Biological antifreeze

Do you ever wonder how polar fish survive when their body fluids should, by all logic, freeze? Nature, who always thinks of everything, has provided them with antifreeze glycoproteins, biomolecules that lower the freezing temperature of the body fluids. To better understand how these glycoproteins work, researchers in Japan and Canada have made synthetic versions of these biomolecules and studied their antifreeze activity in relation to their structural conformations (Y. Tachibana *et al. Angewandte Chemie-International Edition* 43, 856–862; 2004). Antifreeze glycoproteins have a protein skeleton, made of a repeating tripeptide unit, with a sugar moiety attached to a specific peptide residue. Looking at the nature and configuration of the chemical groups and their arrangement as an extended left-handed helix, the authors have identified the essential structural motifs responsible for the antifreeze activity. Moreover, they found that even just two tripeptide units are enough to obtain an appreciable effect. Although the detailed antifreeze mechanism remains to be elucidated, these results give important clues pointing to a role for the amphipatic (partly hydrophilic and partly hydrophobic) structure of these proteins. The availability of this new biomimetic approach to prevent freezing might have important implications for clinical procedures and biomedical materials.

Parallel printing

Dip-pen nanolithography (DPN) is a promising tool for depositing and patterning everything from proteins to polymers onto a surface. The materials to be patterned are contained in 'inks' and delivered using the tip of an atomic force microscope, in a manner similar to writing with a feather quill — but at a much smaller scale. The flexibility of DPN for depositing a variety of materials, combined with its ability to generate patterns with submicrometre features, gives it the potential to create physically and chemically complex nanostructures for a range of applications from nanoelectronics to proteomics. But, because a conventional DPN system can deposit only one ink at a time, constructing even the most rudimentary patterns is prohibitively slow. To address this, writing in *Applied Physics Letters* (**84**, 789–791; 2004), David Bullen and colleagues use not one, but an array of ten dip-pen tips at once. Not only does this allow ten different inks to be used, but actuating each tip individually allows ten different patterns to be made, which authors demonstrate by writing the numbers 0 to 9 all at once.

INTELLIGENT WINDOW COATINGS

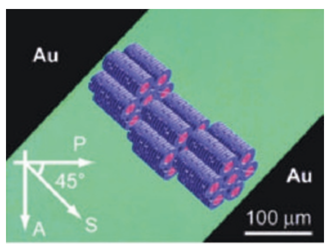
Incorporating thermoelectric films into window products can be of great technological and environmental interest. For example, enhancing the reflectivity of a window coating with increasing external temperature would decrease solar heating on hot days, thus reducing air-conditioning costs. Metal oxides exhibiting a fully reversible metal-semiconductor phase transition at ambient temperature, associated with drastic changes in electrical conductivity and optical properties in the near infrared region, are currently being considered for applications. Ivan Parkin and colleagues at University College London, writing in *Journal of Materials Chemistry* (http//:dx.doi.org/10.1021/cm034905y), show that thin films of tungsten-doped vanadium oxide on glass substrates can be prepared at atmospheric pressure by chemical vapour deposition. The films showed many properties necessary for commercial applications of intelligent window coatings, such as a low transition temperature approaching room temperature (42 °C), and large changes in infrared reflectance and transmittance, with minimal changes in visible properties.

A blinking good idea

Colloidal quantum dots — nanoscopic semiconducting crystal particles — show great potential as fluorescent markers for staining structures within living tissues and cells so that they can be seen under a microscope. Unfortunately, their potential for tracking dynamic processes within these systems is limited by the fact that they blink — their fluorescence is intermittent with time. But now, researchers in Illinois, USA, have discovered a way to almost completely suppress this behaviour in ambient conditions (S. Hohng and T. Ha *Journal of the American Chemical Society* **126,** 1324–1325; 2004). They find that short-chain thiol-containing molecules can reduce blinking events of streptavidin-coated CdSe/ZnS quantum dots by up to 80%. It has been suggested previously that the OFF-state of the emission is due to charged dots losing their electrons to surface traps. The researchers in Illinois propose that the thiols donate electrons to these surface traps, thus preventing them from accepting electrons from the quantum dots, hence reducing the blinking frequency. The authors believe that with further development, this method could make quantum dots ideal single-molecule light sources for various applications.

One-dimensional ion transport

Transport of electrons, ions and molecules can be enhanced by using complex hierarchical structures, such as those formed by liquid crystals. Researchers in Japan have now demonstrated one-dimensional ion conduction for uniaxially oriented columnar liquid crystals formed from a new class of ionic liquids (M. Yoshio, T. Mukai, H. Ohno & T. Kato *Journal of the American Chemical Society* 126, 994–995; 2004). The new compounds form hexagonal columnar phases (see figure) over wide temperature ranges, with intercolumnar distances of 3.5 and 3.8 nm, respectively, at 25 °C. These columns were uniformly and uniaxially oriented over a range of millimetres by shearing the material between glass; the long axis of the columns following the shearing direction. On measuring the complex impedance of this material between two gold electrodes, the authors found that its conductivity was greater in the direction parallel to the columns than perpendicular to them. They attributed this to the insulating effect of the alkyloxyphenyl groups on these molecules. The authors also found that by adding $LiBF_4$ to one of the compounds, the conductivity in the parallel direction increased significantly, whereas that in the perpendicular dimension remained the same; indicating that the ions become incorporated only within the central ionic cores of the columns.



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