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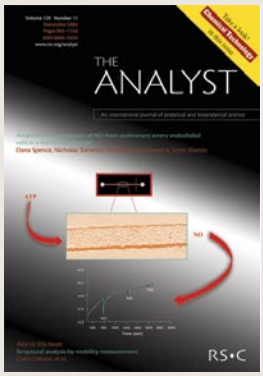
Chemical Technology

Emerging electrodes



Scientists in the UK and Poland have developed two new types of biphasic electrodes to study biphasic redox systems. Frank Marken, from Loughborough University, and colleagues at the Polish Academy of Sciences deposited thin hydrophobic sol-gel films on tin-doped oxide substrates, and for the second system they gold-sputtered the sol-gel film on glass to construct a porotrode. The electrodes were tested by oxidising t-butylferrocene, and the effective triple phase arrangement of the porotrode achieved fast, efficient electrochemical reactions. Their porotrode is likely to be valuable in the future development of biphasic sensors.

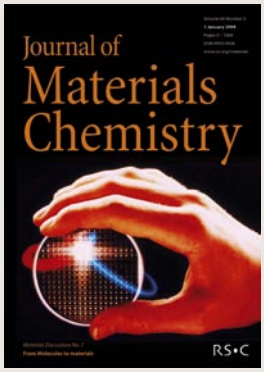
F Marken *et al*, *Analyst*, 2004 (DOI: 10.1039/b410935j)

Greener industry

Frank Agterberg at the European Chemical Industry Council, Belgium and his colleagues address the challenges involved in making chemical technologies sustainable. Industrial sustainability dictates the use of less material and energy, using renewable resources as starting products, minimising harmful side-products and producing recyclable or biodegradable merchandise. Agterberg highlights case-studies where greener technology has been successfully implemented and suggests areas in which further research is necessary to meet the challenges posed by industry.

J F Jeneck, F Agterberg and M J Doescher, *Green Chem.*, 2004 (DOI:10.1039/b406854h)

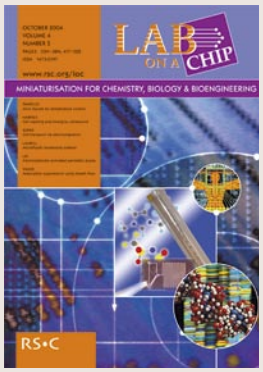
Oil-free plastics



By the end of this century world oil resources are expected to run out. With this problem comes a growing awareness of the need for synthetic plastics produced from sources other than petroleum and many groups are looking at the production of polymers from renewable resources. Malcolm Chisholm and Ziping Zhou from Ohio State University, US, discuss the role of metal alkoxides as catalysts in the production of polyoxygenates from epoxides and cyclic esters.

M H Chisholm and Z Zhou
J. Mater. Chem., 2004 (DOI:10.1039/b405489j)

Progress on a small scale



Recent progress in miniaturising polymerase chain reaction analysis of nucleic acids has been examined by a group of European scientists. Philip Day and colleagues have looked at published studies since 2002, and have reviewed the current state-of-play in sample preparation methods within microfluidic devices, including cell culture, cell identification and trapping, lysis and extraction of DNA. New approaches to DNA amplification, and both sequence-independent and sequence-specific detection at a microscale level are also discussed.

P Day *et al*, *Lab Chip*, 2004 (DOI: 10.1039/b408850f)

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Cell culture on ultra-thin membranes provides a model of the blood-brain barrier

Culturing the blood-brain barrier

A new model of the blood-brain barrier, which allows a high degree of direct contact between capillary and brain cells, has been developed by US scientists, .

Endothelial cells line capillaries in the brain and have extremely tight junctions with other cells, forming an almost impermeable barrier to water soluble molecules between the blood and the brain. This blood-brain barrier (BBB) protects the brain and provides a constant environment for neural processes, and it is thought that direct contact between endothelial cells and astrocytes is at least partially responsible for the development of these tight intercellular junctions.

Although results from several *in vitro* BBB models suggest that direct contact is necessary for full BBB endothelial cell differentiation, the membranes in most commercially available culture kits do not have the right physical dimensions to allow many interactions between cells grown on different sides. Now, Michael Shuler and co-workers at Cornell University in Ithaca, New York, and the Laboratory of Nervous System Disorders in Albany, New York, have made membranes from silicon nitride that are much thinner and more porous than existing BBB model membranes. Culturing astrocytes and endothelial cells on opposite sides of these membranes allows the potential for high degrees of contact between the cell types.

The blood-brain barrier provides an environment for neural interactions to take place

Synergy between the two cell types has yet to be achieved, possibly because commercially available endothelial cells have lost the ability to respond to astrocyte differentiating signals. However, the authors believe that using nanofabricated silicon nitride membranes will have great potential for BBB models, and may also be useful in other co-culture systems. *Rowena Milan*

Reference:
S Harris Ma *et al*, *Lab Chip*, 2004 (DOI: 10.1039/b405713a)

Thin film deposition is key for optimising thermal imaging

Image is everything

Thermal imagers – originally for military applications – are now used in many applications: from security and surveillance, through to determining the locations of people following fires and earthquakes. Devices like this are invaluable but materials scientists are looking to improve their performance. These devices' detector arrays consist of thin films of multi-component oxides with a perovskite-like crystal structure.

Thermal imagers help firefighters t o locate victims

These large, mixed-metal oxide films need to be of high quality to produce good images but their manufacture remains a challenge to scientists. At the RSC's materials discussion meeting, held at the University of London, UK, in September, Peter Wright presented recent results. Wright, who works for QinetiQ, Malvern, UK, has been looking into the effect different compound mixes have when deposited as thin films.

The arrays studied were formed using various precursor compounds in conjunction with an advanced technique known as liquid-injection chemical vapour deposition. The compounds used – a mix of the appropriate metals required to form the thin film – were coordinated to a variety of different ligands to determine the effect they and different mixes of compounds had on the quality of the film. Wright found that controlling the effective stability of the different complexes used was very important. By modifying the initial coordination compounds, the efficiency of the all-important vaporisation step could be controlled along with the subsequent compound decomposition to form the films.

The main advantage of perovskite-type oxide thin films is their potential to be used in 'uncooled' thermal imagers. 'Uncooled' imagers do not require cryogenic cooling necessary for some current, high-resolution machines. *Vikki Allen*

Reference
P J Wright *et al*, *J. Mater. Chem.*, 2004 (DOI: 10.1039/b405874g)

Pinning down a protein to analyse enzymes

By immobilising a protein in a biomimetic membrane on an electrode it is possible to analyse its structure and activity, reports a team from Germany.

Peter Hildebrandt and his co-workers attached cytochrome *c* oxidase to a modified silver electrode and then built a lipid environment around the protein. The resulting protein-tethered lipid bilayer was examined by surface enhanced resonance Raman (SERR) spectroscopy to study the haem groups at the protein's active site. The group discovered that the haem's structure is unchanged after immobilisation on the electrode and suggests that the entire enzyme structure is preserved. The enzyme also retains its activity; it can be reduced and re-oxidised by efficient electron exchange with the electrode.

Cytochrome *c* oxidase's active site is preserved when it is immobilised on an electrode

Hildebrandt concludes that this immobilisation method is also applicable to other proteins and provides a method for analysing the proteins under biomimetic conditions. It therefore 'may constitute a promising concept for studying interfacial biological processes, thereby complementing other powerful techniques,' he says. *Caroline Evans*

Reference
M G Friedrich *et al*, *Chem. Commun.*, 2004 (DOI: 10.1039/b410998h)

Demonstrating technology for toxicity

Scientists from the UK have used a technology demonstration project to compare fast toxicity assessment kits, in an effort to validate these new tests against standard benchmark procedures.

Monitoring the toxicity of complex materials such as industrial effluents is vital, particularly when implementing the requirements of the EU water framework directive. But the toxicity of the material as a whole cannot be predicted from those of the substances it contains.

Andrew Knight and colleagues at Gentronix, Manchester, together with co-workers at AstraZeneca Global Safety, Vickers Laboratories, Euroclone and the University of Luton, have examined seven alternative direct toxicity assessment (DTA) tests, comparing them with tests using regulatory organisms. The DTA approach monitors the effect of a whole sample on living organisms, therefore detecting the combined effect of all the chemicals present. The results, which highlight the tests' strengths and weaknesses, are extremely useful for industrial monitoring and water quality testing. *Rowena Milan*

Water quality tests have been scrutinised by UK scientists

Reference
M Daniel *et al*, *J. Environ. Monit.*, 2004 (DOI: 10.1039/b408939a)

Cleaning up kerosene

Spanish researchers have optimised a mild method to remove sulfur from fuel that could make life a lot easier for oil refineries that are under increasing pressure to reduce sulfur in fuels.

Burning trace amounts of organosulfur compounds in fuel has long been known to yield sulfur oxides that poison catalytic converters and can also cause acid rain. Environmental legislation dictates that refineries must cut sulfur levels further still in the future. Current sulfur removal technology utilises hydrodesulfurisation (HDS), requiring high pressure hydrogenation reactors and with limitations on the substrates that will respond to treatment. An alternative energy- and cost-efficient technique is called for to meet the new stringent specifications.

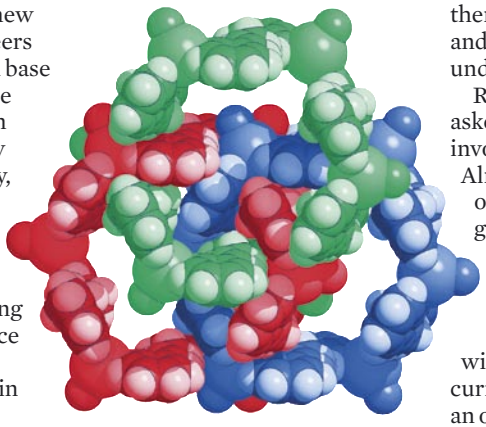
Jose Fierro and colleagues from Instituto de Catalisis y Petroleoquimica in Madrid, explored factors influencing the oxidative desulfurisation (ODS) of aromatic sulfur-containing compounds. They applied the resulting conditions to kerosene, lowering sulfur levels by over 99 per cent. The authors suggest that a feasible, economic solution to cleaner, greener fuel would be to integrate their process after the HDS step in existing refineries. *Sula Armstrong*

Reference
J M Campos-Martin, M C Capel-Sanchez and J L G Fierro, *Green Chem.*, 2004 (DOI:10.1039/b409882j)

Essential elements

Crystal engineering networks

The RSC has launched a new website for crystal engineers that will provide a central base for researchers worldwide and give them access to an array of services. The new site, CrystEngCommunity, provides an online community setting and plans to bring together researchers from all walks of chemistry, offering research groups the chance to get involved directly.



The website, launched in September 2004, will run alongside the already popular electronic-only journal *CrystEngComm* published by the RSC. Aimed at all scientists with an interest in crystal engineering the site will bring together people from the many different disciplines – materials scientists and theoreticians alike – and provide them with valuable information and resources to facilitate their understanding of the subject.

Researchers are also being asked to become actively involved in the community. Already, links to the websites of over 80 established research groups are listed and those groups not listed are invited to join by contacting the development team.

'CrystEngCommunity will help people keep up with current research and give them an opportunity to publicise their own work' said Dr Kirsty Anderson, crystallographic data editor at the RSC and one of the developers of the new service.

The site also highlights current hot work in the field and features regularly updated profiles of some of the leading scientists in the area. Published work from the extensive RSC archive may also be accessed with common searches set up for those wanting to browse.

The development team are already looking to extend the community and plan to launch a discussion forum in the near future where opinions on topical subjects – such as crystal nomenclature – can be posted and discussed online .

● To view the site and get your research group involved, visit www.crystengcomm.org/crystengcommunity

In the shade?

Research by scientists at University College, London, into a new intelligent coating for windows has been the focus of recent media attention. The coating, discovered by Professor Ivan Parkin and Dr Troy Manning, blocks out heat when temperatures rise above 29°C. It presents a wealth of exciting opportunities for the future of glass technology and as senior author of the paper and member of the *Journal of Materials Chemistry* international advisory editorial board, Professor Ivan Parkin, comments 'media interest has been intense'. The research has been covered in over 100 newspapers and science magazines (including *The Telegraph*, *Nature*, and *Scientific American*) and several radio and TV interviews.

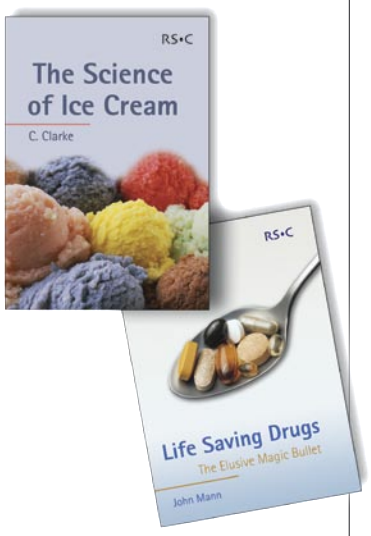
Commercial interest has also been strong, with the authors receiving enquiries from greenhouse manufacturers and space agencies. 'What we have shown is that we can make thermochromic films by a process that is compatible with commercial glass manufacture' says Parkin. And of the future, 'key issues to be addressed are the colour of the films, and development to an industrial scale.'

Reference
T D Manning and I V Parkin
J. Mater. Chem. 2004, **14**, 2554

New from the RSC

● Ever wondered how ice cream is made, and what gives it its unique texture? *The Science of Ice Cream* helps to answer these questions and many more by showcasing the fascinating secrets that lie behind this frozen favourite.
See: www.rsc.org/books/6291

● *Life Saving Drugs: The Elusive Magic Bullet* tells the intriguing stories of the discovery and development of antibacterial, anti-viral and anti-cancer drugs. Meet the colourful characters behind the breakthroughs and learn about the huge improvements in quality of life and life-expectancy that these drugs have produced.
See: www.rsc.org/books/6348



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