Self-assembly

Algorithmic crystals made to order

PLoS Biol. **2,** 2041–2053 (2004)

Erwin Schrödinger famously predicted that biological information is encoded in an 'aperiodic crystal', which turned out to be DNA. Paul W. K. Rothemund *et al.* now show that DNA's 'digital logic' can be used to create an aperiodic crystal that grows in two dimensions in the form of a fractal pattern called a Sierpinski triangle. This object is made up of an orderly array of triangles of all sizes, and can be approximated by building the triangles from discrete 'tiles'. The triangular pattern can be created from tiles of two colours ('black' and 'white') by imposing local rules that govern the colours of neighbouring tiles.

Rothemund *et al.* embody these rules in artificial DNA molecules with dangling single strands that can pair with complementary strands on other tiles. They are either 'white' or 'black' depending on whether or not they contain loops that show up as bright regions when the resulting assemblies are scanned with an atomic force microscope. The DNA tiles do indeed form structures with the Sierpinski-triangle form, albeit fragmented by occasional tiling mismatches which, once formed, introduce erroneous information that propagates from one row to the next.

These molecules thus embody, at the molecular scale, the theoretical entities called cellular automata, which can form complex patterns depending on their pairing rules. In effect, the large-scale, hierarchical structure of the assemblies is determined by a computational algorithm programmed into the building blocks. **Philip Ball**

Particle physics

They do it with lasers

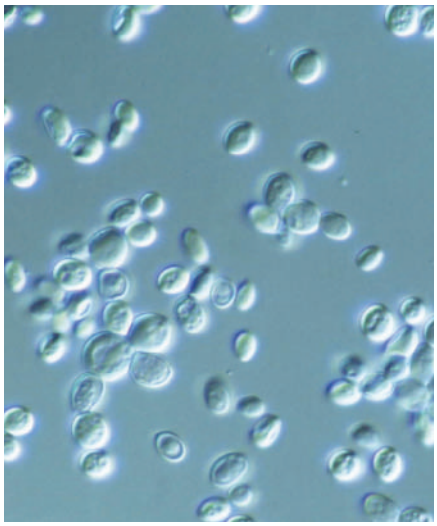
Phys. Rev. Lett. **93,** 263401 (2004)

The antihydrogen quest continues. C. H. Storry *et al.* present a laser-controlled process for creating these anti-atoms, each of which comprises an antiproton and a positron, and is hence the antimatter mirror of hydrogen.

The first anti-atoms — nine in total — were created at CERN, Geneva, in 1995; by 2002, a more significant quantity had been generated. The long-term aim is to make a precise spectroscopic comparison of antihydrogen and hydrogen, to investigate the asymmetry between matter and antimatter.

Storry *et al.* — the ATRAP collaboration — demonstrate a way of making antihydrogen that has the advantage of controlling the energy of the state in which the anti-atoms are created. They use lasers to excite caesium atoms, which, in collision with a positron, lose an electron to produce an excited state of positronium (a bound electron–positron pair). The positronium then collides with an antiproton; the electron is released and the antiproton captures the positron, forming antihydrogen.

Importantly, the anti-atom is in the same laser-selected excitation state as the original caesium atom and probably inherits the low velocity of the antiproton from which it formed. The next step is to show that de-excitation can produce cold, trapped anti-atoms for spectroscopic tests. **Alison Wright**



J. H. MCCUSKER

Molecular evolution

Lab yeast on the fast track

Proc. Natl Acad. Sci. USA
doi:10.1073/pnas.0409159102 (2005)

Around 70 years ago, a strain of the yeast *Saccharomyces cerevisiae* was isolated from a rotten fig — and has been used in experiments ever since. Now, Zhenglong Gu *et al.* show that this lab strain has a faster rate of evolution than its wild counterpart.

The authors compared the entire genome of a wild yeast strain isolated from an AIDS patient's lungs with those of lab *S. cerevisiae* (pictured) and a closely related species, *S. paradoxus*. They found that the lab strain has accumulated many more genetic mutations than the wild strain, especially of a type that alters the amino-acid sequence of encoded proteins. These mutations crop up throughout all genes, suggesting that they are not a result of increased selective pressure on a particular group of genes associated with lab survival.

The findings show that the laboratory strain is evolving faster than its wild counterpart, the authors say, probably because selective pressures have relaxed during lab life. The discovery reinforces the idea that laboratory strains do not precisely mirror the biology of their wild cousins, something that should be borne in mind when examining gene function. **Helen Pearson**

Materials chemistry

Shaping silica softly

J. Am. Chem. Soc. **127,** 325–330 (2005)

Nature is renowned for its 'soft processing' of materials. Taking a leaf from nature's book, Kristian M. Roth *et al.* have identified a small molecule capable of precipitating silica from soluble silicon-containing precursor compounds.

A similar process occurs in the marine sponge *Tethya aurantia*, which uses an enzyme called silicatein to form its silica spicules. From screening studies, Roth *et al.* found a small molecule, cysteamine, which contains two key chemical groups like those in the active site of silicatein. Using this catalyst, they could encapsulate fluorescent proteins, and even living bacteria engineered to express such proteins, in a silica matrix. These encapsulated biomaterials could be useful for sensing and catalytic applications.

Conventional (sol–gel) methods for making silica structures from solution use harsh reagents. But the biomimetic catalyst requires only the mildest of conditions. **Philip Ball**

Cancer

Immune investigations

J. Exp. Med. doi:10.1084/jem.20041379; 10.1084/jem.2004137 (2005)

One treatment hope for melanoma, a particularly deadly form of cancer, is to vaccinate patients with proteins present on the tumour itself. But a closer look at how such vaccines might work suggests that the process is more complex than expected.

Pierre G. Coulie, Thierry Boon and colleagues vaccinated melanoma patients with a tumour protein called MAGE-3. The aim was to produce a large number of immune cells called T cells that could destroy the tumour. Yet even in patients whose tumours regressed, levels of anti-MAGE-3 T cells in the blood were confusingly low — less than 0.001% of T cells. The numbers of T cells that target other tumour proteins, however, were much higher, both before and after vaccination.

In a second paper, the researchers found that — unlike the anti-MAGE-3 T cells — the other anti-tumour T cells were highly enriched in the metastases of a melanoma patient. Moreover, new anti-tumour T cells appeared after vaccination. The authors suspect that the existing T cells are part of a previous spontaneous anti-tumour response that became ineffective, and that they are roused from slumber by the small, yet significant, numbers of T cells raised directly against the vaccine. **Michael Hopkin**