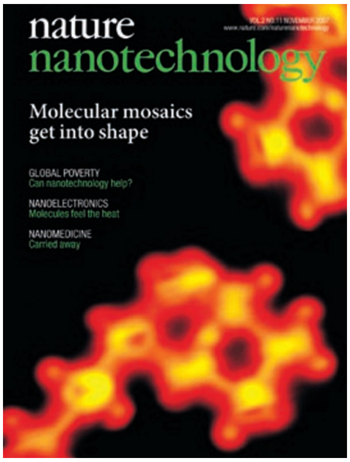


Cover story

Vol.2 No.11 November 2007

The self-assembly of molecular building blocks to form nanostructures on surfaces is a promising strategy for making nanoscale devices. However, structures produced in this way can be rather fragile because they are held together by non-covalent bonds, which tend to be weak. Now Leonhard Grill and co-workers have made robust molecular nanostructures (shown on the cover) that are held together by much stronger covalent bonds. The team worked with porphyrin molecules that each contained between one and four bromine atoms. The bromine atoms were removed by heating the molecules to leave behind carbon radicals, which combined in pairs to form covalent bonds that held the molecules together on a gold surface. The shape of the resulting nanostructure depends on the number of bromine atoms and their arrangement within the porphyrin molecules. **[Letter p687; News & Views p671]**

ULTRASOUND AT THE NANOSCALE

Nanoacoustic waves can be generated with wavelengths as short as tens of nanometres, and could therefore prove useful in applications such as non-invasive ultrasonic imaging. However, diffraction effects mean that the waves are produced with spot sizes on the microscale. Near-field optical techniques can produce waves with smaller spot sizes, but they only work near surfaces. Using a far-field optical technique that does not suffer from such restrictions, Chi-Kuang Sun and co-workers have now shown that nanoacoustic waves can be generated with wavelengths of the order of 10 nm and spot sizes around 100 nm. **[Letter p704]**

MOLECULES FEEL THE HEAT

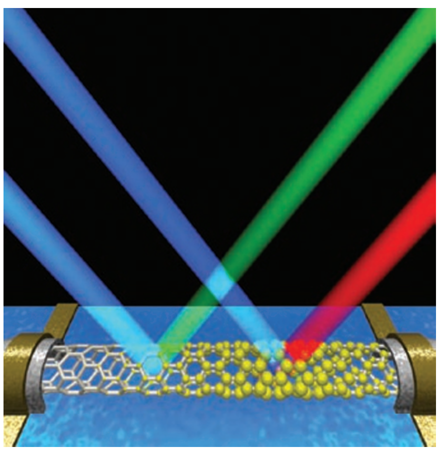
Electron transport through single molecules has been examined in great detail over the past decade, but the impact of the electrons on the molecules — notably the heating caused by the current — has received much less attention. Now Nongjian Tao and co-workers have explored this phenomenon as a function of voltage and molecular length for single molecules attached to two gold electrodes. They find that the effective local temperature of the molecular junction increases with applied bias, but decreases after reaching a maximum, whereas as the molecular length increases, the temperature falls. The results agree with models that include both electron–phonon and electron–electron interactions. **[Letter p698]**

ONE ON ONE

Many different applications have taken advantage of the unique structural and electronic properties of carbon nanotubes. In these applications the nanotubes often interact with the different chemical groups that are found on organic molecules. To gain a better understanding of these processes, Aleksandr Noy and co-workers have measured the strength of the interactions between individual carbon nanotubes and a range of single chemical groups. The team attached different molecules to the tip of an atomic force microscope, lowered it onto a single nanotube, and then measured the forces as the tip was retracted from the surface. **[Letter p692]**

A LOCAL LOOK AT NANOTUBES

Trapped charges, metal contacts and defects can all affect the charge density of a carbon nanotube and make electronic devices based on them perform differently than expected. Now, Phaedon Avouris and colleagues have developed a local probe that can measure changes in the charge density of semiconducting and metallic carbon nanotubes, and also measure local doping in nanotubes in electronic device structures, with a resolution of a few hundred nanometres. **[Article p725]**



Keep it local — looking at nanotubes.

p725

NANODISCRIMINATION

Nanoscale pores are routinely used to analyse the structure and composition of single biomolecules such as DNA and RNA, and have also been used to measure the interactions between enzymes and various polynucleotides, including DNA. Now Mark Akeson and co-workers have shown that a nanopore sensor can accurately identify DNA templates. Moreover, by exploiting finite-state machine logic, nanopores can discriminate between unbound DNA and various binary and ternary complexes in real time. **[Letter p718]**

WATCHING NANOTUBES KILL CELLS

Single-walled carbon nanotubes have been shown to be toxic in a variety of cells but it has not been possible to observe this process directly because it is difficult to image the nanotubes against a background of carbon-rich structures in the cell. Alexandra Porter and co-workers have now combined transmission electron microscopy (TEM) and confocal microscopy to image the nanotubes as they cross the lipid bilayers in the cell wall, enter the cytoplasm and eventually penetrate the nucleus. Whereas conventional cytotoxicity assays give estimates of cell death from a large population of cells, TEM imaging complements these assays by showing the mode of cell death through well-defined ultrastructural characteristics in a single cell. **[Letter p713]**

PUMP IT UP

Aquaporins are special channels in the cell membrane that control the passage of water molecules. Now, a molecular dynamics simulation by Haiping Fang and colleagues shows how to mimic this natural 'pumping' system in a nanofluidic device. The calculations were performed on a system that consisted of a carbon nanotube connecting two reservoirs of water that were confined by graphite sheets. Inspired by the charge distribution in aquaporins, Fang and co-workers show that placing three discrete charges along the vertical axis of the nanotube results in water being pumped from one end to the other. **[Letter p709; News & Views p673]**