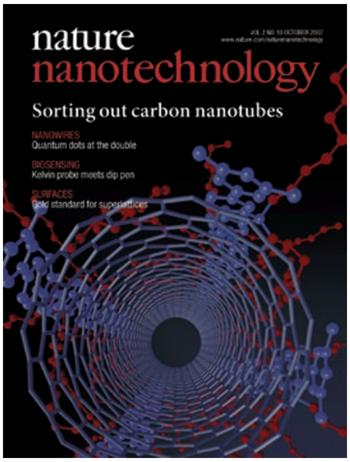


Cover story

Vol.2 No.10 October 2007

Single-walled carbon nanotubes are made as a mixture of tubes with different diameters and different degrees of twist, with both of these attributes depending on the direction in which the graphene sheet has been rolled up to produce the nanotube. This means that some nanotubes are metallic whereas others are semiconducting. Now, Robin Nicholas and colleagues have shown that it is possible to enrich the concentration of certain types of nanotubes in a dispersion by introducing a range of polymers that have a string of aromatic rings along their backbone — shown in blue on the cover — that are bonded to hydrocarbon sidechains (shown in red). The enrichment occurs because different polymers prefer to wrap around different nanotubes. Subtle changes in the structure of the polymers affect the selectivity — whereas one particular polymer discriminates nanotubes by diameter, another selects on the basis of twist. **[Article p640]**

SPIN FREE

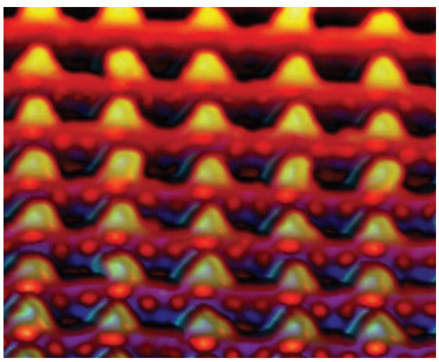
Proposals for spin-based quantum bits (qubits) based on quantum dots are often hampered by the interaction of the spin with the magnetic moments of the surrounding nuclei. This causes the spin to 'forget' its state over time, which is a disadvantage in quantum information processing and other applications. Now, Charles Marcus, Charles Lieber and co-workers have built a double quantum-dot device from a Ge nanowire coated with a Si shell that is a promising prototype for a solid-state qubit. Most of the nuclei in Ge and Si have zero spin, which could enhance the lifetime of the spins on the two dots. Moreover, the charge on the two dots can be sensed with a third dot in another nanowire that is integrated into the device. **[Letter p622; News & Views p595]**

ENTERING A NEW PHASE

Phase-change memory materials are promising for non-volatile data storage as they can easily be switched between an amorphous ('0') or crystalline ('1') state by applying a small current. Nanostructuring these materials is essential for achieving high-density data storage, but their useful properties are often damaged in the process. Taking advantage of a bottom-up strategy, Ritesh Agarwal and colleagues measure the most important properties of self-assembled nanowires made from the phase-change material $Ge_2Sb_2Te_5$. Measurements of write current, switching speed, endurance and data-retention time show that these nanowires are viable for non-volatile data-storage applications. **[Letter p626]**

GIANT LEAP FOR SMALL STEPS

Engineering the electronic properties of a surface requires the ability to control its structure at length scales comparable to the Fermi wavelength of the surface electrons. In certain metal surfaces, known as vicinal surfaces, the atoms re-arrange themselves into atomically flat terraces separated by atom-sized steps. When other metals are deposited on these surfaces, they can self-assemble to form a highly periodic pattern of nanostructures. Stéphane Pons and co-workers have now probed the electronic structure of such patterns and show that the local density of states can be modified in a controlled way by adjusting the type of metal deposited and the degree of coverage. **[Letter p617; News & Views p601]**



Small steps — nanopatterns on metallic surfaces.

p617

NATURAL BIAS

Magnetic exchange bias occurs when the hysteresis loop of a 'soft' magnetic phase is shifted as a result of its interaction with a 'hard' magnetic phase. Although it was discovered some 50 years ago, exchange bias is still not fully understood, so it remains of interest to theoretical physicists as well as researchers developing new magnetic materials. Suzanne McEnroe and co-workers now demonstrate that geoscientists are also interested by presenting the first evidence for an exchange bias of significant magnitude in a natural mineral. **[Letter p631]**

THE INSIDE STORY

Enzyme function is usually studied at the ensemble level, where the measured characteristics are averaged over a large sample. Single enzymes can be investigated by tethering them to a surface, but this approach can alter the way in which the enzyme works, sometimes deactivating it completely. Now, Jeroen Cornelissen and colleagues have used the protein coat of the cowpea chlorotic mottle virus as a nanoreactor, inside which the properties of a single enzyme can be observed. **[Letter p635]**

CHAIN GANG

Polymers are intrinsically 'chain-like' molecules with optical properties that depend on the orientation of these chains. In thin-film form, this orientation is often lost, but Sarah Tolbert, Benjamin Schwartz and colleagues show that by confining a semiconductor polymer within the nanopores of a silica host, they can force the chains to align, creating a natural waveguide ideally suited for optical gain. The result is that the threshold for amplified spontaneous emission is 20 times lower than in comparable non-oriented polymer films. **[Article p647]**

BIOSENSING CHARGES AHEAD

Kelvin probe force microscopy is a scanning probe method capable of mapping electrical charge on a surface. It is particularly suitable for detecting interactions between biomolecules localized on a substrate because such binding events are often associated with an increase in the charge density in a given area. Although previously applied to arrays with micrometre-sized features, Asher Sinensky and Angela Belcher have now extended the technique down to the nanoscale by combining it with dip-pen nanolithography. This label-free detection strategy is shown to selectively sense DNA hybridization and protein binding. **[Article p653; News & Views p596]**