Bioengineering

Joint endeavours with titanium

Proc. Natl Acad. Sci. USA
doi:10.1073/pnas.0500693102 (2005)

An increasing number of people receive artificial joints each year, and not only the elderly. But replacement joints themselves sometimes have to be replaced, one reason being that the commonly used titanium components can loosen over time.

K.-L. Paul Sung and colleagues have taken a closer look at why titanium joints become loose. They found that titanium particles produced by the wear and tear of the implants disrupt bone-building cells known as osteoblasts. Microscopic observations revealed that the particles become concentrated inside these cells, preventing them from attaching to the artificial joint. The researchers also implanted pins in rat thighs and found that the presence of titanium particles made the pins come out more easily.

The results exemplify why scientists team up with clinicians to produce better materials for human implants. Using nanotechnology, Sung and colleagues are now at work developing implant material that has three to five times higher wear resistance than current options. **Roxanne Khamsi**

Physics

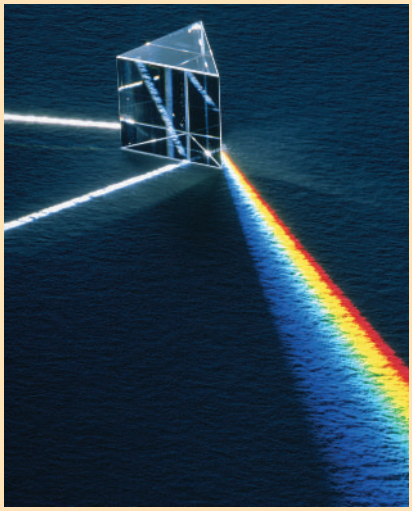
Pause for reflection

Phys. Lett. A **336,** 271–273 (2005)

Total internal reflection occurs in a glass prism when light strikes the interface between glass and air at an angle greater than a critical angle determined by the refractive index of each medium. Isaac Newton proposed that, in these circumstances, the light would be delayed in the air before re-entering the glass; the Hungarian physicist Eugene Wigner predicted a value for this delay in 1955.

Dominique Chauvat *et al.* have now measured the delay. They find that there are in fact two different 'Wigner delays', which depend on the polarization of the light.

Using femtosecond pulses of light polarized perpendicular to the plane of incidence, they found that the delay increased as the angle of incidence approached the critical angle. It reached a maximum of 28 femtoseconds before internal reflection gave way to refraction — when the beam does not return through the glass (see picture). But when the polarization of the pulse was twisted through 90° to be parallel to the plane of incidence, the delay reached 57 femtoseconds. This implies that unpolarized light experiences two separate delays on reflection, the authors argue.



D. PARKER/SPL

Total internal reflection (left) and refraction (right) at a prism–air interface.

Chauvat *et al.* suggest that understanding this phenomenon could be useful for probing materials that have a negative refractive index. They add that similar Wigner delays should also exist for beams of particles such as neutrons. **Mark Peplow**

Chemistry

Stimulating syntheses

J. Am. Chem. Soc. doi:10.1021/ja0422007 (2005)

When it comes to biologically active molecules, nature — naturally — is the first place to look. These 'natural products' occur in microbes, plants and animals worldwide, and many are in use as treatments for a wide range of diseases. But synthesizing these molecules is rarely straightforward: they are often topologically complex, which means that chemists must find creative ways to minimize the number of steps required.

Pengfei Wang *et al.* report the first synthesis of QS-21A, the natural source of which is the bark of a South American tree. QS-21A is a potent immunostimulatory agent, used in more than 80 clinical trials (including trials of vaccines for various cancers, HIV-1 and malaria).

Like many natural products, the molecule is decorated with carbohydrates, which are often necessary to elicit the desired biological activity. It can be difficult to synthesize such polysaccharides and attach them to the molecular scaffold selectively and in high yields, and Wang *et al.* had to use a variety of methods throughout the procedure — for example, 'dehydrative glycosylation', which their group has developed in several key steps for construction of the complex carbohydrate fragments.

The authors say that the synthesis of derivatives of QS-21A is under way, for use in research to explore how this remarkable natural product works *in vivo*. **Joshua Finkelstein**

Neurobiology

Fragile flies

Neuron **45,** 753–764 (2005)

Fragile X syndrome is a single-gene disorder in which symptoms range from mild learning difficulties to severe mental retardation. It affects about 1 in 6,000 people, making it the most common form of inherited mental retardation. Using fruitflies to model the condition, Sean M. J. McBride, Catherine H. Choi and colleagues find that several neurological and behavioural deficits can be reversed pharmacologically.

Studies of mice lacking the causal *FMR1* gene suggest that overactive signalling from neuroreceptors called group I mGluRs underlies the condition. McBride, Choi *et al.* used fruitflies to evaluate the involvement of these receptors, as fruitflies engineered to have no *dfmr1* gene (the fly relative of *FMR1*) show defects in courtship behaviour, brain anatomy and memory that are analogous to aspects of fragile X syndrome.

The authors treated the flies with compounds that inhibit mammalian mGluRs, and found that the insects' courtship and memory, and in certain cases their brain structures, returned to normal. The most dramatic improvements occurred when treatment began in the fly larvae and continued into adulthood. **Helen Dell**

Evolutionary biology

In search of cellulases

Mol. Biol. Evol. doi:10.1093/molbev/msi107 (2005)

Many animals lack the enzymes — cellulases — able to digest the plant material cellulose; instead, they rely on symbiotic organisms in their intestines to do the job. So it is widely assumed that the ancestors of these animals also lacked cellulases, and that animals that now have the enzymes picked them up by gene transfer from elsewhere.

Angus Davison and Mark Blaxter challenge that view. They scoured genetic databases for the genes of a particular class of cellulase enzyme, 'glycosyl hydrolase family 9'. They found these genes in many more animal groups than expected, including earthworms and sea urchins. Because the genes are similar in structure in the different groups, the finding suggests that they were inherited from a common ancestor, perhaps one that existed before the divergence of plants, animals and fungi.

The implication is that the ancestors of many animals that now lack cellulases had the relevant genes but lost them at some point during evolution. It remains unclear why, but one possible reason is that digesting cellulose is not worth it given the benefits to be gained from digesting other foods. **Helen Pearson**