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IN THIS ISSUE

ISSN 1359-7345 CODEN CHCOFS (24) 2429–2544 (2007)



Cover

See Qiang Xu *et al.*, page 2467. The image shows the structure of the unique synthetic metal-organic framework material replicating the topology of fluorite, a crude mineral. Image reproduced by permission of Ru-Qiang Zou, Rui-Qin Zhong, Miao Du, Tetsu Kiyobayashi and Qiang Xu from *Chem. Commun.*, 2007, 2467.

ENERGY SUPPLEMENT

2445

Energy and the Chemical Sciences provides a 'snapshot' of the latest developments in energy and the environment from all RSC publications, showcasing newsworthy articles, upcoming theme issues, recent book titles and feature articles on this topic.

Energy and the Chemical Sciences

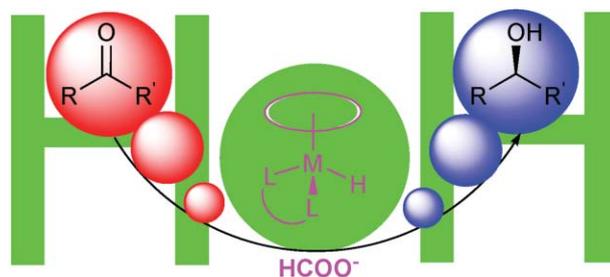
FEATURE ARTICLE

2449

Aqueous-phase asymmetric transfer hydrogenation of ketones – a greener approach to chiral alcohols

Xiaofeng Wu and Jianliang Xiao*

This article summarises the recent progress on transfer hydrogenation reactions in water, showing that various carbonyl compounds can be reduced in high speed, enantioselectivity and chemoselectivity with either off-the-shelf or tailor-made catalysts.



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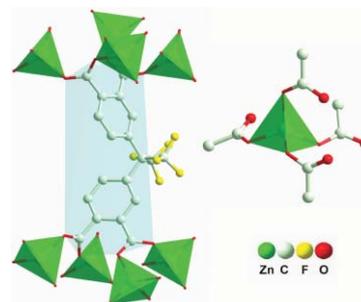
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2467

Highly-thermostable metal–organic frameworks (MOFs) of zinc and cadmium 4,4'-(hexafluoroisopropylidene)-diphthalates with a unique fluorite topology

Ru-Qiang Zou, Rui-Qin Zhong, Miao Du, Tetsu Kiyobayashi and Qiang Xu*

Two highly-thermostable metal–organic framework materials with a unique fluorite topology are presented.

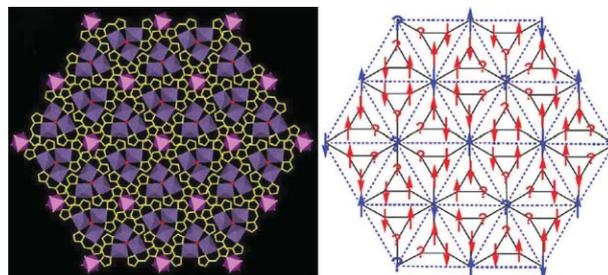


2470

Novel frustrated magnetic lattice based on triangular $[\text{Mn}_3(\mu_3\text{-F})]$ clusters with tetrazole ligands

En-Qing Gao,* Na Liu, Ai-Ling Cheng and Song Gao

Unprecedented $[\text{Mn}^{\text{II}}_3(\mu_3\text{-F})(\mu\text{-N-N})]$ triangular clusters with tetrazole ligands are linked by Mn^{II} ions to generate a novel spin-frustrated 2D lattice exhibiting antiferromagnetic ordering.

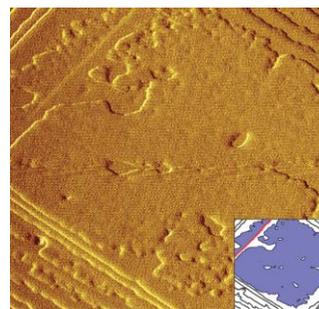


2473

Differentiating fundamental structural units during the dissolution of zeolite A

L. Itzel Meza,* Michael W. Anderson* and Jonathan R. Agger

The dissolution of the $\{100\}$ facets of zeolite A crystals in alkaline conditions occurs *via* a two-step process; uncorrelated dissolution of a single-four ring layer and step retreat of a sodalite-cage layer. The rates of dissolution have been successfully calculated for the first time by means of *in situ* atomic force microscopy examination.

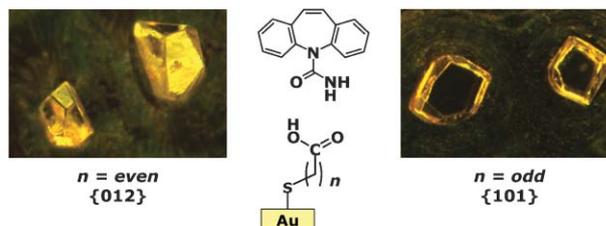


2476

Effect of alkyl chain parity on the face-selective crystal growth of a drug polymorph

Marta Dabros and Venkat R. Thalladi*

Carboxy terminated alkanethiol self-assembled monolayers promote the face-selective nucleation of the *P*-monoclinic polymorph of carbamazepine; the type of face nucleated depends on the parity of the alkyl chain. Coplanarity of the carboxy groups and amide dimers at the interface guides this selectivity.



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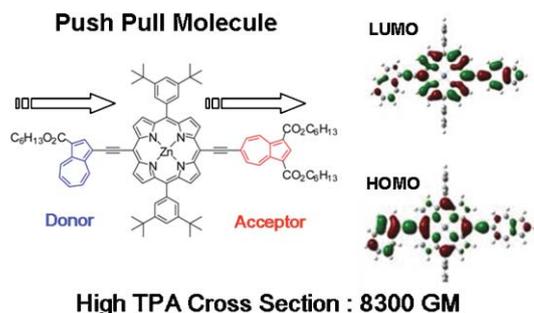


2479

Charge transfer induced enhancement of near-IR two-photon absorption of 5,15-bis(azulenylethynyl) zinc(II) porphyrins

Kil Suk Kim, Su Bum Noh, Takayuki Katsuda, Shuji Ito, Atsuhiko Osuka* and Dongho Kim*

Intramolecular charge transfer in 5,15-bis(azulenylethynyl) substituted zinc(II) porphyrin leads to a significant enhancement of two-photon absorption at near-IR region, which has been investigated by femtosecond Z-scan method.

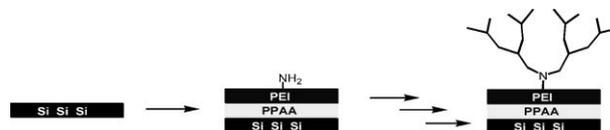


2482

Synthesis and characterization of immobilized PAMAM dendrons

Neal Pollock, Greg Fowler, Lance J. Twyman* and Sally L. McArthur*

The synthesis and characterization of dendrons immobilized onto a silicon surface functionalized with plasma polymerized acrylic acid and polyethyleneimine are described.

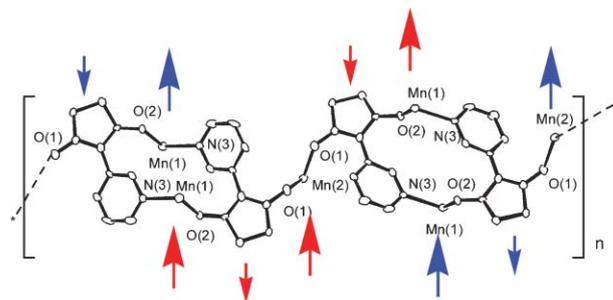


2485

Preparation, structure, and magnetic interaction of a Mn(hfac)₂-bridged [2-(3-pyridyl)(nitronyl nitroxide)-Mn(hfac)₂]₂ chain complex

Keiji Okada,* Shiori Beppu, Koichiro Tanaka, Masato Kuratsu, Kimiaki Furuichi, Masatoshi Kozaki, Shuichi Suzuki, Daisuke Shiomi,* Kazunobu Sato, Takeji Takui, Yasutaka Kitagawa and Kizashi Yamaguchi*

Red and blue spins align as shown at low temperatures in a new one-dimensional chain complex, [2-(3-pyridyl)(nitronyl nitroxide)]₂·[Mn(hfac)₂]₃.

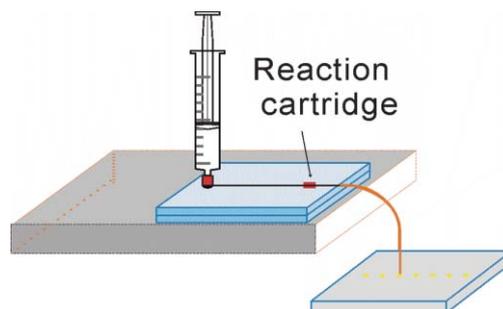


2488

Subfemtomole level protein sequencing by Edman degradation carried out in a microfluidic chip

Wenzhang Chen, Xuefeng Yin,* Jinxia Mu and Yan Yin

A microfluidic chip based Edman degradation system that employs a nanoliter-scale C18 column as a reaction cartridge.



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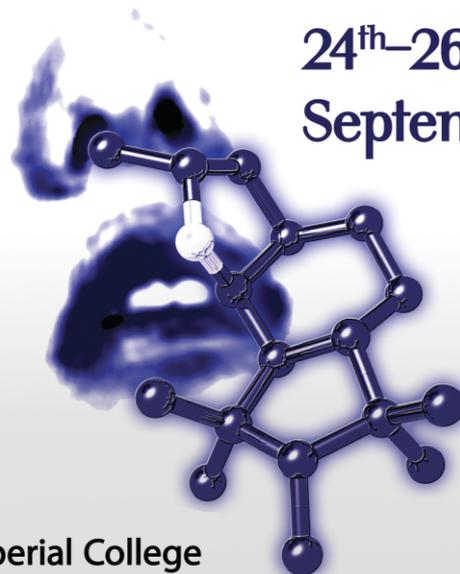
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Imperial College London

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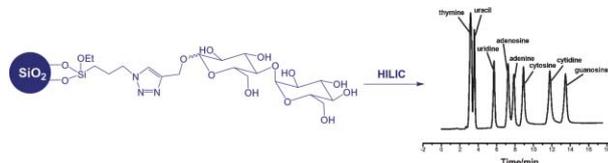
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2491

“Click saccharides”: novel separation materials for hydrophilic interaction liquid chromatography

Zhimou Guo, Aiwen Lei,* Yongping Zhang, Qing Xu, Xingya Xue, Feifang Zhang and Xinmiao Liang*

Saccharides were covalently bonded onto silica beads *via* click chemistry and were employed as separation materials for HILIC, demonstrating excellent efficiency for separation of polar compounds.



2494

A catalytic asymmetric protocol for the enantioselective synthesis of 3(2*H*)-furanones

Charles M. Marson,* Esra Edaan, James M. Morrell, Simon J. Coles, Michael B. Hursthouse and David T. Davies

A catalytic asymmetric protocol for the preparation of 3(2*H*)-furanones from enynones.

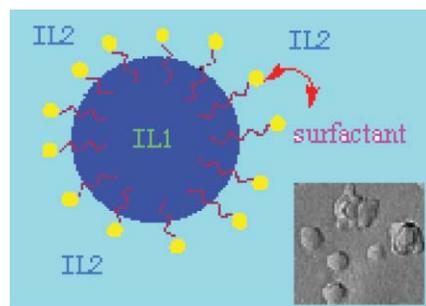


2497

Novel microemulsions: ionic liquid-in-ionic liquid

Siqing Cheng, Jianling Zhang, Zhaofu Zhang and Buxing Han*

The hydrophobic IL1 1-butyl-3-methylimidazolium hexafluorophosphate ([bmim][PF₆]) can be dispersed in hydrophilic IL2 propylammonium formate (PAF) with the aid of sodium bis(2-ethylhexyl) sulfosuccinate (AOT), and [bmim][PF₆]-in-PAF microemulsions are formed.

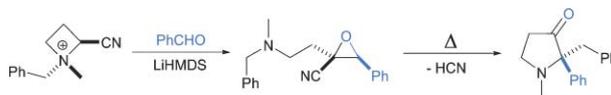


2500

Strained azetidinium ylides: new reagents for epoxidation

Audrey Alex, Bénédicte Larmanjat, Jérôme Marrot, François Couty and Olivier David*

Azetidinium ylides effected facile epoxidation of various carbonyl compounds furnishing tri- or tetrasubstituted epoxides that were unattainable *via* classical ammonium ylide chemistry; the produced trisubstituted oxiranes gave rise to a remarkable cascade of reactions leading to some original pyrrolidin-3-ones.



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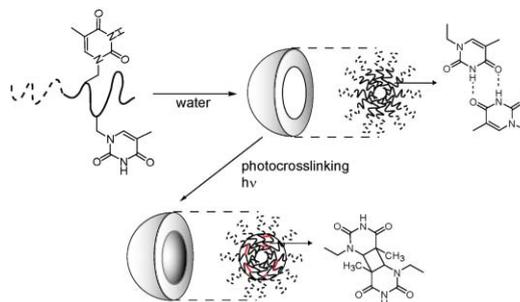
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2503

Core-bound polymeric micellar system based on photocrosslinking of thymine

Kei Saito, Laura R. Ingalls, Jun Lee and John C. Warner*

Core-bound polymer micellar aggregates were synthesized by leveraging H-bonding and photocrosslinking properties of thymines.

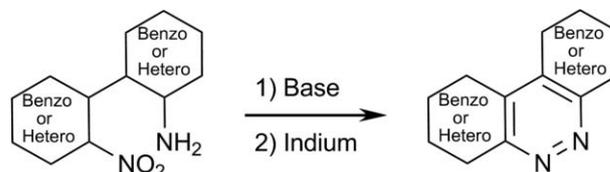


2506

A versatile synthesis of diverse 3,4-fused cinnolines via the base-catalysed condensation of 2-amino-2'-nitrobiaryls

Åsa Slevin, Tobias Koolmeister and Martin Scobie*

The base-catalysed cyclisation of 2-amino-2'-nitrobiaryls provides a flexible synthetic route into diverse tricyclic pyridazine-based systems.

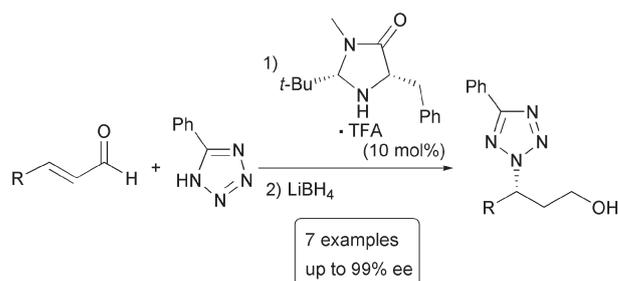


2509

Organocatalytic enantioselective aza-Michael reaction of nitrogen heterocycles and α,β -unsaturated aldehydes

Uxue Uribe, Jose L. Vicario,* Dolores Badía and Luisa Carrillo

The asymmetric organocatalytic aza-Michael reaction of several nitrogen heterocycles and α,β -unsaturated aldehydes has been studied. The conjugate addition products have been obtained in good yields as single regioisomers, and in high to excellent enantioselectivities.

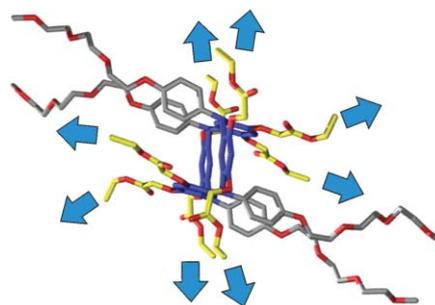


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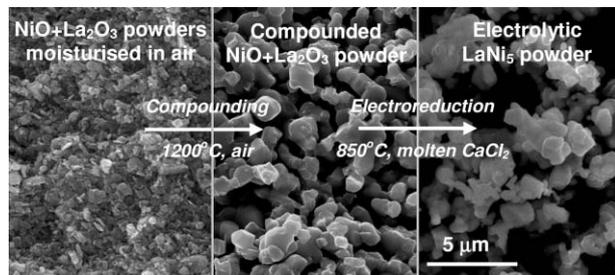
Novel octavalent cross-linker displays efficient trapping of protein-protein interactions

Simon R. Foster, Alice Pearce, Alexander J. Blake, Melanie J. Welham and James Dowden*

A novel octavalent, resorcin[4]arene derived, cross-linker designed to overcome some of the limitations of commercially available reagents is significantly more efficient for covalent stabilisation of protein-protein interactions.



2515

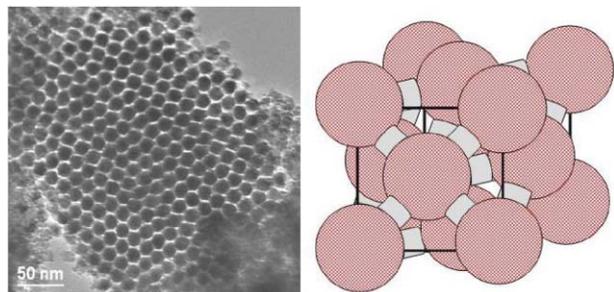


More affordable electrolytic LaNi₅-type hydrogen storage powders

Yong Zhu, Dihua Wang,* Meng Ma, Xiaohong Hu, Xianbo Jin and George Z. Chen*

Compounding La₂O₃ with NiO protects the former from water and molten salt attack, and enables electrolytic synthesis of high performance LaNi₅-type hydrogen storage powders from oxide precursors at low energy consumption [$< 5.5 \text{ kWh (kg-LaNi}_5\text{)}^{-1}$].

2518

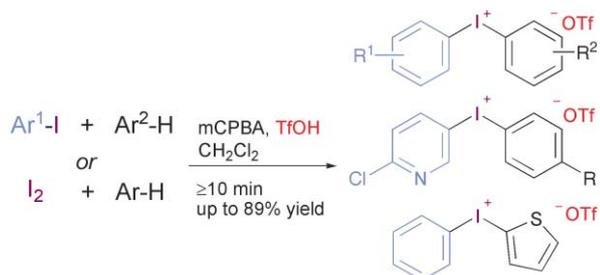


Mesoporous single-crystal Co₃O₄ templated by cage-containing mesoporous silica

Wenbo Yue, Adrian H. Hill, Andrew Harrison and Wuzong Zhou*

Mesoporous single-crystal Co₃O₄ was obtained using cage-containing mesoporous silicas, FDU-12 and SBA-16, as templates and the structural characterisation was made by XRD, HRTEM and nitrogen adsorption-desorption while SQUID magnetometry was used to probe the magnetic character.

2521

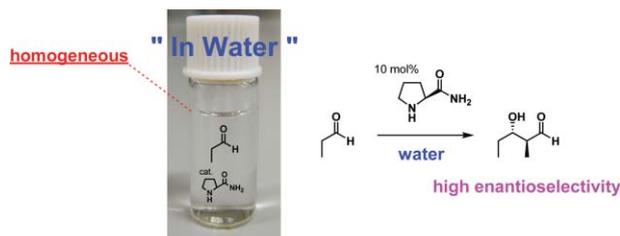


High-yielding one-pot synthesis of diaryliodonium triflates from arenes and iodine or aryl iodides

Marcin Bielawski and Berit Olofsson*

Unsymmetric and symmetric diaryliodonium triflates are synthesized from both electron-deficient and electron-rich substrates in a fast, high yielding, and operationally simple protocol employing arenes and aryl iodides or iodine.

2524



Small organic molecule in enantioselective, direct aldol reaction “in water”

Seiji Aratake, Takahiko Itoh, Tsubasa Okano, Takahiro Usui, Mitsuru Shoji and Yujiro Hayashi*

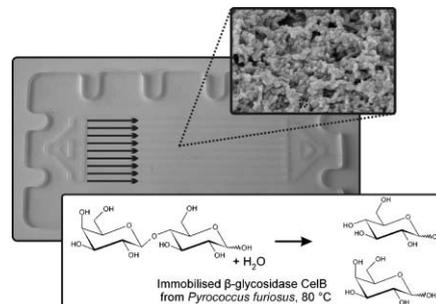
A small organic molecule, Pro-NH₂, catalyzing the enantioselective aldol reaction “in water” not merely “in the presence of water” with good enantioselectivity has been discovered for the first time.

2527

Development of a microfluidic immobilised enzyme reactor

Malene S. Thomsen, Peter Pölt and Bernd Nidetzky*

A microfluidic immobilised enzyme reactor was used for kinetic characterisation of a thermophilic β -glycosidase under pressure-driven flow conditions and continuous conversion of lactose by this enzyme at 80 °C.

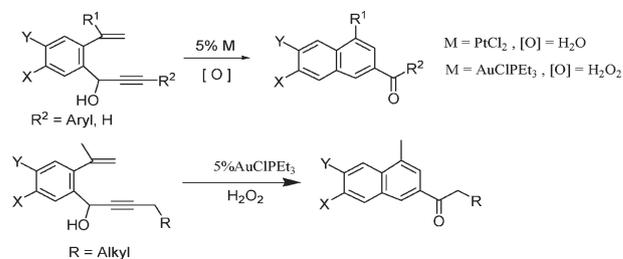


2530

Pt- and Au-catalyzed oxidative cyclization of 2-ethenyl-1-(prop-2'-yn-1'-ol)benzenes to naphthyl aldehydes and ketones: catalytic oxidation of metal-alkylidene intermediates using H₂O and H₂O₂

Bhanu Pratap Taduri, Shariar Md. Abu Sohel, Hsin-Mei Cheng, Guan-You Lin and Rai-Shung Liu*

2-Ethenyl-1-(prop-2'-yn-1'-ol)benzenes were cyclized through catalytic oxidation with PtCl₂/CO/H₂O and PEt₃AuCl/H₂O₂; the metal-naphthylidene intermediates were identified and oxygenated with water and H₂O₂, respectively.

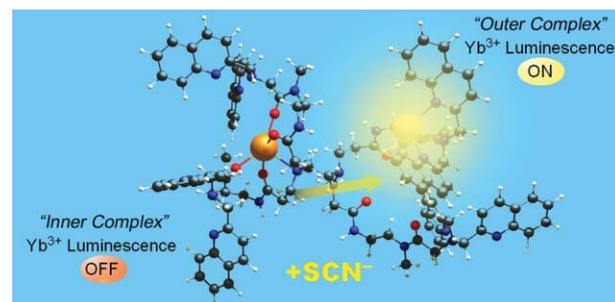


2533

Dendrimer container for anion-responsive lanthanide complexation and “on–off” switchable near-infrared luminescence

Hiroshi Tsukube,* Yukiko Suzuki, Dharam Paul, Yumiko Kataoka and Satoshi Shinoda

A new dendrimer-type ligand dynamically switched the lanthanide complexation and luminescence profiles in response to external anions.

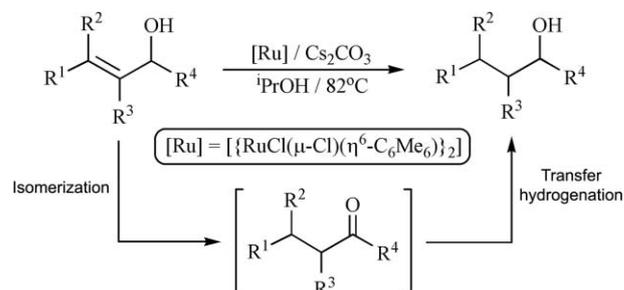


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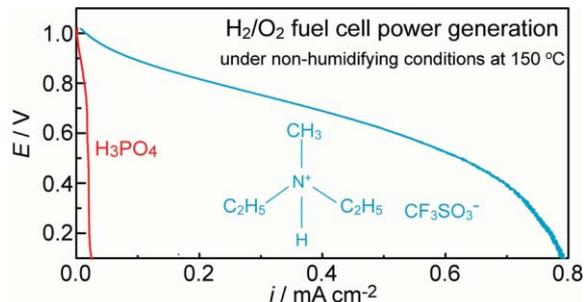
Ruthenium-catalyzed reduction of allylic alcohols: An efficient isomerization/transfer hydrogenation tandem process

Victorio Cadierno,* Javier Francos, José Gimeno* and Noel Nebra

A general and efficient procedure for the selective reduction of the C=C bond in allylic alcohols, through a ruthenium-catalyzed isomerization/transfer hydrogenation tandem process, has been developed.



2539



Bronsted acid–base ionic liquids for fuel cell electrolytes

Hirofumi Nakamoto and Masayoshi Watanabe*

A simple protic ionic liquid obtained from the combination of diethylmethylamine and trifluoromethanesulfonic acid exhibits the remarkable results as a medium temperature fuel cell electrolyte under non-humidifying conditions, affording a higher and stable open-circuit potential, wide liquid temperature range, and high thermal stability.

ADDITIONS AND CORRECTIONS

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Stefan K. Weidt, C. Logan Mackay,
Pat R. R. Langridge-Smith and
Peter J. Sadler

Platination of superoxide dismutase with cisplatin: tracking the ammonia ligands using Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS)

Zhimou Guo, Aiwen Lei, Yongping Zhang,
Qing Xu, Xingya Xue, Feifang Zhang and
Xinmiao Liang

“Click saccharides”: novel separation materials for hydrophilic interaction liquid chromatography

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Energy & the Chemical Sciences

Sugar catalysts can turn waste vegetable oil into biodiesel

A sweet future for biodiesel

As fossil fuel reserves start to run dry, alternative fuel sources such as biodiesel, which is made from renewable biological material, are needed. Now, Min-Hua Zong at the South China University of Technology, Guangzhou, and colleagues have used a sugar catalyst to prepare biodiesel from waste vegetable oil. Sugar catalysts, made by the sulfonation of partially carbonized D-glucose, have previously been used for making biodiesel from new vegetable oils, but had never been successfully used in making biodiesel from waste oil.

According to Zong, one factor holding back the widespread use of biodiesel is the cost of the vegetable oil starting materials. And the presence of free fatty acid impurities in waste vegetable oil makes it difficult to convert this cheap and readily available potential fuel source into biodiesel. A number of solid acid catalysts, such as zeolites, have found limited success in converting waste oil to biodiesel,



but they can't operate effectively under the required harsh conditions. Sulfated zirconia has shown to be a very effective

Sugar catalysts aren't put off by the impurities in waste vegetable oil

catalyst for the reaction, but the cost of the rare zirconium metal is prohibitive. Zong's sugar catalysts have a higher activity than zeolites, and are cheaper to prepare than the zirconia catalysts.

Zong is committed to further research in this area. 'Environmentally-friendly production of cheap renewable fuels is very important,' she said. 'I am sure that biodiesel research is a growth area and that sugar catalysts will be an important part of it.'

Mark Keane, a chemical engineer at Herriot-Watt University, Edinburgh, UK, agreed that this work could be significant. 'The use of sugars as catalytic agents to convert waste oils is certainly intriguing and could potentially serve as a progressive approach to a burgeoning waste treatment issue,' he said.

Rebecca Gillan

Reference

Min-Hua Zong et al., *Green Chem.*, 2007, 9, 434
DOI: 10.1039/b615447f

Energy themed issues in RSC journals

Green Chemistry presents research on Fuel Synthesis and Processing

PCCP explores Alternative Fuel Technologies in a series of issues

New Energy Materials are highlighted in the *Journal of Materials Chemistry*

Dalton Transactions is hosting a web theme issue on CO₂ at Metal Centres

Journal of Environmental Monitoring takes a look at Organic Contaminants: Sources, Fate, Behaviour & Effects



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Research Highlights

Rhenium builds model bridges with uranium

Safer storage of nuclear waste

Nuclear waste repositories could be safer places, thanks to UK chemists, who have revealed the likely structure of a contaminant in reprocessed nuclear fuel.

Nuclear fuel is generally reprocessed by extracting out the actinide metals uranium and plutonium. However, this extracted material is often contaminated with another radioactive metal, technetium, which can catalyse unwanted side reactions and complicate waste storage. Now, Iain May, David Collison and colleagues at the University of Manchester have discovered how technetium, in the form of pertechnetate $[\text{TcO}_4]^-$, is extracted during reprocessing.

'Pertechnetate would traditionally be classed as a weakly coordinating anion,' said May, 'and we were very interested in why pertechnetate so effectively co-extracted.' Pertechnetate contaminates the extracted material by forming a



Reprocessed nuclear fuel often contains radioactive technetium as a contaminant

complex with uranium, said May. Studying perrhenate, $[\text{ReO}_4]^-$, a non-radioactive analogue of pertechnetate, the team showed that perrhenate can act as a bridge between two uranium ions, as well as a simple, singly bonding ligand.

'The demonstration of perrhenate as an inner-sphere ligand in these

uranyl complexes serves as a good model for how pertechnetate may coordinate actinyl compounds in general,' said Thomas Albrecht-Schmitt, an expert in actinide complexes at Auburn University, Alabama, US.

'A better molecular understanding of the behaviour of pertechnetate in this waste could ultimately aid safe and cost-effective treatment and disposal,' said May. 'Nuclear power is now being seriously considered by many countries as a key component of a secure "carbon neutral" energy policy. Future fuel processing technology will require a sound fundamental understanding of actinide and fission product coordination chemistry.'

James Mitchell Crow

Reference

Gordon H. John *et al.*, *Dalton Trans.*, 2007, 1603
DOI: 10.1039/b614481k

Enzymes bound to electrode take away the need for mediator molecule

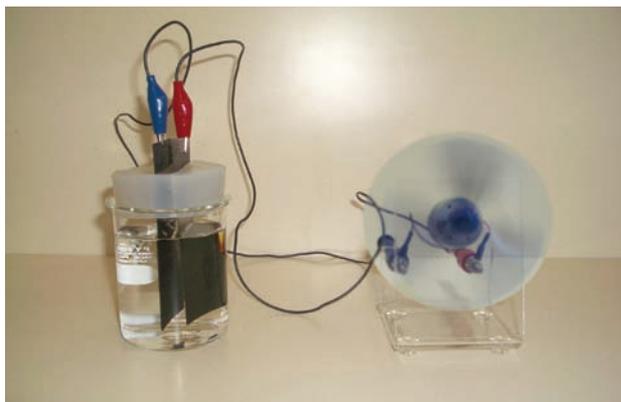
Simply biofuels

A simple enzyme-based biofuel cell has been made by a team of Japanese scientists.

The cell, made by Kenji Kano, Seiya Tsujimura and colleagues at Kyoto University, Japan, uses enzymes to catalyse oxidation of D-fructose and reduction of dioxygen to generate electricity.

The fuel is oxidised by one enzyme at the anode, and the electrons reduce dioxygen via another enzyme at the cathode.

Most previous biofuel cells have needed a mediator molecule, which is stable in two oxidation states, to speed up electron transfer from the enzyme to the electrode. By engineering carbon electrodes with carbon nanoparticles, the team bound a fructose oxidising enzyme, D-fructose dehydrogenase, onto



The cell in action

Reference

Y Kamitaka *et al.*, *Phys. Chem. Chem. Phys.*, 2007, DOI: 10.1039/b617650j

the electrode surface, increasing the speed of electron transfer to the anode without needing a mediator. Another enzyme, laccase from *Trametes sp.*, was used to reduce dioxygen at the anode, completing

the circuit.

Eliminating the need for mediators may simplify the construction of biofuel cells, and as the device can operate under mild conditions, Kano hopes that 'one compartment biofuel cells may be developed as power sources of implantable devices within humans, such as pacemakers, insulin pumps, sensors and prosthetic units.'

Frederic Barriere of the University of Rennes, France, said the work is a significant development, and that he 'awaits impatiently future developments such as refining such electrodes towards a layer by layer approach to increase the maximum current density.'

Victoria Chapman

To find out more about energy at the RSC visit: www.rsc.org/energy

Interview

Investing in a greener future

Richard Pike gives his thoughts on the energy debate



Richard Pike

Richard Pike is the Chief Executive of the Royal Society of Chemistry. Dr Pike has worked in a wide spectrum of scientific, engineering and management roles in the UK and internationally, with a long track record in the chemical sector notably in the oil, gas and petrochemicals industries.

What do you think are the important issues in the energy sector at the moment?

Undoubtedly climate change and security of energy supply, but also clarity in what we teach our children about energy, its use and consequences.

What motivated you to work in the energy industry?

It was probably a classic example of parental influence! My father worked as a chartered engineer, in the shipping sector of the oil industry. As a child, I was surrounded by books on science and engineering, and experienced - even as a ten-year old - having a tour of the engine room of one of the world's largest oil tankers, and being shown around an oil refinery. At school I was interested in mathematics and the physical sciences, and at Cambridge University studied engineering with a BP scholarship. Energy has been in my blood since!

What attracted you to the job of CEO of the RSC?

I had had a fascinating 30 years in the oil and gas industry, working all over the world, with a 5-year interlude as Director General of the Institution of Mechanical Engineers. It meant I appreciated the significance of chemistry in underpinning many of the issues facing the world - and their solutions - and had the experience of running a learned society. But I was not entirely familiar with all the topics now covered by the chemical sciences, nor indeed the precise workings of the chemistry profession, and therefore the job would be an interesting challenge. And that is what it has turned out to be!

How do you think the RSC can contribute to the energy debate?

We lobby key decision makers on matters relating to energy policy, research, funding and the availability of highly skilled people. And, the RSC educates people at all levels about the key scientific and technical issues associated with energy.

In the next 20-50 years what do you think the key challenges are for the chemical sciences in terms of energy?

There is a need to decarbonise transport by developing highly efficient biofuels, lightweight construction materials, hybrid and electric vehicles, battery technology and hydrogen as a fuel. Additionally, there is a need to maximise the efficiency of conventional vehicles and fuels. We must harness renewable energy more efficiently,

particularly to improve the efficiency in the next generation of photovoltaic cells. It is important to develop carbon capture and storage technology so that the vast coal reserves and the remaining oil and gas resources that will be exploited are done so with minimal green house gas (GHG) emissions. Finally, and perhaps most importantly we must invest in skilled people and high quality research and development such that sustainable energy technologies can be developed for the future.

How can the chemical sciences help with the energy problem?

The chemical sciences underpin almost all aspects of energy and are critical in developing new energy options. Perhaps the most exciting issues are the development of photovoltaics, new biofuels and solving the problem of energy storage. For photovoltaic devices the key issues are improving efficiency and reducing cost - work on artificial photosynthesis is particularly exciting. For biofuels, which are currently made from food crops, there is competition for land between food and fuel. This could be eliminated if next generation biofuels are made from lignocellulosic biomass, such as straw or wood. This may result in yield improvements and carbon emission reduction compared with current biofuels. Finally, energy storage is a critical issue as there are limited options for both large and small scale storage. Hybrid and electric vehicles and intermittent renewable energy sources (e.g. wind power) are limited by current storage technologies. New developments here, such as those in the areas of lithium based batteries and "lab on a chip" devices could be vital in developing new energy technologies.

Are there any scientists you most admire and why?

I admire those who have challenged the status quo, and have provided order to what seemed uncoordinated or inconsistent observations at the time. I always have time to read about Darwin, Mendeleev, Einstein and Bohr. More latterly, the popular work of Crick and Watson, and others, in understanding the genetic code has been fascinating.

The next generation of scientists will play a key role - if you had one piece of advice to pass onto them, what would it be?

Be enthusiastic, look at the big picture, and make a difference.....but get your facts straight!

To read the full interview visit: www.rsc.org/energy

News & Policy

The RSC responds to the energy challenge

Filling the energy gap

The next half-century will almost certainly be a period of significant change in Europe and globally when it comes to the provision of energy. Concerns over energy security and improved predictions on the consequences and costs of climate change will be key drivers toward an energy policy that promotes diversity over reliance on one or two main energy sources.

In July 2006 the government published a report 'The Energy Challenge' which described its energy policy and the long term challenges facing the UK. In particular that the UK will become increasingly reliant on imported oil and gas as North Sea reserves diminish, and that several nuclear and coal fired power stations are closed. Indeed, it is expected that the UK will be importing as much as 90% of its gas requirements by 2020, and in the medium term the UK will have a shortfall in electricity of approximately 25GW by 2025. To put this in perspective the current peak electricity demand is 60GW.

To counteract the growing



The UK will be importing as much as 90% of its gas requirements by 2020

reliance on imported energy the report proposed a number of measures. These included extending the EU Emissions Trading Scheme and Climate Change Levy to encourage companies to invest in cleaner energy-producing technology both in the UK and abroad; encouraging individuals and companies to save energy through education and new products; encouraging the use of cleaner-combined heat and power plants; developing a diverse energy system based on several fuel types, routes and storage facilities and finally investing in new power stations.

The RSC responded to the report with the following key points. The UK energy policy must promote a diverse energy mix avoiding over reliance on a single energy source; a clear coordinated energy policy is essential and should be long-term, unbiased toward specific technologies and independent (there must be cross party consensus); that technology alone will not be enough in closing the gap, reducing demand must also

be addressed; and finally that the chemical sciences will play a crucial role in developing clean energy technologies in the medium and long term. The RSC also believe that a UK geological repository for nuclear waste is also necessary as part of the long term solution.

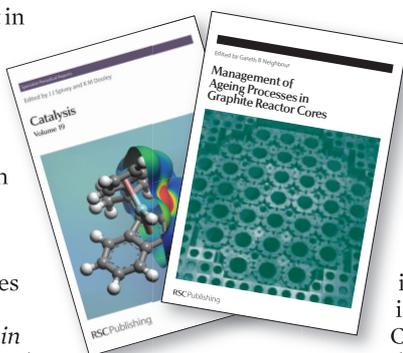
It is clear that the chemical sciences will make important contributions in the development and implementation of new energy strategies. The transition from an economy based on fossil fuels to a more sustainable energy mix will require considerable ingenuity from chemists and the other science and engineering disciplines. Scientists will have to develop both sustainable energy systems and also find more efficient ways of producing, refining and using fossil fuels during the transition.

To read the full report 'The Energy Challenge' visit www.dti.gov.uk/energy/review/ and to find out more about the RSC energy policy please contact Dr Jeff Hardy (tel: +44 (0)20 7440 3395; email: hardyj@rsc.org)

Focusing on the future

The rapid growth of interest in energy and environmental issues has created the need for authoritative reviews on such matters. This need has been addressed by many RSC authors and much of this work is presented in the renowned book series Issues in Environmental Science and Technology, titles include *Transport and the Environment* and *Chemicals in the Environment: Assessing and Managing Risk*. Other popular titles include *Clean Energy* (Dell, Rand), *Sustainability and Environmental Impact of Renewable Energy Sources* (Harrison, Hester) and *Management of Aging Graphite Reactor Cores* (Neighbour).

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on Catalysis, Volume 19. Catalysis is essential in the processes used to find cost efficient and environmentally sound methods of converting natural resources into fuels and energy. This book, fully referenced to the primary literature, brings together the most recent work of recognised international experts and includes chapters on The Catalysis of Biodiesel Synthesis, and Catalytic Reforming of Liquid Hydrocarbon Fuels for Fuel Cell Applications, Promotion Effects in Co-based Fischer-Tropsch Catalysis.

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