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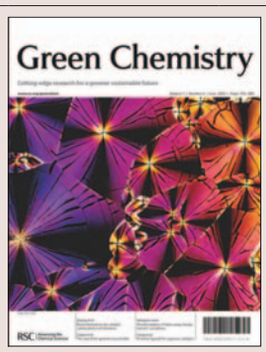
Chemical Technology

Cd sensing that mimics life

Justin Gooding and colleagues at the University of New South Wales in Sydney, Australia, have developed a portable cadmium sensor with a detection limit of 0.5 part per billion. The device is based on a gold electrode covered with glutathione molecules, which bind to cadmium ions. The bound cadmium can then be detected by voltammetry. The sensor is particularly interesting because it mimics the way that biological systems bind toxic heavy metals, making it useful for environmental toxicology measurements.

E Chow, D B Hibbert and J J Gooding
Analyst, 2005, **130**, 831

Removing stubborn sulfur



A novel approach to removing sulfur from diesel fuel, developed by a team of French scientists, could help meet strict regulations on fuel in the future. The researchers, led by Marc Lemaire from the Université Claude Bernard Lyon 1, Villeurbanne, France, have developed a polymer that can bind sulfur compounds that are difficult to remove from fuel using conventional techniques. The polymer can be used multiple times and the process takes place under very mild conditions, without consuming any hydrogen.

M Sévignon *et al*
Green Chem., 2005 (DOI: 10.1039/b502672e)

Airborne aluminium exposed

Since cumulative exposure to airborne aluminium particles can cause respiratory diseases in industrial workers, Stephan Weinbruch at Technische Universität Darmstadt, Germany and Norwegian colleagues have developed a way to investigate the composition of individual aerosol particles. A combination of scanning and transmission electron microscopy provides information on size, morphology and chemical composition of the particles. Weinbruch shows that coatings on the particles can increase their surface area and potentially cause more complex health effects.

B Höflich *et al*
J. Environ. Monit., 2005, **7**, 419

Storing hydrogen

As part of a strategy to develop hydrogen storage materials with improved recharging/discharging kinetics, UK researchers at the Universities of Birmingham and Oxford have revealed a new way to activate MgH_2. Magnesium hydride has the highest storage capacity of all applicable hydride materials, but its hydrogen sorption rates are too slow for practical use without energy-intensive milling. Peter Edwards and colleagues have discovered they can chemically modify MgH_2 by reacting it with small amounts of $LiBH_4$, producing desirable kinetic properties without the need for mechanical milling.

S R Johnson *et al*
Chem. Commun., 2005 (DOI: 10.1039/b503085d)

Contact us: Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, UK CB4 0WF. E-mail chemicaltechnology@rsc.org, Tel +44 (0)1223 420066.

Application highlights

Photocatalyst provides efficient decontamination of air polluted with bacteria

Illuminating end for germs

Chemists in France have devised a method to kill bacteria in flowing air in an attempt to combat diseases like SARS in high-risk areas such as hospitals and commercial aircraft.

Valérie Keller and colleagues at the Louis Pasteur University in Strasbourg have designed a purification method using titanium dioxide, a powerful oxidising species that damages microorganisms when illuminated with UV light.

This photocatalytic reaction has already been effective in water-based systems but this is the first example of it being used for photokilling gas-phase bacteria.

Keller's group designed a vessel where contaminated air passes over the illuminated photocatalyst at room temperature. The process was extremely efficient and removed over 99 per cent of the contaminant *Escherichia coli* from the air stream. This non-pathogenic bacterium was chosen as a model for the system because of its similar size to *Legionnella pneumophila*, the microorganism that causes Legionnaires' disease.

SARS outbreaks in Asia caused worldwide concern and have prompted research into killing bacteria

The worldwide reaction to the recent SARS epidemic in Asia illustrates the level of public concern about the spread of disease by airborne agents. The next step is to test the ability of the new method to remove viruses like SARS and pathogenic bacteria from the air stream.

The purification process has the potential to replace existing industrial-scale purification methods of filtration, thermal treatment and disinfection with chemical agents. 'We need to treat larger volumes of flowing air contaminated by the biological agents [to meet industrial requirements],' said Keller.

Alison Stoddart

Reference
V Keller *et al*, *Chem Commun.*, 2005 (DOI: 10.1039/b503638k)

Cancer growth targeted by cyclic peptides and biotin

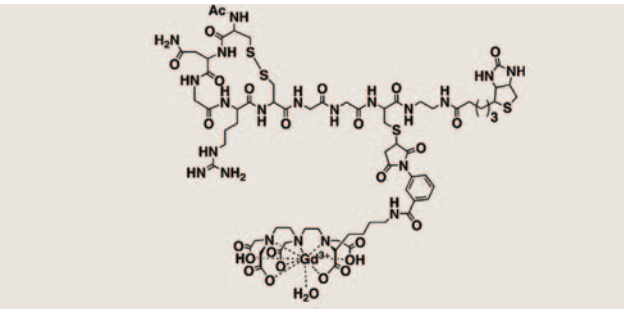
MRI agent developed for angiogensis

A magnetic resonance imaging (MRI) contrast agent that targets the growth of new blood vessels has been developed by scientists in the Netherlands.

MRI is a non-invasive technique used in medicine to look inside the body. Contrast agents, which work by altering the local magnetic field of different tissues, are used to make the images clearer.

Bert Meijer and colleagues at the Eindhoven University of Technology and the Cardiovascular Research Institute Maastricht have produced a contrast agent that targets angiogenesis, the growth of new blood vessels, after being told by colleagues working in medical research that there wasn't one available.

Excessive angiogenesis is a feature of cancer. New blood vessels grow to feed the tumour allowing cancer cells to escape into the bloodstream and travel around the body.



Contrast agents are being developed to target new blood vessel growth

Target-specific contrast agents must meet two criteria; the contrast agent must accumulate around the regions of angiogenesis, and the sensitivity of the contrast agent must be increased.

The former was achieved by incorporating a cyclic peptide containing the asparagine-glycine-arginine sequence (cNGR), which is a specific ligand for the aminopeptidase CD13, a protein over-expressed by angiogenic endothelial cells.

To increase the contrast of the agent, a gadolinum(III) chelate was bound to biotin and four biotins were in turn connected to avidin, a large carrier protein.

The cNGR was connected to the Gd(III) chelate and the biotin-avidin system to create a target-specific contrast agent capable of accumulating in tissues near angiogenic cells.

Donald Tomalia, an expert on dendrimer applications at Dendritic Nanotechnologies, Michigan, US, is enthusiastic about the new contrast agent.

'This brilliant innovation has demonstrated enhanced sensitivity of the MRI agent. The next step will be to demonstrate the *in vivo* targeting efficacy of these agents, which if successful, portends dramatic progress and possibilities in the earlier stage detection of cancer and other diseases,' he said.

Lorna Jack

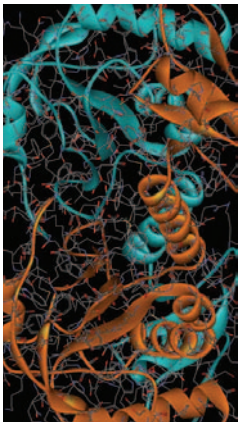
Reference
A Dirksen *et al*, *Chem. Commun.*, 2005 (DOI:10.1039/b502347e)

Standard protein helps analysis

A new approach to investigating metals incorporated in proteins has been developed by chemists in France and Poland.

Ryszard Lobinski and colleagues have synthesised a selenium-containing protein (selenoprotein) standard, which they have used to devise an analytical method based on state of the art elemental and molecular mass spectrometry.

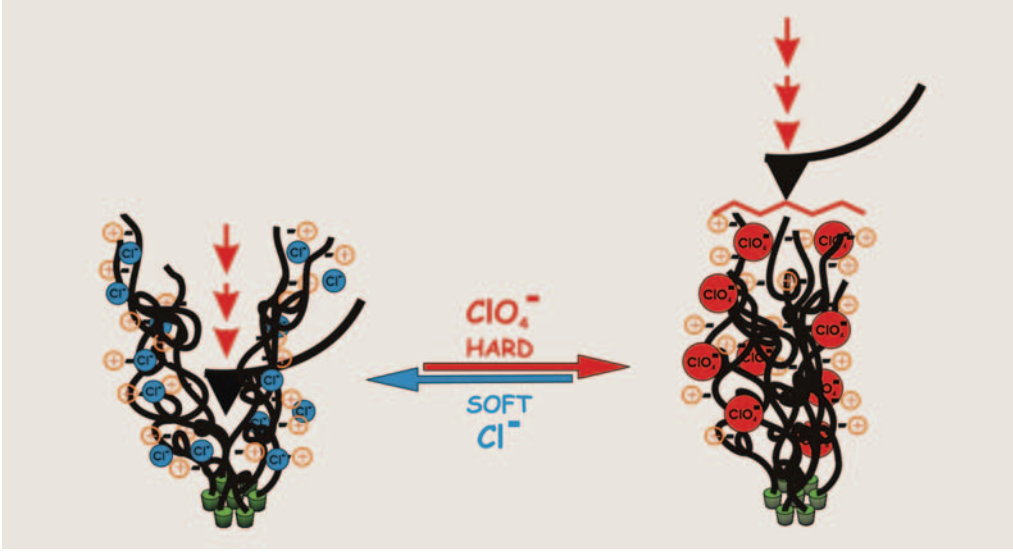
Selenoproteins have attracted interest in recent years because of the role selenium is thought to play in cancer prevention, although the processes involved are not fully understood. Traditional methods for analysing selenoproteins involve using radioactive tracers, making human studies impossible.



With the availability of Lobinski's protein standard, study in this area will be helped considerably. Work is continuing to optimise these methods, particularly for sample preparation, so they can be applied to animal and human samples.
Niamh O'Connor

Reference
G Ballihaut *et al*, *J. Anal. At. Spectrom.*, 2005 (10.1039/b500719d)

Polymer brushes switch from soft to hard



Changing the solvent switches polymer brushes from hard to soft matter

An innovative way to modify the physical properties of polymers has been discovered by scientists in the UK.

Wilhelm Huck and colleagues at the University of Cambridge are designing materials that respond to their environment by investigating the behaviour of surface-tethered polyelectrolyte chains, known as polymer brushes, under various conditions.

They saw that the stiffness of the positively charged polymer chains in solution greatly depends on the solvent. In water, the cationic polymer brushes adopt an extended conformation and are easily deformed by applying a force with an atomic force microscope (AFM) tip.

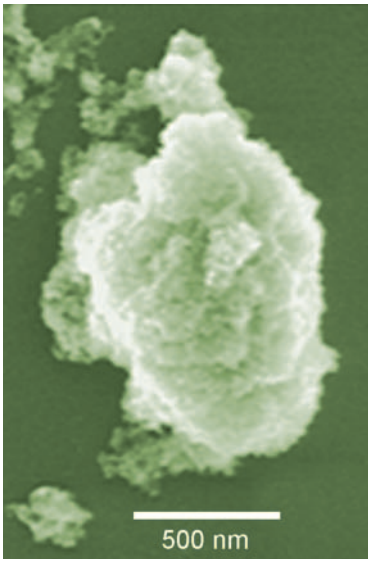
In electrolyte solutions where the anions are strongly coordinated to the polymer chains the brushes become so rigid they cannot be indented by the AFM tip. This transition from soft to hard matter can be reversed by simply changing the solvent. It is hoped this discovery can be exploited to develop smart surfaces.
Rachel Hopper

Reference
T Farhan *et al*, *Soft Matter*, 2005 (DOI: 10.1039/b502421h)

Biomolecule microsensor

An electrical microsensor capable of detecting and quantifying traces of biological molecules has been developed by scientists in the US.

Rosemary Smith's group at University of California, Davis and University of Maine, has developed a sensor to detect biomolecules such as the protein avidin.



The target molecule aggregates to nanoparticles modified with protein-binding biotin. The key advance is the use of electrical detection – dielectrophoretic impedance – in this system to confirm and quantify the protein's presence in the aggregate. The sensor can also detect antibodies.

The real-time sensor, a 'micro total analysis system', is selective for the target molecule and is also sensitive to trace amounts, down to nano- (10^{-9}) or even pico- (10^{-12}) molar concentrations.

The work exemplifies the growth of research programmes to improve methods to detect, identify and quantify very small amounts of biological materials, including the toxins, viruses and bacteria used as terror and warfare agents.
Adrian Kybett

Reference
P J Costanzo *et al*, *Lab Chip*, 2005, **5** (DOI: 10.1039/b417535b)

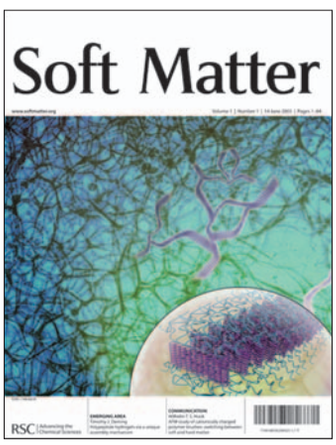
Essential elements

The softer side of science

Soft matter – what is it, and just what area of science does it cover? Nobel Prize winner and 'founding father' of soft matter research, Pierre-Gilles de Gennes, offers his views on the subject in the first issue of the new RSC journal of the same name.

Launching this month, *Soft Matter* aims to provide an interdisciplinary platform for the exchange of information and discussion between researchers working at the fringes of traditional disciplines (such as chemistry, physics, materials science and biology), who have a particular interest in soft materials.

Papers in the first issue demonstrate the diversity of



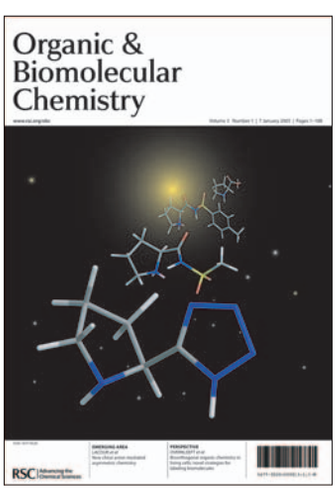
research already underway at these interfaces - ranging from the switching of polymer brushes from soft to 'hard' matter, modelling of the flow of complex fluids in channels, the use of gels in art conservation, and the use of microfluidic devices to formulate double emulsions.

'By bringing together scientists from different disciplines, we hope not only to promote communication ... but to see further growth of the area as a whole' state Ullrich Steiner and Carol Stanier (*Soft Matter* editorial board chair and editor, respectively) in the first issue editorial, '*Soft Matter* is the future home of soft matter research'.

●Read the first issue of *Soft Matter* and judge for yourself at www.softmatter.org

RSC journal scores Top Ten hit

A paper detailing a new breed of organocatalyst used in asymmetric reactions, published in *Organic & Biomolecular Chemistry* (*OBC*)[1], is among the Chemical Abstracts Service top ten most requested articles in the first 3 months of 2005. The new proline-based catalysts, discovered by Steven Ley's research group at the University of Cambridge, UK, perform as well as traditional organocatalyst systems but are needed in much smaller quantities. The new catalysts can also be used in a wider range of solvents, making them much easier to work with.



The interest in the paper, which is freely available on the *OBC* website, reflects the increasing number of research groups that are working in this area. The quest for new and more effective reaction pathways is producing a wealth of published material, and a recent article by Benjamin List[2], from the Max-Planck Institute, Germany, provides a timely overview of the area.

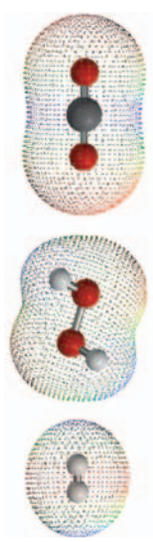
●To read these papers for free, or to find out more about *OBC* visit: www.rsc.org/obc

1 *Org. Biomol. Chem.*, 2005, **3**, 84
2 *Org. Biomol. Chem.*, 2005, **3**, 719

And finally.....

Nobel prize winner Ryoji Noyori from Nagoya University, Japan, is the author of the third in a series of 40th Anniversary Articles in *ChemComm*.[1]

'In the 21st century, the field of chemistry will face more than just academic challenges,' he



says. Urging chemists to practise 'practical elegance' by using truly efficient catalytic systems, he maintains that 'our ability to devise straightforward and practical chemical syntheses is indispensable to the survival of our species'. Noyori was previously the subject of a Profile in *Green Chemistry*.[2]

●Find out more at www.rsc.org/chemcomm

1 *Chem. Commun.*, 2005, 1807
2 *Green Chem.*, 2003, **5**, G37

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