

New polymer enables room-temperature plastic magnet

Physicists at the University of Durham in the UK have created the first plastic magnet that operates at room temperature, using a new polymer, PANiCNQ. Naveed Zaidi and colleagues synthesized the new material out of a combination of emeraldine base polyaniline (PANI) and tetracyanoquinodimethane (TCNQ). The measurements made by the group indicate that the material has a Curie temperature above 350 K and, more tentatively, that it is ferri-magnetic (Zaidi *et al.* 2004).

Some of the most compelling evidence for the magnetic nature of the new material comes from magnetic force microscopy, in which sequential images show evidence for the movement of a magnetic domain wall. Intriguingly, the magnetically ordered state apparently

develops with time, and this seems to be correlated with structural changes – possibly a gradual alignment of the polymer chains – indicated by X-ray diffraction measurements.

The choice of materials is interesting, with PANi being a metal-like conductor that is stable in air and TCNQ serving as a source of free radicals (i.e. unpaired electrons). PANiCNQ is only about 1/100th the strength of conventional metal magnets, but the researchers are hopeful about improvements. In any case, it is good enough to pick up iron filings, which is already impressive.

Further reading

N Zaidi *et al.* 2004 *Polymer* **45** 5683.
M Killea 2004 *New Scientist* 28 August p19.

Exotic coat turns fibre into superwire

New superconducting wires made from carbon fibres coated with an unusual magnesium–carbon–nickel compound may offer a great combination of lightness, physical strength and high current-carrying capacity. Phil Adams and David Young of Louisiana State University manufacture the wires by heating nickel-coated carbon fibres in magnesium vapour to produce the superconducting MgC₂Ni₃. Estimates of the currents that these wires should be able to carry at absolute zero are some 40 MA/cm², corresponding to magnetic fields of 15 T.

This performance is close to what one

would expect from more conventional superconductors, but this material is strange even for an exotic superconductor. Lacking the copper and oxygen that go into the cuprate high-T_c superconductors with critical temperatures of around 100 K, this material, with a T_c of 8 K, seems to be another kind of exotic superconductor working via mechanisms that are still not understood.

Further reading

D P Young, M Moldovan and P W Adams 2004 *Phys. Rev. B* **70** 064508.

Following the tracks of the pioneers

The European Space Agency (ESA) may become involved in trying to nail down what has become known as the Pioneer anomaly and perhaps change the way we understand gravity. The effect in question is that the spacecraft Pioneer 10 and Pioneer 11 seem to be following paths that are not what one would expect from present-day theory. At distances of several billion kilometres from the Sun they seem to suffer an unexpected

constant acceleration directed towards the Sun, at a level some 10 billion times weaker than the Earth's gravitational pull.

Despite searches for some conventional explanation the effect remains persistent and mysterious. Whether it is to do with dark matter or any of the other present-day cosmic exotica is still unknown, but ESA is now considering a special mission that would measure the Pioneer anomaly a thousand times more precisely than is possible today, so as to lay to rest the question of its reality once and for all.

Further reading

S Turyshv *et al.* 2004 *Physics World* **17**(9) 21.

How nature can carve out a fractal

In introducing the concept of fractals, it's quite common to begin with a discussion of how long a coastline is – clearly the answer depends on the resolution you use. It turns out that an object like this needs to be described by a non-integer dimension a little larger than one and somewhat less than two. Now Bernard Sapoval and A Baldassarri of the Ecole Polytechnique and A Gabrielli of the



A fractal coastline in northern Portugal.
(Credit: Jeff Schmaltz, MODIS Rapid Response Team, NASA/GSFC.)

Enrico Fermi Centre in Rome have gone beyond merely noting this feature of coastlines and have suggested some detailed dynamics that could produce the observed fractal dimension of about 4/3.

Their idea is that waves erode the weak points in a smooth shoreline, increasing its length by making it indented. With new weak points exposed by erosion, the same process repeats. The increased roughness of the coastline also increases damping of the waves, so helping to maintain the stability of the larger features. It seems that in this way nature can carve out a fractal.

Further reading

B Sapoval, A Baldassarri and A Gabrielli 2004 *Phys. Rev. Lett.* **93** 098501;
www.aip.org/pnu/2004/split/697-2.html.

2003
CERN CMS
Gold & Crystal
Awards Winner

When Your
Concepts Require
Creative Solutions

Explore Our
Capabilities

Light Guiding Capillary ■ Custom Flow Cells
Hermetic Sealed Ferrules ■ Microfluidic Devices
Flexible Capillaries ■ Custom Assemblies
Specialty Optical Fibers / Draws



Polymicro Technologies, LLC

18019 North 25th Avenue ■ Phoenix, Arizona 85023-1200

Phone: 602-375-4100 ■ Fax: 602-375-4110

URL: <http://www.polymicro.com> ■ E-Mail: sales@polymicro.com

Innovators in Silica

Detectors
Materials
Applications



Solutions

Dedicated
Scintillation
Detectors



SCIONIX Holland B.V.

Tel. +31 30 6570312

Fax. +31 30 6567563

Email. sales@scionix.nl

www.scionix.nl

SCIONIX USA

Tel. +1 407 578 6469

Fax. +1 407 578 6104

sales@scionixusa.com

www.scionixusa.com

26 years ago F.u.G. Elektronik GmbH was founded by Erich Fritz and Gerhard Giebichenstein. CERN was a good customer of this Bavarian power supply manufacturer from the beginning. With the years this relationship was extended and developed for the mutual advantage. Nowadays F.u.G. Elektronik has customers in the whole world. The particle physicists of CERN still belong, however, to our best customers.

high voltage

high stability

fug

power supplies

high reliability

high power

**CERN 50 Years -
Congratulations!**

More than 26 years power
supplies from F.u.G. at CERN ...

Photo: CERN



Photo: CERN

F.u.G. Elektronik GmbH
Florianstraße 2
83024 Rosenheim
GERMANY

Tel.: +49 8031 2851 - 0

Fax: +49 8031 81099

Email: info@fug-elektronik.de

Web: <http://www.fug-elektronik.de>