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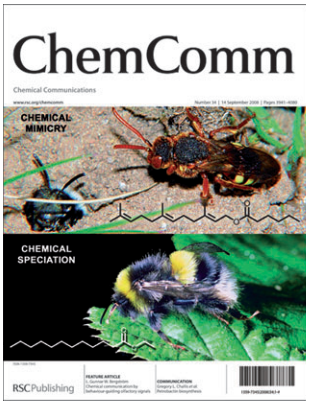
IN THIS ISSUE

ISSN 1359–7345 CODEN CHCOFS (34) 3941–4080 (2008)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Cover
See L. Gunnar W. Bergström, pp. 3959–3979.
Two cases of chemical communication in insects are shown: Chemical Mimicry between parasitic and host female bees, and Chemical Speciation through species-specific marking pheromones in male bumble bees.
Images reproduced by permission of Anders Nilsson and Bertil Kullenberg, respectively, of Uppsala University, from L. Gunnar W. Bergström, *Chem. Commun.*, 2008, 3959.


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Inside cover
See Christopher J. Easton *et al.*, pp. 3980–3982.
A rotaxane constructed from stilbenes and cyclodextrins has been developed as the basis of a light driven molecular muscle.
Artwork by H. Onagi and R. Dawson.
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CHEMICAL TECHNOLOGY

T65

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.

Chemical Technology
September 2008/Volume 5/Issue 9
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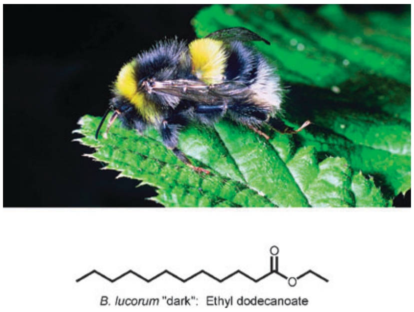
FEATURE ARTICLE

3959

Chemical communication by behaviour-guiding olfactory signals

L. Gunnar W. Bergström

All living organisms have chemical signals to guide their behaviours. They are linked to all vital functions such as mating, nesting, feeding, alarm/defence and pollination. These phenomena are being studied in the new interdisciplinary area of Chemical Ecology. Here, examples are presented from insects and from flowering plants.



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Chemical Communications (print: ISSN 1359-7345; electronic: ISSN 1364-548X) is published 48 times a year by the Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, UK CB4 0WF. All orders, with cheques made payable to the Royal Society of Chemistry, should be sent to RSC Distribution Services, c/o Portland Customer Services, Commerce Way, Colchester, Essex, UK CO2 8HP. Tel +44 (0)1206 226050; E-mail sales@rscdistribution.org

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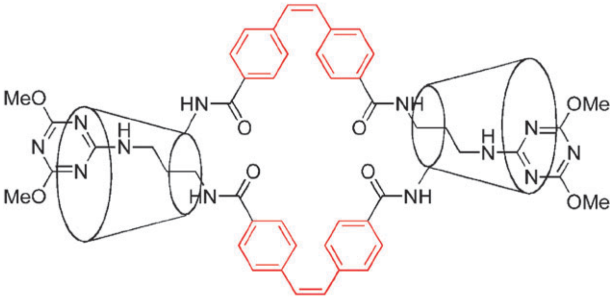
3980

The foundation of a light driven molecular muscle based on stilbene and α-cyclodextrin

Ryan E. Dawson, Stephen F. Lincoln and Christopher J. Easton*

Flexing muscle: the rotaxane pictured serves as the basis of a light driven molecular muscle, where reversible photoisomerisation of the stilbene units causes the cyclodextrins to move on and off the stilbene units, extending and contracting the distance between the blocking groups.

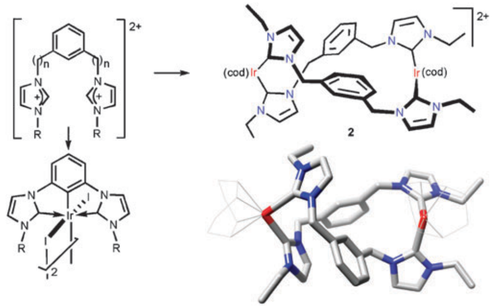


3983

An unprecedented, figure-of-eight, dinuclear iridium(I) dicarbene and new iridium(III) 'pincer' complexes

Matthieu Raynal, Catherine S. J. Cazin, Christophe Vallée, Hélène Olivier-Bourbigou and Pierre Braunstein*

Depending on the spacer in the bis(imidazolium) precursors, the unusual dinuclear Ir(I) complex **2** bridged by two *N*-heterocyclic biscarbene ligands and forming a 20-membered, figure-of-eight dimetallacycle, or new $C_{NHC}CC_{NHC}$ Ir(III) pincer complexes have been obtained from $[Ir(\mu\text{-}Cl)(cod)]_2$.

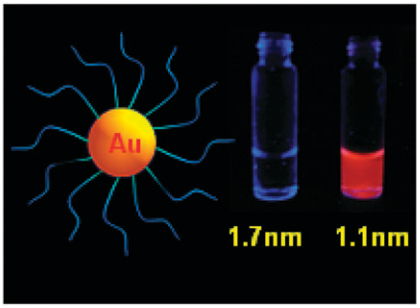


3986

Fluorescent or not? Size-dependent fluorescence switching for polymer-stabilized gold clusters in the 1.1–1.7 nm size range

Nicolas Schaeffer, Bien Tan, Calum Dickinson, Matthew J. Rosseinsky, Anna Laromaine, David W. McComb, Molly M. Stevens, Yiqian Wang, Laure Petit, Catherine Barentin, David G. Spiller, Andrew I. Cooper* and Raphaël Lévy*

The synthesis of water-soluble polymer-stabilized gold nanoparticles is described; size-dependent visible fluorescence is observed, the size and fluorescence of the particles being controlled by the polymer-to-gold ratio.

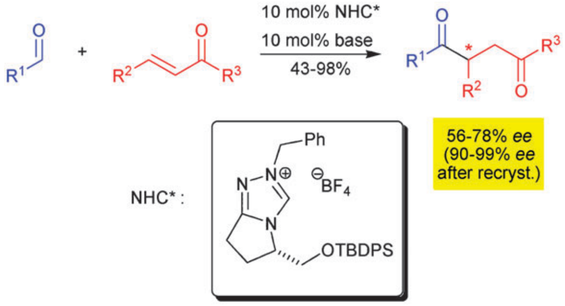


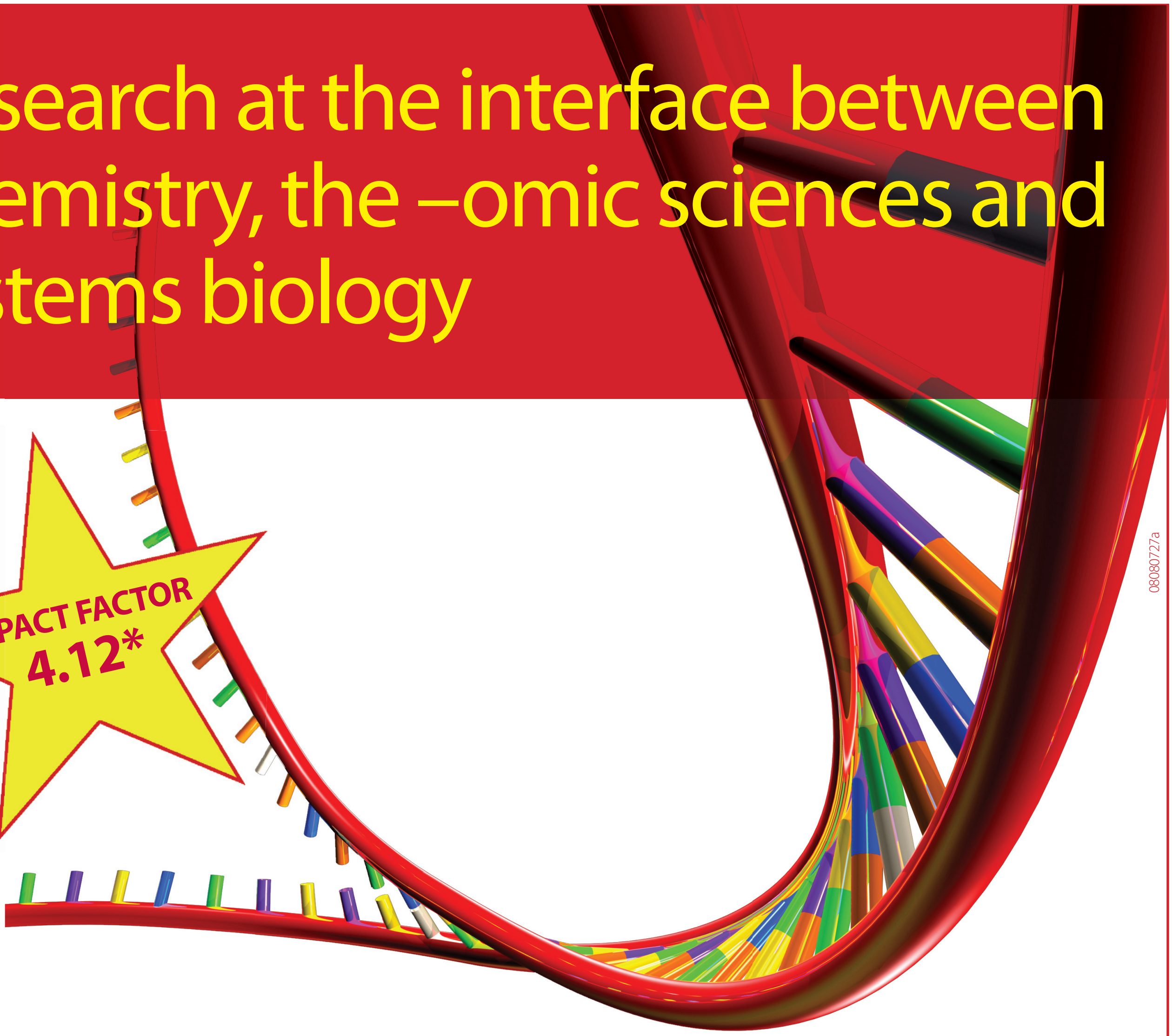
3989

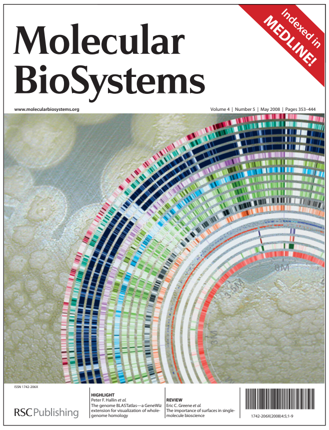
Asymmetric intermolecular Stetter reactions catalyzed by a novel triazolium derived N-heterocyclic carbene

Dieter Enders,* Jianwei Han and Alexander Henseler

The asymmetric intermolecular Stetter reaction is catalyzed by a novel triazolium salt derived N-heterocyclic carbene. The corresponding 1,4-diketones could be obtained in good yields and excellent enantiomeric excesses, after one recrystallization.





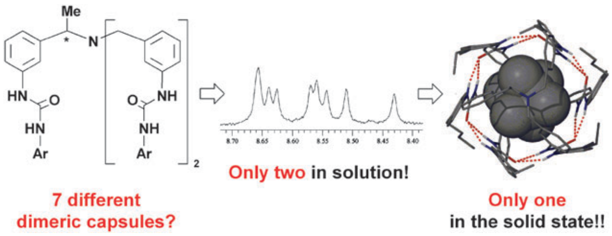


3992

Highly diastereoselective self-assembly of chiral tris(*m*-ureidobenzyl)amino capsules

Mateo Alajarín,* Aurelia Pastor,* Raúl-Angel Orenes, Andres E. Goeta and Jonathan W. Steed

Chiral tris(*m*-ureidobenzyl)amines form dimeric capsules. In solution, the self-assembly process is highly diastereoselective. Moreover, the formation of the corresponding capsules in the solid state is also a completely regioselective event.

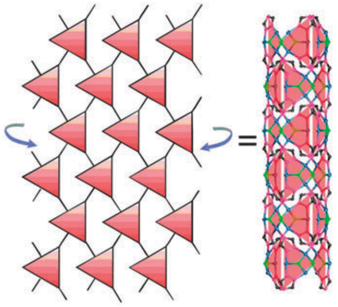


3995

A metal–organic framework containing discrete single-walled nanotubes based on curved trinuclear $[Cu_3(\mu_3\text{-}O)(\mu\text{-}OH)(triazolate)_2]^+$ building blocks

Xiao-Chun Huang,* Wei Luo, Yu-Feng Shen, Xin-Jian Lin and Dan Li*

A novel three-dimensional nanotubular coordination polymer is assembled from cupric ions and a simple triazolate ligand, containing discrete single-walled nanotubes presumably generated from planar sheets just like carbon nanotubes.

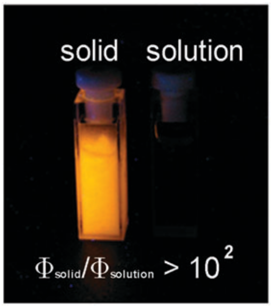


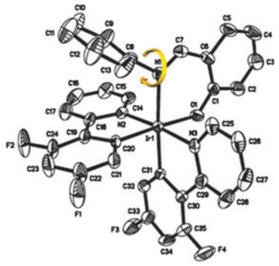
3998

Comment on 'aggregation-induced phosphorescent emission (AIPE) of iridium(III) complexes': origin of the enhanced phosphorescence

Youngmin You, Hyun Sue Huh, Kil Suk Kim, Soon W. Lee, Dongho Kim and Soo Young Park*

An investigation of phosphorescent Ir(III) complexes attests that the most probable explanation for the reported 'aggregation-induced phosphorescent emission' is restricted intramolecular motion.



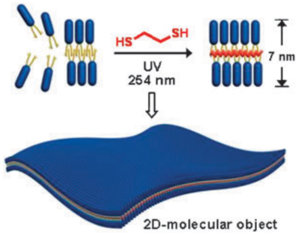


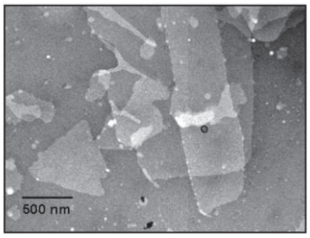
4001

Bioactive molecular sheets from self-assembly of polymerizable peptides

Kyung-Soo Moon, Eunji Lee, Yong-beom Lim and Myongsoo Lee*

We have demonstrated that polymerizable peptides self-assemble into a unique sheet-like 2D structure in bulk solution that can be covalently fixed to produce 2D molecular objects which were shown to be efficient at delivering cargos into living cells and are nearly nontoxic in contrast to non-polymerized nanostructures.



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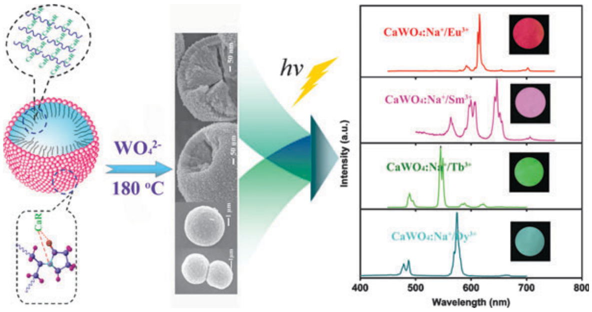
4004

Self-assembly and multicolor emission of core/shell structured $CaWO_4$:Na^+/Ln^{3+} spheres

Yiguo Su, Liping Li and Guangshe Li*

A novel core/shell $CaWO_4$ microsphere co-doped with Na^+ and Ln^{3+} (Ln = Dy, Tb, Sm, Eu) was prepared and showed a unique multicolor emission in the visible region when excited by single-wavelength light.

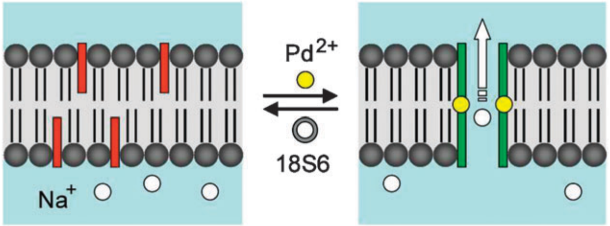


4007

Palladium(II)-gated ion channels

Craig P. Wilson and Simon J. Webb*

A cholic acid-derived channel that can be gated by palladium(II) has been developed. Addition of palladium(II) assembled the channel and allowed Na^+ or K^+ to cross the bilayer; subsequent addition of hexathia-18-crown-6 (18S6) extracted the palladium(II) and stopped ion flow.

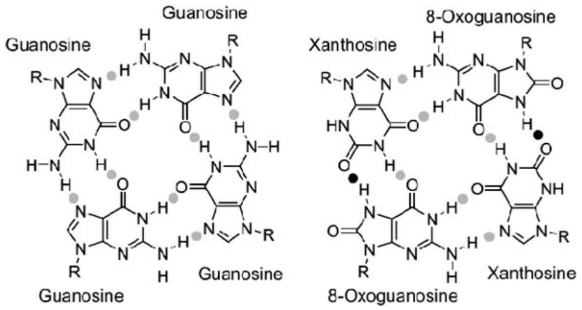


4010

Redesigned tetrads with altered hydrogen bonding patterns enable programming of quadruplex topologies

Armin Benz and Jörg S. Hartig*

Incorporation of xanthosine and 8-oxoguanosine into G-rich oligonucleotides makes it possible to selectively program the topology of quadruplex structures. The guanosine derivatives assemble into tetrads, restricting the number of possible conformations of the four-stranded nucleic acid structures.

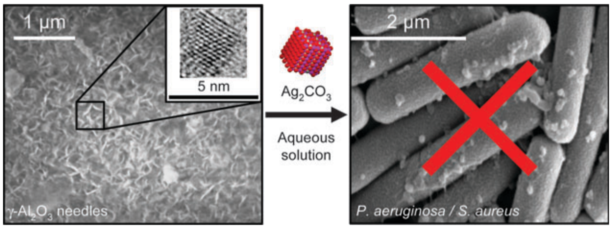


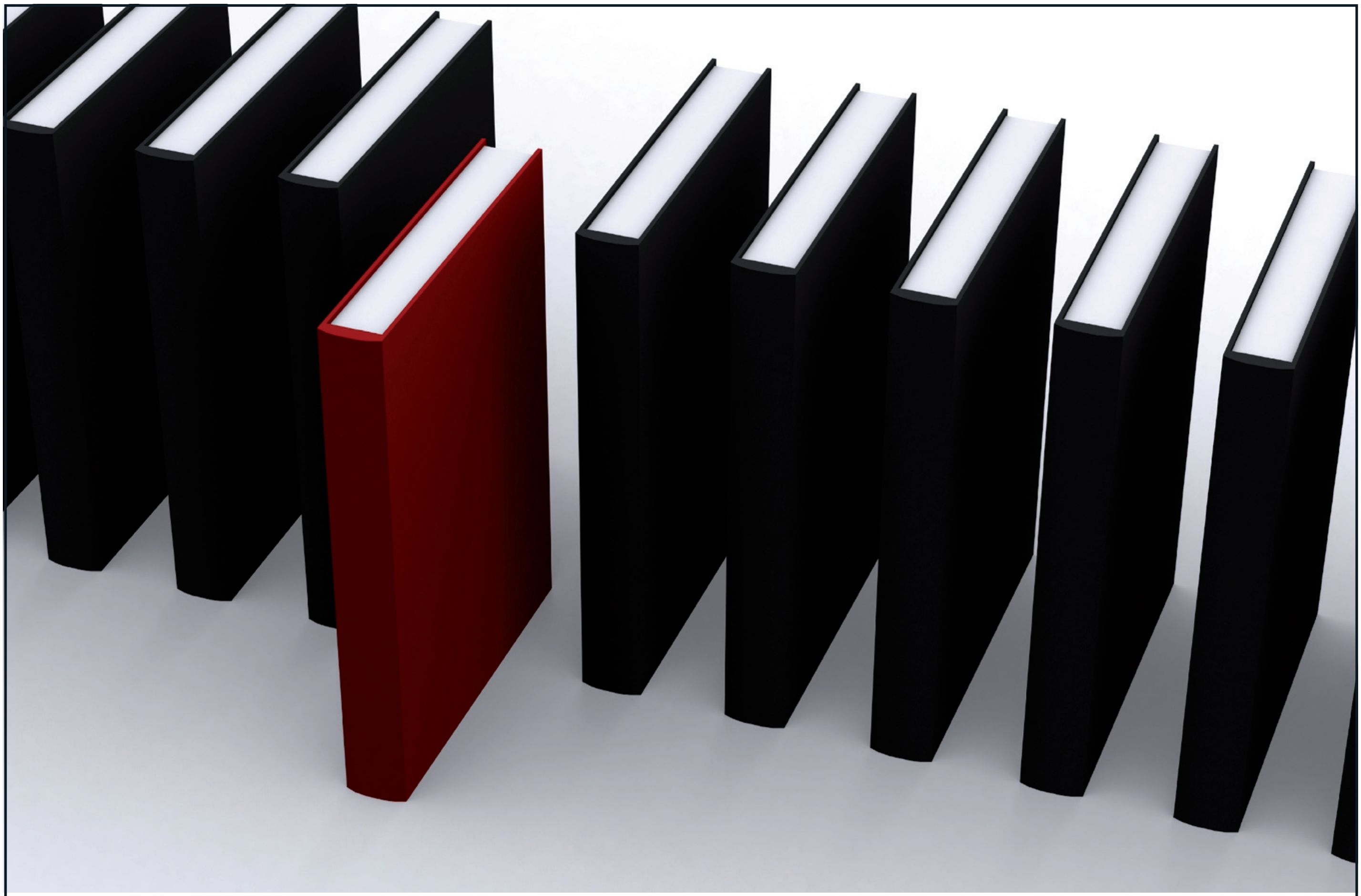
4013

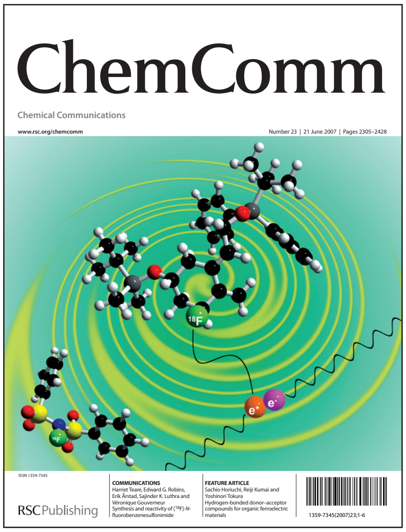
Silver carbonate nanoparticles stabilised over alumina nanoneedles exhibiting potent antibacterial properties

Joanna J. Buckley, Pratibha L. Gai, Adam F. Lee,* Luca Olivi and Karen Wilson*

Simple wet chemical methodologies allow the preparation of Ag_2CO_3 nanoparticles dispersed over γ-alumina nanoneedles that exhibit potent antimicrobial properties.





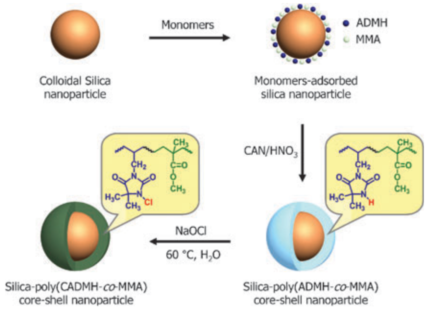


4016

Fabrication of monodisperse silica–polymer core–shell nanoparticles with excellent antimicrobial efficacy

Jyongsik Jang* and Yura Kim

Monodisperse nanoparticles with antimicrobial polymer shells were fabricated using a seeded copolymerization; they exhibited excellent antibacterial activities.

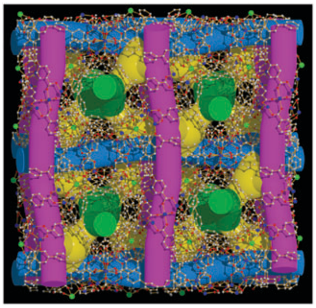


4019

Two highly-connected, chiral, porous coordination polymers featuring novel heptanuclear metal carboxylate clusters

Lei Hou, Jie-Peng Zhang,* Xiao-Ming Chen* and Seik Weng Ng

Two unprecedented (3,12)-connected, chiral, porous frameworks are constructed by benzene-1,3,5-tribenzoate and two types of heptanuclear clusters, featuring 3D pore structures, selective sorption and solvothermal resistance properties.

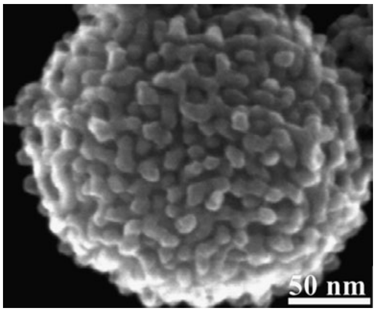


4022

Ordered mesoporous Co_3O_4 as highly active catalyst for low temperature CO-oxidation

Harun Tüysüz, Massimiliano Comotti and Ferdi Schüth*

Cubic ordered mesoporous Co_3O_4, prepared *via* the nanocasting pathway using KIT-6 as hard template, was found to be an excellent catalyst for low temperature CO oxidation, with the activity clearly depending on surface area and pore systems of the catalysts.

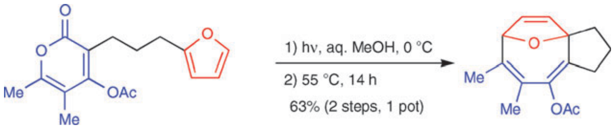


4025

Cyclooctatrienes from pyran-2-ones *via* a tandem [4 + 4]-photocycloaddition/decarboxylation process

Lei Li, Charles E. Chase and F. G. West*

Irradiation of pyran-2-ones connected to furans by a three-carbon tether furnishes [4 + 4]-photocycloadducts as a mixture of *endo* and *exo* diastereomers, whose thermal decarboxylation then provides ether-bridged cyclooctatrienes in generally moderate to good yields.



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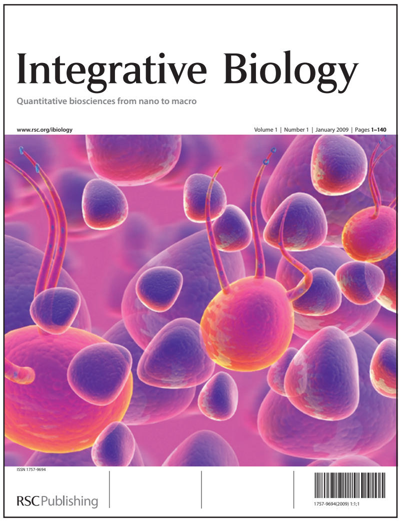
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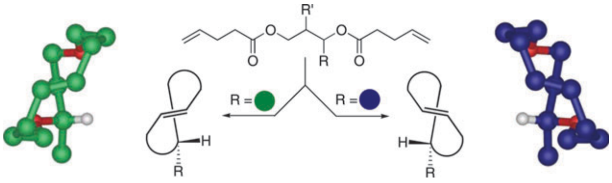
4028

Remote induction of asymmetry in [13]-macro-dilactone topology by a single stereogenic center

W. Sean Fyvie and Mark W. Peczuh*

Analysis of a series of unsaturated [13]-macro-dilactones showed that the configuration of a single carbon dictates the planar chirality of a macrocycle backbone and in turn remotely switches the facial display of an embedded alkene unit.

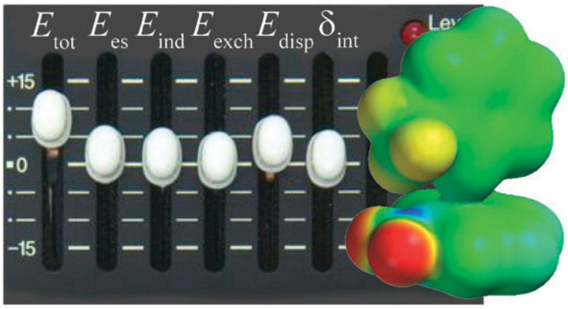


4031

Substituent effects on the aromatic edge-to-face interaction

Felix Raoul Fischer, W. Bernd Schweizer and François Diederich*

The fine tuning of substituent effects on the folding equilibrium of molecular torsion balances is rationalised on the basis of changes in the incremental contributions of dispersion, electrostatic and exchange repulsion forces to the overall interaction energy.

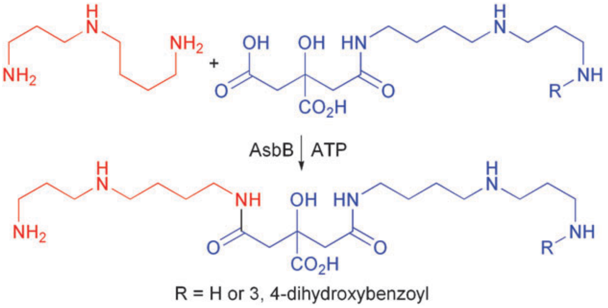


4034

Petrobactin biosynthesis: AsbB catalyzes condensation of spermidine with N^8-citryl-spermidine and its N^1-(3,4-dihydroxybenzoyl) derivative

Daniel Oves-Costales, Nadia Kadi, Mark J. Fogg, Lijiang Song, Keith S. Wilson and Gregory L. Challis*

AsbB is shown to catalyse the regioselective ATP-dependent condensation of spermidine with N^8-citryl-spermidine or its N^1-(3,4-dihydroxybenzoyl) derivative in the assembly of petrobactin, leading to a revision of the proposed biosynthetic pathway for this anthrax stealth siderophore.

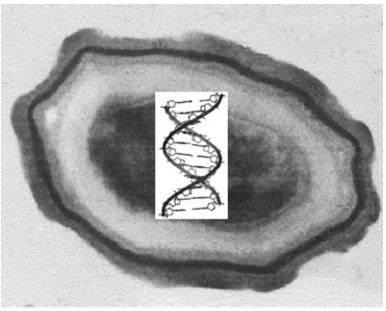


4037

Synthesis and properties of DNA containing a spore photoproduct analog

Eva Bürckstümmer and Thomas Carell*

The spore photoproduct is a unique photolesion, formed in spores upon irradiation with UV light. To investigate the properties of spore photoproduct containing DNA the authors have synthesized 5*S* and 5*R* lesion analogs and incorporated them into DNA.



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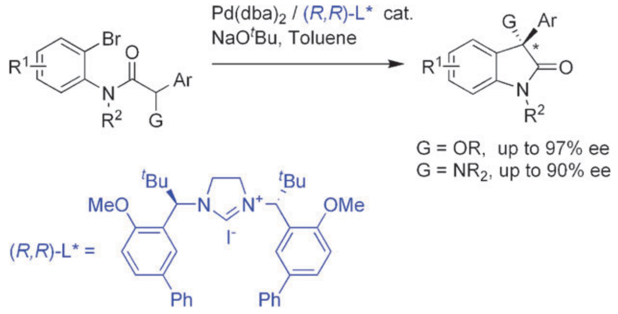
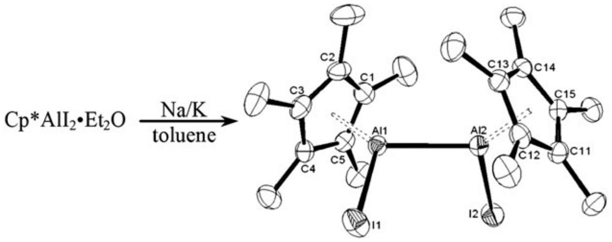


Chiral *N*-heterocyclic carbene ligands for asymmetric catalytic oxindole synthesis

Yi-Xia Jia, J. Mikael Hillgren, Emma L. Watson, Stephen P. Marsden and E. Peter Kündig*

The Pd-catalysed asymmetric intramolecular α-arylation of amide enolates containing heteroatom substituents gives chiral 3-alkoxy or 3-aminooxindoles in high yield and enantiomeric purity. Key to this success is a new chiral *N*-heterocyclic carbene ligand.

4043

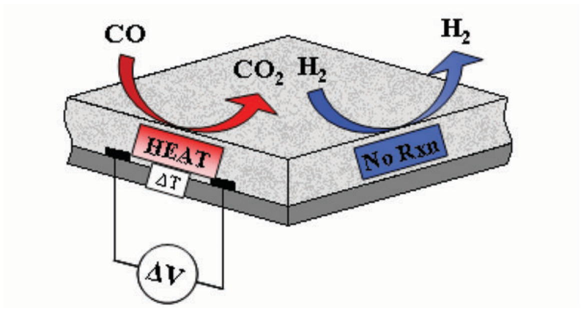


Synthesis and reactivity of bis-pentamethylcyclopentadienyl diiododialane $(Cp^*AlI)_2$: an aluminium(II) precursor to $(Cp^*Al)_4$

Stefan G. Minasian and John Arnold*

Reduction of $Cp^*AlI_2(OEt_2)$ in toluene gave bis-pentamethylcyclopentadienyl diiododialane $(Cp^*AlI)_2$ (**1**), which functions as an intermediate in the synthesis of $(Cp^*Al)_4$ and undergoes oxidative cleavage of the Al–Al bond with an aryl azide.

4046

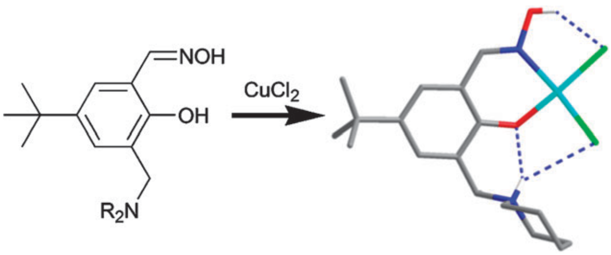


Application of CuO_x–CeO_2 catalysts as selective sensor substrates for detection of CO in H_2 fuel

Christopher S. Polster and Chelsey D. Baertsch*

The applicability and mechanism of CuO_x–CeO_2 as a catalytic microsensor substrate enabling 100% selective detection of low concentration CO in gas mixtures with H_2 is described.

4049



Transport of metal salts by zwitterionic ligands; simple but highly efficient salicylaldoxime extractants

Ross S. Forgan, James E. Davidson, Stuart G. Galbraith, David K. Henderson, Simon Parsons, Peter A. Tasker* and Fraser J. White

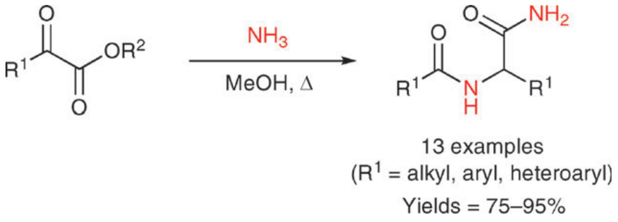
Attaching dialkylaminomethyl arms to commercial phenolic oxime copper extractants yields reagents which transport base metal salts very efficiently.

4052

Direct, facile synthesis of *N*-acyl-α-amino amides from α-keto esters and ammonia

Rukundo Ntaganda, Tamara Milovic, Jorge Tiburcio and Avinash N. Thadani*

A variety of *N*-acyl-α-amino amides are synthesized in high yields in one step by simply heating the corresponding α-keto esters in methanolic ammonia.

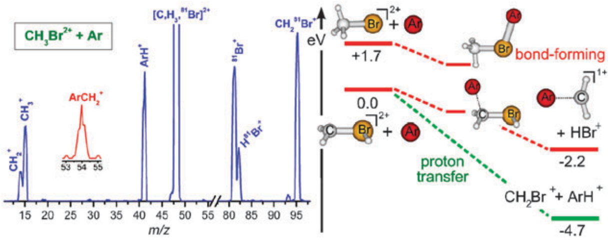


4055

Gas-phase synthesis of the rare-gas carbene cation $ArCH_2^+$ using doubly ionised bromomethane as a superelectrophilic reagent

Daniela Ascenzi, Paolo Tosi, Jana Roithová and Detlef Schröder*

The bimolecular reaction of doubly ionized methyl bromide with argon affords the argon–carbene cation $ArCH_2^+$, which is an example of a new class of organo rare-gas compounds.

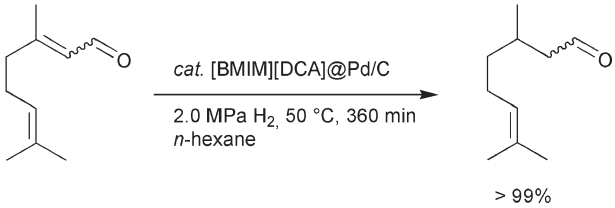


4058

The promoting effect of a dicyanamide based ionic liquid in the selective hydrogenation of citral

Jürgen Arras, Martin Steffan, Yalda Shayeghi and Peter Claus*

Conventional supported heterogeneous palladium catalysts in combination with a dicyanamide based ionic liquid are highly active with excellent selectivity and yield in enabling the one-pot synthesis of citronellal through citral hydrogenation.

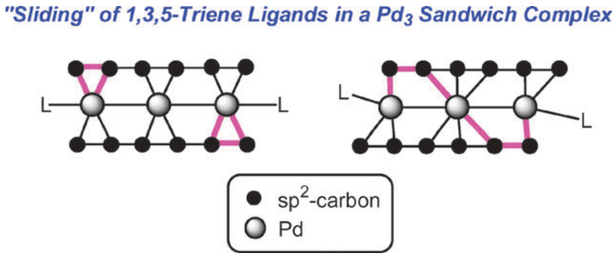


4061

Structures of two haptotropic isomers generated by the sliding of 1,3,5-triene ligands on a Pd–Pd–Pd chain

Tetsuro Murahashi,* Yukari Mino, Koji Chiyoda, Sensuke Ogoshi and Hideo Kurosawa

The structures of haptotropic isomers generated by the sliding of 1,3,5-triene ligands in a linear Pd_3 sandwich complex were structurally characterized by X-ray crystallographic analyses.



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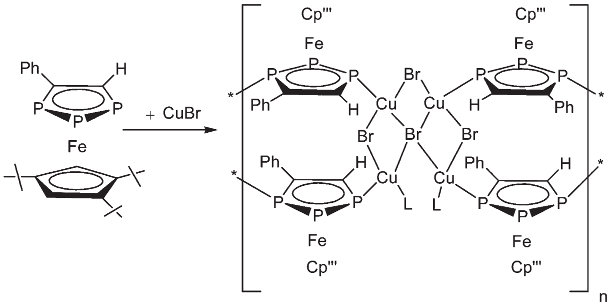
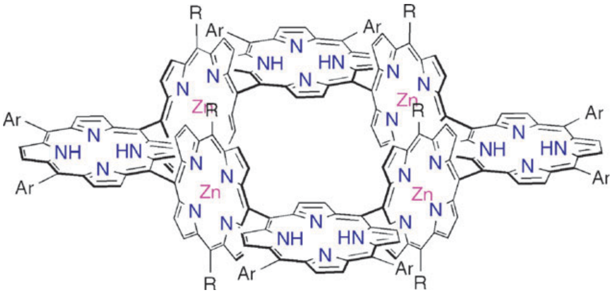


Synthesis and unprecedented coordination behaviour of a novel 1,2,3-triphosphaferrocene complex

Shining Deng, Christoph Schwarzmaier, Christiane Eichhorn, Otto Scherer, Gotthelf Wolmershäuser, Manfred Zabel and Manfred Scheer*

A novel 1,2,3-triphosphaferrocene has been synthesised. It reacts with CuBr to give a 2D polymer, revealing an unprecedented π-stacking of the triphospholyl moieties.

4067

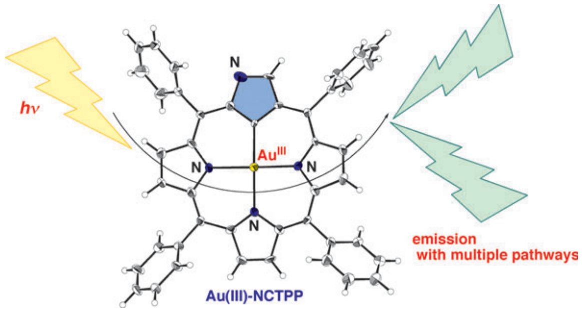


A *meso-meso* directly linked octameric porphyrin square

Naoki Aratani* and Atsuhiro Osuka*

A *meso-meso* directly linked cyclic porphyrin square was synthesized *via* stepwise Suzuki–Miyaura cross coupling reactions. This cyclic architecture has a designed large “nano-space” (*ca.* 1.6 × 1.6 × 0.7 nm^3) as the inside cavity, and can capture a guest molecule.

4070

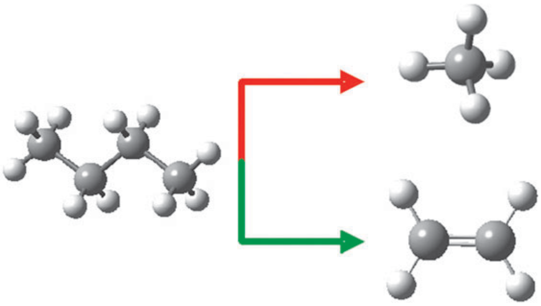


Luminescent Au(III) organometallic complex of N-confused tetraphenylporphyrin

Motoki Toganoh, Teppei Niino and Hiroyuki Furuta*

An organometallic Au(III) complex of N-confused tetraphenylporphyrin has been synthesized; unique emission properties are observed in solution at ambient temperature.

4073



Unexpected bond activation of small organic molecules on a metal oxide—butane/CaO(100)

Evgueni B. Kadossov and U. Burghaus*

An example of bond activation of small alkanes on a metal oxide at low surface temperatures is presented. The reactivity is affected by internal degrees of freedom.

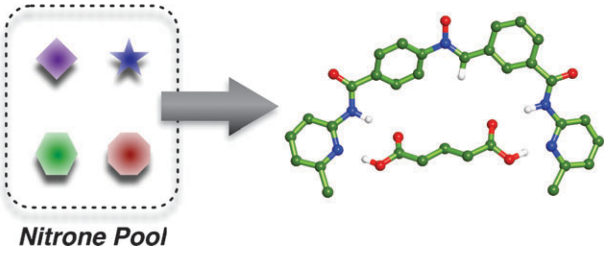
COMMUNICATION

4076

Target-driven selection in a dynamic nitrone library

Simon M. Turega, Christiane Lorenz, Jan W. Sadownik and Douglas Philp*

A receptor for a glutaric acid derivative is selected from a pool of four exchanging nitrones.



AUTHOR INDEX

Alajarín, Mateo, 3992
Aratani, Naoki, 4067
Arnold, John, 4043
Arras, Jürgen, 4058
Ascenzi, Daniela, 4055
Baertsch, Chelsey D., 4046
Barentin, Catherine, 3986
Benz, Armin, 4010
Bergström, L. Gunnar W., 3959
Braunstein, Pierre, 3983
Buckley, Joanna J., 4013
Bürckstümmer, Eva, 4037
Burghaus, U., 4073
Carell, Thomas, 4037
Cazin, Catherine S. J., 3983
Challis, Gregory L., 4034
Chase, Charles E., 4025
Chen, Xiao-Ming, 4019
Chiyoda, Koji, 4061
Claus, Peter, 4058
Comotti, Massimiliano, 4022
Cooper, Andrew I., 3986
Davidson, James E., 4049
Dawson, Ryan E., 3980
Deng, Shining, 4064
Dickinson, Calum, 3986
Diederich, François, 4031
Easton, Christopher J., 3980
Eichhorn, Christiane, 4064
Enders, Dieter, 3989
Fischer, Felix Raoul, 4031
Fogg, Mark J., 4034
Forgan, Ross S., 4049
Furuta, Hiroyuki, 4070
Fyvie, W. Sean, 4028
Gai, Pratibha L., 4013
Galbraith, Stuart G., 4049
Goeta, Andres E., 3992
Han, Jianwei, 3989
Hartig, Jörg S., 4010
Henderson, David K., 4049
Henseler, Alexander, 3989
Hillgren, J. Mikael, 4040
Hou, Lei, 4019
Huang, Xiao-Chun, 3995
Huh, Hyun Sue, 3998
Jang, Jyongsik, 4016
Jia, Yi-Xia, 4040
Kadi, Nadia, 4034
Kadossov, Evgueni B., 4073
Kim, Dongho, 3998
Kim, Kil Suk, 3998
Kim, Yura, 4016
Kündig, E. Peter, 4040
Kurosawa, Hideo, 4061
Laromaine, Anna, 3986
Lee, Adam F., 4013
Lee, Eunji, 4001
Lee, Myongsoo, 4001
Lee, Soon W., 3998
Lévy, Raphaël, 3986
Li, Dan, 3995
Li, Guangshe, 4004
Li, Lei, 4025
Li, Liping, 4004
Lim, Yong-beom, 4001
Lin, Xin-Jian, 3995
Lincoln, Stephen F., 3980
Lorenz, Christiane, 4076
Luo, Wei, 3995
Marsden, Stephen P., 4040
McComb, David W., 3986
Milovic, Tamara, 4052
Minasian, Stefan G., 4043
Mino, Yukari, 4061
Moon, Kyung-Soo, 4001
Murahashi, Tetsuro, 4061
Ng, Seik Weng, 4019
Niino, Teppei, 4070
Ntaganda, Rukundo, 4052
Ogoshi, Sensuke, 4061
Olivi, Luca, 4013
Olivier-Bourbigou,
  Hélène, 3983
Orenes, Raúl-Angel, 3992
Osuka, Atsuhiro, 4067
Oves-Costales, Daniel, 4034
Park, Soo Young, 3998
Parsons, Simon, 4049
Pastor, Aurelia, 3992
Peczuh, Mark W., 4028
Petit, Laure, 3986
Philp, Douglas, 4076
Polster, Christopher S., 4046
Raynal, Matthieu, 3983
Roithová, Jana, 4055
Rosseinsky, Matthew J., 3986
Sadownik, Jan W., 4076
Schaeffer, Nicolas, 3986
Scheer, Manfred, 4064
Scherer, Otto, 4064
Schröder, Detlef, 4055
Schüth, Ferdi, 4022
Schwarzmaier, Christoph, 4064
Schweizer, W. Bernd, 4031
Shayeghi, Yalda, 4058
Shen, Yu-Feng, 3995
Song, Lijiang, 4034
Spiller, David G., 3986
Steed, Jonathan W., 3992
Steffan, Martin, 4058
Stevens, Molly M., 3986
Su, Yiguo, 4004
Tan, Bien, 3986
Tasker, Peter A., 4049
Thadani, Avinash N., 4052
Tiburcio, Jorge, 4052
Toganoh, Motoki, 4070
Tosi, Paolo, 4055
Turega, Simon M., 4076
Tüysüz, Harun, 4022
Vallée, Christophe, 3983
Wang, Yiqian, 3986
Watson, Emma L., 4040
Webb, Simon J., 4007
West, F. G., 4025
White, Fraser J., 4049
Wilson, Craig P., 4007
Wilson, Karen, 4013
Wilson, Keith S., 4034
Wolmershäuser, Gotthelf, 4064
You, Youngmin, 3998
Zabel, Manfred, 4064
Zhang, Jie-Peng, 4019

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September 2008 / Volume 5 / Issue 9 / ISSN 1744-1560 / CTHEC2 / www.rsc.org/chemicaltechnology

Chemical Technology

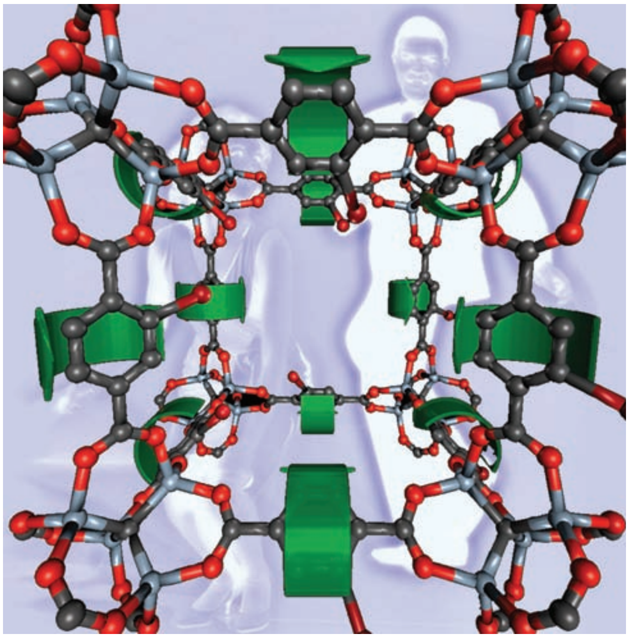
Solid-state rotors may replace liquid crystals

Metal organic frameworks do the twist

Rotating solid-state crystals could outperform liquid crystals for optoelectronic applications, claim US scientists.

John Price and colleagues from the University of Colorado, Boulder, have investigated metal organic framework crystals that can act as molecular rotors. Rotating or twisting molecules using an applied electric field is the principle behind liquid crystals, an important class of optoelectronic materials. However, solid-state crystals – such as metal organic framework (MOF) crystals – could lead to more robust materials for use in the data communications industry.

MOF crystals are metal clusters linked by organic groups to form 1-, 2- and 3-D frameworks. Price's team used an existing MOF containing octahedrally coordinated zinc oxide clusters and incorporated polar functional groups into the organic linker parts of the framework. They demonstrated that in the presence of an electric field, the effect on the polar group causes the molecule to rotate. Rotation was not observed for an analogous MOF with no polar functional groups.



Polar groups on the metal organic framework cause the molecule to rotate

'MOFs have better structural predictability than we currently have with other solid-state crystals which makes them particularly appealing,' says Erick Winston, a member of Price's group. However, more work is needed as the barrier to rotation of 7.3 kcal mol^{-1} for this particular polar MOF means that it cannot compete with liquid crystals.

The Colorado group plan to keep searching for an MOF structure which can compete with liquid crystals. 'Dealing with these challenges does not appear to be a far off goal,' says Winston, 'particularly if the community becomes more interested in molecular rotation in MOF crystals.'

Miguel Garcia-Garibay, an expert in MOFs from the University of California, Los Angeles, US, says that the work of the Price group represents 'an important step forward' in the application of crystals as molecular rotors.

Ruth Doherty

Reference

E B Winston *et al*, *Phys. Chem. Chem. Phys.*, 2008, **10**, 5188 (DOI: 10.1039/b808104b)

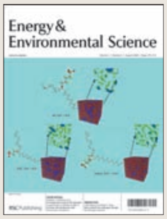
In this issue

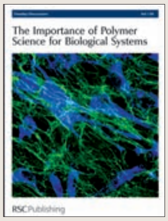
Artificial cells seek out disease
Polymers self-assemble into drug delivery vesicles that release contents on cue

Fabrics reveal their explosive secrets
New detection method could improve airport security

Interview: Chemistry's gain
Ryong Ryoo tells Rachel Cooper how he took a risk and became an expert in mesoporous materials

Instant insight: The wonder of gold
Graham J Hutchings, Mathias Brust and Hubert Schmidbaur introduce the newly discovered allure of gold





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

Application highlights

Detection using surface plasmon resonance could save lives

Faster test for tuberculosis

Early diagnosis of tuberculosis is now a step closer, say scientists from India and Japan.

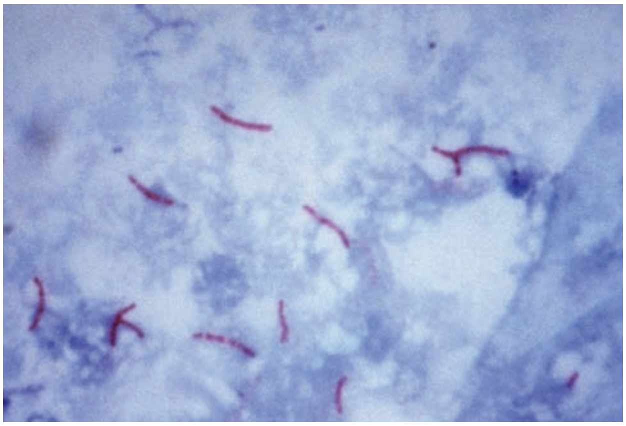
Bansi Malhotra from the National Physical Laboratory in New Delhi, India and colleagues have made a detection device that is quick, precise and efficient to use.

According to the World Health Organization, tuberculosis kills nearly three million people every year. Patients suffer damage to their lungs, bones and central nervous system. Current detection techniques, such as the polymerase chain reaction (PCR) and immunoassays, although sensitive, can take from hours to days to complete and are expensive. A faster and cheaper test is an absolute necessity, says Malhotra.

Malhotra's sensor detects the DNA of the disease-causing bacterium *Mycobacterium tuberculosis*. When a serum sample containing the bacterium passes over the sensor, the bacterial DNA binds to complementary nucleotide sequences fixed to a gold surface. This causes a change in optical properties which can be detected using surface plasmon resonance.

The device was so sensitive, it could detect *M. tuberculosis* DNA without PCR amplification or rigorous washing, decreasing the detection time to around 12 minutes. Malhotra says that the next step is to make a commercial sensor for clinical samples and miniaturise it for point-of-care use. But the research doesn't stop there: 'This technique has implications for the diagnosis of other diseases, such as cholera, and sexually transmitted infections like *Neisseria gonorrhoeae*,' he explains.

Rebecca Brodie



The disease-causing bacterium can be detected in about 12 minutes

CDC

Reference

N Prabhakar *et al*, *Analyst*, 2008, DOI:10.1039/b808225a

Microfluidic array allows complex biological experiments

On-chip sequential cell treatment

US scientists have designed a chip that can subject cells to different chemical treatments in a continuous sequence.

James Sturm and colleagues at Princeton University have tested a method that can handle complex sequential cell analyses.

On-chip experiments produce faster results than conventional approaches and use smaller sample and reagent volumes. But their application to biological systems is limited because sequential treatments are often required, causing reagent mixing that is difficult to reverse.

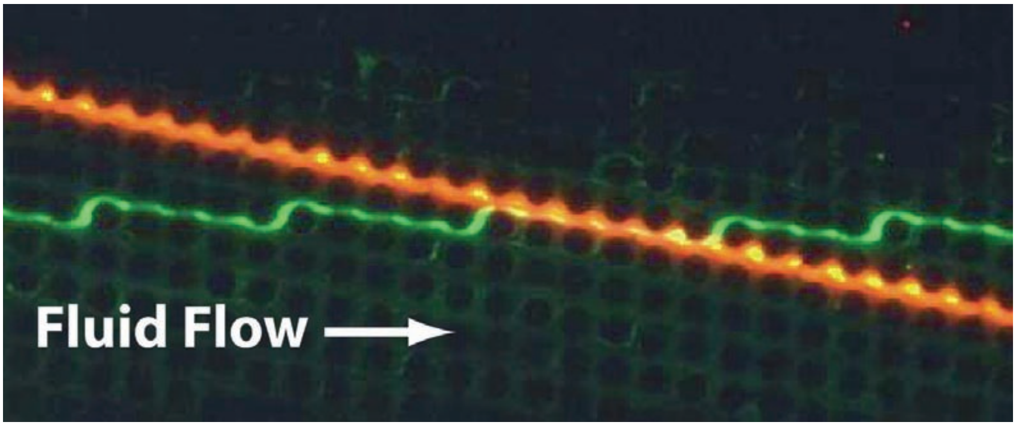
Sturm's chip has an asymmetric arrangement of posts that causes cells to move across the surface at an angle. Parallel streams of reagents, known as microfluidic channels, flow over the chip so that the cells pass through each chemical zone without any cross-contamination.

Sturm's team demonstrated the technique could be used for labelling and washing a blood cell, which proved to be much simpler than other methods currently used. They also broke down a bacterial cell on the chip and removed the intact chromosome.

'For whole bacterial chromosome isolation, the method is without peer,' comments co-worker Keith Morton. He says he hopes the technique will advance whole chromosome research. The next challenge is to design a system capable of more complex reactions.

Harold Craighead of Cornell University, Ithaca, US, an expert in biomolecule microfluidics, says, 'This approach presents exciting new possibilities for continuous analysis of cells, bacteria, and biomolecules.'

Harriet Brewerton



An asymmetric arrangement of posts directs particles across multiple reagent streams

Reference

K J Morton *et al*, *Lab Chip*, 2008, **8**, 1448 (DOI: 10.1039/b805614e)

Polymers self-assemble into drug delivery vesicles that release contents on cue

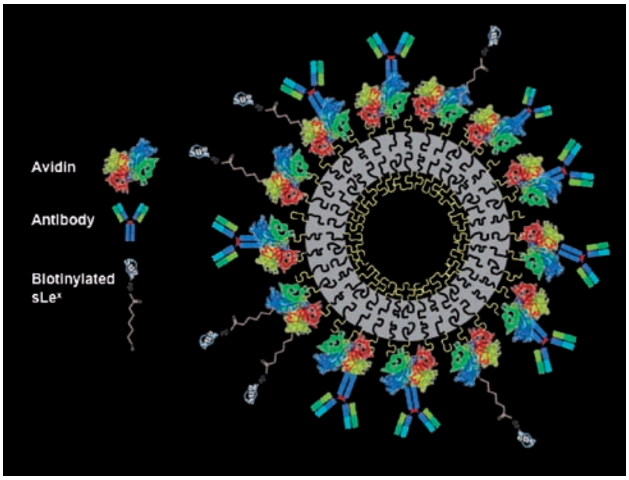
Artificial cells seek out disease

Scientists in the US have made an artificial cell that can locate sites of disease within the body.

Daniel Hammer and colleagues at the University of Pennsylvania, Philadelphia, and the University of Minnesota, Minneapolis, say they can engineer the cell to release its contents on cue, allowing it to deliver drugs directly to sites of disease. This approach could be useful in treating diseases such as cancer, they claim.

The artificial cells, known as leuko-polymersomes, are made from polymers that can self-assemble into vesicles that can be used for drug delivery. Polymersomes have been used in this way before but Hammer has now developed a way to make them behave like white blood cells. This lets them travel quickly and easily through blood vessels in the body.

'After the invention of polymersomes, it seemed natural to make an artificial white blood cell from them because there are so many ways that one can engineer the mechanical properties and release characteristics of polymersomes,' says Hammer.



Leuko-polymersomes can encapsulate drugs and deliver them to sites of disease

Hammer and his team now plan to use different types of ligands on the polymersome's surface to target different locations within the body. 'These leuko-polymersomes are designed to travel to sites of inflammation,' explains Hammer. 'However, with different homing ligands, we envision developing particles that could find sites of cancer or other diseases.'

'The leuko-polymersome is a great example of biomimetics, and their tuneable strength and surface adhesion are proving useful for a range of clinical applications in drug delivery and medical imaging,' comments Michael King, an expert in biomedical engineering at the University of Rochester, US. 'Looking forward to the future, one could imagine the polymersome as an important building block in the field of synthetic biology, for instance incorporating ion channels to produce "smart" polymersomes which sense their surroundings, or encapsulating enzymatic cargo within circulating "micro-factories".'

Sarah Dixon

Reference

D A Hammer *et al*, *Faraday Discuss.*, 2008, **139**, 129 (DOI: 10.1039/b717821b)

New class of CO_2 binding agents could help reduce global warming

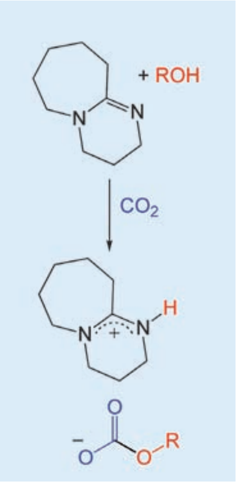
Organic liquids capture greenhouse gas

Carbon dioxide-binding organic liquids (CO_2BOLs) can hold more than twice as much CO_2 as current capture agents, say scientists in North America. The liquids could be used in coal power plants to capture the greenhouse gas from combustion exhaust.

David Heldebrant at the Pacific Northwest National Laboratory, Richland, US, and colleagues, made CO_2BOLs from mixtures of organic alcohols and strong organic bases. They found that the CO_2BOLs can store up to 19 per cent of their weight in CO_2, much higher than the maximum of seven per cent achievable with current aqueous amine systems.

'The biggest obstacle in efficient chemical CO_2 capture and release is the cost of stripping CO_2 from the aqueous capture agent due to the high specific heats associated with water,' says Heldebrant. Removing, or stripping, the CO_2 from the capture agent allows the liquid to be recycled and capture more CO_2. With CO_2BOLs, less fluid is needed to capture the same amount of CO_2, and less energy is needed to strip the CO_2, Heldebrant explains. 'Such a system can potentially offer large energy savings for CO_2 stripping when employed on an industrial scale,' he adds.

In addition, Heldebrant's group found that the CO_2BOLs, which were designed to be a direct replacement for the aqueous amines currently used in coal plants, could go through five cycles of capturing and releasing CO_2 without losing activity or selectivity.



'The release of CO_2 in a controlled fashion is important for permanent sequestration of CO_2 or other applications such as carbonation in the beverage, dry cleaning or chemical industries,' explains Heldebrant. 'Just because CO_2 is a greenhouse gas doesn't mean it has no useful applications or market value.'

Kazunari Ohgaki, an expert in carbon capture and storage, from Osaka University, Japan, sees the potential of the study. 'In the future, these mixtures could replace aqueous amine solutions as a way of removing CO_2 from post-combustion waste gases,' he says .

Heldebrant's team are currently modelling the system to check for any obstacles to implementation and also plan to investigate whether CO_2BOLs could be used to capture CO_2 before the fuel is burned .

Christina Hodkinson

Reference

D J Heldebrant *et al*, *Energy Environ. Sci.*, 2008, DOI: 10.1039/b809533g

New detection method could improve airport security

Fabrics reveal their explosive secrets

Explosives and drugs on fabrics can be detected within seconds using mass spectrometry, say US scientists. The method could be used to improve travel security in airports, they claim.

Graham Cooks and colleagues from Purdue University, West Lafayette, analysed a variety of fabrics for drugs and explosives using desorption electrospray ionisation (DESI) mass spectrometry. They showed they could identify compounds of interest in less than 10 seconds, even if the fabric also contained other chemicals, such as insect repellent or skin lotions.

Typically, scientists have to extract compounds from fabrics using time-consuming techniques, such as solvent extraction. In DESI, charged droplets from an electrospray source are directed at the fabric. Compounds on the fabric's surface are picked up by the charged droplets and analysed in a mass spectrometer. The method, which can detect compounds at picogram levels, requires no sample preparation or work-up. It allows mass spectrometry to address important problems in forensics and public safety rapidly with the accuracy of slower traditional mass spectrometry methods, says Cooks.

Even though this method seems to overcome quite a few of the background and interference problems associated with other methods, further investigations are still needed, states Christopher Latkoczy, a specialist in the applications of mass spectrometry from the Swiss Federal Institute of Technology, Zurich. 'After overcoming some of the current limitations, in the future this method could be used as a rapid screening technique coupled to handheld devices for security people working, for example, at airports,' he says.

Nowhere to hide: drugs and explosives on clothing can be identified within seconds

Cooks already plans to miniaturise the technique: 'The next challenge is to develop a handheld mass spectrometer capable of performing the same ambient ionisation experiments in situ,' he says.

Michael Brown

Reference

N Talaty *et al*, *Analyst*, 2008, DOI:10.1039/b807934j

Interview

Chemistry's gain

Ryong Ryoo tells Rachel Cooper how he took a risk and became an expert in mesoporous materials

Ryong Ryoo

Ryong Ryoo is a professor of chemistry at Korea Advanced Institute of Science and Technology and has been on the *Chemical Communications* editorial board since 2006. He has received numerous awards and was named Korea's national scientist by the Korean government in 2007.

What first attracted you to science?

In the second year of high school in Korea, students are divided into two groups. One group is taught science and engineering and the other is taught an advanced level of literature, such as English. I belonged to the non-science group, so I never thought I would become a scientist. When I was almost at the end of my high school studies, I realised that my ability was science-based, so I decided to risk taking the entrance exam for science at Seoul National University. Fortunately, I succeeded.

What made you choose chemistry as a career?

At university, I liked chemistry. I took the entrance exam for KAIST [Korea Advanced Institute of Science and Technology], a university that gave special exemption from military service. People graduating from KAIST could instead take a job in industry, a research institute or even in a university, with three years' regular salary. I would never have thought about being a chemist otherwise, as my parents could not afford to pay for my graduate studies. Korea was totally different 30 years ago – ordinary people couldn't think about sending their children to study. It cost too much.

Which area of chemistry did you work in?

Initially, I chose computational chemistry, calculating thermodynamic properties of liquid helium and other liquids. After working at a national lab, the Korea Atomic Energy Research Institute, for three years, I went to Stanford University for my PhD. There, I chose more practical chemistry – heterogenous catalysis. I learnt about xenon gas NMR, and its use on porous materials, such as zeolites, but I didn't learn how to synthesise porous materials at that time. I returned to Korea after a one-year post-doctoral stay at the University of California, Berkeley and I did the same kind of research as I had done in the US. I used zeolites as supports for platinum. I used xenon NMR, extended X-ray absorption fine structure and other physical tools to characterise porous zeolites and supported metal nanoparticles, at that time called clusters.

What is your favourite piece of research?

At a conference in Japan in 1993, I happened to hear about mesoporous silica MCM-41. I was fascinated by its structure and large pores. I wanted to use the material as a support for metal nanoparticles, but I couldn't obtain it then. Although I knew nothing about the chemistry of silica, I decided to synthesise it in my laboratory. I struggled for several years, and somehow became an expert in mesoporous materials. Because I hadn't been trained how to do it, I used my own ideas and this is what brings the field forwards. In 1999, I published a very important paper on the synthesis of ordered mesoporous carbon, using mesoporous silica as a template. Before that, there were no carbon materials showing ordered porosity, so my synthesis of the first ordered mesoporous carbon, named CMK (carbon metastructure at KAIST), was very surprising. It was the first material to exhibit Bragg X-ray diffraction peaks (due to the structural order) with porosity. People were fascinated by the material; they began to use it and to follow the synthesis. So that was my favourite, and best, work.

What do you see as the most important future applications for mesoporous materials?

These days, I work on zeolites with mesoporosity as well as the inherent microporosity. Microporous materials have pores smaller than two nanometres, and mesoporous materials have pores between two and 50 nanometres. Zeolites have micropores about one nanometre and normally they are synthesised as crystals, with no mesoporosity. However, if you synthesise zeolites with mesopores penetrating the crystals then you make a zeolite with both micropores and mesopores; these are called hierarchical zeolites. The advantage of such hierarchical zeolites is that molecular diffusion can take place very rapidly through large mesopores into small micropores. Without mesopores, the diffusion into micropores is very slow. The consequence of such facile diffusion is that zeolites, in many reactions, show dramatically increased lifetimes when they are used as catalysts. This is a great advantage, as you can continuously operate two or three times longer without catalyst replacement, saving money.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The wonder of gold

Graham J Hutchings, Mathias Brust and Hubert Schmidbaur introduce the newly discovered allure of gold

Gold is a material that has fascinated humankind since it was first discovered. It is the most noble of metals; it does not tarnish on exposure to the atmosphere and retains its beautiful lustre undiminished for millennia. It has been the inspiration for great artworks and also the cause of great conflicts. It is also a metal with high monetary value and, in these current times of high energy costs, gold has increased in value dramatically. Hence, from the perspective of the monetary, art and historical communities, gold is an important metal, something that has high value and is readily traded.

Gold was also the fascination of alchemists as they tried, in vain, to make gold from base metals. However, for mainstream chemists, until recently, gold has presented very little fascination. Its chemical inertness in a bulk state convinced chemists that few, if any, exciting chemistries awaited deeper investigation. Hence, the real wonders of gold chemistry have only recently been discovered and the observation that gold, when sub-divided to the nanoscale, can be exceptionally active as a catalyst, has spurred a great number of discoveries. In tandem with catalysis discoveries, there have been enormous developments in the fabrication and uses of gold nanoparticles that are underpinned by the growing field of structural and theoretical advances that are being made in gold chemistry.

Gold now fascinates material scientists, catalysis, surface and synthetic chemists and theoreticians in great numbers. From a catalysis viewpoint, gold has become the hot topic and is now the catalyst of choice for many reactions. Indeed, the observation that it can catalyse the oxidation of carbon monoxide at temperatures as low as minus 76 degrees Celsius has fascinated many researchers in the recent past.

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In terms of application, gold catalysts are starting to show efficacy in selective oxidation and hydrogenation, often showing activities far higher than other previously tried catalysts. There still remains a fascination with carbon monoxide oxidation, since this is expected to find applications in fuel cells for removal of the last traces of carbon monoxide impurities in the hydrogen fuel, something that gold can readily achieve without oxidizing the valuable hydrogen. A key discovery has been the discovery that gold–palladium alloys can act as efficient catalysts for the direct formation of hydrogen peroxide by hydrogenation of oxygen, which we anticipate will find commercial application.

Although the field of gold chemistry and catalysis has been significantly advanced in recent years, many key challenges remain. In the case of gold chemistry, we now need to gain precise control in the preparation strategies of the particle shape. Most effort has gone into controlling particle size, but controlling shape will be more challenging. In the field of catalysis, the remaining main challenge concerns the nature of the active site for supported gold nanoparticles. This has proved to be a highly controversial topic and a number of key debates concern the electronic nature of the active species. It is most likely that different gold species will be active for the myriad of reactions that gold can catalyse. However, as yet the active site for most reactions remains an area of intense activity.

Gold is a metal with high monetary value that is now finding new uses in chemistry

Read more in 'Gold - an introductory perspective' in issue 9 of Chemical Society Reviews.

Reference

G J Hutchings, M Brust and H Schmidbaur, *Chem. Soc. Rev.*, 2008, **37**, 1759 (DOI: 10.1039/b810747p)

Essential elements

Molecules of Murder book launch

On 30 July the RSC, with Waterstone's bookshop Gower Street London, were delighted to host the launch of John Emsley's highly anticipated book *Molecules of Murder: Criminal Molecules and Classic Cases*. John Emsley is a great science communicator, best known for his series of highly readable books about everyday chemistry. His latest book looks at 10 toxic molecules, discusses their chemistry and effects in humans, and re-examines their deliberate misuse in high profile murder cases.

At the book launch, guests were joined by two actors in Victorian costume, posing as the murderer and victim from Chapter 2 of the book: Hyoscine and the Murder of Belle Elmore (Mrs Crippen). The infamous Edwardian killer Dr Crippen poisoned his wife, Belle Elmore, then dissected and buried her under the cellar floor. The victim was a minor celebrity noted for her flamboyant clothing, and had appeared at music halls around the country at that time. The two came to life in the basement of Waterstone's bookshop, and intrigued guests with spine chilling tales of poison and murder!

John Emsley signed copies of the book, described his reasons for embarking on the project and then read a piece of the work. Guests reading the book for the first time were interested to find out about other murder cases, such as the use of ricin in a rolled umbrella to assassinate Georgi Markov 30 years ago, and most recently the murder of Alexander Litvinenko in London by polonium. *Molecules of Murder* is a gripping read with appeal to chemists and non-chemists alike. Anyone with an interest in popular science and crime will be enthralled by this exciting new book.

For more information please visit www.rsc.org/books

A science feast in Philadelphia

It was an action-packed few days at the ACS Fall 2008 National Meeting in Philadelphia. The first print issue of *Energy & Environmental Science* generated a lot of interest, with its impressive range of articles on solar cells, hybrid fuel cells, hydrogen storage, biofuel production, sustainable energy, and more. *Integrative Biology* and *Metallomics*, the two new journals launching in 2009, were in the spotlight and grabbed the attention of many visitors to the RSC booth. RSC Publishing staff were on hand as people signed up for journal e-alerts, hoping to win a solar-powered charger for mobile devices. The book sale proved popular, and authors John Emsley (*Molecules of Murder*) and Stephen Beckett (*The Science of Chocolate*) signed copies of their recent books for an appreciative audience. Other activities included stimulating talks on science writing and chocolate – and the arrival of cookies, cakes and other goodies, gave everyone a chance to boost their energy levels!

The RSC Reception, held at a nearby Philadelphia hotel, gave assembled guests the opportunity to hear from RSC President Dave Garner about developments across the whole of the RSC, including how the RSC Roadmap will shape future RSC strategy.

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Chemical Technology (ISSN: 1744-1560) is published monthly by the Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge UK CB4 0WF. It is distributed free with *Chemical Communications, Journal of Materials Chemistry, The Analyst, Lab on a Chip, Journal of Atomic Absorption Spectrometry, Green Chemistry, CrystEngComm, Physical Chemistry Chemical Physics, Energy & Environmental Science* and *Analytical Abstracts*. *Chemical Technology* can also be purchased separately. 2008 annual subscription rate: £199; US $396. All orders accompanied by payment should be sent to Sales and Customer Services, RSC (address above). Tel +44 (0) 1223 432360, Fax +44 (0) 1223 426017 Email: sales@rsc.org

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