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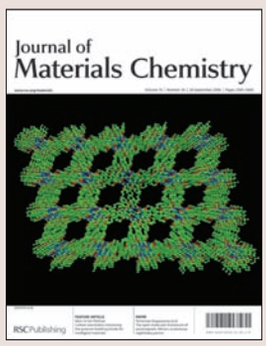
Chemical Technology

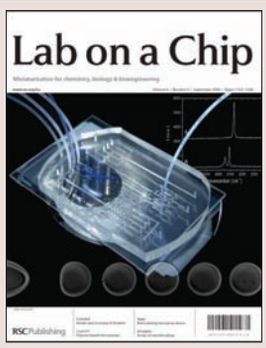
Bigger and better batteries



A material for large-scale lithium ion batteries has been studied at the atomic level to explain how it works so well. Those currently used are prohibitively expense, according to Josh Thomas and colleagues, who studied the lithium iron silicate.

M A Nytén *et al*
J. Mater. Chem., 2006, **16**, 3483

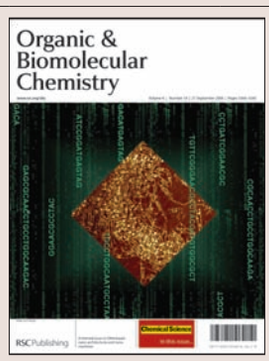
Wobbling gels deliver drugs



A gel that shrinks in the heat and swells in the cold has been used as a valve in a microchip drug delivery system by Japanese researchers. When the gel is swollen at lower temperatures the flow is restricted, but warming it up allows the drug to be administered.

A R Yoshida *et al*
Lab Chip, 2006, **6**, 1384

Biochemistry goes digital



Digital design is set to revolutionise biochemical analysis, according to US scientists. The advantage of their technique is that the regular pattern of molecule forms a digital signal that can be fed into a computer, making an assay much faster and easier.

J J La Clair and M D Burkart
Org. Biomol. Chem., 2006, **4**, 3052

Removing herbicides from water

A herbicide can be removed from water with better efficiency using a method developed by US scientists. Using fibrous activated carbon, the team removed atrazine down to the level recommended by the US Environmental Protection Agency.

Z Yue *et al*
J. Mater. Chem., 2006, **16**, 3375

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Application highlights

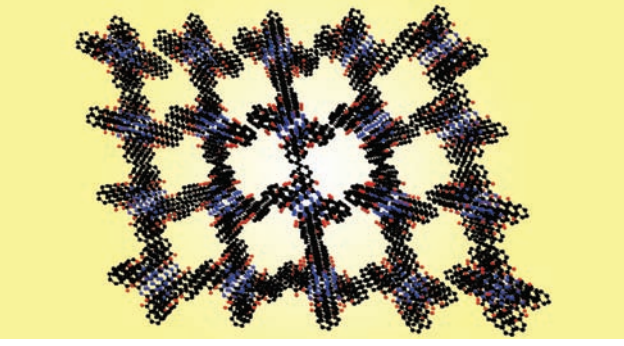
Lithium framework compound's magnetic properties exploited

Probing oxygen levels in the body

An oxygen-sensing probe for the emerging medical technology *in vivo* EPR has been made by scientists in the US and India.

The probe, made by Periannan Kuppusamy and his colleagues at the Ohio State University and the Indian Institute of Technology, Chennai, is biologically stable, non-toxic and sensitive to the amount of oxygen in its surroundings.

The probe is made of lithium and macrocyclic organic groups, and has an unusual crystal structure with channels running lengthwise through it. The probe is injected into living tissue where oxygen molecules can enter its channels, disturbing the magnetic properties of the material. Kuppusamy used electron paramagnetic resonance (EPR) spectroscopy to measure these changes, which give a very accurate measurement of the amount of oxygen in the probe's environment.



Oxygen can enter channels in the probe's structure

Although the use of *in vivo* EPR is currently limited to small animals, Kuppusamy is upbeat about the potential uses for his new probe. 'There is a great need for reliable and non-invasive measurements of oxygen levels in body tissues,' he said, 'because oxygen imbalances result in conditions within the tissues that are implicated in illnesses such as heart attacks and strokes.'

'We have just completed some studies establishing the use of this probe for non-invasive tracking of stem cells labelled with it, and *in situ* measurements of oxygen concentration of transplanted stem cells in hearts with dead tissue resulting from a loss of blood supply,' he added.

Bernard Gallez, director of the Biomedical Magnetic Resonance Unit at the University of Louvain, Belgium, welcomed their findings. 'This work is excellent, offering a convincing interpretation about the mechanisms by which some paramagnetic materials may act as oxygen sensors,' he said. 'Kuppusamy has established a rational basis for measuring these essential molecules in biological systems using *in vivo* EPR.'

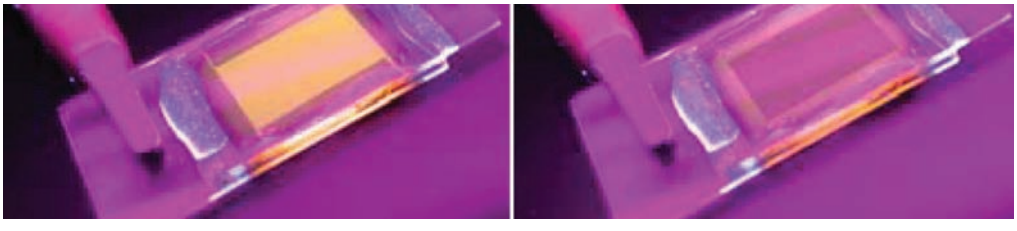
Kuppusamy is now investigating other materials with similar properties, and using the probe to investigate cardiovascular disease.

Susan Batten

Reference
R Pandian *et al*, *J. Mater. Chem.*, 2006, **16**, 3609

Redox chemistry and fluorescence combine in stable switch

Switch to a brighter future



The neutral molecule fluoresces, the anion is colourless

A fluorescent switch that can be made to turn on and off merely by changing the voltage across it has been prepared by a collaboration between French and South Korean scientists. The switch could have potential for optical display panels, said the researchers.

The switch relies on a polymer-based electrolyte containing chloromethoxytetrazine. Under ultraviolet light the neutral molecule is fluorescent, but the anion is colourless. By adjusting the voltage across an electrolyte containing the tetrazine, Pierre Audebert, from the Ecole Normale Supérieure in Cachan, and Eunkyoung Kim from Yonsei University, Seoul, were able to make the cell switch between the fluorescent and non-fluorescent states.

Since the anion was found to be too reactive to use in conventional solutions, the researchers sandwiched a thin layer of the tetrazine-containing electrolyte between two transparent electrodes, one of which was coated in an inert polymer electrolyte. When the current was switched on, the conversion between the two forms of the molecule was fast enough to avoid any decomposition. What's more, the contrast between these two states remained the same even after 120 switching cycles, said Audebert.

According to Knut Rurack, an expert in fluorescence probes at the Federal Institute for Materials Research and Testing in Berlin, Germany, Audebrt and Kim have 'combined in a unique way the advantages of fluorescence and redox chemistry'.

Koji Araki from the University of Tokyo, Japan, was also enthusiastic about the research, saying that it 'will open the way for development of novel displays or electro-optical switches'. He pointed out, though, that in order to achieve this, the cell response time and the durability of the device will be important – work which Audebert said is now in progress.

David Barden

References
Y Kim *et al*, *Chem. Commun.*, 2006, 3612

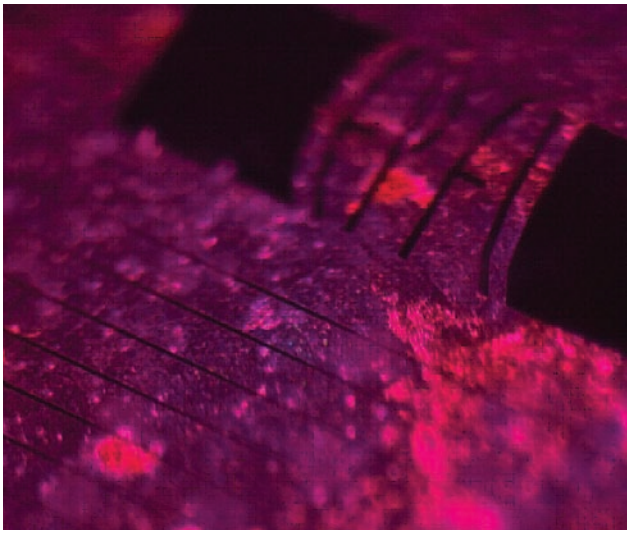
Miniature electrical imaging system monitors structural changes in living tissue

Shrink-to-fit electronics

A downscaled geophysical technique could be used to study biological processes such as wound healing, according to Swiss bioengineers.

The resistance of cells to an alternating current can yield information about cell and tissue structure and movement, said Pontus Linderholm. With colleagues from the Swiss Federal Institute of Technology in Lausanne, he created an electronic device that measures this resistance in a layer of cells grown on top of it. The system images vertical cross-sections of the cell layer, and provides more structural information than current electrical techniques.

According to the team, their method can gain information ranging from the density of cells in a tissue to the type of cells present. They successfully used the technique to study the migration of cells across a 'cut' made in a cell layer.



The cell density in tissue can be measured

Linderholm said that the devices may be used to gain a better understanding of cell migration in the body, for instance in wound healing and the development of embryos.

He also sees potential for drug-screening: 'It is important to know what effect drugs have on cell mobility,' he said. He added that being able to screen hundreds of compounds simultaneously using electronics would save a lot of time compared to studying the effect of each compound on cell movement through a microscope.

The group borrowed their technique from geophysicians, who use resistance measurements on a much larger scale to study things like glaciers and groundwater flow. Although the idea of using this technique to image cells is about twenty years old, Brian Brown of the University of Sheffield, UK – himself a pioneer in the field – believes that this is the 'first significant development of a microsystem able to record cell migration'.

Danièle Gibney

Reference
P Linderholm *et al, Lab Chip*, 2006, **6**, 1155

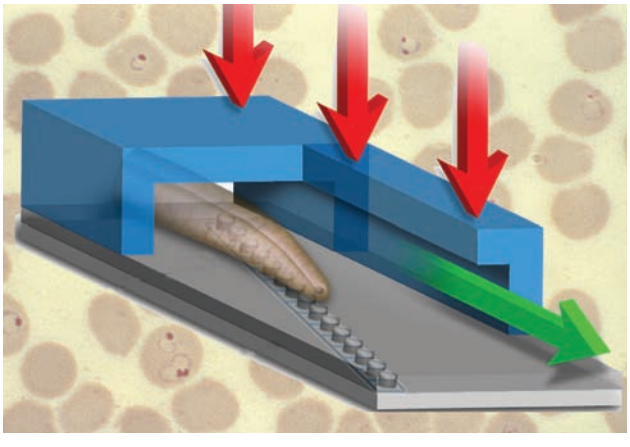
Compact and cheap device could replace bukly microscopes

Microfluidic device could fight malaria

A microfluidic imaging method that could be incorporated into a hand-held microscope may be a significant step forward for medicine in the developing world.

Changhuei Yang, Xin Heng and colleagues from the California Institute of Technology, Pasadena, US, have developed a technique known as optofluidic microscopy (OFM), which they claim could help doctors to diagnose malaria more quickly.

The lensless OFM device uses lab-on-a-chip technology to image a sample with high resolution; Yang hopes that it will be made into a hand-held device to screen cells. At the moment a conventional microscope is needed to look for infected cells in a laboratory sample. The process can be both labour intensive and time consuming. 'This bulky and expensive microscope can be replaced by a cheap OFM device that a doctor can easily carry in his pocket,' Yang said.



The device images cells with a high resolution

OFM is based on an array of sensors on a chip covered by a layer of metal, etched with small holes. The sample is passed over the metal through a microfluidic channel and imaged through the holes.

'The novel geometric arrangement of the holes ensures that each hole maps uniquely onto individual pixels. That's the key to the operation of this optofluidic microscope,' explained Yang. 'In this case, the hole size defines the resolution. With existing technology, we can fabricate holes down to tens of nanometres with relative ease. This means we can potentially provide resolution that is better than that of a conventional microscope.'

Yang hopes that the OFM will change the way bioscience and clinical work is done in the future. 'It has the dual advantage of compactness and low cost,' he said.

Ruth Needham

Reference
X Heng *et al, Lab Chip*, 2006, **6**, 1274

Essential elements

A warm reception across the globe

RSC members, authors, referees and readers met at three separate events on three continents in as many weeks, recently.

On 15 August, 120 delegates gathered at a reception in the Arabella Sheraton Grand Hotel in Cape Town at the 37th International Conference of Coordination Chemistry, to celebrate weekly publication of *Dalton Transactions*. Following short welcoming speeches by Andrew Scott, RSC Membership Sales and Marketing Manager, and RSC Council Member, Professor Paul O'Brien, the Chairman of the *Dalton Transactions* Editorial Board, Professor Paul Walton, spoke about some of the journal's successes so far. '*Dalton Transactions* continues to go from strength to strength. It is now the highest ranked European journal for inorganic chemistry,' he explained, 'moving to weekly publication in January this year confirms its leading position and we're delighted to have you celebrate this exciting development with us'.

A week later in Budapest, newly appointed RSC President, Professor Jim Feast, and RSC Chief Executive, Dr Richard Pike, hosted a joint reception with the GDCh at the 1st European Chemistry Congress in Budapest. Among the guests were representatives from the European Association for Chemical and Molecular Sciences (EuCheMS, formerly FECS) and international figures from the world of chemical sciences.

A popular annual event, the RSC Reception at the 232nd National Meeting & Exposition meeting took place on 10th September in the Grand Ballroom at the Hilton San Francisco. Addressing the ACS dignitaries, RSC members and other guests present, Professor Jim Feast introduced some new products in the RSCs portfolio and made an exclusive announcement regarding the RSC's policy on Open Access publishing.

Find out more in the next issue of *Essential Elements*.

Chinese medicine ... naturally

China is a hotbed for natural product related sciences, a fact demonstrated in the latest issue of *Natural Product Reports*. This special issue, guest edited by Professor R X Tan, Nanjing, focuses on 'Natural Product Chemistry in China' and brings together review articles from well established Chinese laboratories undertaking research in this vast field.

China is a country rich in plants and microbe species that cultivates a remarkable diversity of natural products; therefore it is no surprise that traditional Chinese medicine has used extracts from these plants to treat many diseases and that research into natural products remains important.

The comprehensive reviews in this special issue cover the areas of phytochemicals; the bioactivity of the Liliaceae steroidal alkaloids; microorganisms as a source of biologically active natural products; mass production of important natural products and the development of plant tissue culture protocol for plant-derived medicines.

To read more visit *www.rsc.org/npr*

And finally....

From popular science books such as *Lust and Love: Is it more than chemistry?* to *Protein-Carbohydrate Interactions in Infectious Diseases* the RSC publishes books for all levels of readership and interest.

The new edition of *Nucleic Acids in Chemistry and Biology* has just been published. This popular undergraduate textbook has been thoroughly revised and updated, with expanded coverage on reactions and interactions with proteins and drugs. 'This book uniquely provides an introduction to both the chemistry and biology of nucleic acids, and thus will be of use to a very wide group of students and researchers. I can recommend it highly.' Stephen Neidle, Professor at the School of Pharmacy, University of London.

Another textbook recently published, *Chemistry and Medicines* provides an introduction to the subject of medicinal chemistry with additional sections on drugs to combat infectious diseases and cancers.

The RSC Biomolecular Sciences Series is a collection of research level books covering all areas of the biological sciences. Titles include: *Exploiting Chemical Diversity for Drug Discovery* and *Structural Biology of Membrane Proteins*. Other high level books include *Dendrimers in Medicine* and *Biotechnology and Metallochemistry of Neurodegeneration: Biological, Chemical and Genetic Aspects*.

Find out more about RSC books at *www.rsc.org/books*

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