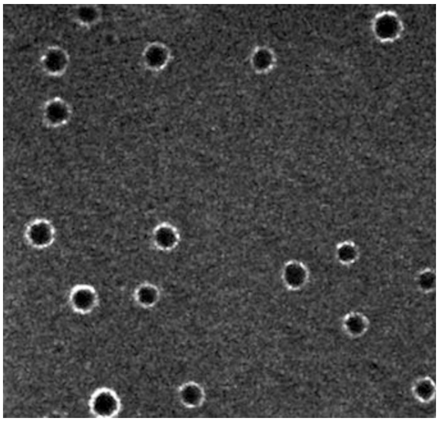
Templates for titania



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Controlling the morphology of nanostructured metal oxide films can now be achieved using dendritic amphiphilic macromolecules as templating agents, report Klaus Müllen and co-workers. Each macromolecule directs the formation of a TiO_2 nanoring, and at high macromolecule concentrations the nanorings connect to form a well-organized, nanoporous TiO_2 film. The central core of the template is a rigid polyphenylene dendrimer, from which twelve amphiphilic polymer arms protrude. These arms are composed of an inner hydrophobic polystyrene block and an outer hydrophilic shell of poly(acrylic acid). The outer shell can incorporate a titanium-based material, which on calcination — and hence removal of the organics — forms a TiO_2 shell. The pore size of the TiO_2 nanorings, and hence the pores within the film, is governed by the length of the inner polystyrene block. Such morphological control of TiO_2 films could have advantages in many applications, including gas sensors, photocatalysts and solar cells.

Sensitive clay

Adv. Mater. doi:10.1002/adma.200800914 (2008)

Photonic crystals (PCs) are attractive optical materials for controlling and manipulating the flow of light. A few examples of tunable one-dimensional PCs — the structurally simplest form — have been designed, but they are sensitive to environmental conditions associated with their nanoscale porosity. Geoffrey Ozin and colleagues now report on PCs containing Laponite clay as a chemically active component that can behave as an optical transducer for adsorption and ion-exchange processes. The potential of thin films of clay for use as sensors with optical read-out is also demonstrated. The new family of clay-based PCs combine the dimensional flexibility and chemical sensitivity of clay with the tunable structural colour of photonic multilayer systems. Ozin and colleagues suggest that once the mechanism of analyte uptake and release is better understood, applications such as smart-patch materials, as well as detoxification and drug release are possible.

Switchable surfaces

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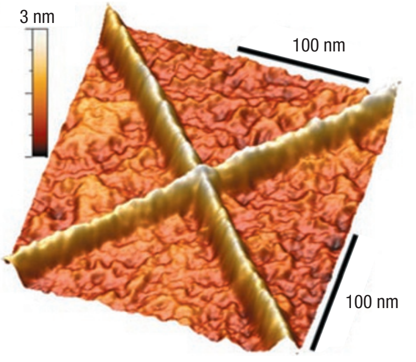
Implanting materials and devices into the body inevitably leads to the introduction of potentially harmful microorganisms. Although antimicrobial coatings are known to kill microorganisms in such circumstances, once dead, these species can remain attached to the materials and cause inflammatory or immune responses. Now, Shaoyi Jiang and co-workers have devised a biocompatible polymer surface that switches between antimicrobial and non-fouling properties. As a result, the surface can effectively kill *Esherichia coli* bacteria, release the dead cells and then prevent the further attachment of proteins and microorganisms. The initial antimicrobial surface is a cationic polymer coating, and on hydrolysis, a zwitterionic polymer is formed, from which the dead bacterial cells are released. This zwitterionic surface is resistant to protein adsorption and is non-fouling. The hydrolysis rate, which can be changed by altering the chemical structure of the cationic polymer, pH and temperature, is shown to control the switching process. The combination of two beneficial characteristics in a biocompatible polymer coating shows great potential for the fabrication of new medical implants.

Plasmons go a long way

Nano Lett. doi:10.1021/nl802603r (2008)

Surface plasmon polaritons (SPPs) are key to many nanophotonics devices, as they enable the propagation of light on a scale much smaller than the wavelength. However, the use of SPP-based designs has been hampered by high losses. Engineers from the University of California, Berkeley, now demonstrate how the same technique that enables long-distance optical communication may also significantly expand the reach of SPP waveguides. Similar to optical fibre amplifiers, the SPPs are replenished by erbium ions embedded within the glass matrix surrounding the gold waveguide strip. The erbium ions are first excited by a pump pulse so that the signal pulse (that arrives shortly after the pump pulse) then induces the stimulated emission of SPPs by the erbium ions. Rather like the amplification process in a laser, the stimulated emission enhances the original signal pulse. The maximum enhancement achieved in the present study was about 50%. Further improvements may be achieved through an optimized waveguide design, offering a feasible route towards the use of SPP waveguides in integrated photonic devices.

Productive oxidation



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Nano Lett. doi:10.1021/nl801599k (2008)

Silicon nanostructures compatible with integrated circuit technologies have great potential for the development of biological and chemical sensors. Several 'bottom-up' and 'top-down' approaches have so far been followed to fabricate ultra-narrow silicon nanowires, with variable success. Top-down is the approach used by Javier Martínez and colleagues, who obtained reproducible Si nanowires, with widths as small as 4 nm, by using atomic force microscopy (AFM). The principle is very similar to that used in standard photolithography, except that instead of using masks of photo-resist, the researchers used an AFM tip to oxidize a specific area on top of a silicon layer, effectively covering the area corresponding to the desired nanowire and the contact pads with SiO_2. The uncovered part of the Si layer was then etched, leaving only nanowire transistors. The team also fabricated wires with combined linear and circular geometries, thus demonstrating the versatility of this type of atomic force nanolithography technique.