## Baseball colloids

What if colloidal particles could be given a valence similar to tetravalently bonded carbon and silicon atoms? Chemical linkers or DNA strands could then be anchored to these particles to make sensors or catalysts. Moreover, the particles could self-assemble into colloidal arrays for photonic applications. Writing in *Nano Letters* (http://dx.doi.org/10.1021/nl0202096) David Nelson explores this possibility with a detailed theoretical analysis of the elastic free energy of a sphere coated with anisotropic particles, such as metallic or semi-conducting nanorods, triblock copolymers or liquid crystals. He notes that a layer of nematic liquid crystals on a sphere can form a tetrahedral symmetry, similar to the seams on a baseball (see image), that could be used as a template to attach chemical linkers for directional bonding. Thermal disruptions of these configurations would be reduced when other characteristics (such as the aspect ratio of nanorods) of the system are appropriately designed. It is suggested that tetravalent colloidal crystals, featuring a diamond lattice structure and an appropriate dielectric constant, will have a very large photonic bandgap.

## X-ray vision

**Although X-rays have been used to probe the structure of materials for more than a century, their use in high-resolution imaging has been limited by the poor focusing ability of X-ray lenses. Using coherent X-rays, researchers have now imaged three-dimensional structures that eluded previous X-ray diffraction techniques (*Phys. Rev. Lett.* 89, 088303; 2002). By using an 'oversampling' technique, Jianwei Miao and colleagues were able to form images of irregular two-dimensional nanostructures buried within a sample at a resolution of 8 nm. Moreover, by collecting diffraction patterns over a range of angles, they were able to form 3D images of the irregular, non-crystalline nanostructures over a range of several micrometres and at 50 nm resolution. The 'oversampling' technique avoids the aberrations introduced by X-ray lenses, enabling such high resolutions. The results are a step towards 3D atomic resolution imaging of nanostructured materials and biological samples.**

## Metals make a flat deposit

The ability to form and control interfaces between metals and metal oxides at the nanoscale is critical for the design of micro-electronic devices, and for our understanding of adhesion, corrosion and catalytic processes. Typically, metals deposited in a vacuum on metal oxides, such as alumina, form three-dimensional clusters, thereby preventing the growth of ultrathin multilayers with clear laminar interfaces. Chambers and colleagues (*Science* **297**, 827–831; 2002) now demonstrate that cobalt can be deposited in ultrahigh vacuum on the surface of alumina to promote the growth of a planar interface only a few atomic layers thick. In their room-temperature experiment they exploit the reaction between cobalt and hydroxyl species adsorbed on the surface of alumina to form metal cations that strongly bind to both the substrate and metallic atoms. These cations are able to change the metallic growth morphology, and when their density is sufficient to prevent island formation, laminar growth occurs. The authors believe that this simple process could work for other metals and metal oxides. A thin magnetic cobalt layer on alumina may also be useful in magnetoresistive random-access memory.

## That in-between phase

**Melting in a two-dimensional system can be very different from that in the bulk, as confirmed in a paper published last month (*Phys. Rev. Lett.* 89, 076101; 2002). Thirty years ago, theoretical studies predicted the existence of a 'hexatic phase', somewhere between the crystal and liquid phases, for a single layer or thin film of molecules. Such molecules would be able to move as in a liquid, but also have long-range order as in a crystal. The hexatic phase was first observed in liquid crystals in the 1980s, but has been elusive in simple systems, such as spherical molecules or ball bearings. Now, both molecular simulations and experiments confirm the existence of the phase in a porous material. In the experiment, molecules of carbon tetrachloride or aniline were trapped in the nanoscale pores of activated carbon fibres and become hexatic when heated to 330 K. Moreover, this hexatic phase was stable over a wider temperature range (up to 55 K) than seen for liquid crystals.**

## Something old, something new

Last month, materials researchers threw some light on a 40-year-old mystery. The so-called Vinland map was discovered in Europe in the late 1950s and shows the known world, including Iceland, Greenland and the north-eastern coast of America ('Vinland'). If genuine, the map would confirm that a group of Vikings reached mainland North America some 50 years before Columbus. Now, a paper by Brown and Clark (*Anal. Chem.* **74**, 3658–3661; 2002) describes Raman microprobe spectroscopy measurements that seem to suggest that the chart is a sophisticated forgery. The authors found the telltale signature of anastase in the inks used to draw the map. Anastase — the least common form of titanium dioxide — was not synthesized until the 1920s, casting serious doubts on the map's authenticity. Other researchers writing in the August issue of *Radiocarbon* have carbon dated the Vinland parchment to roughly 1434 AD. So the parchment is the right age, but the forger appears to have used the wrong inks — unless anastase is not as modern an invention as we think.

[Image courtesy Yale University Press]

## HEARTBREAKING COLLAGEN FIBRES

**The failure of bioprosthetic heart valves (BHVs) might be partly caused by mechanical degradation of the collagen matrix from which these implants are made. Until now, calcification of the collagen was blamed for the short lifetime of BHVs. Sacks and Schoen (*J. Biomed. Mater. Res.* 62, 359–371; 2002) provide evidence that degradation occurs from mechanical stress during prosthetic function rather than just calcification. Using small-angle light scattering, the authors analysed the fibre orientation and structural integrity of degraded BHV implants that had been removed from patients. They created maps of the collagen fibre damage, which were then compared with the sites of calcific deposits. Non-calcific structural damage occurs more frequently than calcification. Moreover, the two processes were always observed at different sites, which rules out interdependence between them.**