

## Molecular gyroscopes



A new toy has been added to the multitude of molecular mechanical components made through chemistry: a gyroscope. But what J. A. Gladysz and colleagues report (*Angew. Chem. Int'l Edn* <http://dx.doi.org/10.1002/anie.200460534>) is not just the result of their playing around in the lab. Rotors of this kind may become the components of future miniaturized fluidic devices. The authors based their synthetic design on the trigonal-bipyramidal geometry of an iron complex. The two ligands at the apices of the bipyramid are phosphanes with three long-chain substituents that were joined together

through a metathesis reaction to form the three external spokes of the stator. Inside this, there are three equatorial ligands free to rotate around the iron centre, albeit not in a frictionless way as in an ideal gyroscope. These ligands are initially three carbonyl groups but, as a last stage in their synthesis, the authors managed to replace one of them with a nitrosyl cation, despite the fact that the spokes (the methylene chains) could have hindered such a reaction. The replacement ligand creates an electric dipole moment that could be a way to drive unidirectional rotation, a necessary feature of functional rotor systems.

## Hybrid block copolymers

Separately, conjugated polymers and conducting polymers have attracted much interest for their potential use in a range of biological applications. For example, conjugated polymers are likely to be central to the creation of functional materials for probing biomolecular interactions, and conducting polymers providing a promising biocompatible material for making wire for electrically stimulating cell growth. Researchers in Washington now describe the synthesis and self-assembly of hybrid triblock copolymers that combine both (Kong, X. & Jenekhe, S. A. *Macromolecules* <http://dx.doi.org/10.1021/ma048888p>). By using both  $\pi$ -conjugated polymer and polypeptide blocks they create a copolymer that exhibits both photoactivity and electroactivity. In addition, they demonstrate the ability to form both rod-rod and rod-coil conformations, which may improve the interaction of the different blocks with biomolecules, and has the potential to form self-assemblies with new properties. These materials are likely to be useful in applications in biosensors, scaffolds for tissue engineering and in nanoelectronics.

## Going to high-res

Improvements in the performance of mobile electronic devices have not only made them faster, smaller, lighter and cheaper but also much more power hungry. In order that such developments do not outpace improvements in battery technology, there is great demand for electrical components, in particular displays, whose operation requires as little power as possible. Electrochromic displays, which are based on materials that change colour when an electrical current is passed through them, are of particular interest in this endeavour as they only draw power when switched between states,

and require no power to maintain a displayed image. Writing in *Advanced Materials* (16, 1558–1562; 2004), Lorenz Walder and colleagues describe the construction and operation of a bistable electrochromic display device that achieves an image resolution of 360 dots per inch — the highest reported so far. To construct this device the authors first grew a mesoporous titanium dioxide electrode to encapsulate the electrochromic dye molecules that generate the image. These molecules were then patterned onto this electrode in the desired image using a modified dot-matrix printer.

## BANANA-SHAPED MOLECULES

Self-assembled structures having a regular icosahedral form (such as those observed for protein virus capsids) can be observed widely in nature and occur as a result of biomineralization processes. The reason for the high symmetry is related to the basic principle that increasing the number of elements with the same symmetry reduces the amount of independent structural information. Now, Makoto Fujita and colleagues at the University of Tokyo (*Angewandte Chemie* <http://dx.doi.org/10.1002/ange.200461422>) demonstrate that simple banana-shaped organic molecules can self-organize into spherical coordination networks of up to 7 nm through a process of metal–ligand interactions. These finite networks, which consist of 36 small components (12 equivalent metal centres and 24 equivalent ligands), exhibit cuboctahedron symmetry, and contrast with the common formation of two-dimensional infinite networks that takes place with a linear organic ligand. By attaching a functional group (for example, porphyrin or a fullerene) to each ligand, these groups can be aligned equivalently at the periphery of the sphere, thereby mimicking the behaviour of light-harvesting proteins or chlorophylls.

## Flipping single atom spins

The magnetic properties of nanometre-scale structures play an important role in classical and quantum computation. Recent years have seen a variety of studies in which the magnetic properties of individual atoms have been probed by placing them in magnetic tunnel junctions. Using a scanning tunnelling microscope, Andreas Heinrich and colleagues at IBM have now measured the energy required to flip the spin of single manganese atoms adsorbed on a partially oxidized NiAl surface (*Science Express* <http://dx.doi.org/10.1126/science.1101077>).

Above a threshold voltage, tunnelling electrons are able to transfer energy to spin-flip excitations of single Mn atoms, resulting in a conductance step at a characteristic voltage. Conductance spectra reveal how strongly the local environment can influence the magnetic properties of each atom. Isolated Mn atoms on oxide terraces have markedly different conductance spectra from Mn atoms next to an interface between metal and oxide. The new technique means that site-specific studies can be made of magnetic moments, and should allow the study of spin-excitations in custom-engineered nanostructures.

