Golden sensors

The scattering spectra of nanoparticles exhibiting unprecedented resonance behaviour make them attractive for potential environmental, biological and chemical sensing applications. So far, the development of single-nanoparticle biosensors using scattered light as a reporter signal for molecular binding has been hindered because the total number of biomolecular binding events — necessary for a detectable signal — is drastically reduced. Now G. Raschke and colleagues demonstrate that molecular sensors based on light scattering from single gold nanoparticles can be significantly improved by the use of gold nanoshells (*Nano Letters* http://dx.doi.org/10.1021/nl049038q). Compared with conventional solid-gold nanospheres, these nanoshells — composed of a gold sulphide core coated with thin gold layers — exhibit a three-fold increase in sensitivity to changes in the refractive index of the environment. Moreover, these structures have the advantage of a narrow plasmon resonance, which means that not only is the biological spectral window easily accessible, but also the scattering properties are extremely promising with respect to their applicability to optoelectronic switching devices.

Molecular gears

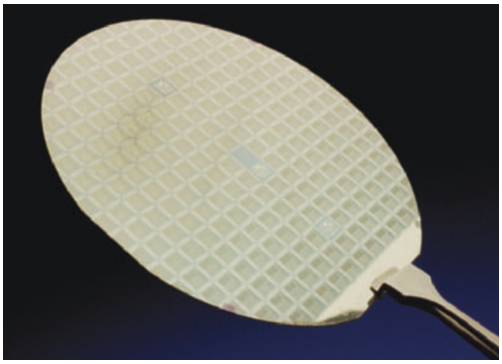
The future success of the often talked about nanomachines depends on the ability to fabricate the necessarily tiny component parts. Ye Tian and Chengde Mao of Purdue University have now managed to create a gear system formed of two 'cogs' made from DNA (*Journal of the American Chemical Society* http://dx.doi.org/10.1021/ja046507h). Each cog was formed from four strands of DNA: a central circle as the main body with three linear strands — different for each cog — forming the 'teeth' of the cogs. The cogs are brought together and rolled against each other by a combined action of linker and removal strands of DNA — the linker strands link the two cogs by attachment to one tooth from each cog, then the removal strand slowly breaks that link while the next pair of teeth are connected by another linker strand. This process is repeated such that the two gears are continuously rolling against each other, with the two cogs always being connected by one linker strand. The authors suggest that, in combination with previously devised 'walker' DNA systems, these gears could perform complicated motion in nanomachines.

GENERATING ELECTRICITY FROM GAS FLOW

Last year, A. K. Sood and colleagues at the Indian Institute of Science in Bangalore showed that the flow of liquids over single-walled carbon nanotubes generates a voltage in the tubes along the direction of flow (Ghosh, S., Sood, A. K. & Kumar, N. *Science* 299, 1042–1044; 2003). This phenomenen is specific to the one-dimensional nature of carbon nanotubes, and was not observed in graphite, for example. Now, the same researchers have demonstrated a similar phenomenon in the flow of gases over carbon nanotubes (Sood, A. K. & Ghosh, S. *Phys. Rev. Lett.* 93, 086601; 2004). However, in contrast to the liquid-flow nanotube sensors, the effect observed in gases is not specific to nanotubes. Doped semiconductors and metals exhibit the same effect, which is due to an interplay of Bernoulli's principle and the Seebeck effect. Pressure differences along streamlines in the gas flow give rise to temperature differences across the sample, which in turn produce the measured voltage. The direct generation of electrical signals from gas flow has clear applications in gas-flow sensors and energy conversion devices.

Silicon carbide picks up the pace

As the relentless drive for ever-faster computer chips approaches fundamental physical limits to the performance of silicon-based electronics, the search for a successor to silicon is gaining pace. For high-power, high-frequency and high-temperature electronic applications, silicon carbide is widely regarded as the front runner in this quest. The development of silicon-carbide-based electronics, however, has been hindered by difficulties in producing high-quality SiC material. Writing in *Nature* (430, 1009–1012; 2004), Daisuki Nakamura and colleagues now report a synthesis technique that allows the growth of large — up to two inches in diameter — single-crystal wafers of SiC that are almost entirely defect free. In the immediate term, the material will probably be used for making devices that must endure extremes of temperature and power, such as in avionics or in the control of hybrid automobile engines — applications for which silicon devices are eithertoo fragile or waste large amounts of energy.



A boron bullet to target cancer

A new boron-containing lipid, synthesized by Japanese chemists, may bolster research efforts in neutron-capture therapy. Boron neutron capture is an experimental therapy for highly malignant tumours that enhances the effect of radiation on cancer cells while minimizing the effect on nearby healthy cells. The idea is to use boron-containing compounds that preferentially accumulate at tumour sites, so that when irradiating with a neutron beam, the radioactive particles will damage only the tumour and spare the healthy tissue. Liposomes made of lipid bilayers can carry the boron compounds inside them and selectively deliver them to the cancer cells.

An even better system is one in which boron is incorporated in the bilayer wall. This can be realized by linking a boron cluster to a long hybrophobic moiety. The system recently presented by H. Nakamura and colleagues is a boron cluster linked to two hybrophobic chains (*Chemical Communications* 17, 1910–1911; 2004), forming a new lipid that generates liposomes stable in physiological conditions. Moreover the boron-containing lipid accumulates in high concentrations in other liposomes that have the potential to be effective drug-delivery systems.