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Cover
See Ulf Hanefeld *et al.*, pp. 4613–4633.
Prins observing synergy in his Brønsted-acid catalysed reaction. Image reproduced by permission of Selvedin Telalović, Jeck Fei Ng, Rajamanickam Maheswari, Anand Ramanathan, Gaik Khuan Chuah and Ulf Hanefeld from *Chem. Commun.*, 2008, 4631.

Inside cover
See Matthias Treier *et al.*, pp. 4555–4557.
Interdigitation between helical aromatic units in 2D leads to honeycombs that are enantiopure in their coupling motif as illustrated by the homochiral snail shells. Illustration by Anton Koster. Image reproduced by permission of Matthias Treier, Pascal Ruffieux, Pierangelo Gröning, Shengxiong Xiao, Colin Nuckolls and Roman Fasel from *Chem. Commun.*, 2008, 4557.

CHEMICAL TECHNOLOGY

Drawing together research highlights and news from all RSC publications, *Chemical Technology* provides a 'snapshot' of the latest applications and technological aspects of research across the chemical sciences, showcasing newsworthy articles and significant scientific advances.

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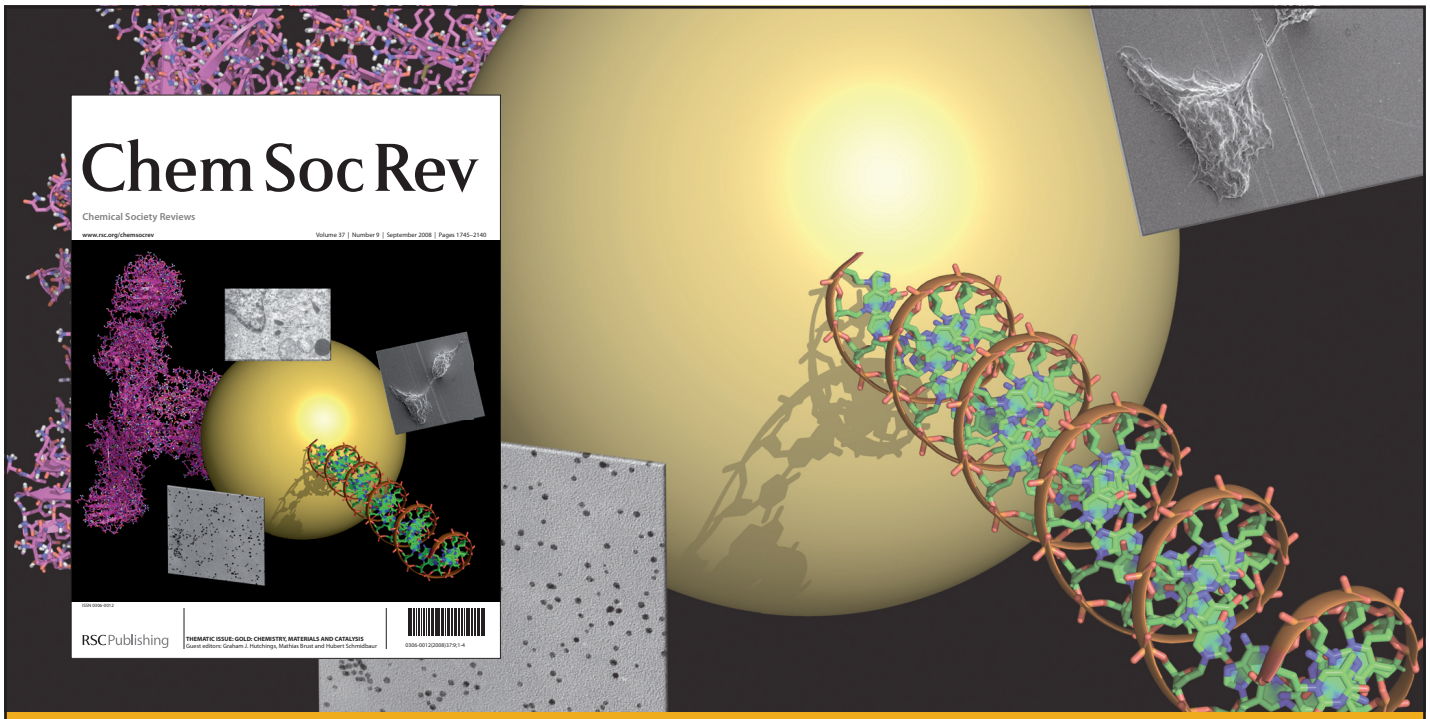

Gold: Chemistry, Materials and Catalysis theme issue

This collection of reviews sets out the state of the art with respect to gold catalysis, the synthesis and application of gold nanoparticles and gold chemistry. As such the issue takes a very broad approach to the topic, which has now become a hot topic in chemistry as a whole. We hope the reviews will inspire new discoveries and new researchers into this exciting field. The issue is timely as the field is expanding rapidly and hence these articles allow us to take stock of the great progress already achieved, as well as highlighting the remaining challenges.

Reviews include:

The relevance of shape and size of Au_{55} clusters
Günter Schmid

The chemistry of gold as an anion
Martin Jansen

Catalytically active gold on ordered titania supports
Mingshu Chen and D. Wayne Goodman

Biological applications of gold nanoparticles
Ralph A. Sperling, Pilar Rivera Gil, Feng Zhang, Marco Zanella and Wolfgang J. Parak

Shape control in gold nanoparticle synthesis
Marek Grzelczak, Jorge Pérez-Juste, Paul Mulvaney and Luis M. Liz-Marzán

The use of aurophilic and other metal–metal interactions as crystal engineering design elements to increase structural dimensionality
Michael J. Katz, Ken Sakai and Daniel B. Leznoff

Supported gold nanoparticles as catalysts for organic reactions
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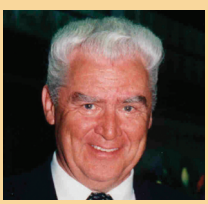

Hubert Schmidbaur
Technische Universität München

'Catalysis is reaching a golden age, as gold is finding many new applications as a catalyst for selective oxidations and hydrogenations. It is a really exciting time to be working in the field of catalysis'

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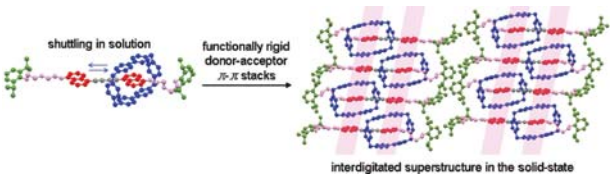
4561

An interdigitated functionally rigid [2]rotaxane

Il Yoon, Ognjen Š. Miljanić, Diego Benítez, Saeed I. Khan and J. Fraser Stoddart*

The molecules of functionally rigid donor–acceptor [2]rotaxane, incorporating π-electron rich 1,5-disubstituted naphthalene (NP) ring systems, encircled by the π-electron deficient tetracationic cyclophane cyclobis(paraquat-*p*-phenylene), line themselves up in parallel π–π stacks of alternating NP ring systems and bipyridinium units, affording an interdigitated superstructure in the solid state.

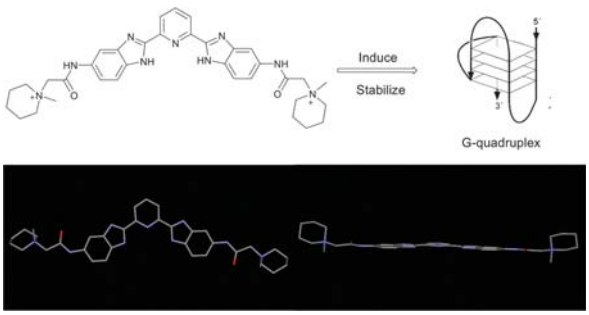


4564

Bis(benzimidazole)pyridine derivative as a new class of G-quadruplex inducing and stabilizing ligand

Guorui Li, Jing Huang, Ming Zhang, Yangyang Zhou, Dan Zhang, Zhiguo Wu, Shaoru Wang, Xiaocheng Weng, Xiang Zhou* and Guangfu Yang

Bis(benzimidazole)pyridine derivative has been prepared and shown to induce and stabilize formation of a G-quadruplex.

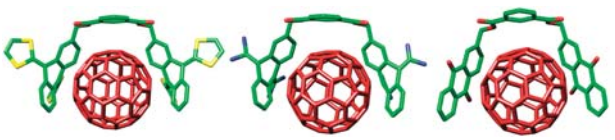


4567

Weighting non-covalent forces in the molecular recognition of C_{60}. Relevance of concave–convex complementarity

Emilio M. Pérez, Agostina L. Capodilupo, Gustavo Fernández, Luis Sánchez, Pedro M. Viruela, Rafael Viruela, Enrique Ortí,* Massimo Bietti* and Nazario Martín*

The relative contributions of several weak intermolecular forces to the stability of complexes formed by structurally related receptors and C_{60} are compared.

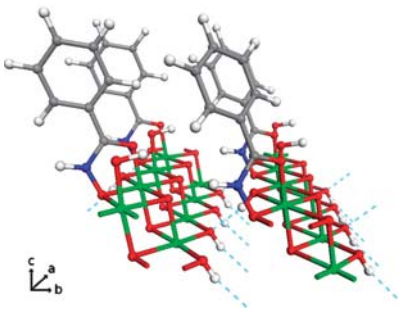


4570

Surface binding *vs.* sequestration; the uptake of benzohydroxamic acid at iron(III) oxide surfaces

Iria M. Rio-Echevarria, Fraser J. White, Euan K. Brechin, Peter A. Tasker* and Steven G. Harris*

Benzohydroxamic acid is shown to be an unexpectedly good ligand for iron(III) oxides, favouring surface attachment to the formation of trisbenzohydroxamato complexes, which are known to have very high thermodynamic stability in solution.



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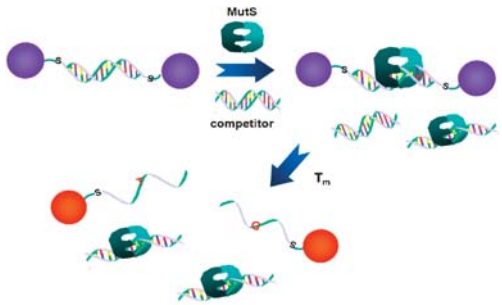
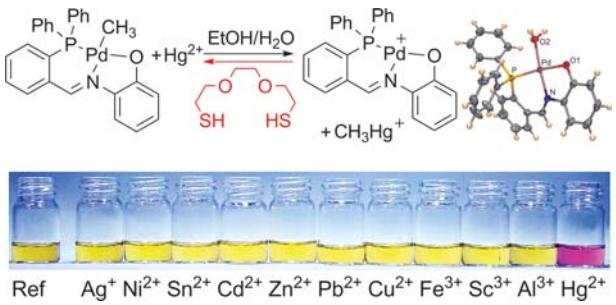


Detection of mismatched DNAs *via* the binding affinity of MutS using a gold nanoparticle-based competitive colorimetric method

Minseon Cho, Min Su Han* and Changill Ban*

A simple gold nanoparticle-based colorimetric assay can detect mismatched DNAs using MutS, a mismatch repair protein. This assay allows determination of the binding affinity of MutS to mismatched DNAs by a simple color change and T_m measurements.

4576

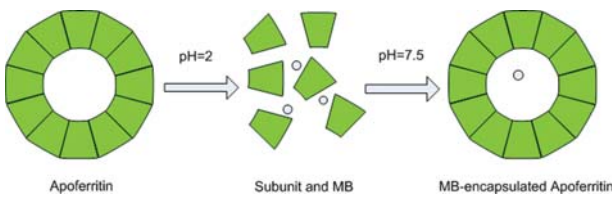


An organopalladium chromogenic chemodosimeter for the selective naked-eye detection of Hg^{2+} and $MeHg^+$ in water–ethanol 1 : 1 mixture

O. del Campo, A. Carbayo, J. V. Cuevas, A. Muñoz, G. García-Herbosa,* D. Moreno, E. Ballesteros, S. Basurto, T. Gómez and T. Torroba*

An organopalladium complex methylates Hg^{2+} giving an aqua–palladium complex that is methylated by $MeHg^+$ and a dithiol, undergoing colour changes that permit the naked-eye detection of Hg^{2+} and $MeHg^+$.

4579

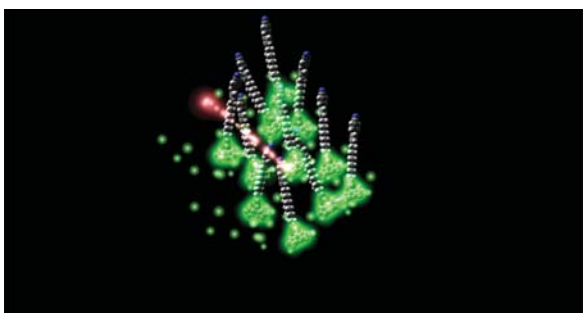


Apoferritin protein cages: a novel drug nanocarrier for photodynamic therapy

Fei Yan, Yan Zhang, Hsiang-kuo Yuan, Molly K. Gregas and Tuan Vo-Dinh*

A methylene blue-encapsulated apoferritin complex shows cytotoxic effects on MCF-7 human breast adenocarcinoma cells when irradiated at the appropriate wavelength.

4582



Mesogenic dipyrrins—building blocks for the fabrication of fluorescent and metal-containing materials

Christopher J. Wilson, Leanne James, Georg H. Mehl* and Ross W. Boyle*

Coupling of a mesogenic cyanobiphenyl group to 5-phenyldipyrrin and coordination with nickel and boron results in complexes exhibiting nematic liquid crystalline behaviour.

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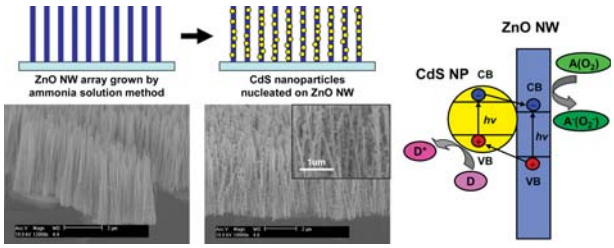

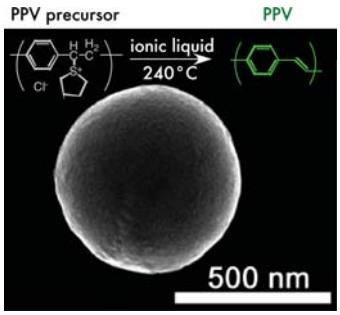

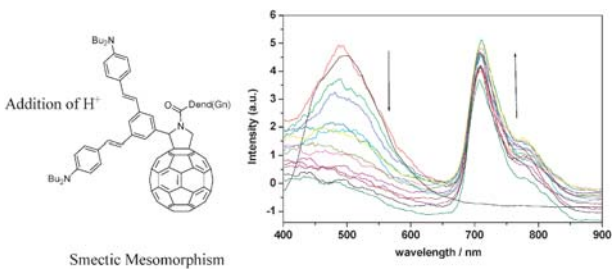

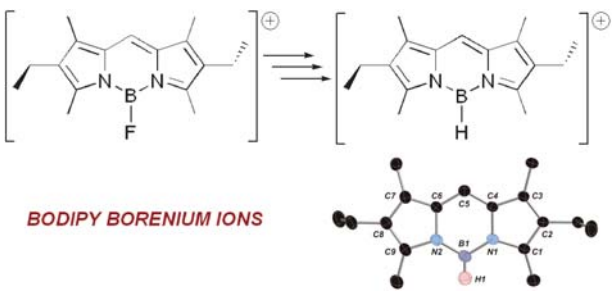

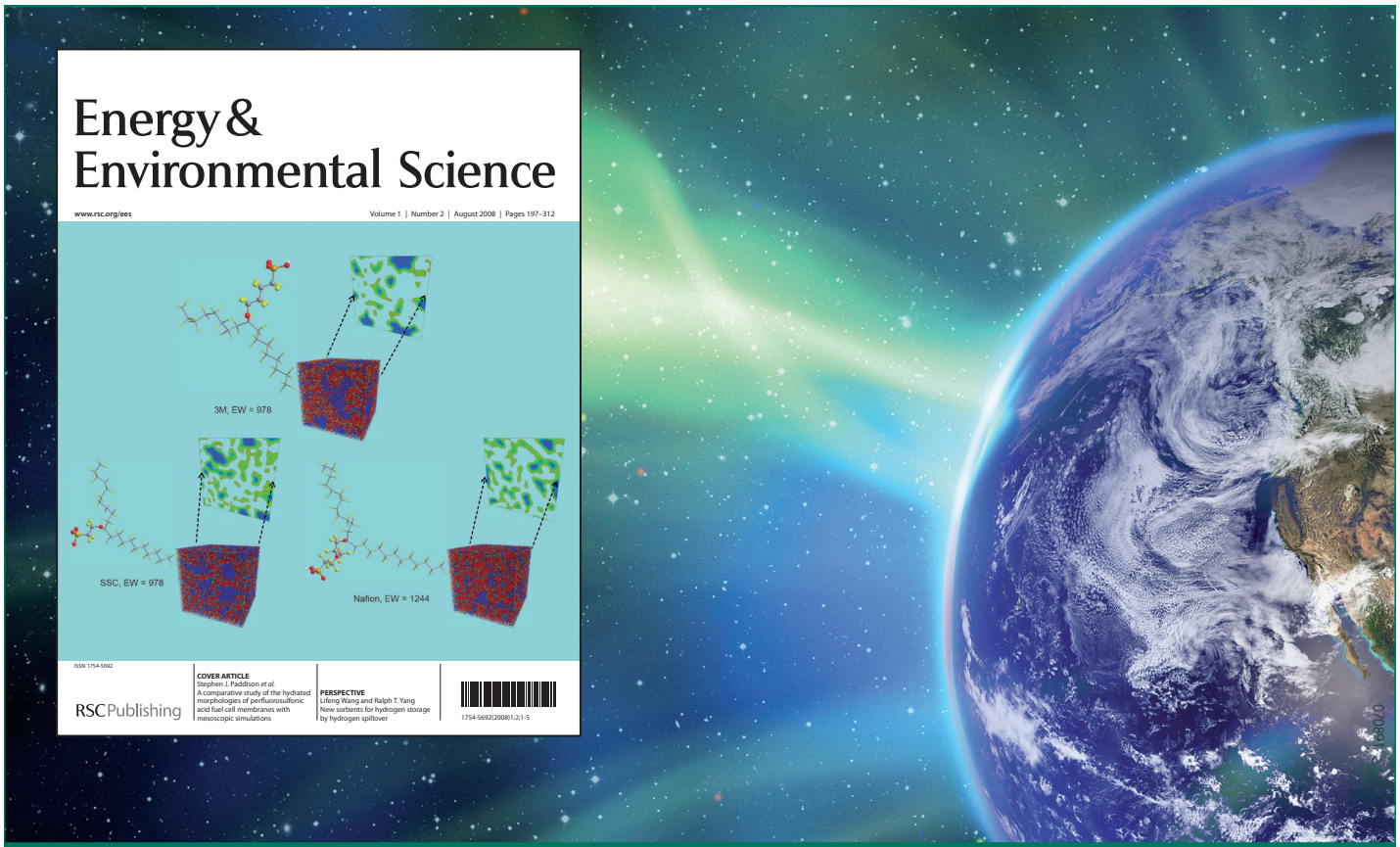

Coming soon

Inverse opal ceria–zirconia: architectural engineering for heterogeneous catalysis
Grant A. Umeda, William C. Chueh, Liam Noailles, Sossina M. Haile and Bruce S. Dunn, University of California, USA and California Institute of Technology, USA

Ammonia borane as an efficient and lightweight hydrogen storage medium
Bo Peng and Jun Chen, Nankai University, People's Republic of China

Engineering materials and biology to boost performance of microbial fuel cells: a critical review
Antonio Rinaldi, Barbara Mecheri, Virgilio Garavaglia, Silvia Licoccia, Paolo Di Nardo and Enrico Traversa, University of Rome, Italy

Performance and low temperature behaviour of hydrous ruthenium oxide supercapacitors with improved power densities
Xiaorong Liu and Peter G. Pickup, Memorial University of Newfoundland, Canada

Kinetic study of accelerated carbonation of municipal solid waste incinerator air pollution control residues for sequestration of flue gas CO_2
Jia Sun , Marta Fernández Bertos and Stefaan J. R. Simons, University College London, UK

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Fanxing Li and Liang-Shih Fan, The Ohio State University, USA

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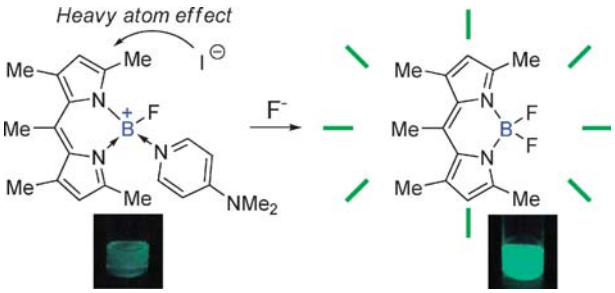
4596

A BODIPY boronium cation for the sensing of fluoride ions

Todd W. Hudnall and François P. Gabbaï*

In a novel turn-on fluoride sensing scheme, an unprecedented BODIPY boronium cation, which is efficiently quenched by iodide ions, reacts with fluoride ions to afford the corresponding brightly fluorescent difluoride [**1**–F].

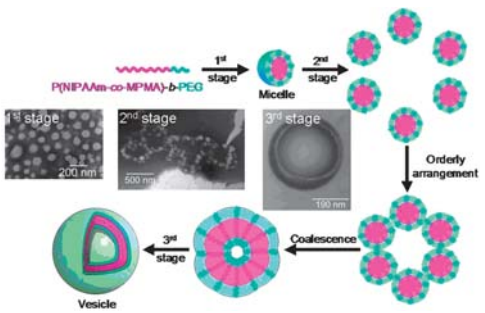


4598

Direct observation of time and temperature dependent transition from spherical micelles to vesicles

Hua Wei, Cui-yun Yu, Cong Chang, Chang-yun Quan, Shao-bo Mo, Si-xue Cheng, Xian-zheng Zhang* and Ren-xi Zhuo*

An interesting transition from spherical micelles to vesicles, which was time and temperature dependent, was observed for the first time. The transition from micelle to vesicle is ascribed to the thermal hysteresis of temperature-responsive poly(*N*-isopropylacrylamide) chains.

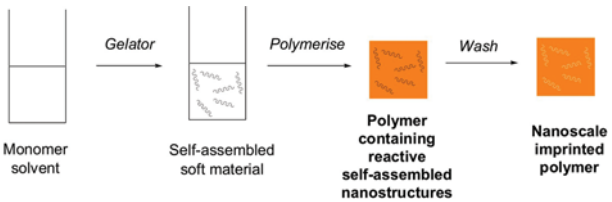


4601

Nanostructured polymers with embedded self-assembled reactive gel networks

Jamie R. Moffat, Gordon J. Seeley, Jeff T. Carter, Andrew Burgess and David K. Smith*

Generating polymers in the presence of a self-assembling gelator with terminal double bonds yields polymeric materials with embedded reactive nano-skeletons—subsequent washing gives nanoscale imprinted materials with fibrillar architectures.

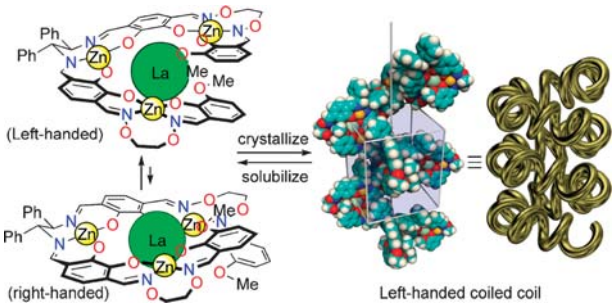


4604

Spontaneous formation of a chiral supramolecular superhelix in the crystalline state using a single-stranded tetranuclear metallohelicate

Shigehisa Akine, Takashi Matsumoto and Tatsuya Nabeshima*

An unprecedented one-handed coiled-coil structure was formed in the crystal of a Zn_3La tetranuclear metallohelicate, in which the handedness of both the helical component and the helical array was well controlled by the chiral auxiliary of the flexible acyclic ligand.



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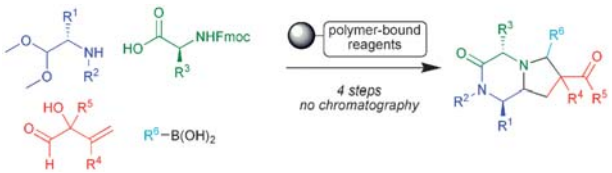
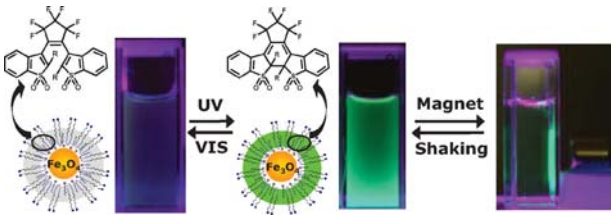
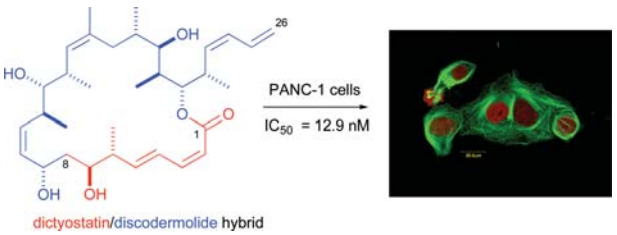
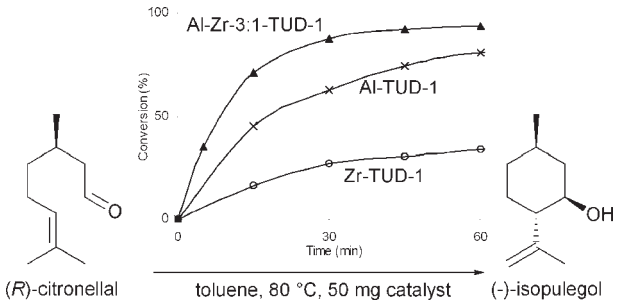




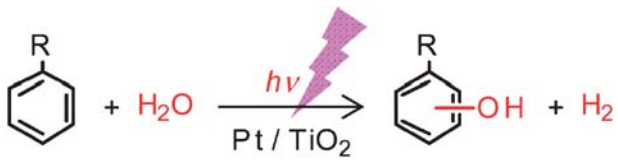




Synergy between Brønsted acid sites and Lewis acid sites

Selvedin Telalović, Jeck Fei Ng, Rajamanickam Maheswari, Anand Ramanathan, Gaik Khuan Chuah and Ulf Hanefeld*

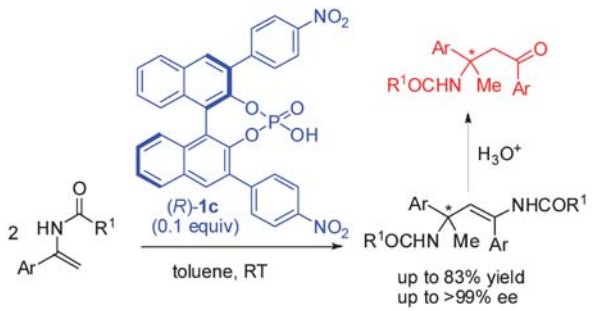
The combination of purely Lewis acidic Zr with Al in the sponge like silicate TUD-1 yielded the new, mesoporous Al-Zr-TUD-1. Synergy between Brønsted acid sites and Lewis acidic sites in this material was demonstrated in the Prins cyclisation.



Photocatalytic hydroxylation of aromatic ring by using water as an oxidant

Hisao Yoshida,* Hayato Yuzawa, Masanori Aoki, Kazuko Otake, Hideaki Itoh and Tadashi Hattori

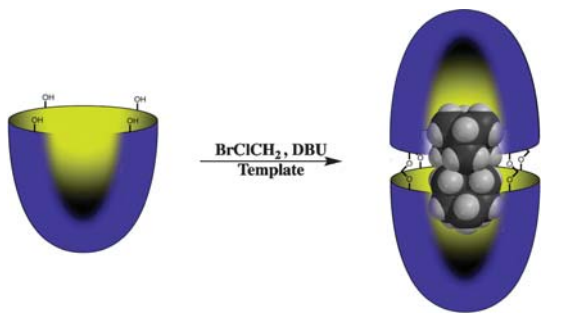
Benzene and its derivatives can be selectively converted to the corresponding phenols over Pt/TiO_2 photocatalyst by using water as an oxidant when illuminated with light of appropriate wavelength in the absence of molecular oxygen.



Highly enantioselective organocatalytic formation of a quaternary carbon center *via* chiral Brønsted acid catalyzed self-coupling of enamides

Christine Baudequin, Alexandru Zamfir and Svetlana B. Tsogoeva*

The enantioselective formation of a quaternary carbon center, bearing a *N*-atom has been achieved through the self-coupling reaction of enamides. The application of the products to the synthesis of versatile synthetic building blocks—β-aminoketones—has been demonstrated.



Synthesis of nanoscale carceplexes from deep-cavity cavitands

Kannupal Srinivasan and Bruce C. Gibb*

Large guest molecules such as steroids and diadamantanes are shown to template the formation of nanoscale carceplexes. The efficiency of this irreversible assembly process is intimately tied to the shape of the ultimately incarcerated guest.

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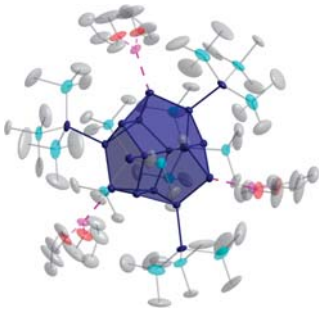
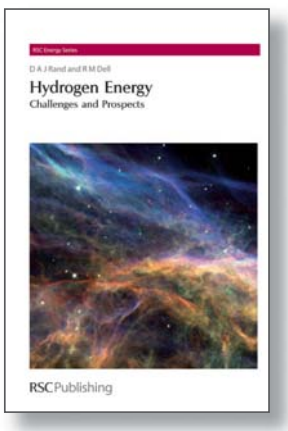


RSC Energy Series



Hydrogen Energy
Challenges and Prospects

Authors: D A J Rand & R M Dell

Hydrogen Energy Challenges and Prospects, a new book from the authors of **Clean Energy,** outlines the potential and future prospects of hydrogen energy. Each of the many facets of hydrogen energy is discussed and the challenges faced are addressed. It is not possible to reach a simple unequivocal conclusion regarding overall prospects, since the international energy situation is so complex and predicting long-term futures is notoriously difficult. Nevertheless, the authors provide pointers as to the way that events might develop in the decades ahead.

This exciting new book considers the prospects for hydrogen as a universal energy vector and will appeal to a wide audience including researchers in the field and those interested in the topic of sustainable and renewable energy.

BB Hardback | ca xxxiv + 298 pages | ISBN 9780854045976 | 2007 | £45.00

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Electronic supplementary information (ESI) is available *via* the online article (see http://www.rsc.org/esi for general information about ESI).

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October 2008 / Volume 5 / Issue 10 / ISSN 1744-1560 / CTHEC2 / www.rsc.org/chemicaltechnology

Chemical Technology

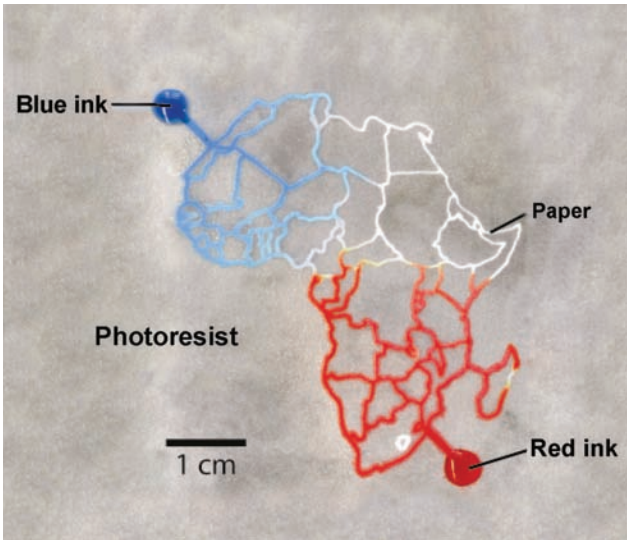
Paper-based devices for diagnostics in the developing world

Microfluidics in a FLASH

US scientists have made microfluidic devices using only paper, a pen and sunlight. The cheap and simple equipment could be used in the developing world for diagnosing disease and monitoring water.

George Whitesides and colleagues from Harvard University, Cambridge, call their new method FLASH (Fast Lithographic Activation of SHeets). Using a special type of paper, they made patterned microfluidic devices using only an ink-jet printer, UV lamp and hot plate. They demonstrated that a pen and sunlight can be used instead if printers, lamps or hot plates are unavailable.

Whitesides says the FLASH paper can be prepared in bulk in advance and stored for more than six months. It is made from a piece of paper impregnated with photoresist (a light-sensitive chemical) and sandwiched between a transparency film and black paper. When a microfluidic device is needed, a pattern is printed on to the transparency film with an ink-jet printer, photocopier or pen. The paper is then exposed to UV light or sunlight to polymerise the photoresist where it is not covered by ink, before the transparency film and black backing paper are removed. Finally the paper is baked – although this step is not needed if sunlight is used instead of UV light – and rinsed to remove the unpolymerised photoresist. Making the device takes less than 30 minutes, says Whitesides.



An Africa-shaped microfluidic device patterned using the FLASH method

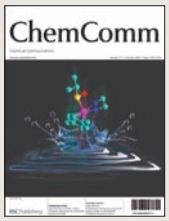
'I like the simplicity of the method and the ingenuity to impregnate an entire sheet of paper with photoresist to create barriers,' says Abraham "Abe" Lee, an expert on microfluidics from the University of California at Irvine, US. 'It triggers the "why didn't I think of this?" thought that so many great ideas do,' he adds.

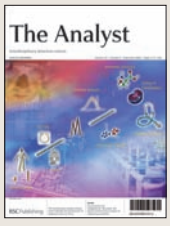
The Harvard team have shown that a variety of different papers of different sizes can be patterned with channels as small as 200 micrometres wide. They say the patterns can be reproduced quickly using a photocopier and the cost of materials per device is as low as one to three US cents, depending on its size.

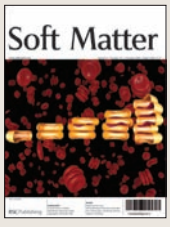
Freya Mearns

Reference
A. W. Martinez *et al*, *Lab Chip*, 2008, DOI: 10.1039/b811135a

In this issue







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

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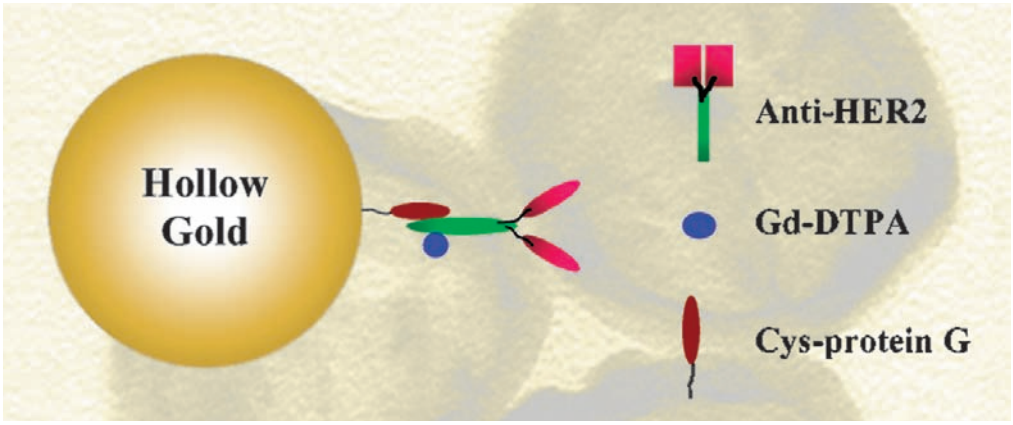
Application highlights

Therapeutic nanostructures combine gold, gadolinium and antibodies

Nanoparticles hunt down cancer cells



The modified nanoparticles seek out and destroy cancer cells

Cancer cells can be detected then destroyed using a nanostructure designed by South Korean researchers.

Bong Hyun Chung and colleagues at the Korea Research Institute of Bioscience and Biotechnology in Daejeon base their structures on hollow gold nanoparticles.

The structures have antibodies on their surface which allow them to bind to cancer cells. They also contain gadolinium, which acts as a molecular resonance imaging (MRI) contrast agent and allows the cells to be seen. When Chung shone an infrared laser on the gold nanoparticles, the heat that formed destroyed the surrounding cancer cells.

The gold nanostructures overcome the drawbacks of commonly-used iron oxide MRI contrast agents, suggests Chung. Iron can lead to interference and negative contrast effects, causing errors in diagnosis. The design of the gold nanostructures leads to an enhanced signal and better diagnosis, he says.

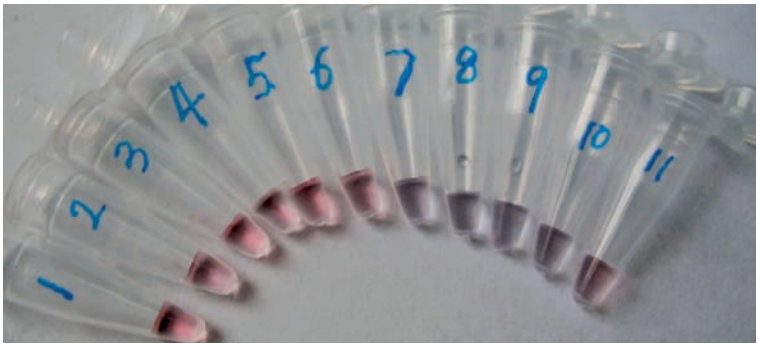
Chung's approach is non-invasive and is likely to be effective in the treatment of early-stage cancers because it treats a specific area, unlike chemotherapy which affects the whole body. In the future 'the nanoparticles may be used for the analysis of cancer dissection in surgery', says Chung.

Michael Brown

Reference
Y T Lim *et al*, *Chem. Commun.*, 2008, DOI: 10.1039/b810240f

New portable device enables detection at contamination site

Probing mercury contamination



Mercury turns the nanoparticles from red to purple

Detecting mercury pollution could become a lot easier, thanks to a new visual technique developed by scientists in China.

Chunhai Fan and colleagues at the Chinese Academy of Sciences and East China University in Shanghai have designed a new gold nanoprobe that changes colour when it comes into contact with mercury(II) ions.

The mercury(II) ion is the most stable form of inorganic mercury and is known to have detrimental effects on humans and the environment. Methods to detect mercury usually require lab-based instruments but there is an increasing demand for techniques that allow rapid mercury detection in drinking water, food and soil at the site of contamination.

The new technique, which combines micro- and nano-technologies, allows rapid, selective and portable detection of mercury within microfluidic channels at room temperature. When the gold nanoprobes come into contact with solutions containing mercury, their colour rapidly alters from red to purple. The higher the concentration of mercury, the greater the intensity of the colour change.

'Given its simplicity and low cost, we believe that this device provides a convenient approach for rapid mercury screening in the field detection of water pollution,' says Fan. He adds that the technique could be particularly useful for monitoring mercury contamination in developing countries.

Although the device currently has a mercury detection limit of only five micromolar, Fan expects that 'further design of the nanoprobe and the incorporation of signal amplification will significantly improve the sensitivity to meet more challenging requirements'.

Kathryn Lees

Reference
S He *et al*, *Chem. Commun.*, 2008, DOI: 10.1039/b811528a

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Chemists trade white coats for wetsuits to test lab-on-a-surfboard

Surf's up for science

Scientists in Hawaii have developed a green way to make chemicals using a favourite local combination – sun and surfing.

Robert Liu, from the University of Hawaii, Honolulu, and colleagues have designed a solar reactor that floats on the ocean and synthesises organic compounds under the Sun. The reactor uses solar energy to make hindered isomers of vitamin A. While these isomers aren't particularly useful, Liu believes they can use the method to make other, more valuable chemical feedstocks.

Photochemical reactions use a molecule's ability to capture a photon from the Sun. This energy is then used for chemical reactions that cannot usually be done by heating. Liu used a method called triplet sensitisation, where light is absorbed by a coloured material and the excess energy is passed on to the reactant. 'In this way, we can tap a major portion of the visible light from the Sun,' says Liu.

ROBERT LIU, UNIVERSITY OF HAWAII, HONOLULU, US

The floating reactor makes organic compounds using solar energy

The reactor does not require electricity or running water and is small enough to be fitted into a boogie-board (a small surf-board). The reactor uses the Pacific Ocean as an immense heat sink to dissipate excess heat, avoiding the need to circulate cooling water through the device. The reactions can be done within half an hour, the time period of a short surfing session, says Liu.

'An appealing idea,' says Axel Griesbeck, an expert in photochemistry at the University of Cologne, Germany. 'We need to support experiments like these now and not wait for the end of all natural oil, gas and coal.' *Sarah Corcoran*

Reference
Y-P Zhao, R O Campbell and R S H Liu, *Green Chem.*, 2008, DOI: 10.1039/b809007f

Screening method helps to identify fake Tamiflu

Cracking down on counterfeit drugs

US scientists have developed a method for screening Tamiflu in an attempt to foil counterfeiters.

Counterfeiters have targeted Tamiflu, an antiviral flu drug effective against bird flu, due its high cost and demand. Scientists have found fake Tamiflu containing vitamin C instead of the active ingredient, oseltamivir.

Facundo Fernández and colleagues at Georgia Institute of Technology and the US Centers for Disease Control and Prevention, Atlanta, used desorption electrospray ionisation mass spectrometry (DESI MS) to help authenticate Tamiflu capsules. They doped the electrospray solvent with crown ethers and studied the competitive complexation of the crown ethers with oseltamivir. They found that by using two different crown ethers with different binding affinities for oseltamivir, they could determine the amount of oseltamivir in the capsules without using an internal standard.

Niklas Lindegardh, head of the Clinical Pharmacology Laboratory at the Mahidol–Oxford Tropical Medicine Research Unit, Bangkok, Thailand, says he believes this is important research. 'Rapid analytical methods for screening potentially counterfeit Tamiflu capsules are of the utmost importance. The new reactive DESI method combines rapid throughput with ultimate selectivity and will provide an excellent tool for rapid semi-quantitative screening of large batches of capsules,' he says.

ROCHE

The high cost and demand for Tamiflu makes it a target for counterfeiters

'The new method improves throughput by at least two orders of magnitude,' says Fernández. 'Even with existing instrumentation, this assay could be widely adopted.' He says the next challenge is to couple the ionisation reaction to portable detectors, such as ion mobility spectrometers or portable mass spectrometers. 'This will truly produce a network of point-of-care drug quality screening tools. The challenge is mostly on the engineering side. The basic knowledge is already there and we have proven the basic chemical concepts,' adds Fernández. *Edward Morgan*

Reference
L Nyadong *et al*, *Analyst*, 2008, DOI: 10.1039/b809471c

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Biological assays can be carried out in stabilised water droplets

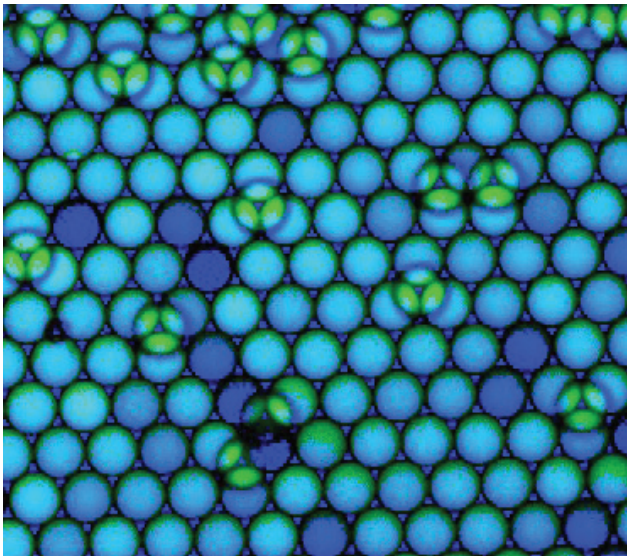
The perfect surfactant

Water droplets can be used as microvessels for bioassays thanks to a new surfactant developed by scientists in Europe and the US.

Fluorocarbon oils are an ideal medium to carry water droplets for biological assays because gases that are needed by biological cells can be dissolved in them, but they prevent cross-contamination of biological material between the droplets. They are also ideal for microfluidic devices, as the oils do not cause the material forming the channels within the device to swell up.

Until now, all commercially available surfactants for water droplets in fluorocarbon oils have either not stabilised the droplets for long enough or have interacted with their contents. Now, researchers from Germany, Italy and the US have come up with a new class of surfactants without these problems.

Christian Holtze at BASF Aktiengesellschaft, Ludwigshafen, Germany, and colleagues made surfactants with a fluorocarbon tail and a polyethylene glycol head. By testing different variations of these surfactants they created an emulsion that is stable for weeks, suitable for biological assays which can take hours or days. Holtze also looked at how the emulsion would fare in a microfluidic device. Even when highly compressed, for example, the emulsion stayed stable.



The water droplets remain stable and do not fuse, making them ideal for bioassays

Next Holtze trapped a piece of enzyme-coding DNA in the water droplets together with all the molecules needed to make the enzyme. He found that a fluorescent product formed in the droplets, showing that the new surfactants are biocompatible. Holtze says this could be because they are non-ionic. He also found that his emulsions can be used to contain biological cells.

Holtze says that his surfactants could allow 'unprecedented speed and control of high-throughput analyses ranging from in vitro biochemistry to single cell studies'.

Madelaine Chapman

Reference

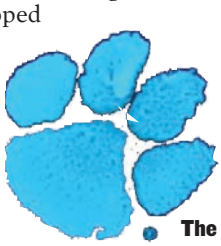
C Holtze *et al*, *Lab Chip*, 2008, DOI: 10.1039/b806706f

Organic inks shine in an electric current

Colloids light the way to printable electronics

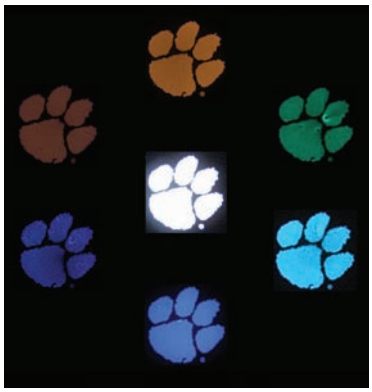
Cheap electronic devices can be printed using commercial printing presses thanks to light-emitting colloidal inks developed by US scientists.

Stephen Foulger and colleagues from Clemson University made colloidal particles from organic molecules that emit red, blue or green light. They used different ratios of the particles to make organic light emitting devices (OLEDs) in a wide range of colours.



The printed patterns light up when a voltage is applied

The light emitting molecules are in a water-based colloid so they can be used as ink in commercial high-volume printing techniques, explains Foulger. The team printed the colloidal particles onto a conductive surface and lit up the printed pattern by applying a voltage across the surface. Foulger says the particles could be used to make coloured electronic displays for car dashboards, for example. He adds that the combination of low cost starting materials and high volume printing will mean cheaper products.



'The most significant finding is that individual colour has been realised in a colloidal particle and each colloidal particle still emits its original colour even when mixed together in the OLED,' says Hideyuki Murata, an expert in organic electroluminescence at the Advanced Institute of Science and Technology, Ishikawa, Japan.

Foulger says the results will help bring printable electronics to the market quickly. 'We are continuing to improve the luminosity of the devices and reduce defects in printed structures,' he adds. 'The next step is improving yields and transitioning the technology to full-scale printing presses.'

Rachel Cooper

Reference

C F Huebner *et al*, *J. Mater. Chem.*, 2008, DOI: 10.1039/b809450k

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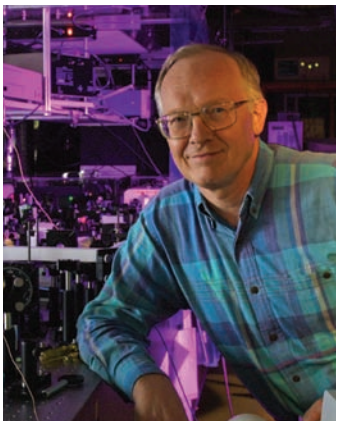
Interview

Finger on the pulse

Paul Corkum talks to Hilary Crichton about attosecond pulses and how developing new ideas is like skiing downhill



Paul Corkum

Paul Corkum OC, FRS, FRSC is director of the Joint University of Ottawa/National Research Council Attosecond Science Laboratory and a professor of physics at the University of Ottawa. He introduced many of the concepts in strong field atomic and molecular science. His many awards include the Canadian Association of Physicists' gold medal for lifetime achievement in physics and the American Physical Society's Arthur L. Schawlow prize for quantum electronics.

Who inspired you to become a scientist?
It was my high school physics teacher. He believed that he should prove any statement. In my very first physics class, he introduced us to the concept that the dimensions of equations must balance. I remember thinking about this a lot and I liked the idea very much. From then on, I loved the simplicity and beauty of physics.

Tell us about your scientific background.
After high school, I attended an excellent small college, Acadia University, in Canada. There were only undergraduates in the physics department, so I was able to get a summer job in the laboratory every year. These summer positions introduced me to research. I published my first paper as an undergraduate.

Then, I headed to the US to attend Lehigh University, Pennsylvania. After Lehigh, I managed to get a postdoctoral fellowship at the National Research Council (NRC) of Canada, where I have worked until this year. About six months ago, the NRC and the University of Ottawa formed a joint laboratory for attosecond science. I am now director of the joint laboratory and I have a faculty position at the university.

Your research paved the way in producing attosecond pulses. What are you currently using them to investigate?
Many things. Attosecond science has implications everywhere. I will single out one very exciting one that has guided a great deal of my research for the past five years. Attosecond technology opens a class of new methods for imaging molecules. The methods are all fully compatible with measuring chemical and electronic dynamics. The image can be of an orbital, the position of the atoms or both simultaneously. That means that it is possible to see the electronic and nuclear structure of a molecule and watch it change. So far, we have concentrated on diatomic or triatomic molecules but I think we can extend the methods to molecules of more chemical or biological interest.

What's going to be the next big thing in your field?
Combining space and time – attosecond and Ångström. What we have really done so far is to introduce a systematic way to sub-divide the laser cycle – currently the shortest laser pulse is only one-thirtieth of the period of the light that generated it. Equally, it is possible to sub-divide the light wavelength. If we can systematically achieve a spatial resolution of one-thirtieth of a wavelength then we have a powerful tool for nanotechnology. Already, for molecular problems, my group resolves one Ångström features. In other words, our spatial resolution is less than one nanometre. Looking further ahead, the methods that we have developed are only the first of many possible methods. In essence, it is the high nonlinearity that leads to attosecond pulses. Other approaches that do not rely on re-collision will surely arise. They will open even shorter timescales. At this point, the horizon seems limitless.

Which piece of research are you most proud of?
The re-collision model [a unique interplay between a coherent electron, coherent atoms or molecules and coherent light] has become the organising concept of a whole sub-field of science. What more can one ask for as a scientist? I am also pleased that I realised its implications almost immediately – for making and measuring attosecond pulses and for imaging molecules.

What is the most rewarding aspect of your work?
I will single out two things. First, there is nothing more rewarding or exciting than to develop a new idea. I think of it as the intellectual equivalent of downhill skiing. When skiing, you slide down a snow-covered hill as fast as you dare. To me, this is the definition of physical fun. In science, you follow a new idea – one that no one has ever thought about before – with total concentration. To me, this is the highest intellectual satisfaction possible.

Second, I like the interplay between the intellectual and social aspects of science. Most people (including me when I started) think of a scientist's life as isolated – always working alone in the laboratory. In fact, science is just the opposite. Scientists almost always work in teams. They discuss ideas openly and continually. Once they make an advance, it is their job to tell others. To do this, they travel the world. I have scientific friends to whom I am as close as to my neighbours. I have met their families and they mine. From them I gain a unique insight into other countries and other cultures. This, to quote physicist and science writer, Jeremy Bernstein, is 'the life it [science] brings'.

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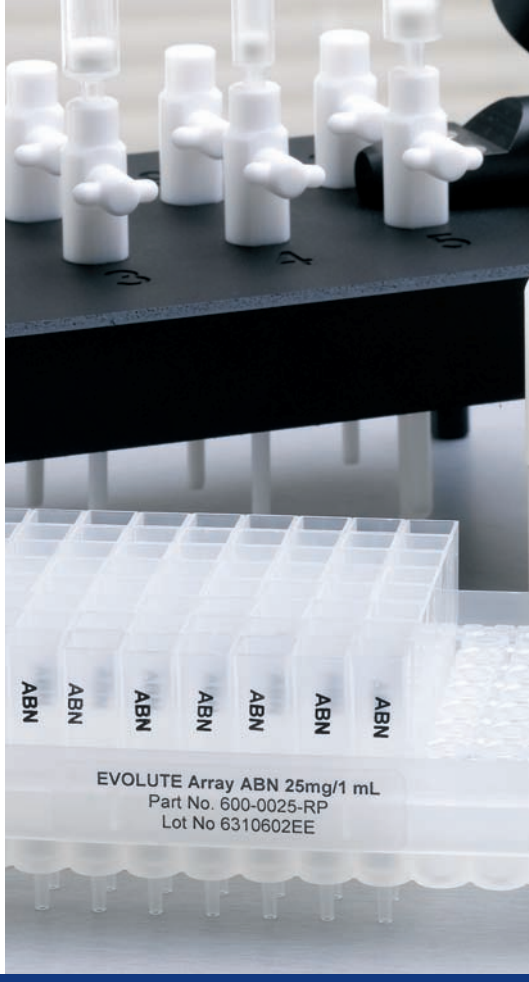

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Instant insight

Colloids deliver the goods

Unilever's Krassimir Velikov and Eddie Pelan reveal the design behind innovative, nutritious and tasty foods

Product functionality is a complex product description that covers the formulation, structure, texture, stability, appearance, taste, flavour and bioavailability of food ingredients. To design nutritious foods, we need to introduce the nutrients, known as micronutrients and nutraceuticals, in a proper form to assure the stability, as well as good taste, of the final product. Micronutrients, such as vitamins and minerals, are essential for growth and development whereas nutraceuticals are not essential for life but have a positive effect on health. Unfortunately, they often cause problems when added to food due their physico-chemical properties or interaction with other ingredients. As a result, the food functionality is often compromised.

Incorporating soluble active ingredients into food products can cause a bitter taste, lipid oxidation, colour changes and chemical instability. Use of the insoluble salts can lead to physical instability and insufficient bioavailability. We need a balance between solubility and dispersibility of the active ingredient. We also need control over this balance in order to have flexibility in solving technical issues.

A generic solution for these problems is to use colloidal delivery systems, which are insoluble in the product but dissolve in the gastrointestinal tract when eaten. Colloidal dispersions are small enough not to cause physical instabilities like sedimentation. Unfortunately, there are not readily available natural colloidal delivery systems for most micronutrients and nutraceuticals so custom-made delivery systems are required.

Colloidal dispersions can be used to design and fine tune product structure and enable new product formats. Both nutraceuticals and micronutrients are used in relatively low concentrations, so their ability to alter product structure can be limited. Nevertheless, particles like rods and platelets can be used as alternatives to biopolymers to increase viscosity or create gels at sufficiently low volumes. Colloidal particles can also stabilise fluid-in-fluid dispersions meaning that emulsions can be formed using little or no surfactant.

Colloids can enhance the flavour, texture, appearance and nutritional benefits of food

Taste and flavour are crucial for the success of any food product. Changes in flavour are often linked to the inherited taste of the ingredients or to unwanted chemical interactions, for example oxidation. Colloidal dispersions offer control on solubility and, as a result, control on taste.

Because a colloid's optical properties vary depending on its size and shape, colloidal dispersions offer great opportunities for fine tuning product appearance – they can deliver translucency, complete transparency or a desired colour.

Bioavailability of functional ingredients is a rapidly growing issue in the area of functional food design. Often ingredients are poorly soluble, crystalline solids at room temperature and are poorly absorbed from the gastrointestinal tract. There are several common approaches to improve their bioavailability: chemical modification; size reduction; functionalisation of particle surfaces to improve solubility; crystallinity reduction; or polymorph alteration.

The successful application of colloidal delivery systems in foods requires a broad knowledge of molecular, ionic and colloidal interactions in the product, as well as knowledge of the biological function and metabolism of the micronutrients or nutraceuticals. Since these processes are not independent, successful application into industrial products requires an integrated approach. One where the ingredients are pre-formulated to allow easy incorporation and stabilisation in the product is likely to be most useful. This approach requires linking the in-product and in vivo function of the delivery systems. Also, all aspects of product functionality, like stability, texture, taste, appearance and bioavailability, must be simultaneously considered and addressed to achieve a balanced and consumer acceptable solution.

The strategy is valid not only for food systems but also home and personal care products, drug formulations, agricultural compositions and paints. Importantly, many micronutrients and nutraceuticals are also cosmeceuticals in skin care products. The type of industry determines which aspect of the product functionality will be of highest importance.

Read more in 'Colloidal delivery systems for micronutrients and nutraceuticals' in issue 10 of Soft Matter.

Reference
K P Velikov and E Pelan, *Soft Matter*, 2008, **4**, 1964 (DOI: 10.1039/b804863k)

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Essential elements

Engineering success

CrystEngComm celebrated its tenth year of publication in style on 28 August with a lunch reception held at the XXI Congress and General Assembly of the International Union of Crystallography in Osaka, Japan. As part of the celebrations, the journal also awarded five poster prizes at the meeting.

Since its launch in 1999, *CrystEngComm* has gone from strength to strength, growing in size by more than a factor of ten. The journal now boasts the fastest publication times and highest immediacy index for a crystal engineering journal, plus an impressive impact factor of 3.47. In his welcome speech, *CrystEngComm* editor Jamie Humphrey outlined the successes of the past decade and extended his thanks: 'This success has been possible only through the support that you and other members of the

crystal engineering community have given the journal – your support as authors, referees, readers and in some cases editorial and advisory board members.'

Regular *CrystEngComm* author Pierangelo Metrangolo of Milan, Italy, who attended the lunch reception, cites the journal as one of his favourites for publication of his research. 'In particular,' he says, 'I appreciate the speed at which papers are processed and the very kind co-operation of the editorial staff. What else to say: Happy Birthday *CrystEngComm*..., and keep up the good work!'

A decade since launch and the future for *CrystEngComm* has never looked so bright. Celebrations will continue later this year with an anniversary theme issue, including articles by editorial and advisory board members, and the journal is also heavily involved in the organisation of a crystal engineering symposium as part of the IUPAC Congress next year in Glasgow.

Visit www.crystengcomm.org for updates on these and other exciting events.

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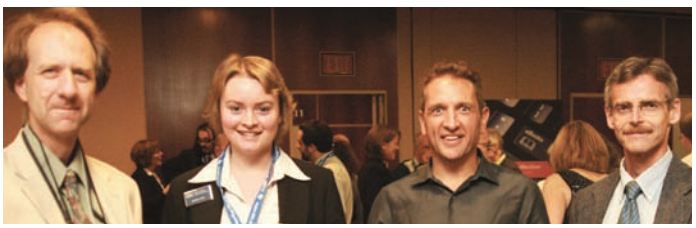
See you there!

A warm reception in Philadelphia

The atmosphere inside the Philadelphia Marriott mirrored the sunny blue sky outside as guests gathered at the RSC Reception. Held on 17 August, it coincided with the 236th American Chemical Society National Meeting and Exposition taking place at the Pennsylvania Convention Center.

Around 200 people listened to RSC president Dave Garner as he welcomed guests, including Nobel prize winner Bob Grubbs from Caltech,



Left to right: Jonathan Sessler (U Texas at Austin), Kate Sear (deputy editor ChemComm, RSC), Kevin Burgess (Texas A&M), Peter Wipf (Pittsburgh)

a variety of eminent and emerging researchers, plus university librarians and local RSC members. The incoming president of the ACS, Tom Lane, was also there with a number of his society colleagues, indicating the continuing warm friendship between the two chemical societies.

Guests enjoyed refreshments while catching up with friends old and new, and RSC staff were on hand to describe the latest RSC initiatives, including the hot topics of *Energy & Environmental Science*, *Integrative Biology* and *Metallomics*, the three newest RSC journals.

At the end of a genial evening, everyone was looking forward to meeting again – so see you all in Salt Lake City in spring 2009!

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