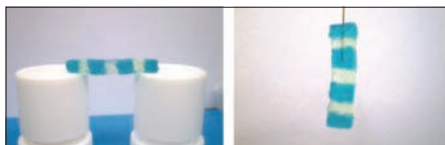


Compiled by John Swain, Northeastern University

A renewed role for clay

Clay has been used in various kinds of pottery since prehistoric times, but in the 20th century plastic objects became much more ubiquitous. Now clay could see a widespread renaissance thanks to research by Takuzo Aida and colleagues at the University of Tokyo in Japan, which has brought a 21st century touch to this ancient material.

It turns out that water and clay (2–3% by mass) plus small amounts of suitable organic compounds (less than 0.4% by mass) can produce transparent hydrogels that could take the place of plastics. The materials produced in this way are mechanically strong, but what is more remarkable is that, if damaged, they will completely self-heal – after all, they are nearly all water. The key to these remarkable properties is the non-covalent supramolecular bonds between the dendritic organic molecules – ones that have many “fingers” to



A bridge constructed by connecting together seven hydrogel blocks can be suspended horizontally and held vertically.

grab onto things – and the clay.

Unlike plastics, these hydrogels are environmentally friendly. Moreover, as the researchers point out, with the world’s focus on reducing dependency on fossil-fuel energy, there is a big role for materials that are much less dependent on petroleum than conventional plastics are.

Further reading

Qigang Wang *et al.* 2010 *Nature* **463** 339.

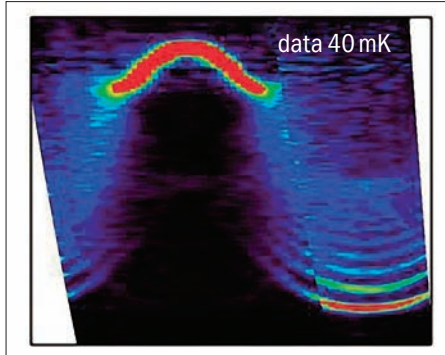
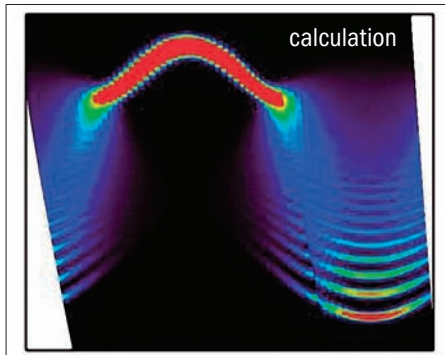
E_8 appears in the real world

Simple Lie groups – in a sense, the basic atoms of symmetry – come in several infinite series. There is also a list of five “exceptional” ones, of which E_8 is the largest and, to many mathematicians and physicists, the most beautiful. For physics, E_8 has mainly attracted the interest of string theorists, but now it has turned up in laboratory studies of quantum magnetism.

Radu Coldea of the University of Oxford and colleagues applied a strong magnetic field to a supercooled crystal of cobalt niobate, which behaves like a quasi one-dimensional Ising ferromagnet. Despite the simplicity of the system, it exhibits a quantum phase transition that is predicted to have excitations corresponding to an emergent E_8 symmetry. The two lowest-lying “meson” states turn out to have a mass ratio of the golden mean (about 1.618), just as predicted from the E_8 theory.

Further reading

R Coldea *et al.* 2010 *Science* **327** 177.



Spectrum of magnetic resonances in cobalt niobate in zero applied field, as calculated and observed by neutron scattering data. Near the critical field the two lowest frequencies approach the golden ratio, one of the key signatures of the predicted E_8 structure.

Water splashes are supersonic

Drop a rock on a pond and watch the splash – but look carefully, because some of the air in the splash comes out faster than sound. Stephan Gekle of the University of Twente and colleagues carefully studied what happens when a 2 cm disc is pulled through water at just 1 m/s. The cavity produced in the water rapidly forms into an hourglass shape and air forced through the narrow “waist” can exceed the speed of sound even though it is driven by a pressure difference of just 2% of an atmosphere. At times, the dynamically evolving cavity resembles nozzles used for supersonic jet engines, but the way that it changes in time makes it a completely unique physical system.

Further reading

S Gekle *et al.* 2010 *Phys. Rev. Letts.* **104** 024501-1.

Liquid materials for invisibility cloaks

Metamaterials with effective negative indices of refraction offer the possibility of making invisibility cloaks by routing light around a concealed object. A new approach on this theme is based on a novel form of ferrofluid. The idea by Y Gao of Fudan University in Shanghai and the Chinese University of Hong Kong and colleagues is to use silver-coated iron-oxide nanoparticles suspended in water.

An external magnetic field would cause the particles to line up into chains so that the desired metamaterial would form by self-organization. Experimental demonstration of the technique still remains to be done, but the idea is quite new in the field, which has so far concentrated on solid devices. Maybe this is what the author JK Rowling had in mind in the Harry Potter novels, where she describes invisibility cloaks as “fluid and silvery”.

Further reading

Y Gao *et al.* 2010 *Phys. Rev. Letts.* **104** 034501-1.