Chemical biology

Light switch for proteins

J. Am. Chem. Soc. **126,** 14306–14307 (2004)

An enzyme has been given light-switchable activity by having one of its key amino acids replaced with a 'photocaged' version.

Ning Wu and colleagues have accomplished this feat in yeast by developing a way of loading transfer RNA (tRNA) with the non-natural amino acid. The tRNA molecule carries the amino acid to the cell's protein-synthesizing machinery, the ribosome, where it is stitched into the growing protein chain. This approach has been used previously to incorporate many non-natural amino acids into proteins. The trick is twofold. First, an artificial codon, or coding unit of DNA, is built into the gene encoding the protein, and this is recognized in the messenger RNA transcript only by the tRNA loaded with the non-natural amino acid. Second, the enzyme responsible for 'charging' the tRNA must be modified to accept that new amino acid.

Using *in vitro* selection, Wu *et al.* found mutant enzymes that attach three non-natural amino acids to a tRNA that normally carries leucine. That way, they replaced a cysteine residue in the active site of the protease enzyme caspase 3 with *o*-nitrobenzyl cysteine. Ultraviolet light removes the nitrobenzyl group and triggers enzyme activity. **Philip Ball**

Structural biology

Some like it (very) cold

Proc. Natl Acad. Sci. USA
doi:10.1073/pnas.0405109101 (2004)

Although X-ray crystallography has been used to elucidate the molecular mechanisms of many biological processes, it rarely reveals the exact position of important hydrogen atoms. Neutron crystallography, by contrast, can determine the location of these atoms. But collecting data at low temperatures, which often increases the number of ordered residues, is a technical challenge, because the crystals required for neutron crystallography are quite large.

Recently, however, it has proved possible to cool large crystals of the sugar-binding protein concanavalin A to 15 K. Now, M. P. Blakeley *et al.* report the neutron structure of the saccharide-free protein at 2.5 Å resolution. This structure contains twice as many ordered water molecules as the authors' previously published structure at 293 K (room temperature). In that structure, the nuclear density for water molecules in the saccharide-binding site was poorly defined, but at 15 K there is an extensive hydrogen-bonding network, involving five water molecules and their interacting amino acids.

Low-temperature neutron structures of other proteins have been solved (the authors refer to unpublished data for lysozyme and rubredoxin). Analysis of these structures at 15 K, and comparison with room-temperature structures, could teach us a great deal about protein function.

The development also opens up the possibility of time-resolved, neutron protein crystallography via freeze-trapping. **Joshua Finkelstein**

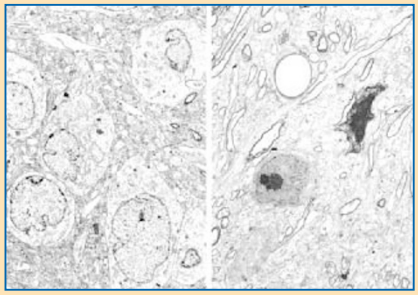
Neurodegenerative diseases

Model matters

Hum. Mol. Genet. doi:10.1093/hmg/ddi004 (2004)

Huntington's disease remains a devastating neurodegenerative disorder for which no cure exists, although scientists continue to investigate its genetic and cellular causes. Their understanding of the disease might benefit from an improved experimental model: the most common mouse model reproduces many of the clinical features, such as impaired coordination, but, strangely, little neuronal death has hitherto been detected in these mice.

Åsa Petersén *et al.* now show, however, that the animals do suffer a dramatic deterioration and loss of certain brain cells, as shown here — the dark spots on the right image represent degenerating nerve cell bodies; the left image is from a normal mouse. The dying neurons are those in the lateral hypothalamus that express the peptide orexin (also called hypocretin). More specifically, mice in the final stages of the disease had 72% fewer orexin-expressing neurons than controls — and the same percentage decrease in orexin levels in cerebrospinal fluid. The animals were also narcoleptic (prone to excessive daytime sleepiness), as are people with impaired orexin function.



The authors found similarly affected orexin-expressing neurons in patients with Huntington's disease. So Petersén *et al.* suggest that the loss of orexin could be used to assess the progression of the illness. **Roxanne Khamsi**

Physics

In a spin

Science doi:10.1126/science.1105514 (2004)

When an electron travels at right angles to the direction of a magnetic field, it experiences a force along a third axis that is perpendicular to both. This 'Hall effect' makes a stream of electrons veer off course, and can produce a build-up of charge on one side of an electrical conductor.

Y. K. Kato *et al.* now present the first experimental evidence for the 'spin Hall effect', which is due to the magnetic field generated by the angular momentum of the electrons themselves, and is predicted by theory. This leads to 'spin up' and 'spin down' electrons moving in opposite directions transverse to an applied electric field, even in the absence of an external magnetic field: spin currents without net charge flow. The authors' observations of gallium arsenide and indium gallium arsenide semiconductors show that one side of the material accumulates electrons that spin in one direction, while the other side becomes enriched with electrons spinning in the opposite direction — just as predicted.

The spin Hall effect could now be used to manipulate electron spins without using magnetic fields, the authors note. Potential applications lie in the emerging field of spin electronics. **Mark Peplow**

Materials chemistry

Protean paper

Adv. Mater. **16,** 1729–1732 (2004)

Filters, catalysts and sensors are some of the possible applications of a nanostructured 'paper' material made by Jikang Yuan and colleagues. The material consists of fibres of manganese oxide arranged into stacks of sheet-like aggregates, and it is — given its high degree of hierarchical ordering — astonishingly easy to make.

Each individual fibre is crystalline, with a molecular-sieve structure perforated by linear channels just a few ångstroms wide. This microporous phase of manganese oxide is known already, and is made by heating a mixture of metal salts in water. The porous fibres that result are about 30 nm wide and several micrometres long, and they precipitate to form a tangled, woolly mass. When this is coated onto a solid substrate and heated, it produces a papery film that can be unpeeled from the surface.

The researchers find that the fibres become organized into layers, and are oriented at right angles in successive layers. The paper can be folded and cut, and may be 'recycled' by re-dispersing the fibres in water. Metal particles deposited in the micropores could turn this substance into a membrane for size-selective catalysis. **Philip Ball**