

Further reading

C A Regal, M Greiner and D S Jin 2004 *Phys. Rev. Lett.* **92** 040403.