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Cover

See Jaume Veciana, Concepció Rovira, Jean-François Nierengarten *et al.*, page 4345. Intramolecular interactions of the fullerene subunit with the π-conjugated bridge modulate its ability of carrying one electron from one redox unit to the other. Image reproduced by permission of Teresa M. Figueira-Duarte, Vega Lloveras, José Vidal-Gancedo, Aline Gégout, Béatrice Delavaux-Nicot, Richard Welter, Jaume Veciana, Concepció Rovira and Jean-François Nierengarten from *Chem. Commun.*, 2007, 4345.

CHEMICAL TECHNOLOGY

T81

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Chemical Technology

November 2007/Volume 4/Issue 11

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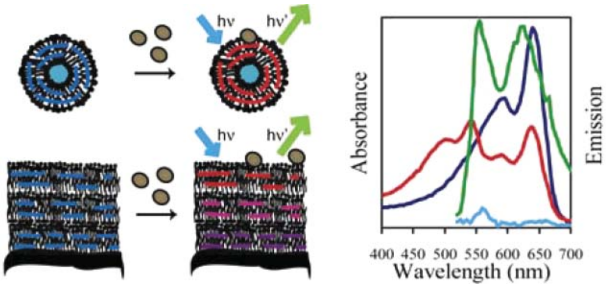
FEATURE ARTICLE

4317

Biosensing with polydiacetylene materials: structures, optical properties and applications

Mary A. Reppy* and Bradford A. Pindzola

In this feature article we describe different polydiacetylene (PDA) material formats, discuss PDA optical properties as a basis for signal generation, and review the use of PDA for biosensing.



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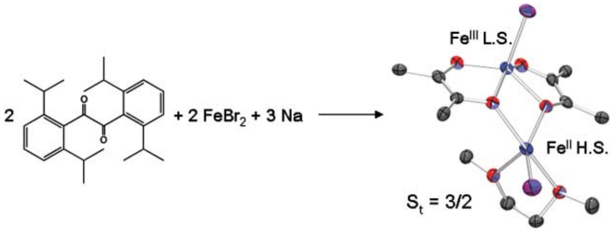
4339

Unusual mixed valent $Fe^{III}Fe^{II}$ complex (S_t = 3/2) stabilised by a reduced bulky 1,2-diketone

Geoffrey H. Spikes, Eckhard Bill, Thomas Weyhermüller and Karl Wieghardt*

The reduction of a bulky 1,2-diketone and $FeBr_2$ with Na results in a Class 2 mixed valent H.S. Fe^{II} L.S. Fe^{III} complex with two five-coordinate Fe centres which are antiferromagnetically exchange-coupled to give a total spin S_t = 3/2 ground state.

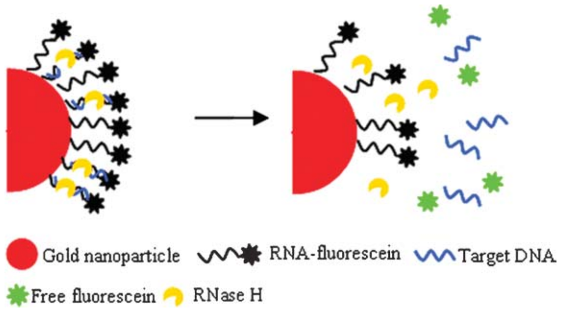


4342

Specific and sensitive detection of nucleic acids and RNases using gold nanoparticle–RNA–fluorescent dye conjugates

Joong H. Kim, R. August Estabrook, Gary Braun, Briana R. Lee and Norbert O. Reich*

Gold nanoparticles were modified with RNA and utilized to detect specific DNA sequences and various RNA nucleases.

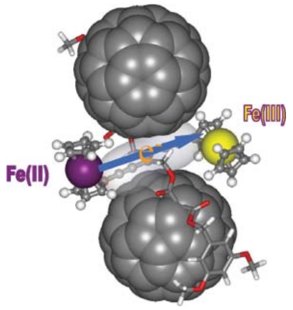


4345

Changes in electronic couplings of mixed-valence systems due to through-space intramolecular interactions

Teresa M. Figueira-Duarte, Vega Lloveras, José Vidal-Gancedo, Aline Gégout, Béatrice Delavaux-Nicot, Richard Welter, Jaume Veciana,* Concepció Rovira* and Jean-François Nierengarten*

Electronic interactions between the redox moieties in fullerene-substituted mixed-valence bis(ferrocenylethynyl)ethenes are modulated by the through-space interactions of C_{60} with the bridging conjugated system.

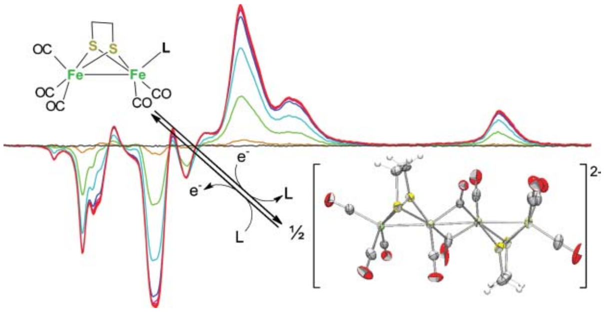


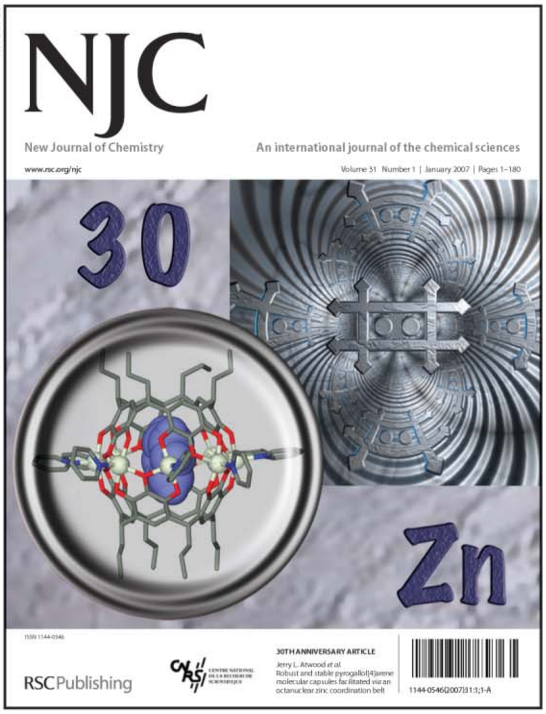
4348

On the structure of a proposed mixed-valent analogue of the diiron subsite of [FeFe]-hydrogenase

Stephen P. Best,* Stacey J. Borg, Jonathan M. White, Mathieu Razavet and Christopher J. Pickett*

CO-bridged tetrairon species, and not hydrogenase H_{ox} structural analogues, are the products of the chemically-reversible, one-electron reduction of dithiolate-bridged diiron compounds that incorporate a hemilabile ligand.



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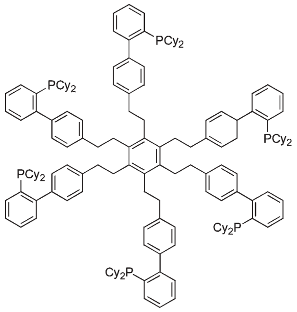
4351

Efficient and recyclable dendritic Buchwald-type catalyst for the Suzuki reaction

Julietta Lemo, Karine Heuzé* and Didier Astruc*

A Buchwald-type ligand attached to a star-shape molecule was synthesized in high yield, and, its catalytic properties for the Suzuki reactions are shown to be excellent (down to 50 ppm with a simple chloroarene) including recovery/re-use of this hexa ligand.

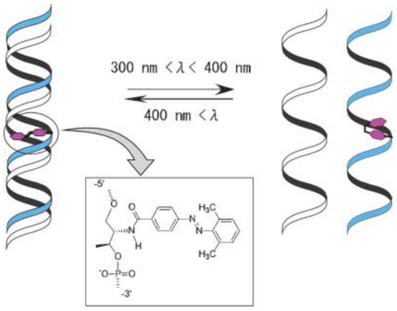


4354

2′,6′-Dimethylazobenzene as an efficient and thermo-stable photo-regulator for the photoregulation of DNA hybridization

Hidenori Nishioka, Xingguo Liang, Hiromu Kashida and Hiroyuki Asanuma*

The introduction of methyl groups into two *ortho* positions (2′ and 6′ positions) of the same benzene ring in an azobenzene remarkably raised both its photoregulation ability and the thermal stability of the *cis*-form.

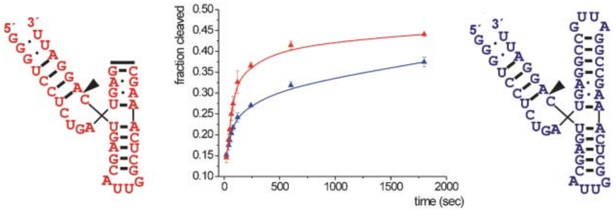


4357

Pyrene modification leads to increased catalytic activity in minimal hammerhead ribozymes

Verena Looser, Simon M. Langenegger, Robert Häner and Jörg S. Hartig*

We introduce pyrene-based hairpin mimics that allow for displacement of stem-loops of a hammerhead ribozyme. The modifications result in maintained stability of the catalytically active fold, proving that no further functions such as tertiary interactions are connected to the stem-loops in minimal hammerhead motifs.

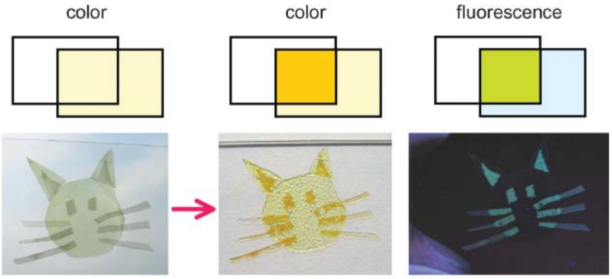


4360

Optodynamers: expression of color and fluorescence at the interface between two films of different dynamic polymers

Takashi Ono, Shunsuke Fujii, Tadahito Nobori and Jean-Marie Lehn*

Color and fluorescence changes were expressed at the interface between two different polyhydrazone polymer films, induced by hydrazone bond exchange and component recombination through the interface, resulting in an extension of conjugation.



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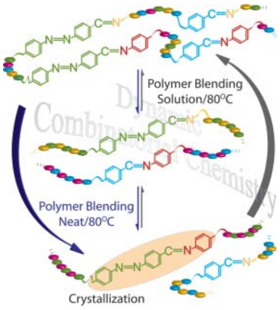
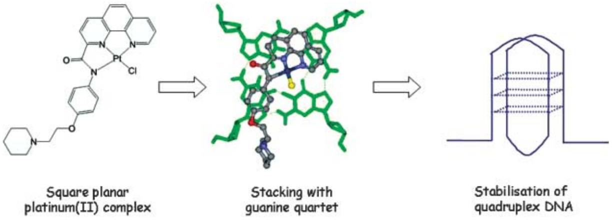


Crystallization-driven constitutional changes of dynamic polymers in response to neat/solution conditions

Cheuk-Fai Chow, Shunsuke Fujii and Jean-Marie Lehn*

Dynamic polymers (dynamers) based on reversible imine interactions were generated and found to respond to changes in neat/solution environment, thus displaying adaptive behavior through modification of their constitution in order to maximize the stability of their mesoscopic state as a function of conditions.

4366

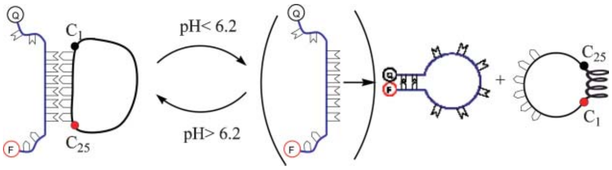


Stabilisation of human telomeric quadruplex DNA and inhibition of telomerase by a platinum–phenanthroline complex

Julie E. Reed, Stephen Neidle* and Ramon Vilar*

Two new mono-substituted phenanthrolines and their corresponding platinum(II) complexes have been prepared. One of the platinum complexes has been shown to be a good quadruplex DNA stabiliser and telomerase inhibitor.

4369

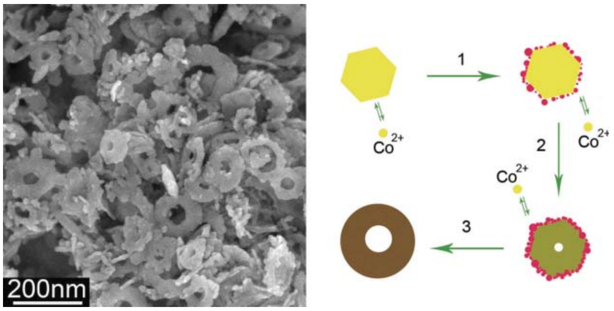


An i-motif-containing DNA device that breaks certain forms of Watson–Crick interactions

Yifan Wang, Xinming Li, Xiaoqian Liu and Tianhu Li*

An i-motif-embedded circular oligonucleotide was used to construct a DNA device capable of breaking the hydrogen bonds that sustain an 11-mer duplex structure.

4372



Synthesis and magnetic properties of Co–Sn–O nanorings

Cheng Peng, Lian Gao* and Songwang Yang

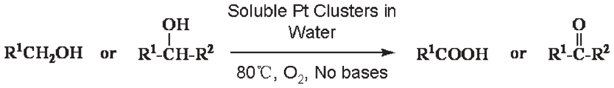
A novel Co–Sn–O nanoring structure was synthesized *via* a simple hydrothermal route; the difference in diffusion rates of ions was considered to be the main reason for the formation of such a ring structure.

4375

Aqueous-phase aerobic oxidation of alcohols by soluble Pt nanoclusters in the absence of base

Tao Wang, Chao-Xian Xiao, Liang Yan, Lin Xu, Jie Luo, Heng Shou, Yuan Kou* and Haichao Liu*

A soluble Pt nanocluster catalyst (Pt-GLY) is efficient in the absence of base for aqueous-phase aerobic oxidation of, in particular, non-activated alcohols with high recyclability.

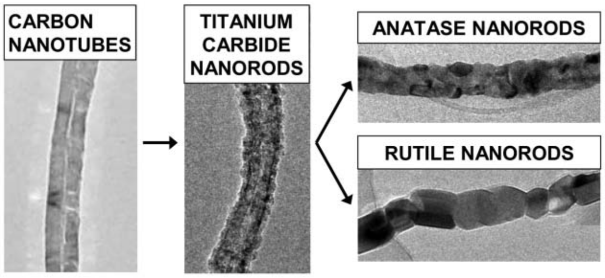


4378

Synthesis of oriented arrays of TiO_2 nanorods *via* a high temperature conversion of carbon nanotubes

Ben F. Cottam and Milo S. P. Shaffer*

Oriented arrays of both rutile and anatase nanorods have been synthesised in a two-stage process, employing multi-walled carbon nanotubes as the initial structural template.

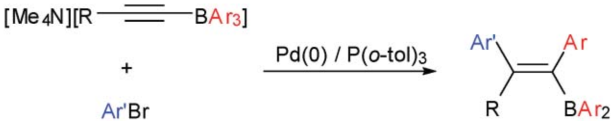


4381

Stereoselective synthesis of trisubstituted alkenylboranes by palladium-catalysed reaction of alkynyltriarylborates with aryl halides

Naoki Ishida, Tomoya Miura and Masahiro Murakami*

The palladium-catalysed reaction of alkynyltriarylborates with aryl halides afforded trisubstituted alkenylboranes, in which two different aryl groups were installed across the carbon–carbon double bond in a *cis* arrangement.

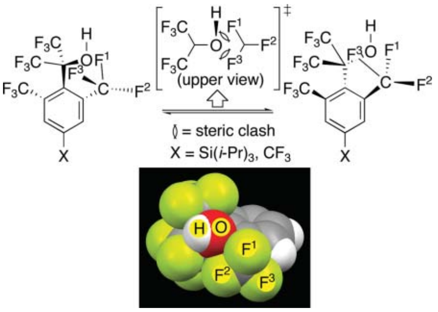


4384

Is there any *bona fide* example of O–H···F–C bond in solution? The cases of $HOC(CF_3)_2(4\text{-}X\text{-}2,6\text{-}C_6H_2(CF_3)_2)$ (X = Si(*i*-Pr)$_3$, CF_3)

Camino Bartolomé, Pablo Espinet* and
Jose M. Martín-Alvarez

Reinvestigation of the title compounds, the only reported to show experimentally supported O–H···F–C bonds in solution, proves that the evidence in favor of such bonds was deceptive and was misinterpreted.

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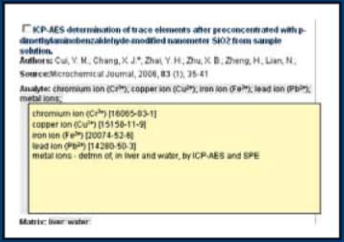

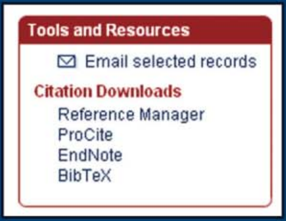
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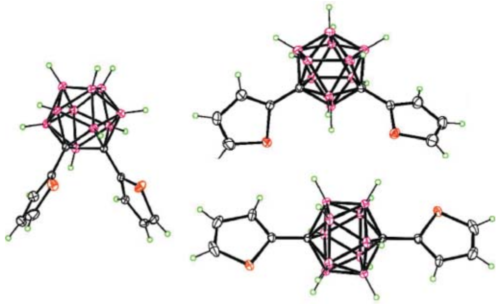
4387

Poly[di(2-thiophenyl)carborane]s: conducting polymers with high electrochemical and thermal resistance

Erhong Hao, Bruno Fabre,* Frank R. Fronczek and M. Graça H. Vicente*

The synthesis, X-ray structure and electropolymerization of three new carbon–carbon linked di(2-thiophenyl)carboranes (**1o**, **1m** and **1p**) are reported.

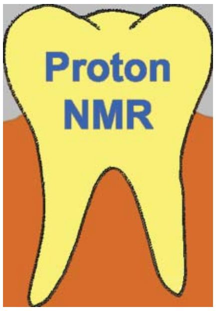


4390

Concentration of hydroxyl groups in dental apatites: a solid-state ^{1}H MAS NMR study using inverse ^{31}P → ^{1}H cross-polarization

Joanna Kolmas and Waclaw Kolodziejski*

Polish scientists have determined the content of structural OH groups in the apatite mineral of human hard dental tissues.

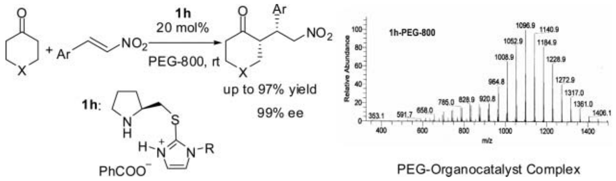


4393

Organocatalysts wrapped around by poly(ethylene glycol)s (PEGs): a unique host–guest system for asymmetric Michael addition reactions

Dan Qian Xu, Shu Ping Luo, Yi Feng Wang, Ai Bao Xia, Hua Dong Yue, Li Ping Wang and Zhen Yuan Xu*

Asymmetric Michael addition reactions of unmodified ketones to nitroalkenes were performed in PEGs catalyzed by novel pyrrolidinyl-thioimidazolium salts. ESI mass spectrometric detection for the first time gave evidence of the presence of the PEG–organocatalyst host–guest complex.



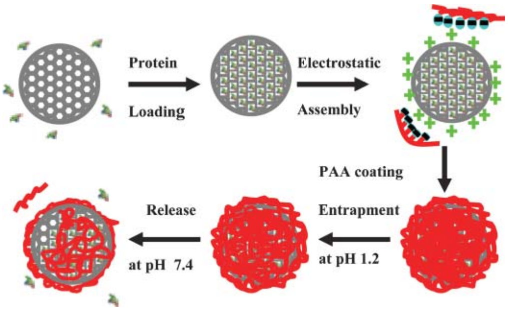
PEG-Organocatalyst Complex

4396

pH-Controllable drug release using hydrogel encapsulated mesoporous silica

S.-W. Song, K. Hidajat and S. Kawi*

Amine-functionalized mesoporous SBA-15 encapsulated with PAA can release entrapped BSA at the higher pH of 7.4 rather than at the lower pH of 1.2, providing potential application for pH-controllable release of protein drug to the site of higher pH value, such as the small intestine.



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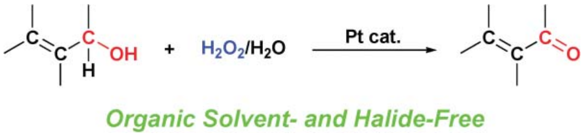
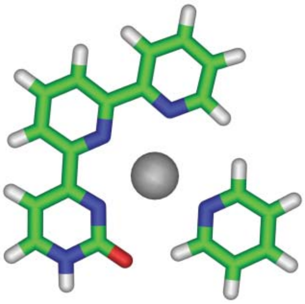


Oxidation of allylic alcohols to α,β-unsaturated carbonyl compounds with aqueous hydrogen peroxide under organic solvent-free conditions

Yoshihiro Kon, Yoko Usui and Kazuhiko Sato*

Allylic alcohols are chemoselectively oxidized to α,β-unsaturated carbonyl compounds in high yield with aqueous H_2O_2 in the presence of Pt black catalyst under organic solvent-free conditions. The catalyst is easily recyclable and effective for at least 7 cycles.

4401

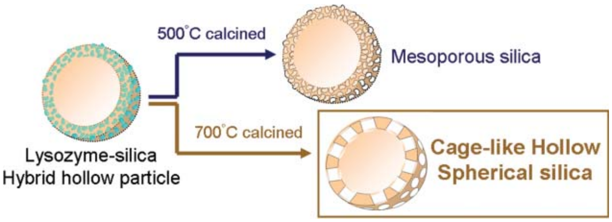


A metallo base-pair incorporating a terpyridyl-like motif: bipyridyl-pyrimidinone·Ag(I)·4-pyridine

Dongwon Shin and Christopher Switzer*

A DNA metallo base-pair with a terpyridyl-like motif is designed and characterized: Pyr^{bipy}·Ag(I)·4-Py

4404

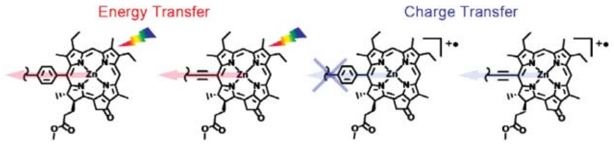


Formation of cage-like hollow spherical silica *via* a mesoporous structure by calcination of lysozyme–silica hybrid particles

Toru Shiomi, Tatsuo Tsunoda,* Akiko Kawai, Fujio Mizukami and Kengo Sakaguchi*

Calcination of lysozyme–silica hybrid hollow particles gives novel cage-like hollow spherical silicas with differently patterned through-holes on their shell structure. The authors report the morphologies of CHS and the formation process of through-holes.

4407



Controlling energy and charge transfer in linear chlorophyll dimers

Richard F. Kelley, Michael J. Tauber, Thea M. Wilson and Michael R. Wasielewski*

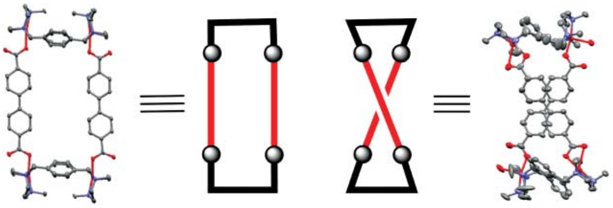
A series of linear chlorophyll dimers shows how the specific positioning of a phenyl spacer can be used to control energy and charge sharing between these chromophores.

4410

Self-assembling of nanoscopic molecular rectangles, extended helicates and porous-like materials based on macrocyclic dicopper building blocks under fine supramolecular control

Laura Gómez, Anna Company, Xavier Fontrodona, Xavi Ribas* and Miquel Costas*

Nanosized molecular rectangles and double-stranded helicates have been obtained by self-assembly of macrocyclic dicopper complexes and dicarboxylate linkers under a fine three-level supramolecular control.

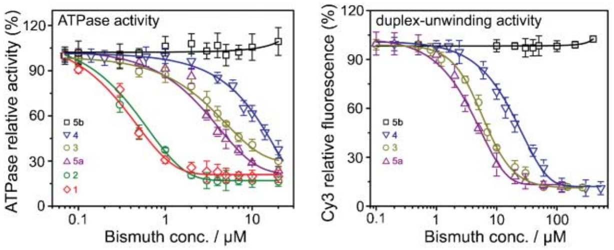


4413

Inhibition of SARS coronavirus helicase by bismuth complexes

Nan Yang, Julian A. Tanner, Zai Wang, Jian-Dong Huang, Bo-Jian Zheng, Nianyong Zhu and Hongzhe Sun*

The SARS-CoV NTPase/helicase being able to unwind both RNA and DNA duplexes, is an attractive target for anti-viral drug design. A series of bismuth complexes were synthesized and characterized, and exhibit the inhibition against the SARS helicase ATPase and duplex-unwinding activities at micromolar concentrations.

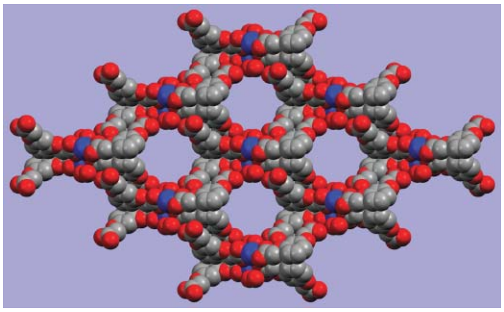


4416

An unprecedented nanoporous and fluorescent supramolecular framework with an $SrAl_2$ topology controllably synthesized from a flexible ditopic acid

Su-Na Wang, Yong Yang, Junfeng Bai,* Yi-Zhi Li, Manfred Scheer, Yi Pan* and Xiao-Zeng You

A novel supramolecular framework was obtained from a flexible ditopic ligand H_2BDOA that exhibited $SrAl_2$ topology with 1.7 × 1.7 nm channels formed by strong hydrogen bonds, and demonstrated an interesting crystal-to-crystal transformation as well as unusual luminescent properties.

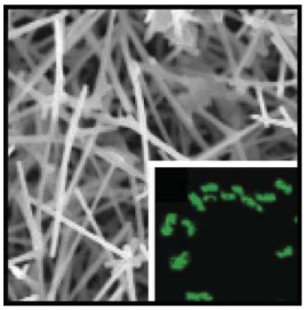


4419

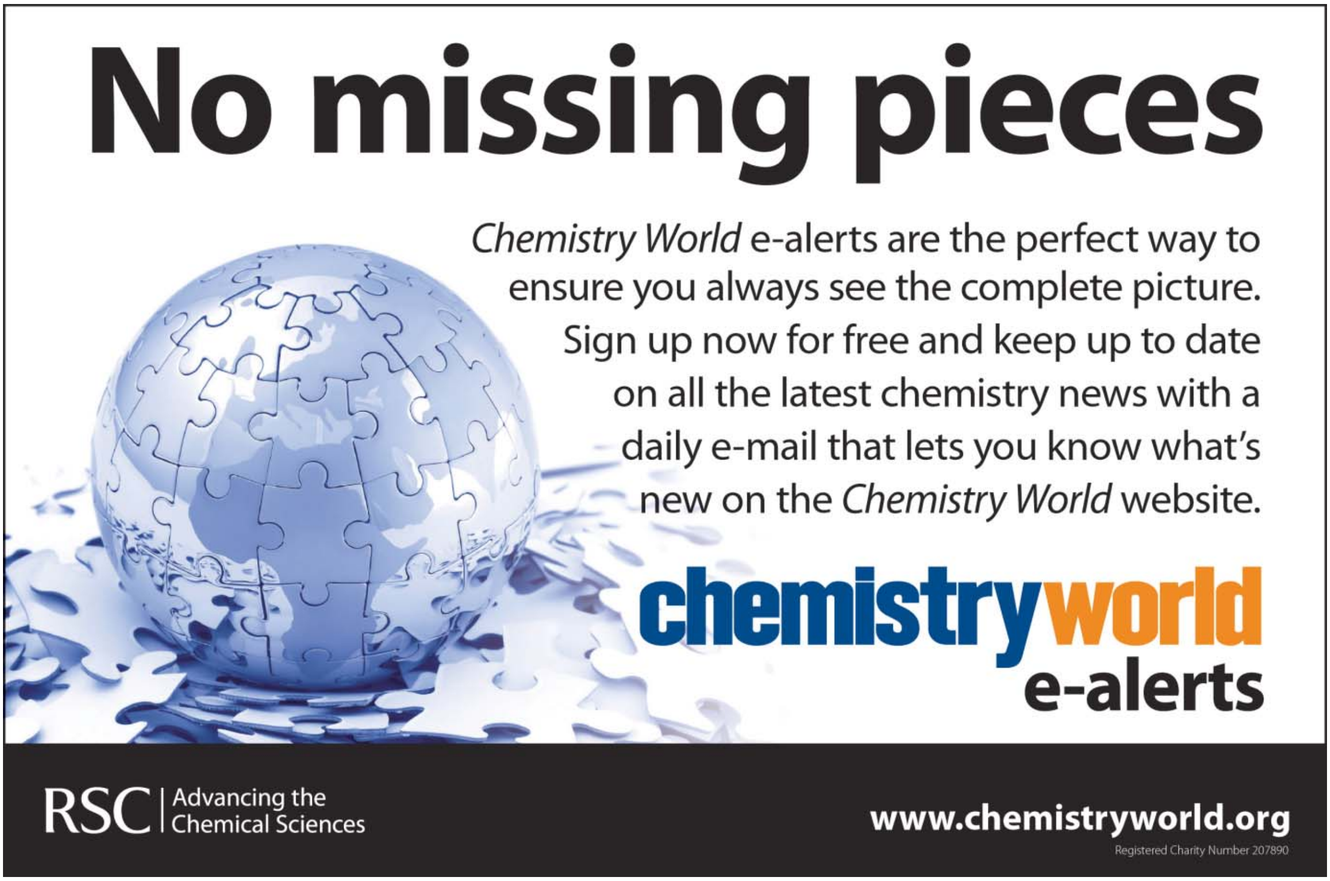
A study on the antibacterial activity of one-dimensional ZnO nanowire arrays: effects of the orientation and plane surface

Xiaolei Wang, Fan Yang, Wen Yang and Xiurong Yang*

In this study, CLSM and FE-SEM were employed for understanding the disparities in antibacterial activity between different orientations of 1-D ZnO nanoarrays.



ADDITIONS AND CORRECTIONS



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REVIEW
Georgina Estrada, Elba Villegas and Gerardo Corzo
Spider venoms: a rich source of acylpolyamines and peptides as new leads for CNS drugs
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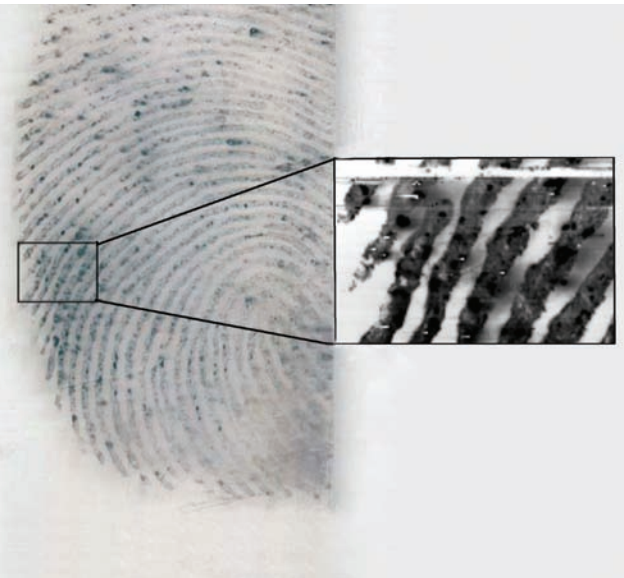
November 2007 / Volume 4 / Issue 11 / ISSN 1744-1560 / CTHEC2 / www.rsc.org/chemicaltechnology

Chemical Technology

Gold nanoparticles stick to skin secretions on complex surfaces

Electrochemical method reads fingerprints



Even wet surfaces may yield their secrets in future

Swiss scientists have developed a way to detect fingerprints by measuring the chemical traces they leave on a surface. Using a scanning electrochemical microscope (SECM) to detect invisible traces of sweat and natural skin oils, the team created a chemical picture of a fingerprint.

The advance comes from a team led by Christophe Champod from the University of Lausanne and Hubert Girault at the Ecole Polytechnique Fédérale de Lausanne. They hope their method will make it possible to read fingerprints from textured or illustrated surfaces, such as banknotes, plastic and paper, and from wet surfaces. Conventional fingerprinting methods rely on optical detection and do not work well on surfaces like these.

An SECM has a very fine tip which can detect chemical changes on a surface. The team exposed the fingerprints to gold nanoparticles, which stick electrostatically to the skin secretions. They then added a layer of silver on top of the gold to help improve the contrast between the fingerprint and the background.

Claude Roux, Director of the Centre for Forensic Science at the University of Technology Sydney, is confident that the method 'has the potential to develop fingermarks on surfaces that are known to generate poor results with current techniques. In other words, latent fingermarks that remain undetected with current techniques could be made visible when using this method.'

The method 'could provide significant advantages for fingermark detection on a range of difficult surfaces,' agreed Chris Lennard, professor of forensic studies at the University of Canberra. 'However,' he cautioned, 'before such an imaging technique could be readily applied on items submitted for examination, the technology would need to improve so that larger areas can be scanned within a much shorter period of time. At present, the technique would be impractical for use in routine casework.'

Clare Boothby

Reference
M Zhang *et al*, *Chem. Commun.*, 2007, DOI: 10.1039/b710947d

In this issue

Catalyst problems dissolve away
Hydroformylation reaction product does the job of co-solvent

Glutamate brainwave
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Instant insight: Organic nanofiltration
Ivo Vankelecom of the Catholic University of Leuven, Belgium, looks at the potential for solvent-resistant filtration

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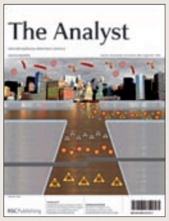


The latest applications and technological aspects of research across the chemical sciences

Application highlights

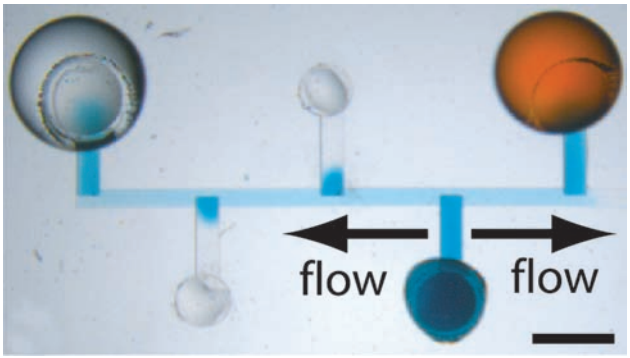
Simpler chips with less volume mean fewer cells required

Digital chips cut down on complexity

Programmable microfluidic devices could help reduce animal testing, according to scientists in the US.

David Beebe and colleagues from the University of Wisconsin have developed microfluidic components that can act in the same way as logic gates, timers and rheostats, essentially the basic building blocks of a computer. They created a system that uses various channel geometries and the presence or absence of droplets on access points to indicate a 1 or a 0. This makes the devices essentially digital and therefore programmable. The fluid is moved via passive pumping: ‘the pressure created in a droplet is a function of the size of the droplet, and fluid flow can be created in a microchannel positioned between droplets of different sizes,’ explained Beebe.

The idea of these devices is to take the complexity out of the microfluidics and cut down the amount of connections to the chip, which could all be built in to the device. One potential application is in cell culture and biological assays that have many staining and washing stages. Ideally, you could design a device that can be pre-programmed by the appropriate placement of droplets, placed in an incubator and left for the duration of the experiment.



The microfluidic components act as logic gates

Reference
M W Toepke, V V Abhyankar and D J Beebe, *Lab Chip*, 2007, DOI: 10.1039/b708764k

Another advantage is the reduction in reagents; often microfluidic devices require large reservoirs of reagents. These new chips have very little dead volume, so reagent and cell quantities can be reduced dramatically. ‘For example, in some cases it is possible to reduce the number of cells required by 100 fold (that is, running an experiment that now requires 100 mice with just one),’ said Beebe.

In the future, ‘controlling evaporation and making devices out of alternative materials, such as polystyrene, are areas that will be explored so that the platform can be used with a variety of different liquids,’ added Michael Toepke, a colleague of Beebe’s.

Michele Zgraggen

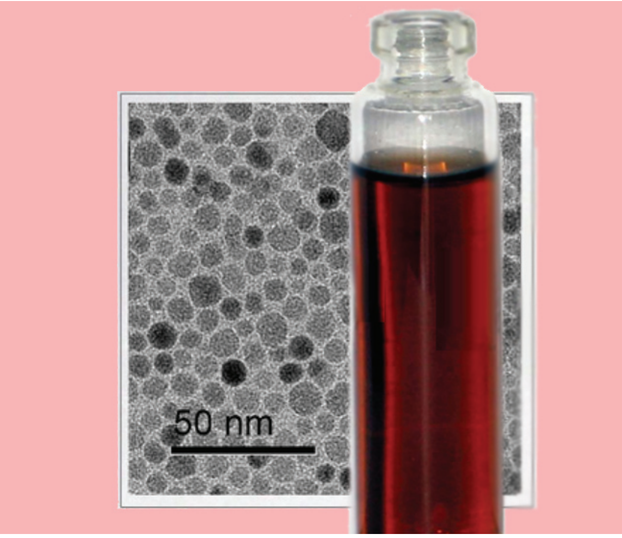
Highly crystalline and uniform magnetite prepared by polyol route

Contrasting nanoparticles

Medical imaging methods may soon have a new contrast agent thanks to a different way of preparing nanoparticles. This simple method developed by Chinese scientists involves heating an iron salt in a polyalcohol to give a water soluble material.

Magnetite (Fe_3O_4) nanoparticles are a promising class of materials for improving the contrast in biomedical imaging techniques, such as MRI. To be useful for imaging, the contrast agent should be non-toxic, water soluble and not prone to aggregation. High crystallinity and a uniform size distribution also improve the reproducibility and effectiveness.

Now Wei Cai and co-workers at Harbin Institute of Technology, China, have developed a new synthesis of magnetite nanoparticles using the polyol process. This method involves heating an iron (III) salt in triethylene glycol to give highly crystalline magnetite-based nanoparticles with a uniform size. The magnetite has a hydrophilic surface which prevents aggregation and ensures solubility in water (or buffered saline) without requiring any further surface modification.



The iron oxide particles are water soluble – ideal for use as biomarkers

Wei Cai said that the synthesis ‘provides an alternative approach to the traditional coprecipitation method for large scale preparation of magnetic nanoparticles for biomedical applications’. The synthesised magnetite nanoparticles also had high uptake by cancer cells. Preliminary experiments suggest that these nanoparticles could also be useful as a biomarker for imaging cancer cells.

‘Using the polyol process provides a convenient way to prepare highly monodisperse and water-soluble Fe_3O_4 nanoprticles,’ commented Chen-Sheng Yeh, an expert in nanomaterials at the National Cheng Kung University, Taiwan. ’The strong magnetization and specific targeting to cancer cells from the resulting magnetites are promising for applications in in vivo cancerous studies,’ he added.

Russell Johnson

Reference
J Hu, J S Foord and K B Holt, *Phys. Chem. Chem. Phys.*, 2007, DOI: 10.1039/b710241k

Feedback from 'dissatisfaction coefficient' exerts control

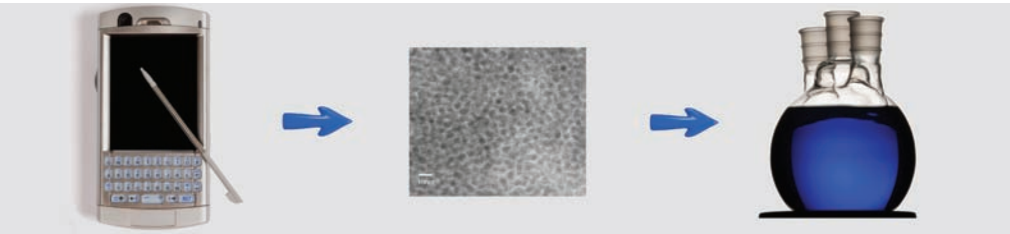
Computer-aided nanoparticle synthesis

Fed up with having to optimise your own reactions? Ever wondered why you can't get a computer to do it for you? Thanks to researchers from the UK, this possibility is not as far away as you may think.

Nanoparticles are finding uses in all manner of interesting applications from photonics to bioanalysis, but to be able to exploit them properly, it is essential to be able to carefully control their properties.

John deMello and colleagues from Imperial College London set about designing a microfluidic system that would automatically optimise the emission wavelength of fluorescent nanoparticles. 'A spectrometer monitors the particles as they exit the microfluidic chip. The spectra are fed to a computer which assigns a "dissatisfaction coefficient" to the particles depending on how far they are from some pre-set goal. The computer repeatedly updates the reaction conditions to minimise this coefficient and in so doing forces the chip to produce particles with the desired properties,' said deMello.

The next step will be to try and apply this kind of set up to other synthetic systems. 'The control routines we use are fairly versatile and should be easy to adapt to other types of materials,' deMello continued. 'All that's needed is some property of the product that can be measured directly at the point of production and two or three reaction parameters to optimise.'



A computer dictates reaction conditions to a chip to optimise the fluoresence of the nanoparticles formed

'This is a very cool piece of work that has potential in the synthesis of many different complex materials, and especially for heterogeneous systems like the nanoparticle synthesis described,' said Vincent Rotello from the University of Massachusetts, Amherst, US. 'The next challenge will be to come up with a way to translate this success to a large scale. It could then have an impact in more traditional areas such as organic synthesis.'

Stephen Davey

Reference

S Krishnadasan *et al*, *Lab Chip*, 2007, DOI: 10.1039/b711412e

Sensing shadows sizes microwires

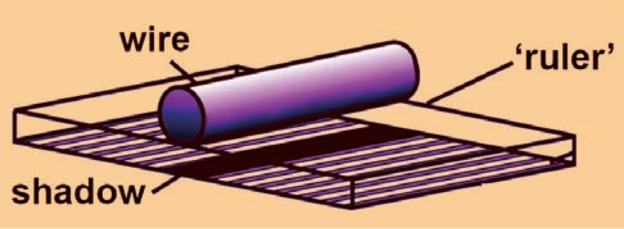
A photoelectrochemical ruler

European scientists have developed a photoelectrochemical sensor that can be used to measure micron-sized objects, and could lead to a faster, more cost-effective tool compared to conventional microscopy.

Richard Compton and his colleagues from Oxford University, UK, and the National Centre of Microelectronics (CNM) in Barcelona, Spain, used a net of microelectrodes in a transparent cell to make a self-contained 'photoelectrochemical ruler.' Compton said: 'Electrochemistry has long concerned itself with the temporal measurements, such as rates of diffusion and lifetimes of intermediates, but the scope for probing spatial domains in solution has only recently been realised. The question arose as to whether this approach can be used for sizing objects without the need for them to be submerged in solution.' As a test system, Compton used the ruler to measure the thickness of a series of wires.

A wire was placed above the ruler and illuminated from behind, casting a shadow on the array of electrodes. The transparent cell forming the ruler contained a solution that stimulates an electrochemical current only in the presence of light. Compton explained: 'The level of the photocurrent decreases with increasing diameter of the wire, as the photochemical reaction is not taking place at the parts of the electrode array that are covered by its shadow.'

By comparing the photocurrent with and without the presence of the wire, its dimensions can be determined from the known array spacing. The photoelectochemical ruler has measured microwires down to 50μm in diameter.



The ruler measures a wire's shadow cast on an array of electrodes

'Although this seems to be just a basic idea rather than an invention (it could) be of interest from a fundamental point of view,' said Ali Eftekhari of Avicenna Institute of Technology, Ohio, US, 'as photoelectrochemical processes can be used for the measurement of physical scales.'

Compton concluded: 'We are confident that this concept can be expanded to measure smaller objects if the width of the micobands and the separating surfaces are adjusted accordingly.' Isis Innovation, the IP transfer company associated with Oxford University, has applied for a patent on this work and is actively seeking collaborators to commercialise the work.

Michael Spencelayh

Reference

N Fietkau *et al*, *Analyst*, 2007, **132**, 983 (DOI: 10.1039/b711828g)

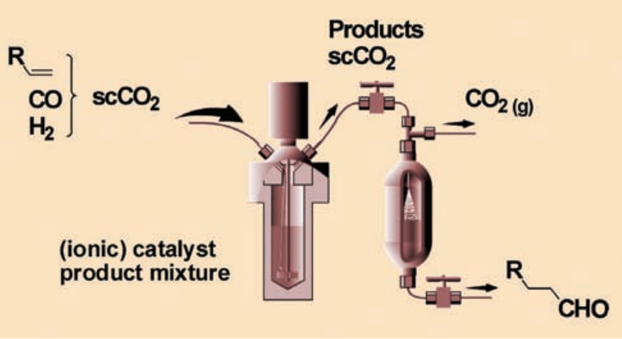
Hydroformylation reaction product does the job of co-solvent

Catalyst problems dissolve away

UK scientists have come up with a method that for the first time enables medium-chain aldehydes to be synthesised in a continuous-flow process using a homogeneous catalyst.

Homogeneous catalysts have always been difficult to use in industrial-scale continuous-flow synthesis, because they have to be both soluble in and separable from the reaction mixture. David Cole-Hamilton's team from the University of St Andrews, UK, has now overcome this obstacle by using the product of the reaction to dissolve the catalyst, and then extract it as it is being formed with supercritical CO_2.

The hydroformylation of alkenes is an important industrial process, and involves adding hydrogen and carbon monoxide to an alkene to generate an aldehyde. Supercritical carbon dioxide (scCO_2) has been much used as a solvent for these reactions because of its green credentials. However, the catalysts used tend not to dissolve in the scCO_2, requiring the addition of other liquids as co-solvents. Unfortunately, because the products tend to be soluble in these liquids too, an extraction step is needed. Cole-Hamilton and colleagues have now found the products of the hydroformylation of medium-length alkenes can dissolve the catalysts themselves, dispensing completely with the need for co-solvents.



scCO_2 is used to move reactants and products into and out of a reactor in a continuous process

Cole-Hamilton's system works by mixing the alkene (octene) and aldehyde (nonanal) together, then forming the rhodium imidazolium catalyst while pressurising the system with CO, H_2 and scCO_2. Once the reaction gets going, 'scCO_2 can be used to transport everything continuously into and out of the reactor,' said Cole-Hamilton.

Philip Jessop, from Queen's University in Kingston, Canada, said the new method 'is a brilliant twist' on the concept of adding a liquid to the mixture to dissolve the catalyst. Future work, said Cole-Hamilton, 'will aim to increase the reaction rate and to extend the methodology to a wide variety of other reactions.'

David Barden

Reference

A C Frisch *et al, Dalton Trans.*, 2007 (DOI: 10.1039/b712683b)

Neurotransmitter detected in brain tissue

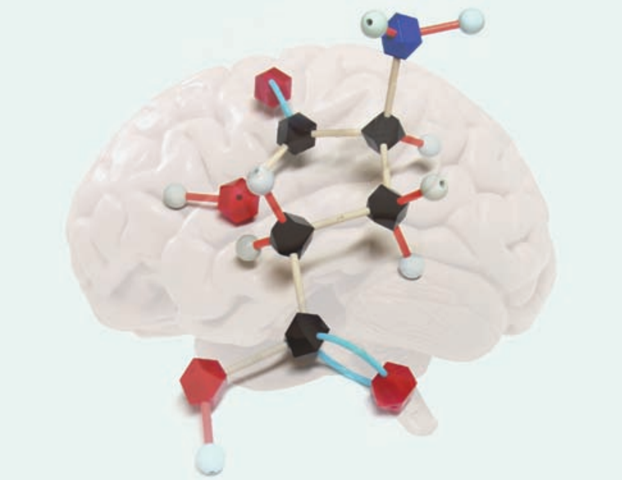
Glutamate brainwave

Selective detection of glutamate in brain tissue using microelectrode arrays has been achieved by scientists in the US.

Glutamate is an amino acid neurotransmitter and plays an important role in the mammalian central nervous system. A number of neurological and psychiatric disorders are thought to be linked to abnormalities in the transmission of glutamate.

Nigel Maidment and his colleagues at the University of California, Los Angeles, therefore developed ceramic-based platinum microelectrode arrays (MEAs) coated with an electropolymerized, overoxidized polypyrrole (OPP) that selectively detects glutamate in brain tissue.

The challenge has been for scientists to develop selective glutamate sensors with sensitive and rapid responses to glutamate. They should also not experience interference from other neurotransmitters, such as dopamine (DA) and ascorbic acid (AA). Interference is usually caused by the direct oxidation of DA or AA at the platinum electrodes.



The team's sensor detects the amino acid with interference

Current methods use electrodes coated with Nafion, a well-known co-polymer, to overcome this problem. Maidment and his team showed that using their OPP-coated MEAs produced similar glutamate sensitivity and response times to those previously found for Nafion-coated MEAs. Unlike the Nafion-coated MEAs, their system is not affected by DA (at a concentration of 5 μM), which results in a highly selective glutamate detection.

Maidment's future plans 'are to selectively load different enzymes onto individual sites on multi-electrode arrays, thereby permitting detection of several neurotransmitters simultaneously'. But the team's primary challenges are 'improving sensitivity, longevity and further miniaturization [for these systems]', said Maidment.

Emma Shiells

Reference

E Walker *et al, Analyst*, 2007, DOI: 10.1039/b706880h

Hazard warning

David Russell is using chemistry in the fight against terrorism and disease. Joanne Thomson finds out how...

David Russell

David Russell is a professor of chemistry at the University of East Anglia, UK. His research focuses on analytical bionanotechnology, using biological structures for the development of optically based molecular recognition systems.

What inspired you to become a scientist?
I was given a book as a child called 'The Secrets of Chemistry' and I found it fascinating. That is why I got into chemistry initially but it was an inspirational lecturer when I was an undergraduate who inspired me to become an academic.

What are you working on at the moment?
A lot of our work is based on molecular recognition. We use biological molecules to target different analytes that we want to detect. We make planar gold surfaces onto which we self-assemble monolayers of the biological molecules. We do the same with metal nanoparticles. We use the nanoparticles to deliver different molecules or as a vehicle for detection.

You are developing an on-the-spot detection system for dangerous biological substances. Could you explain how it works?
It is designed to detect toxins like ricin so that a first responder at a crime scene can determine whether the material that they have found is innocuous or whether it is something harmful that requires a specialist disposal team. We are also trying to develop a device that gives a simple yes/no answer to say whether cholera toxin is present in water supplies for use in developing countries. We are working in collaboration with Rob Field, also at the University of East Anglia. Rob's group synthesises different types of carbohydrates, which specifically recognise the cholera toxin or ricin. The carbohydrates are attached to the surface of gold nanoparticles. In the absence of any toxin, the particles are red. But as soon as the toxin is added, the particles change colour from red to blue or purple. Those colour changes indicate immediately that the toxin is present.

When do you estimate that these devices will be available on the market?
We've been talking with a large company which wants to develop the ricin detector so it could be pretty imminent. Regrettably, we don't have anyone interested in developing the cholera detector at present. Frankly, I would much rather develop the cholera device. People are dying right now; over 500 people died of cholera last year in just one epidemic in Sudan. There is no need for it.

How important do you think science is in the fight against terrorism?
It is essential. Staying one step ahead of terrorists is absolutely crucial. It is important that science is applied to develop new tools to be able to detect terrorist activity as well as trying to prevent it. Both are equally important.

Your work has made an impact in the wider media, being covered by the BBC and CNN. How important do you think it is for chemistry to get this kind of exposure?
It is important for all scientists to be able to relay some of the excitement associated with their work and try to explain it in relatively simple terms. People are genuinely interested and want to know. I view talking to journalists as part of my job. It is important to explain what we do to those who fund our research through their taxes.

What message do you have for young scientists?
Science is really exciting but to appreciate how exciting it is you have to work really hard. We have to relay our excitement and hopefully inspire the next generation. They have to appreciate that they will need to work hard to understand concepts but, when they do, it really is a very rewarding job.

What is the most rewarding aspect of your work?
I am still thrilled when people in my group get their PhDs. It is an enjoyable time, to see smiles on faces after all the hard work and effort that everyone puts in – and, of course, the stressful experience of the PhD examination itself. That is always rewarding.

I don't do science in the lab anymore regrettably but when one of my research group comes through my door with a positive result, that is really exciting. For example, one of my MChem project students, Emma Lee-Smith, wanted to try something new and we had an idea: could we detect drug metabolites in the sweat of a fingerprint? Emma tried a few things and it was so thrilling to get a positive result – yes, this works, it can be done. That one result to me was so exciting and it spawned a huge amount of research for us.

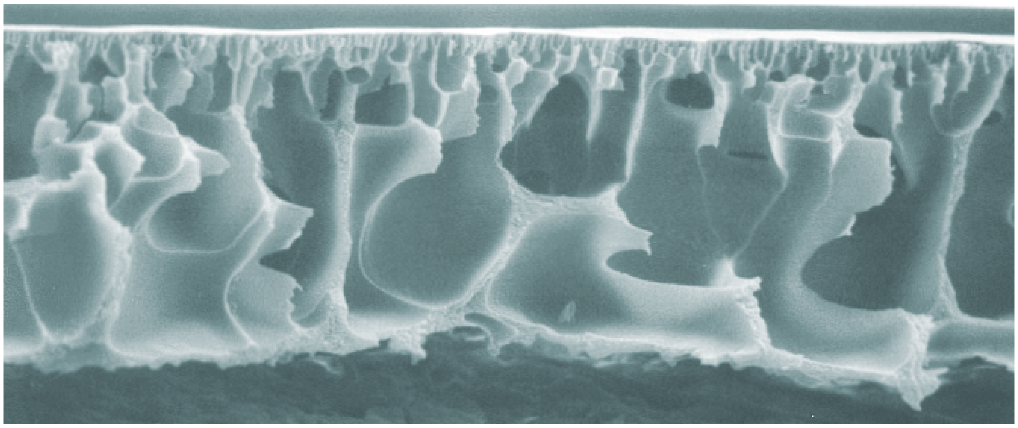
If you weren't a scientist, what would you be?
I think I'd be a yachtsman. I used to race windsurf boards when I was a student. I'd prefer to sit now and probably in a larger boat so it's not so rocky. I really enjoy being on the water and sailing. If I could make a career out of that, it would be wonderful.

Chemical Technology

Instant insight

Organic nanofiltration

Ivo Vankelecom of the Katholieke Universiteit of Leuven, Belgium, looks at the potential for solvent-resistant filtration – from the lab to the plant



Nanostructured polymer and ceramic membranes (~100μm) can separate organic mixtures at the molecular level

Membrane technology, being a waste- and energy-efficient process, has experienced a significant growth over recent years, spurred by increasing environmental concerns and energy prices. This technology has set the new standard for treating aqueous streams, which still forms the major membrane market. Meanwhile, new technical achievements and a growing acceptance of membrane technology in industry have recently increased interest in using membranes to separate organic streams. As new membranes are able to separate organic mixtures at the molecular level things get particularly exciting. Such membranes inherently have extremely small pores. Permeation often has to take place through the available polymer free volume only. External pressures above 5 bar are thus needed to realize reasonable membrane fluxes. Membrane processes at such pressures are referred to as reversed osmosis and nanofiltration. In the context of organic feeds, solvent resistant nanofiltration (SRNF) is the name most commonly used.

The main advantages of SRNF over other unit operations are the ease of combining it with existing unit separations into a hybrid process, and the possibility to recycle solvents, reduce waste streams and decrease energy consumption. The main challenges that remain are: (1) the required robustness of the membranes to survive long-term performance with organic solvents, even under reactive conditions, and (2) the right combination of sufficiently high fluxes with acceptable rejections for a given solvent/solute pair. Efforts to address these have been increased recently and several new types of better performing membranes – both ceramic- and polymer-based – are being developed, some of which are already commercially available.

SRNF has the potential to be applied in a wide variety of industrial processes, in lab scale organic synthesis and in the more fundamental unravelling of chemical reactions. The last two applications have yet to be exploited, often because pressurized filtration cells are simply not available in organic synthesis labs, or because the separation power of the membranes is not known to the organic chemist running the experiments. Much better documented are the industrial processes, where SRNF forms an alternative or complement to existing unit operations to de-bottleneck a process, increase its efficiency or capacity.

Even though many process streams in the food industry are water-based, SRNF has great potential in, for instance, the vegetable oil industry where acetone and hexane are often used in refining the oil, or in synthesising food additives. In the chemical industry, SRNF can eliminate often destructive post-reaction work-up needed to remove catalysts from reaction mixtures. Many opportunities and challenges are for instance in the energy and separation-intensive petrochemical industry. Since 1998 SRNF has complemented the existing distillation plant in the 11 500 m^3 per day recycling of solvents used in lube oil dewaxing at an ExxonMobil refinery in Texas. The hybrid installation requires only 25% of the heat consumption, 20% of the size and 10% of the conventional refrigeration capacity. Even under these harsh conditions, the applied polymeric membranes proved to be stable for many years. Other refinery applications potentially benefiting from SRNF implementation are gasoline desulfurization and crude oil deacidification. Pharmaceutical production can benefit from SRNF in downstream processing, or in between two different reaction steps via athermal solvent exchange and intermediate purification or recycle steps.

As is expected from a young technology, the effective number of large-scale industrial SRNF-applications is still limited. However, several potential applications have recently made the move from lab tests to pilot plant, so new industrial implementations can surely be anticipated in the near future.

Reference

I Vankelecom, L Gevers and P Vandezande, *Chem. Soc. Rev.*, 2007, DOI: 10.1039/b610848m

Read the full Critical Review 'Solvent resistant nanofiltration: separating organics on a molecular level' in Chemical Society Reviews.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A successful launch

On September 7th, over 200 senior industrialists and academics gathered in Beijing to mark the launch of *Chemistry World: China* magazine, and to hear leading chemists and policymakers stress the importance of developing science links between China and the UK.

The launch follows months of collaboration between the RSC and two of the key membership organisations promoting the interests of the chemical sciences in China: the Chinese Chemical Society (CCS) and the Chemical Industry & Engineering Society of China (CIESC).

Jim Feast, RSC president, led the launch event and introduced the accompanying inaugural *Chemistry World: China* lectures.

Richard Pike, RSC's chief executive, acknowledged that 'We face the same global issues and opportunities and we need our best minds working together across international boundaries to show leadership in matters such as improving health, materials, energy, the environment, and better use of global resources.'

He noted that, with the launch of *Chemistry World: China,* the science community at large now had an authoritative and influential magazine that would report on significant Chinese research in the context of such global issues, which in turn would help to focus future strategic debate between the RSC, CIESC and CCS.

Find out more at www.chemistryworldchina.org

Under the spotlight...

This month sees three RSC journals focus on key research areas:

***Molecular BioSystems,* Issue 10**

Hagan Bayley's special issue on 'Understanding and Manipulating Channels and Pores'. The investigation of channels and pores is a delightfully varied field requiring a wide range of knowledge and experimental tools taken from a multiplicity of scientific disciplines.

***Natural Product Reports,* Issue 5**

A themed issue, guest edited by Alison Smith and Finian Leeper from the University of Cambridge, UK, brings together six reviews which take different aspects of research into the chemistry, biochemistry and biology of vitamins and cofactors and show how, for each aspect, there are common themes for many of the pathways.

***Journal of Materials Chemistry,* Issue 38**

Guest edited by Cameron Alexander, University of Nottingham, UK, this issue focuses on the increasing demands for better healthcare products and biomedical materials.

To find out more, visit www.rsc.org/journals

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Editor: Neil Withers

Associate editors: Nicola Nugent, Celia Clarke

Interviews editor: Joanne Thomson

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