
## Cover story

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In magnetic materials, the electron spin and the local magnetization interact with each other. For example, when electrons move across a region of large magnetization gradients, they exert a torque on the magnetization vector, an effect known as spin transfer. Teruo Ono and colleagues have focused on a typical magnetization configuration, that is, the magnetic vortex that forms in a submicrometre disks. In a vortex, the magnetization vector rotates in the disk plane, following the edges, but in the core, it is directed out of plane. The researchers demonstrate that the vortex core magnetization can be switched upside down by an alternating electrical current. This effect could form the basis of all-electrically controlled memory devices, in which the core magnetization direction is used to store the data. **[Letter p269; News & Views p255]**

### MULTIFERROIC SPINTRONICS

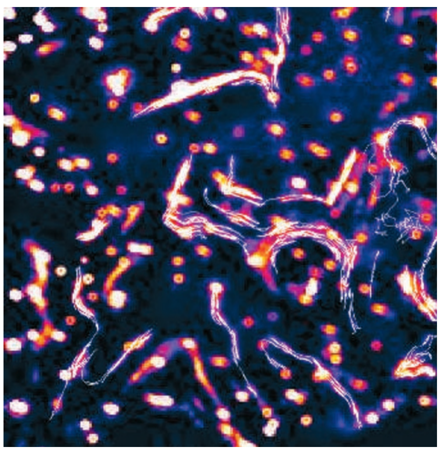
Multiferroic tunnelling junctions hold great promise for storage applications. Depending on the electric and magnetic fields in the tunnelling layer, the electrical resistance across the film changes, which can be used as the fundamental element of a memory device. Crucially, the coupling of electric and magnetic fields in multiferroic materials could mean that in future such devices could be electrically or magnetically written and read, representing the ideal scenario for storage applications. Presenting the first multiferroic tunnelling device, Manuel Bibes and colleagues take an important step in a direction that could eventually overturn existing memory device concepts and might lead to the widespread commercialization of multiferroics.
**[Article p296; News & Views p256]**

### HOW TOUGH IS BONE?

Our bones are full of cracks. They are weaker than many engineering materials but there is one trick that keeps them ahead: they repair themselves. Small cracks that form and grow as a result of daily loading activities can be detected and removed before they become long enough to be dangerous. This fascinating topic is reviewed by David Taylor and colleagues who emphasizes the need for an interdisciplinary approach to answer some very big questions. We are now able to describe and quantify mechanical damage and to elucidate the mechanisms of cracking and toughness, but the most difficult parts of the puzzle are those that concern the concerted responses of the living system. **[Progress Article p263]**

### MAPPING OUT POROUS CHANNELS

Tracking molecular movement and diffusion in confined spaces such as porous materials is crucial for understanding transport phenomena associated with membrane separation and molecular sieving. Although tracking individual molecules provides additional information about heterogeneous molecular diffusion and the host structure, such direct characterization has so far proved elusive. Christoph Bräuchle and colleagues now use single-molecule fluorescence microscopy to monitor individual dye molecules inside mesoporous silica thin-films. The dye molecules act as beacons while they diffuse through the different structural phases, and their trajectories provide a detailed picture of the structure and connectivity of the different pore systems. **[Article p303]**



Single dye molecules are used to explore the internal structure of mesoporous channels.

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### BIOSENSORS IN FULL COLOUR

Most techniques to detect proteins rely on changes of fluorescence intensity. Nicolas Kotov and colleagues have now developed a promising biosensor where the peak emission wavelength shifts as a function of protein concentration. In their devices, the authors successfully use molecular springs to bind gold nanospheres to semiconducting nanowires. The spring molecules themselves carry antibodies. As soon as the target protein attaches to the antibody, the molecular spring extends and moves the nanospheres further away from the nanowire — reducing the exciton–plasmon interaction between sphere and wire. This leads to noticeable changes in the luminescence emission from the nanowire and therefore to a molecule-specific biosensor.
**[Letter p291; News & Views p259]**

### GLASS MADE OF FOOD

Carlos Co and colleagues explore oil as a medium for amphiphilic self-assembly. They discover that sugar and surfactants suspended in oil form molten glasses spontaneously without mixing. The optical clarity and solid appearance of these glasses belie their inclusion of over 50 vol.% oil, which confers liquid-like diffusivity. The coexistence of solid- and liquid-like properties may lead to applications as sensors and optical devices, particularly in the pharmaceutical and/or food industry.
**[Letter p287]**

### IMITATION INTERFACES

The section of polymer located around nanoparticles when they are used as fillers in nanocomposites is of the utmost importance in determining the properties of these materials, but understanding and controlling this region is a complex problem. John Torkelson and colleagues simplify the challenge by creating model composites, where a layer of polymer is sandwiched between two silica surfaces. They find that the experiments offer a more straightforward route to gain insight into the effect of interparticle spacing on the glass-transition temperature of the polymer, and to predict the approximate ageing response of real nanocomposites.
**[Letter p278; News & Views p257]**