Cover story

Vol.2 No.8 August 2007

The novel optical properties of quantum dots and photonic crystals have been the focus of intense research for a decade or more. In addition to being of fundamental interest, both systems are being investigated for a wide range of applications in optics, bioimaging, communications and other areas. Now, Brian Cunningham and co-workers have shown that the fluorescence from colloidal quantum dots can be enhanced by placing them on the surface of two-dimensional photonic crystal slabs. By fabricating photonic crystals with 'leaky' modes that overlap with the absorption and emission wavelengths of the quantum dots, they demonstrate enhancement factors of up to 108. The cover image shows the calculated transmission efficiency of the photonic crystal as a function of wavelength (vertical axis) and angle (horizontal axis): the colour scale runs from white (0% transmission) through yellow and red to black (100%). **[Article p515]**

DOWN TO THE WIRE

Most of us are familiar with a.c. to d.c. converters, but a well-known quantum effect in superconductors works the other way: a constant voltage applied across a thin insulator between two superconductors can induce an alternating current. It has been shown that external sources, such as radio waves, can interact with this current. Now Alexei Marchenkov, Uzi Landman and colleagues explore interactions between the current and atomic-scale mechanical motion. They form a two-atom 'wire' of niobium between superconducting niobium leads and see evidence for vibrations of the atoms in the current–voltage characteristics of the device. **[Letter p481]**

SPOT ON

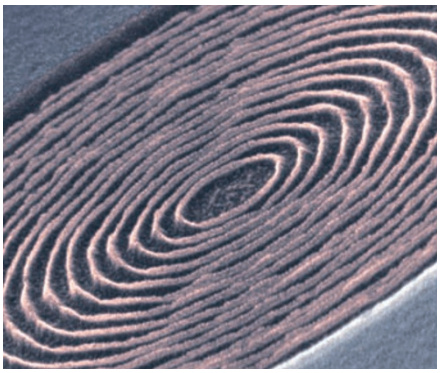
Aerosols are widely used to treat lung disorders such as asthma and respiratory infections. Targeting them to diseased tissues can improve the therapeutic efficiency and minimize unwanted side effects but this has not been satisfactorily achieved to date. Now Carsten Rudolph and co-workers have introduced superparamagnetic iron oxide nanoparticles into aerosol droplets and directed them into the lungs of mice with an external magnetic field. Computer simulations and *in vivo* studies showed that lungs subjected to magnetic fields contained more nanoparticles than those that were not exposed. The team also demonstrated the potential of magnetic aerosols for applications in drug delivery and the treatment of localized lung diseases. **[Letter p495; News & Views p467]**

GOING THROUGH A PHASE

Unless nanocrystals are formed in the gas phase, getting them there in one piece is not a trivial task. When nanocrystals are heated they generally decompose and evaporate into fragments, making it difficult to study them with gas-phase techniques such as mass spectrometry. Now, by coating silicon nanocrystals with a layer containing long hydrocarbon chains, Benjamin Horrocks and co-workers have shown that a vapour comprising intact nanoparticles can be formed and subsequently collected on a variety of surfaces. Moreover, the process is size selective, with only the smaller nanoparticles being transferred. The source of the robustness is the strength of the covalent bonds between silicon atoms in the nanocrystals and carbon atoms in the coating. **[Letter p486]**

METALS TOE THE LINE

Improvements in the performance of integrated circuits are generally achieved by squeezing more and more components into a given area. This requires ever-smaller feature sizes to be defined on a surface, but the resolution of photolithography is limited by optical diffraction. Opportunities exist, therefore, for alternative patterning approaches that are compatible with silicon-based fabrication technology. Self-assembly of block copolymers is a promising candidate, and Jillian Buriak and colleagues now show that these materials can be used to produce metallic nanowires with widths as small as 10 nm on a silicon substrate. The two blocks in the copolymer separate to form aligned arrays of cylinders that can be loaded with metal ions. Plasma etching then removes the organic material and converts the ions into nanowires. **[Article p500; News & Views p464]**



On target — self-assembling metallic nanowires on silicon. p500

DNA MOTORS ON

The structural and dynamic properties of DNA make it an attractive material for constructing artificial molecular machines. The predictable pairing between the bases in DNA can be used to direct individual strands to perform specific functions. Although a number of DNA-based machines have already been demonstrated, autonomous motion powered by hybridization of unpaired strands has remained elusive. Now, by mimicking certain bacteria that move by polymerizing protein filaments to produce comet-like tails, Niles Pierce and colleagues have made an autonomous molecular motor from DNA. Single strands of DNA that have been folded into structures known as hairpins are inserted into a growing chain. As these strands unfold to maximize base-pairing interactions, they propel the DNA further and further away from its initial anchor point. **[Letter p490]**

TORSIONAL TWIST

Every time the oscillating tip from an atomic force microscope (AFM) touches a surface, it feels a mechanical force. In principle, the vibrations caused by this force could be used to determine the softness or hardness of surfaces, but most tips lack the sensitivity to do so. Ozgur Sahin, Calvin Quate and co-workers have overcome this problem by designing an AFM probe in which the tip is not at the centre of the cantilever. Whenever such an off-centre tip touches a surface, high-frequency torsional modes that are relatively easy to detect are excited in the cantilever. This allows the new probe to make high-resolution force measurements much faster than is possible with conventional methods. **[Article p507; News & Views p461]**