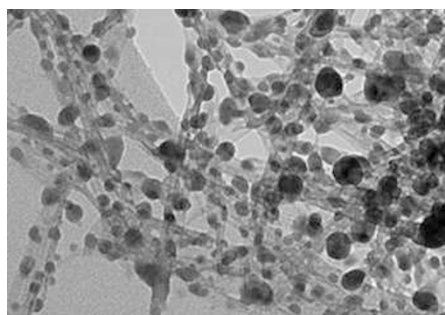


Practical POMs

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Using molecular design to direct nanomaterial growth is an attractive synthetic strategy, particularly if structural information or control can be relayed from the molecular template to the nanomaterial. Now, Leroy Cronin and colleagues show how supramolecular polyoxometalate (POM) structures with silver linking units can be used to synthesize vanadium oxide nanowires with discrete silver nanoparticles embedded within. They found that the crystalline order of the POMs is vital for the formation of the nanocomposite, as equivalent amorphous precursors did not yield nanowires. Two structurally similar POM-based architectures, composed of either a one-dimensional zig-zag chain or a two-dimensional network, were transformed into the nanocomposite material via a room-temperature reduction and degradation process. The composite has a mesh-like arrangement in which the nanowires interweave and cross-connect. On the macroscopic scale, the nanowires assemble into globular structures, with diameters of approximately 5 μm , which are interconnected by nanowire bridges. This aggregation allows the easy separation of the composite from the bulk liquid — a practical advantage in catalytic applications.

Focus on fluidic channels

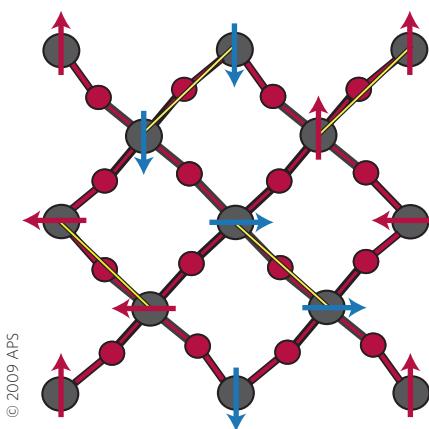
J. Am. Chem. Soc. doi:10.1021/ja904554m (2009)

Multi-photon creation of hydrophilic pathways inside an otherwise hydrophobic polymer host offers the opportunity to create complex microfluidic channels, show Paul Braun and colleagues. They use a silica colloidal crystal as a porous host, in which the inner surface of the pores is functionalized with an acid-hydrolysable — and hydrophobic — polymer brush. The space in the pores is filled with a copolymer to which they add a photoacid generator and a sensitizer. When a laser is focused on the host, acid is produced from the photoacid generator and the sensitizer in a localized two-photon

reaction. During subsequent baking, this acid hydrolyses the polymer brush, removing the hydrophobic component from the ends of the brushes to leave a hydrophilic methacrylic acid moiety exposed instead. Thus, hydrophilic sections can be ‘written’ in the silica host by the laser beam. The researchers show that after a washing stage, water inside the silica is confined to the hydrophilic channel, whereas dodecane fills only the hydrophobic regions. They anticipate that the method could be used to make microfluidic channels that are not accessible using other methods.

Half-doped for full effect

Phys. Rev. Lett. **103**, 037601 (2009)



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Although multiferroic materials are promising for their coupled ferroelectric and magnetic properties, their uptake for technological applications has remained slow, partly because the coupling between ferroelectricity and magnetism has remained comparatively weak. Gianluca Giovannetti and colleagues have now suggested a strong multiferroic coupling in manganites such as $\text{La}_{0.5}\text{Ca}_{0.5}\text{MnO}_3$. These materials are charge-ordered, meaning that their Mn ions separate into alternating chains of Mn^{3+} and Mn^{4+} . Other charge-ordered

compounds have previously been suggested to be multiferroic, but strong coupling has been elusive. In their computational study, Giovannetti *et al.* suggest that manganites such as the half-doped $\text{La}_{0.5}\text{Ca}_{0.5}\text{MnO}_3$ (that is, equal amounts of La and Ca) could in fact be multiferroic with a strong coupling, as well as a large ferroelectric polarization. In these manganites, an applied magnetic field can change the orientation of the Mn spins, leading to a strong ferroelectric polarization. Although these findings still await experimental confirmation, an electrical polarization has indeed been observed for charge-ordered manganites, suggesting we could be on the right track towards a new class of strongly coupled multiferroics.

Bipolar behaviour

App. Phys. Lett. **94**, 253305 (2009)

The resistivity in organic semiconductors changes in response to the application of a magnetic field, a phenomenon known as organic magnetoresistance. The origin of the effect is still under debate, and conflicting explanations have been put forward, attributing it either to excitons (electron–hole pairs) or bipolarons (mixed states of charges and lattice distortions). Abd Yusoff and colleagues have gained insight into the issue by studying the effect of magnetic field on the conductance in bipolar devices, in which both electrons and holes are used to transport current. Their devices based on Alq_3 — a well-known organic semiconductor — shows a striking increase in current of up to 400% in a magnetic field of just 200 mT. However, this effect disappears in devices with only one type of carrier. Apart from being useful for potential applications, the high magnetocurrent observed in the bipolar devices sheds light onto the controversy on the origin of organic magnetoresistance, strongly supporting the excitonic models.

A glowing report

Nano Lett. doi:10.1021/nl901517b (2009)

A nanoparticle composite probe can be used to detect and quantify small-molecule analytes in living cells, show Chad Mirkin and colleagues. The researchers call their probes ‘aptamer nanoflures’, and demonstrate that, unlike present methods to detect adenosine triphosphate (ATP), they can be used without causing cell death and for detection in individual cells, as opposed to just in the bulk. The nanoflures consist of a gold nanoparticle functionalized with a monolayer of aptamer oligonucleotides. A ‘flare’ oligonucleotide with a matching base sequence to the aptamer and an attached fluorescent moiety is bound to the monolayer; in this set-up, the flare fluorescence is quenched by the proximity to the gold surface. The nanoparticle probe enters the cell, and becomes localized in the cytoplasm. When ATP target molecules encounter the probe particles, they bind to the aptamer strands causing them to change configuration to a folded structure. This folding disrupts the pairing with the flare oligonucleotide, releasing it and switching on the fluorescence. Intracellular quantification of other small molecules or proteins is anticipated.