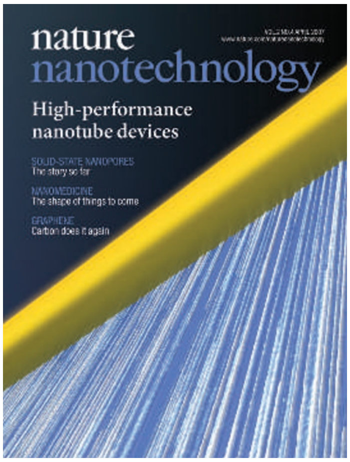


Cover story

Vol.2 No.4 April 2007

Taking advantage of the exceptional electronic properties of single-walled carbon nanotubes in real-world applications will require new approaches to circuit integration that can be scaled up to produce significant numbers of devices. In this issue John Rogers and colleagues report how dense, perfectly aligned arrays of single-walled nanotubes can be used as an effective thin-film semiconductor that is suitable for integration into transistors and other classes of electronic devices. The large numbers of nanotubes in the films lead to excellent device-level performance characteristics — including mobility, scaled transconductance and current — and good device-to-device uniformity, even when starting with a mixture of semiconducting and metallic nanotubes. Rogers and co-workers demonstrate the potential of the technique by making logic gates and flexible transistors. **[Article p230; News & Views p207]**

SPINS TAKE TIME TO RELAX

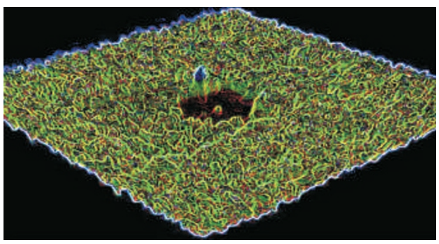
The field of organic spintronics seeks to combine spin-based memory with a flexible device structure. But can spin information be stored in an organic material over realistic amounts of time? Now Supriyo Bandyopadhyay and colleagues have shown that the electrons in an organic material can 'remember' the direction of their spins for as long as a few seconds. They made organic nanowires sandwiched between ferromagnetic electrodes. These behaved like 'spin valves' because their resistance was determined by the relative magnetizations of the two electrodes. The team also explored the mechanisms responsible for spin relaxation in organic nanowires.
[Letter p216; News & Views p204]

CLONING CATALYSTS

Viruses are well-defined nanostructures that comprise genetic material — RNA or DNA — surrounded by a protective coat made from a large number of individual proteins. Taking advantage of the self-assembly and reproductive properties of viruses, Jan van Hest, Thierry Michon and co-workers have developed a method to produce multiple independent copies of a biocatalyst. Potato Virus X was modified so that approximately a quarter of the 1,270 proteins in its coat were linked to an enzyme known to be an efficient catalyst for chemical hydrolysis reactions. Plant leaves were infected with the RNA that corresponds to this modified virus, which then spread throughout the plant and reproduced to form copies of itself. Virus particles extracted from the plant were shown to be catalytically active. **[Letter p226]**

CREATIVE WRITING

The ability to make precise patterns of biologically active molecules on surfaces has many implications for biosensor applications. In the case of protein arrays, the proteins must be handled with care, otherwise the arrays will not work. Now, Robert Tampé and colleagues have developed a nanolithography process that relies on an atomic force microscope to 'write' with fragile protein 'inks' that retain their activity after being deposited. Moreover, patterned proteins in any given location can be selectively replaced by other proteins to produce multiprotein arrays. This technique enables the rapid writing, reading and erasing of protein nanoarrays for sensing applications.
[Letter p220]



Making patterns with proteins.

p220

MEMORIES ARE MADE OF THIS

Memory storage devices based on organics may be flexible and inexpensive to produce, but there are still unanswered questions about the nature of the organic–metal interface, the effects of processing, and even the mechanisms that are responsible for the memory effect. Building on previous work on organic electronic devices, Nikolai Zhitenev and colleagues explore these issues by looking at over 1,500 memory devices, each consisting of a polymer sandwiched between two gold electrodes. By applying a potential difference of a few volts to the electrodes, the devices can be switched from a low conductance 'off' state to a high conductance 'on' state. Moreover, the device remains in the 'on' state after the voltage is removed. The open design of the devices also makes it possible to chemically (and reversibly) modify the switching voltage. **[Letter p237]**

NANOPORES TARGET DNA

Solid-state nanopores are proving to be a surprisingly versatile new tool for biophysics and biotechnology. By monitoring ion currents and forces as single molecules pass through nanopores in insulating membranes, it is possible to investigate a wide range of phenomena involving DNA, RNA and proteins, and it might even be possible one day to sequence DNA with nanopores. With this goal in mind Rashid Bashir and co-workers have shown that nanopores functionalized with a 'probe' of hairpin loop DNA can, under an applied electrical field, selectively transport short lengths of 'target' single strand DNA that are complementary to the probe. Even a single base mismatch between the probe and the target can be detected in the experiments.
[Article p243; Review p209]

SHAPE MATTERS

Shape is important in nature, and in the blood is no exception. Dennis Discher and colleagues have found that flexible polymeric filaments can persist in the blood of mice much longer than their spherical counterparts. They show that short filaments are taken up by cells more easily than longer ones because they are less affected by fluid flow. Circulation time is thought to depend on the ability of the filaments to relax or fragment under flow, or on their interactions with cells. Persistent circulation of such structures could have applications in drug delivery. Indeed, when loaded with the anti-cancer drug, paclitaxel, an eightfold increase in filament length had the same relative therapeutic effect as an eightfold increase in drug dosage for shorter filaments.
[Article p249; News & Views p203]