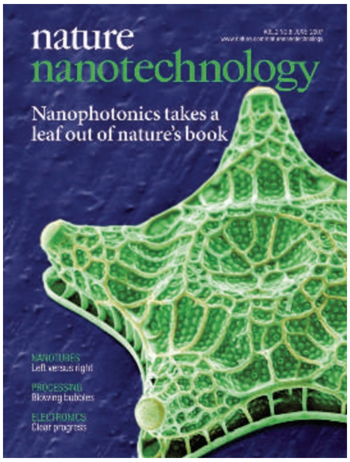


Cover story

Vol.2 No.6 June 2007

The optical properties of butterfly wings and other natural objects have fascinated scientists for centuries, and engineers have copied natural designs to improve the performance of a variety of microwave and optical devices for a number of years. Recently, however, researchers in biomimetics — as this field is called — have started to work with nature, rather than simply imitating it. Teams of biologists, physicists, engineers, chemists and materials scientists are using natural organisms, such as diatoms and viruses, and techniques such as cell culture to make nanostructures for commercial applications. The cover (image courtesy of the Natural History Museum) shows the silica frustule (cell wall) of a diatom that demonstrates useful optical properties at ultraviolet wavelengths. It measures about 90 μm across, but has the same nanostructure as a photonic crystal. This new approach to biomimetics enables photonic nanostructures to be cultured on industrial scales. **[Progress Article p347]**

NANOFIBRES LINE UP

A new method for making polyaniline nanofibres could prove useful for applications such as anti-fog coatings, self-cleaning surfaces, transparent electrodes and various types of sensors. Chemical oxidative polymerization is widely used to make polyaniline nanofibres but they do not have the degree of alignment that is needed for many applications. Arthur Epstein and co-workers now show that by using much lower than usual concentrations of aniline and oxidant, it is possible to control the growth and simultaneous alignment of polyaniline nanofibres on both conducting and non-conducting substrates. Moreover, the coatings display a range of properties including superhydrophilicity and superhydrophobicity. **[Letter p354]**

DETECTING DEFECTS

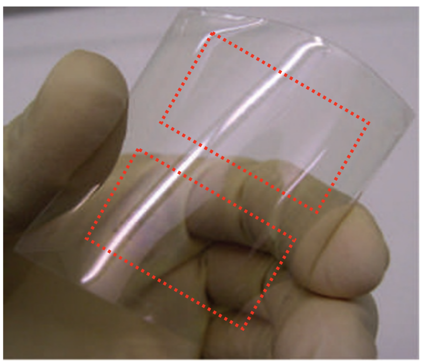
One of the mechanisms responsible for the plastic deformation of single-walled carbon nanotubes is thought to involve active topological defects — non-hexagonal carbon rings that can migrate along the wall of the nanotube. Although transmission electron microscopy (TEM) has been used to look at the deformation of nanotubes, the resolution in previous studies was not high enough to image individual defects and focused on changes in the diameter of the tubes. Now, using high-resolution TEM with a spatial resolution of 0.14 nm, Kazu Suenaga and colleaugues have imaged pentagon–heptagon pair defects at the atomic scale. Moreover, time-resolved studies of nanotubes heated to 2000 °C show that these defects accumulate at kinked regions, implicating them in the deformation process. **[Letter p358]**

LEFT FROM RIGHT

Some molecules, known as 'chiral' molecules, exist as mirror-image forms that cannot be superimposed on each other. In 1849 Louis Pasteur was the first to separate such molecules, by meticulously sorting asymmetric crystals of tartaric acid by hand, using tweezers and a microscope. Following in his footsteps, Naoki Komatsu and co-workers have designed pairs of chemical 'nano-tweezers' that can selectively pluck either left- or right-handed nanotubes from a mixture. Although carbon nanotubes have previously been sorted according to their diameter or length, this method is the first to discriminate between those with opposite helical twists. The ability to separate nanotubes in this way will lead to a better understanding of their optical properties. **[Letter p361; News & Views p340]**

OUT OF SIGHT

When making a display, the associated electronic circuitry should remain out of sight, and for many applications the screen (and the electronics) need to be flexible. Therefore, there is a demand for new transistors that are as transparent and flexible as possible. Tobin Marks, David Janes and colleagues have made nanowire transistors that fit this bill from indium oxide (In_2O_3) and zinc oxide (ZnO). The nanowires themselves are fully transparent, and when they are fabricated on a substrate, the optical transparency remains high — about 82% for both flexible plastic substrates and glass. This level of performance could significantly decrease power consumption in active-matrix displays. **[Article p378]**



Flexible transistors — the difference is clear.

p378

OPEN AND CLOSED

Biological nanochannels made from proteins play a central role in cellular signalling by controlling the flow of charged ions in and out of cells. Recent developments in DNA nanotechnology mean that it should be possible to make similar nanochannels from DNA and explore the movement of ions and other particles through them. You-Dong Mao, Qi Ouyang, Lei Jiang and co-workers have achieved this and discovered that DNA nanochannels display a range of gating behaviour — including ratchet-like transport of solute particles — that is not seen in other similar systems. In particular, the nature of the gating depends on temperature and the concentration of a dye molecule called thionine, and the various types of behaviour observed can be explained by a single theoretical model. **[Letter p366]**

BLOWING BUBBLES

Controlling the density and alignment of semiconductor nanowires and carbon nanotubes over large areas is essential for many applications, but existing assembly techniques do not seem capable of scaling to the metre-scale. Guihua Yu, Anyuan Cao and Charles Lieber have therefore looked elsewhere for inspiration, and found it in the shape of blown film extrusion — a technique that is already widely used to make plastic bags. Yu and co-workers functionalize the nanowires or nanotubes, suspend them in a polymer and then blow large bubbles from the suspension. When the bubble film is transferred to a substrate, such as a silicon wafer, the nanostructures are evenly spaced and all point in the same direction. **[Article p372, News & Views p339]**