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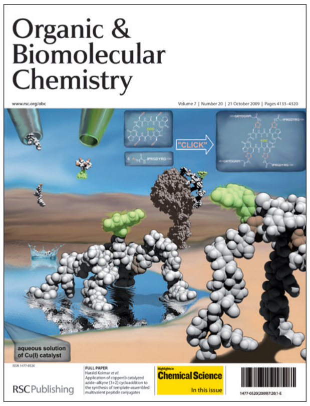
IN THIS ISSUE

ISSN 1477-0520 CODEN OBCRAK 7(20) 4133–4320 (2009)



Cover

See Harald Kolmar *et al.*, pp. 4177–4185.

The image illustrates the click conjugation of an unprotected integrin binding peptide onto a FITC-labelled cyclic template in multiple copies. Coupling partners, resulting conjugates, and a target receptor are drawn as space filling models.

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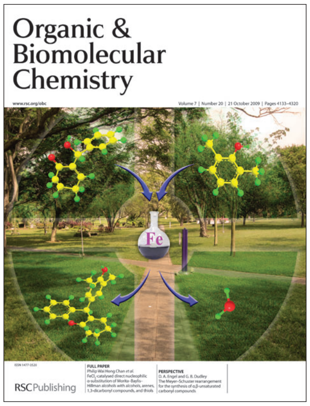

Inside cover

See Philip Wai Hong Chan *et al.*, pp. 4186–4193.

The picture is of Yunnan Garden, which sits in front of the Division of Chemistry and Biological Chemistry, School of Physical and Mathematical Sciences building at Nanyang Technological University, Singapore.

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HIGHLIGHTS IN CHEMICAL SCIENCE

C73

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Highlights in Chemical Science

October 2009/Volume 6/Issue 10

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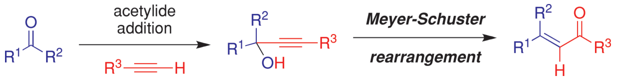
PERSPECTIVE

4149

The Meyer–Schuster rearrangement for the synthesis of α,β-unsaturated carbonyl compounds

Douglas A. Engel and Gregory B. Dudley*

Advances in the Meyer–Schuster rearrangement enable the atom economical olefination of ketones and aldehydes, including those beyond the scope of other olefination methods.



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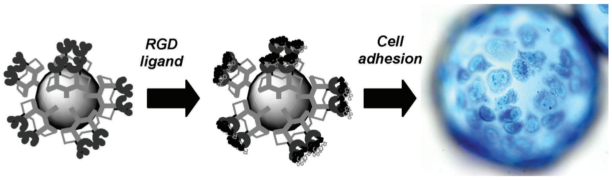
4159

Highly efficient cell adhesion on beads functionalized with clustered peptide ligands

Stéphanie Foillard, Pascal Dumy* and Didier Boturyn*

Resin beads were functionalized with either clustered peptide ligands or individual peptide ligands. With beads presenting clustered ligands, we observed enhanced cell adhesion at various ligand densities until a nanoscale ligand distribution was reached.

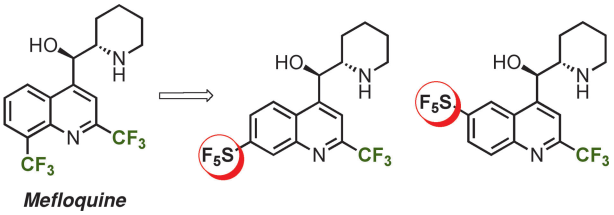


4163

Synthesis and biological evaluation of the first pentafluorosulfanyl analogs of mefloquine

Peter Wipf,* Tingting Mo, Steven J. Geib, Diana Caridha, Geoffrey S. Dow, Lucia Gerena, Norma Roncal and Erin E. Milner

As part of the first report on SF_5-substituted quinolines, we synthesized two pentafluorosulfanyl (SF_5) analogs of the antimalarial agent mefloquine in 5 steps and 10–23% overall yield.

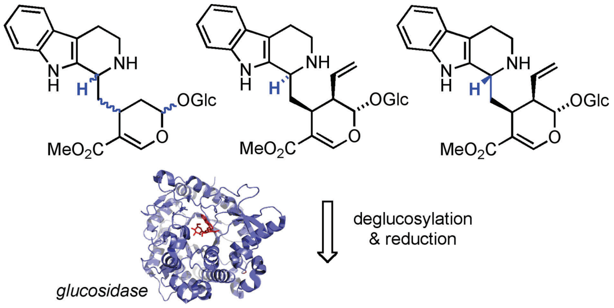


4166

Bypassing stereoselectivity in the early steps of alkaloid biosynthesis

Peter Bernhardt, Nancy Yerkes and Sarah E. O’Connor*

Total synthesis of glycosylated seco-iridoid stereoisomers allows the identification and bypassing of the stereoselectivity of early steps in monoterpene indole alkaloid biosynthesis.

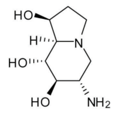


4169

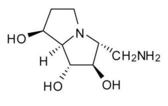
Inhibition of the *exo*-β-D-glucosaminidase CsxA by a *glucosamine*-configured castanospermine and an *amino*-australine analogue

Benjamin Pluvinage, Mariana G. Ghinet, Ryszard Brzezinski, Alisdair B. Boraston and Keith A. Stubbs*

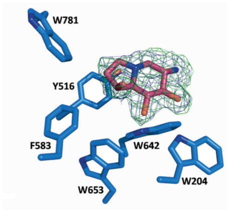
The synthesis of *amino*-derivatives of castanospermine and australine and their characterisation as inhibitors of the *exo*-β-D-glucosaminidase CsxA through enzyme kinetics and X-ray structural analysis is described.

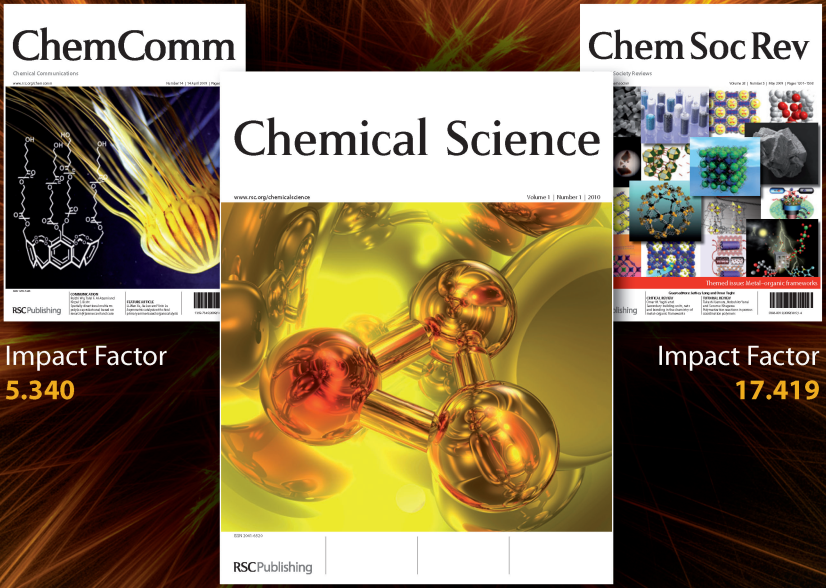


***amino*-castanospermine**



***amino*-australine**

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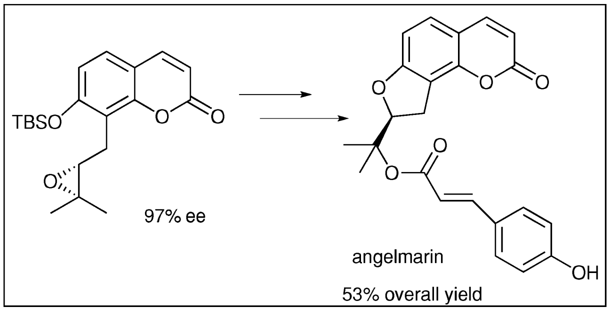
COMMUNICATIONS

4173

Highly enantioselective synthesis of angelmarin

Hang Jiang and Yasumasa Hamada*

Angelmarin (**1**), a novel anti-cancer agent, was efficiently synthesized through a highly enantioselective epoxidation and a copper cyanide-mediated esterification of the hindered alcohol as the key steps in 53% overall yield.



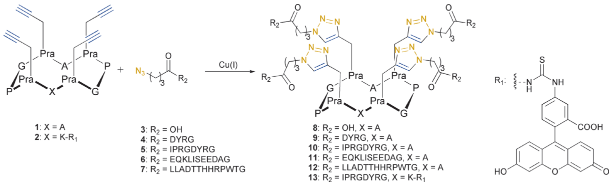
PAPERS

4177

Application of copper(I) catalyzed azide–alkyne [3+2] cycloaddition to the synthesis of template-assembled multivalent peptide conjugates

Olga Avrutina, Martin Empting, Sebastian Fabritz, Matin Daneschdar, Holm Frauendorf, Ulf Diederichsen and Harald Kolmar*

Tetravalent peptide conjugates were synthesized from unprotected peptide monomers on a cyclic decapeptide as a conjugation scaffold using "click" azide–alkyne cycloaddition in water at room temperature within comparatively short reaction times.

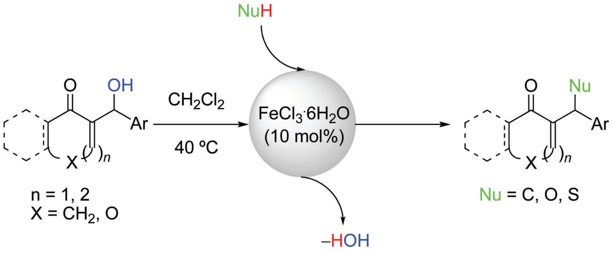


4186

Iron(III) chloride-catalysed direct nucleophilic *α*-substitution of Morita-Baylis-Hillman alcohols with alcohols, arenes, 1,3-dicarbonyl compounds, and thiols

Xiaoxiang Zhang, Weidong Rao, Sally and Philip Wai Hong Chan*

A general and efficient iron-catalysed method for the direct nucleophilic *α*-substitution of Morita-Baylis-Hillman alcohols with a structurally diverse set of nucleophiles that include alcohols, arenes, 1,3-dicarbonyl compounds and thiols, has been reported.

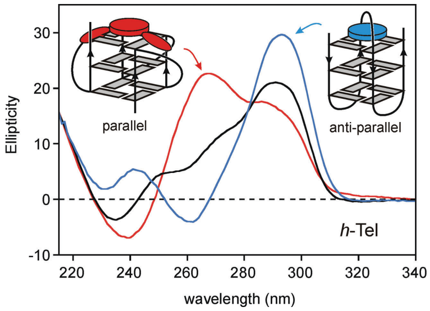


4194

Selectivity of small molecule ligands for parallel and anti-parallel DNA G-quadruplex structures

Thomas P. Garner, Huw E. L. Williams, Katarzyna I. Gluszyk, Stephen Roe, Neil J. Oldham, Malcolm F. G. Stevens, John E. Moses* and Mark S. Searle*

CD studies of the *c*-kit and *h*-Tel G-quadruplex structures with two different classes of high affinity ligands show differences in structural plasticity and ligand selectivity for parallel and anti-parallel-stranded folds.



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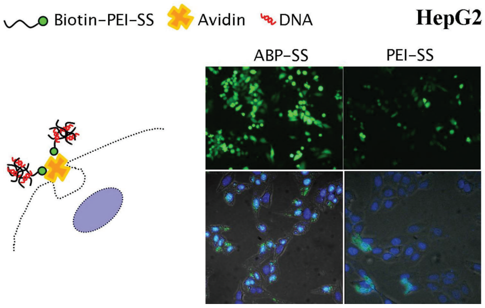
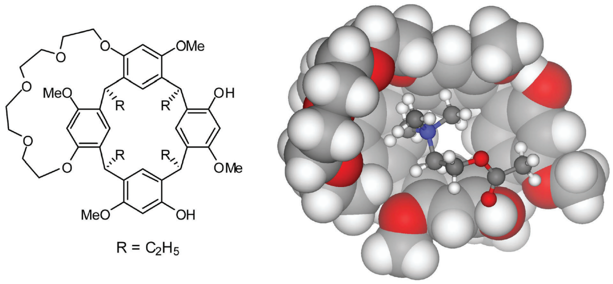


Biotinylated disulfide containing PEI/avidin bioconjugate shows specific enhanced transfection efficiency in HepG2 cells

Xuan Zeng, Yun-Xia Sun, Xian-Zheng Zhang* and Ren-Xi Zhuo

A novel gene vector based on biotinylated PEI-SS/avidin bioconjugate was synthesized, which presented less toxic and higher gene expression, especially in HepG2 cells. It shows a promising potential in targeting gene delivery to liver cells.

4211



Synthesis and structure of mono-bridged resorcinarene host: a ditopic receptor for ammonium guests

Kirsi Salorinne, Tiia-Riikka Tero, Kaisa Riikonen and Maija Nissinen*

The synthesis and structural properties of a mono-bridged resorcinarene host, which was found to serve as a ditopic receptor molecule for acetylcholine and tetramethylammonium cation, is described.

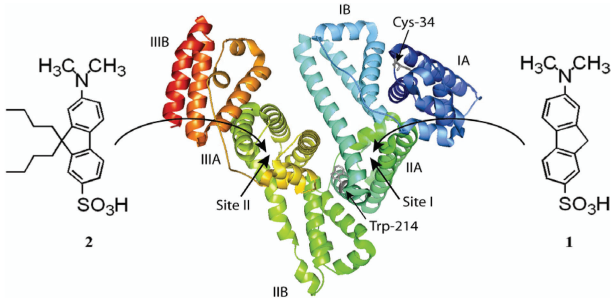
4218

Simultaneous and site-directed incorporation of an ester linkage and an azide group into a polypeptide by *in vitro* translation

Martin Humenik, Yiwei Huang, Igor Safronov and Mathias Sprinzl*

Esterase 2 with an azide group in the polypeptide chain was synthesized by *E. coli in vitro* translation in the absence of release factor 1. Nonsense suppression of the amber stop codon by suppressor tRNA$^{Cys(CUA)}$ acylated with α-hydroxy ε-azido modified lysine led to incorporation of an azide group.

4225



Novel 7-(dimethylamino)fluorene-based fluorescent probes and their binding to human serum albumin

Kwanghee Koh Park,* Joon Woo Park* and Andrew D. Hamilton

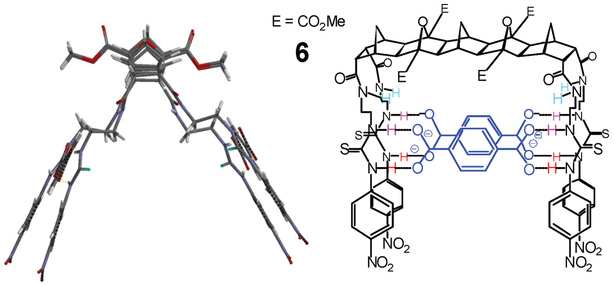
Compounds **1** and **2** are highly sensitive fluorescent probes which bind to sites I and II, respectively, of human serum albumin.

4233

Binding of the terephthalate dianion by di- tri- and tetrathiourea functionalised fused [*3*] and [*5*]polynorbornane based hosts

Adam J. Lowe and Frederick M. Pfeffer*

Anion receptors based on the [*5*]polynobornane framework had greater affinities for the rigid terephthalate dianion due to a higher degree of host:guest size complementarity. Remarkably, host **6** was capable of binding two terephthalate guests in a *pseudo*-parallel orientation.

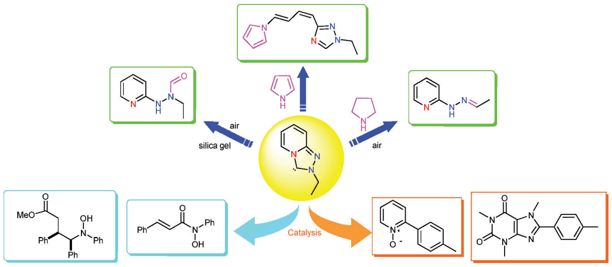


4241

Pyrido[1,2-*c*][1,2,4]triazol-3-ylidene: reactivity and its application in organocatalysis and organometallic catalysis

Siping Wei, Bo Liu, Dongbing Zhao, Zhen Wang, Jie Wu, Jingbo Lan and Jingsong You*

The reactivity and catalytic performance of 2-ethylpyrido[1,2-*c*][1,2,4]-triazol-3-ylidene **6** have been comprehensively investigated. The carbene **6** has shown unusual properties and turned out to be a powerful catalyst owing to the effect of the pyrido-annulation.

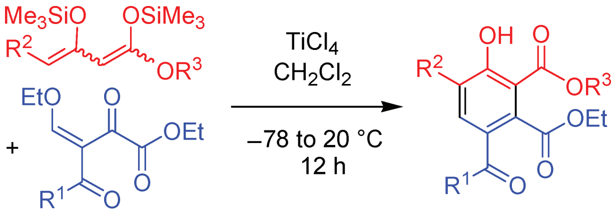


4248

Regioselective synthesis of 4-acyl-1-hydroxy-2,3-benzodioates by chelation-controlled [3+3] annulation of 3-acyl-4-ethoxy-2-oxo-3-enoates with 1,3-bis(trimethylsilyloxy)-1,3-butadienes

Abdolmajid Riahi, Mohanad Shkoor, Olumide Fatunsin, Rasheed Ahmad Khera, Christine Fischer and Peter Langer*

4-Acyl-1-hydroxy-2,3-benzodioates were regioselectively prepared by chelation-controlled [3+3] cyclizations.

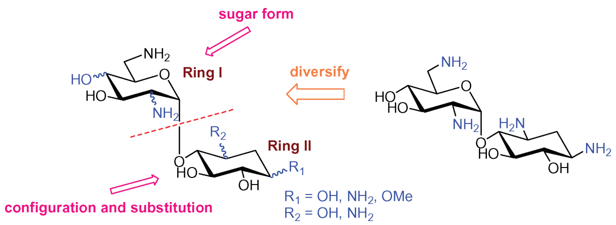


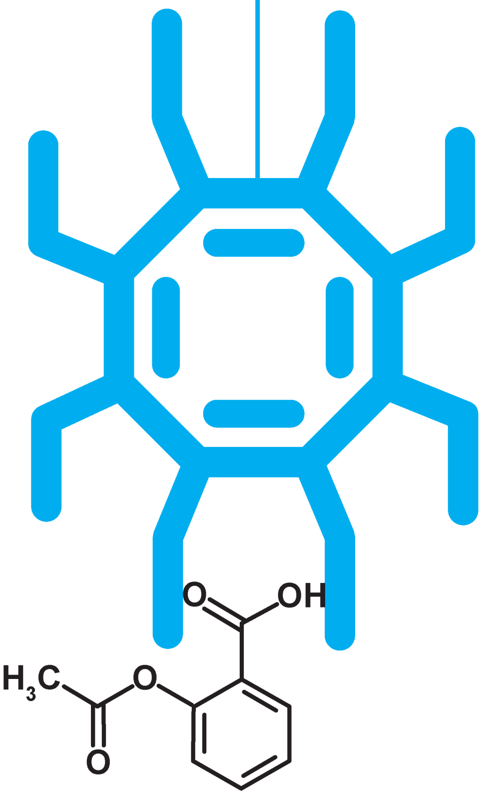
4252

Synthesis of neamine-derived pseudodisaccharides by stereo- and regio-selective functional group transformations

Li-Juan Pang, Dan Wang, Jian Zhou, Li-He Zhang and Xin-Shan Ye*

A series of novel neamine analogues with functional group manipulations on the 2-deoxystreptamine ring or sugar ring were designed and synthesized using the Ferrier II rearrangement as a key step.

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O
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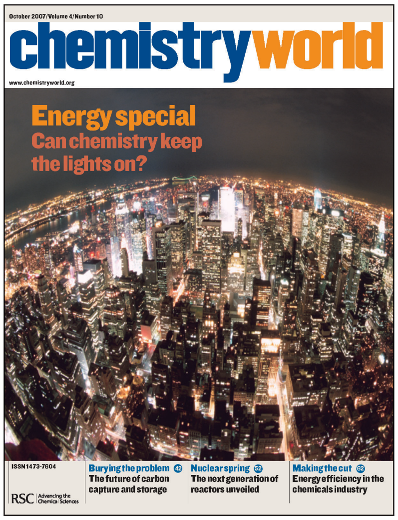

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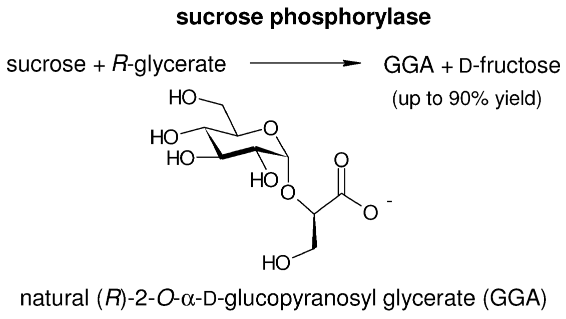
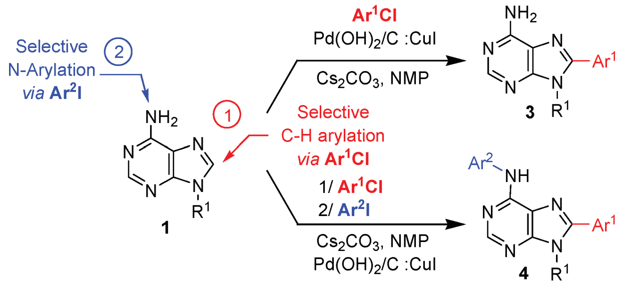


Single-step enzymatic synthesis of (*R*)-2-*O*-α-D-glucopyranosyl glycerate, a compatible solute from micro-organisms that functions as a protein stabiliser

Thornthan Sawangwan, Christiane Goedl and
Bernd Nidetzky*

Regioselective glucosylation of *R*-glycerate catalysed by sucrose phosphorylase in the presence of sucrose as the donor substrate provided the natural compatible solute (*R*)-2-*O*-α-D-glucopyranosyl glycerate with complete regioselectivity in an optimised synthetic yield of 90% *R*-glycerate converted and a concentration of about 270 mM.

4271

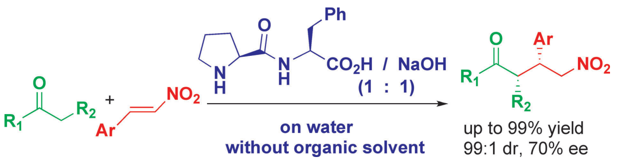


A site selective C–H arylation of free-(NH$_2$) adenines with aryl chlorides: Application to the synthesis of 6,8-disubstituted adenines

Sophian Sahnoun, Samir Messaoudi, Jean-Daniel Brion and
Mouâd Alami*

The use of aryl chlorides as partner in the direct C–H arylation of free-(NH$_2$) adenines allows the selective preparation of C-8 arylated adenines **3** in good yields. Application to the synthesis of non-symmetrical C8/N^6-arylated adenines **4** is described.

4279

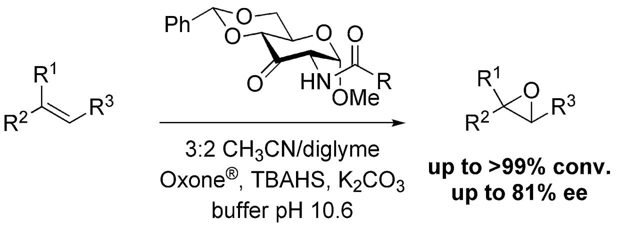


Enantioselective nitro-Michael reactions catalyzed by short peptides on water

Matthias Freund, Sebastian Schenker and
Svetlana B. Tsogoeva*

Simple unmodified *N*-proline-based di- and tripeptides in combination with sodium hydroxide additive was found to catalyze the asymmetric nitro-Michael reaction on water without using organic cosolvents to provide the corresponding γ-nitroketones at room temperature with up to 99% yield, 99:1 dr and 70% ee.

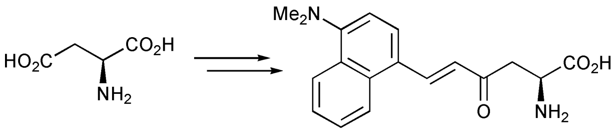
4285



Accessible sugars as asymmetric olefin epoxidation organocatalysts: glucosaminide ketones in the synthesis of terminal epoxides

Omar Boutureira, Joanna F. McGouran, Robert L. Stafford,
Daniel P. G. Emmerson and Benjamin G. Davis*

A systematically varied series of conformationally restricted ketones, readily prepared from *N*-acetyl-D-glucosamine, were tested against representative olefins as asymmetric epoxidation catalysts showing useful selectivities against terminal olefins and, in particular, typically difficult 2,2-disubstituted terminal olefins.


HO₂C
CO₂H
NH₂
Me₂N
O
CO₂H
NH₂

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Contact the editor, Niamh O'Connor, at metallomics@rsc.org for further information or visit the website.

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Highlights in Chemical Science

Damaged teeth could be repaired in the mouth using a simple technique

Enamel regeneration makes scientists smile

Regrowing enamel in the mouth could provide an alternative to crowns and veneers

Chinese researchers are a step closer to being able to regrow tooth enamel in the mouth.

Haifeng Chen and colleagues at Peking University, Beijing, etched a tooth's surface with phosphoric acid to create nucleation sites and then immersed it in a solution of calcium, phosphate and fluoride ions. The ions reacted at the nucleation sites, with help from a chelating agent called *N*-(2-hydroxyethyl)ethylene-diamine-*N,N,N*-triacetic acid (HEDTA), to form a new layer of enamel.

The method could be used to repair damaged teeth or as sealant to prevent cavities, says Chen. Although other methods of making enamel have been developed, none of them can be carried out in dental clinics because they require harsh reaction conditions. The new method is simpler and less expensive than existing methods and can be carried out at body temperature.

'The beauty of this process is that we are on the way to rebuilding our tooth enamel with exactly the same matter and microstructures as natural enamel,' states Chen.

But HEDTA is not safe for consumption so the team is working on a device to separate the HEDTA solution from the mouth so it can be used in the clinic. 'We are also trying to use some small peptides to mimic the enamel protein structure and replace the HEDTA that directs the organisation of enamel crystals,' Chen explains. 'These peptides will bind to these crystals and make our enamel structure less brittle.'

'This novel procedure offers the possibility of real alternatives to replacement crowns and veneers, which are expensive to place and difficult to maintain,' comments Colin Robinson, an expert in biomineralisation at the Leeds Dental Institute, UK.

Sylvia Pegg

Reference

Y Yin *et al*, *Chem. Commun.*, 2009, DOI:10.1039/b911407f

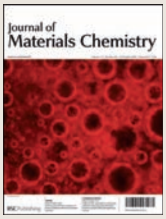
In this issue

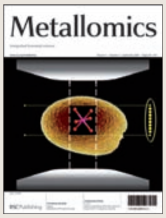
First aid for electronics
Microcapsules filled with nanotubes could repair batteries

Twist of fate for two-to-one assemblies
Unique nanospiral structures could be useful for minaturising optoelectronics

Understanding our food
Proteomics can be used to assure the safety of GM food say German scientists in October's Instant Insight

Riding high
Philip Mountford talks about jockeying, bribing techniques and the challenges ahead for chemistry in this month's interview



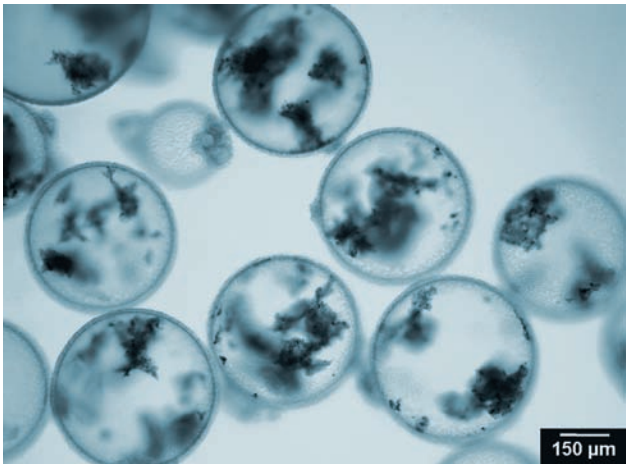


A snapshot of the latest developments from across the chemical sciences

Research highlights

Microcapsules filled with carbon nanotubes could be used to repair batteries

First aid for electronics



On breaking the microcapsule's contents spill out and complete the circuit

US scientists have developed a first aid kit for electrical systems that could stop circuits failing and lead to safer, longer lasting batteries.

Jeffrey Moore, at the University of Illinois at Urbana-Champaign, and colleagues made microcapsules with robust walls and filled them with carbon nanotubes (CNTs). They then ruptured the microcapsules using vigorous stirring and measured the contents' ability to conduct electricity between two electric probes separated by around 100 micrometres. As the team swept the applied voltage from minus to plus 50 volts, the CNTs migrated towards the probe tips. They aligned with the electric field and completed the circuit, enabling the current to flow.

They found the best capsules were between 280 and 350 micrometres – smaller ones were too difficult to break and larger ones broke too easily.

'Battery safety and lifetime are two problems that may benefit from this approach,' says Moore. 'You may want to restore electrical conductivity of damaged battery electrodes. On the other hand, if battery electrodes short circuit, the battery becomes dangerous and has the potential to explode. One may thus want to coat the electrodes with a resistive material to shut down a run-away battery. Exploring these ideas are some of our future plans.'

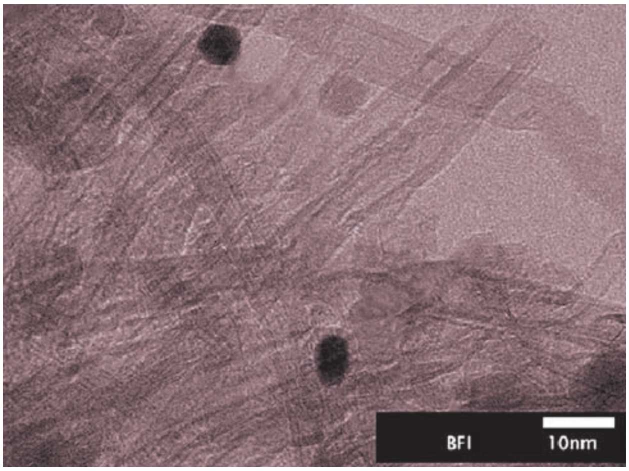
'I think it is a neat approach that can become very useful if taken further,' comments Vsevolod Rostovtsev, a nanotube expert at DuPont, Wilmington, US. 'The capsules need to become smarter so that their precise and accurate placement could be effected. The broken microcapsule shell needs to be removed from the electronic device to reduce contamination.'

Charlotte Beard

Reference
M M Caruso *et al*, *J. Mater. Chem.*, 2009, DOI: 10.1039/b910673a

Metallic impurities in nanotubes can have a large effect on their toxicity

How safe are carbon nanotubes?



Small amounts of contaminants in carbon nanotubes could make them toxic

Carbon nanotubes are increasingly being used in everyday products such as sporting equipment, biomedical devices and aeroplanes. But questions remain as to how safe these nanotubes really are.

A main factor in nanotube toxicity are the metal contaminants that remain from manufacture, which are typically one to ten per cent by weight, say Martin Pumera and Yuji Miyahara at the National Institute for Materials Science, Ibaraki, Japan. 'Carbon nanotubes are often viewed as homogenous materials, which is of course incorrect – they often contain impurities which are not even listed by the manufacturers,' says Pumera. The pair have used an electrochemical method to assess the effect metals have on nanotube toxicity. They say that their method is quicker and cheaper than laborious and expensive biomedical tests and could be more useful for initial assessments of carbon nanotube toxicity.

Pumera and Miyahara measured how well five nanotube samples reduced or oxidised two simple biomarkers – hydrogen peroxide and hydrazine. They found that just 100 ppm of iron was needed to dominate the reduction ability, and therefore the toxicity. Pumera says this is very disturbing, as this value is significantly lower than the detection limits of the methods routinely used to assess nanotube purity. ’It is very likely that metallic impurities are responsible for large scatter in results of toxicological studies,' he adds.

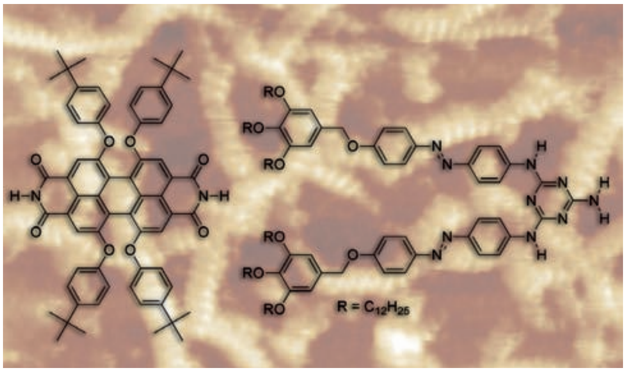
Kostas Kostarelos, who works at the Centre for Drug Delivery Research, The School of Pharmacy, London, UK, says 'this work is yet another testament of the imperative need for well-characterised and reproducible standardised carbon nanotube properties. Until this is achieved, comparative studies will continue to be difficult to interpret and predictive assays of complex interactions impacting the toxicological profile of the material will be difficult to establish.'

David Barden

Reference
M Pumera and Y Miyahara, *Nanoscale*, 2009, DOI: 10.1039/b9nr00071b

Unique nanospiral structures could be useful for miniaturising optoelectronics

Twist of fate for two-to-one assemblies



A melamine and a bisimide combine in an unusual 2:1 ratio to give intriguing spiral structures

A pair of molecules that combine in an unusual 2:1 ratio to give nano-sized spirals have been brought together by an international research team.

Recently, much effort has centred on designing pairs of photo-active molecules that assemble spontaneously to give nanostructures held together by interactions such as hydrogen bonds. Structures containing melamine and imide are particularly interesting as their photoresponsive properties could be used in miniaturising optoelectronics. These two components usually form a 1:1 ratio as they have complementary hydrogen-bonding sites.

However, when Shiki Yagai at Chiba University, Japan, and Frank Würthner at Würzburg University, Germany, mixed two of these molecules – an azobenzene-functionalised melamine and a perylene bisimide – in a 1:1 ratio, they didn't get the linear structures they expected. Instead, they got small assemblies with ill-defined morphologies, explains Yagai.

To their surprise, adding more of the azobenzene to this mixture triggered the formation of what Yagai describes as 'tightly-coiled helical nanostructures,' containing the two components in a 2:1 ratio. He suggests that the additional melamine molecules in the chain reduces the number of hydrogen bonds, making it more flexible and able to curve. When this happens, bisimide molecules can sit in adjacent bends of the helix, and are able to pi-stack, making the structure more stable.

Ronald Castellano, an expert in self-assembly at the University of Florida, Gainesville, US, says 'this work reminds us of the beautiful complexity that can be achieved from the assembly of relatively simple synthetic building blocks and that there is still much to learn about predicting supramolecular structure on the nanoscale.' He adds, 'this work shows that to access new functional assemblies we must be willing to resist taking the most comfortable or intuitive approach.'

Yagai comments that these helices are similar to those seen in the light-harvesting systems of photosynthetic organisms, and he expects them to attract significant attention from supramolecular chemists. He says that unconventional systems like these could have exciting prospects, because 'switching such a structure into a new morphology might be accomplished by small changes of solvent, coordination of an analyte, a light pulse or an electrochemical stimulus.' The team are now developing smart nanostructures with morphologies and light-harvesting functions that can be controlled by light pulses.

David Barden

Reference

S Yagai *et al*, *Org. Biomol. Chem.*, 2009, DOI: 10.1039/b912809c

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The bioavailability of iron and zinc in barley grain is investigated

Essential elements from cereals

Analysing iron and zinc in crops could help improve their nutritional value

Just how much iron and zinc do you get from your breakfast? Scientists in Denmark have been looking for the answer.

Iron and zinc deficiencies are common nutritional disorders, particularly in the developing world where cereal grains are the most common food type. Measuring total concentrations of these elements in food crops is relatively easy but does not give any information about how much will be taken up by the body. This is a much bigger challenge, which Søren Husted at the University of Copenhagen and his team have set about solving. They say investigating how these elements are bound in the plant can give more information about their bioavailability.

Some elements can be indicators of the chemical binding form of others, explains Husted, so by analysing iron, zinc, phosphorus and sulfur in the plant simultaneously, they could determine how the iron and zinc are bound. 'Multi-elemental analysis of plant tissue with sufficient robustness and accuracy is absolutely not trivial,' says Husted. But by using a combination of analytical techniques such as mass spectrometry, size exclusion chromatography and enzymatic extraction, his team were able to do just that.

They found iron and zinc have different chemical binding forms in the plant. This is contrary to the general view in the literature, says Husted, and shows that separate research strategies need to be applied in order to increase the bioavailability of both elements. 'We think that our methods will be an important tool in future molecular plant breeding programmes aimed at improving cereal plants with a higher amount of bioavailable iron and zinc,' he adds.

Husted plans to extend the technique beyond plants. 'We would like to follow the chemical binding forms of iron and zinc from the plant, via the cooked meal, all the way through the human digestion system,' he says. 'This will give important answers to the questions remaining regarding bioavailability of micronutrients.'

Edward Morgan

Reference

S Husted *et al*, *Metallomics*, 2009, DOI: 10.1039/b905688b

An electrochemical reaction can be followed as it happens inside a spectrometer

Spectra issues dissolve in ionic liquids

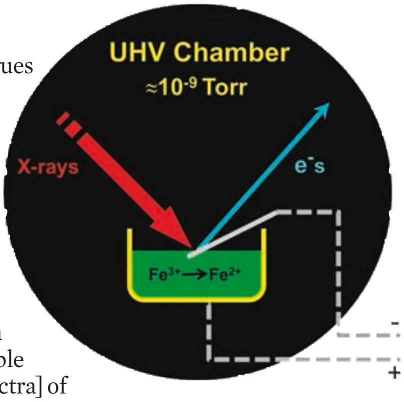
UK scientists have used x-ray photoelectron spectroscopy (XPS) to follow an electrochemical reaction in situ.

Spectroscopic techniques such as infrared and ultraviolet-visible absorption are routinely used to investigate electrochemical reactions, giving important mechanistic and structural information. However, these methods are limited to probing the outer electrons of species and cannot be used to monitor core electronic changes. XPS could fulfil this need but its requirement for ultra-high vacuum (UHV) conditions introduces a critical obstacle: solvent evaporation.

Peter Licence at the University of Nottingham, UK, has overcome this problem using ionic liquids, exploiting both their low volatility and inherent conduction properties. By specifically employing an iron(III)-containing ionic liquid, Licence and his colleagues were able to monitor iron(III)-iron(II) reduction using XPS. Simple though it sounds, the work has been far from easy. 'We had phenomenal problems,' admits Licence, 'we could do the electrochemistry in UHV and we've been able to [measure the XP spectra] of the ionic liquids, but to do both at the same time has been a real uphill struggle.' Given the difficulties, Licence is clearly pleased with his team's success. 'This is the first time that anyone has been able to monitor a real chemical reaction in a high vacuum environment,' he says.

Gregory Wildgoose, an expert in electrochemistry at the University of Oxford, is similarly enthusiastic. 'This is an important step forward; actually being able to do the electrochemistry inside the spectrometer is a very desirable tool for developing sensors and catalysts.' Wildgoose also praises the team's ingenuity in improving the technique's sensitivity. 'Incorporating the redox probe into the ionic liquid is very clever, enabling a sharp XPS signal, which would be difficult in a normal solute–solvent system,' he adds.

Licence is now eager to apply the technique, and test its limits. 'We're interested in designing more efficient catalysts, new probes, sensors, functionalised electrodes,' he explains, 'we really want to push this technology to see how far we can take it.' *Philip Robinson*



The reduction of iron(III) to iron(II) is monitored using X-ray photoelectron spectroscopy

Reference

A W Taylor *et al*, *Chem. Commun.*, 2009, DOI: 10.1039/b915302k

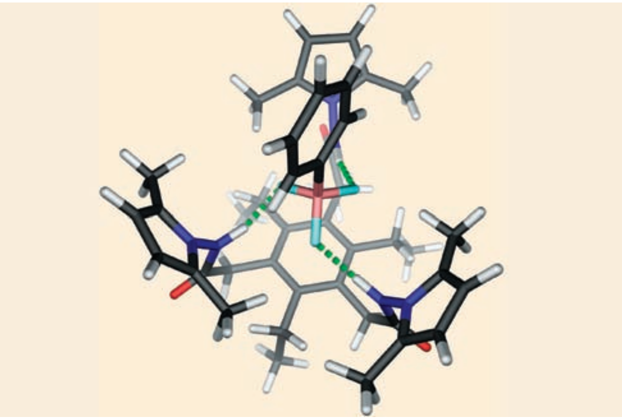
A supramolecular receptor shows that fluorine compounds can form hydrogen bonds

Fluorines make hydrogen bonds

Scientists in the US have shown that fluorine compounds can form hydrogen bonds, a finding that could have implications for the pharmaceutical industry, they say

Fluorine is often used in drug development as its presence in organic compounds can affect properties such as adsorption, distribution and stability. However, exactly how it interacts with biological molecules remains a puzzle, says Julius Rebek Jr at The Scripps Research Institute, California.

While inorganic fluorides are powerful hydrogen bond-acceptors, there is not much evidence that covalently bound organofluorines form hydrogen bonds. Not much sticks to organic C–F bonds, says Rebek, which is why they have been so useful in products such as Teflon. So the group moved up the periodic table to look at the B–F bonds in fluoroborates. Fluoroborates are covalently bonded but also anionic, which makes their hydrogen bonding properties interesting for researchers.



A supramolecular receptor helps to understand the hydrogen bonding of fluoroborates

Rebek and his team made a supramolecular tripodal receptor with three inwardly directed hydrogen donors. They used the receptor to surround the BF_3^- of a trifluoroborate, presenting it with available hydrogen-bond donors, and found the covalently bound fluorine did form hydrogen bonds. 'This is the inaugural case of recognising the BF_3^- group,' says Rebek.

Understanding the nature and strength of hydrogen bonding in this way could be important for drug development, says Rebek. These results could lead to 'the CF_3^- groups that appear in medicines being replaced by the BF_3^- group to improve solubility and, perhaps, bioavailability,' he adds.

Professor Luigi Fabbrizzi, an expert in anion binding in synthetic receptors from the University of Pavia, Italy, says the receptor could be 'a useful tool for [finding] many drug compounds of pharmaceutical interest possessing fluorinated fragments. More sophisticated receptors could be developed, capable of interacting with fluorinated compounds in more competitive solvents including water, which would allow the monitoring of many drugs in physiological fluids.'

Rebek's group are currently looking at commercial applications of the receptor. *Nicola Wise*

Reference

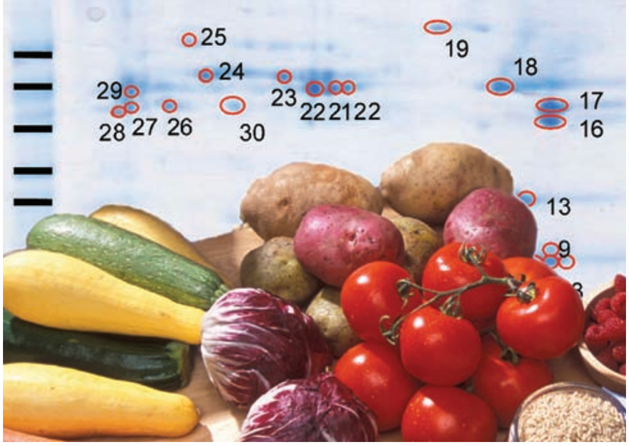
P Restorp *et al*, *Chem. Commun.*, 2009, DOI: 10.1039/b914171e

Instant insight

Understanding our food

Monika Pischetsrieder and Rainer Baeuerlein from the University of Erlangen-Nuremberg, Germany, look at how the safety of GM food can be assured before it reaches supermarket shelves

Fifty-five genetically modified (GM) food or feed items are currently awaiting authorisation by the European Union. Evaluating the safety of GM organisms, which is carried out by the European Food Safety Authority, usually takes more than three years and includes a rigorous risk assessment. In order to simplify the process, the concept of substantial equivalence has been introduced. This means that a GM tomato, for example, is regarded as safe if it has the same composition as a traditionally produced tomato. But what does 'the same composition' mean? Usually, analysing substantial equivalence focuses on the main components, such as sugar and protein concentrations as well as critical nutrients and anti-nutritional factors, such as vitamins or solanine (a toxic tomato component). However, it has been argued that genome modification may lead to unexpected random effects with unknown consequences for the consumer. And these random effects may be overlooked if it is only the main components that are analysed. To combat this, untargeted analytical methods, which promise to give a systematic view of food composition, were introduced into the safety assessment of GM food. The most promising approaches for this purpose are omics-methods.



Proteomics, or proteome analysis, was originally developed for biomedical research to search for diagnostic markers (indicators of disease) or new drug targets, for example. The proteome is the entire complement of proteins in a biological sample such as a cell. Since proteins are the primary products of gene expression (where information from a gene is used to make a protein), a random effect caused by genetic modification of a plant should be reflected in the proteome. So proteome analysis could indicate if a new GM food is indeed substantially equivalent to a traditional food and can be regarded as safe without further evaluation. The goal of proteome analysis is to depict the composition and concentrations of all cell proteins or other biological samples as completely as possible. Since a cell contains several tens of thousands of different proteins, sophisticated methods for protein separation must be applied. This is achieved either by two-dimensional gel electrophoresis (gel-based methods) or by two-dimensional liquid chromatography (shotgun methods). After separation, proteins are usually identified by two-dimensional mass spectrometry. However, taking into account that one shotgun experiment can generate up to 100,000 mass spectra, it is obvious that with this method, data interpretation, evaluation and management cause a bottleneck.

Proteomics promises a simpler way to ensure that genetically modified food is safe to eat

In other areas of food science, researchers have also used proteome analysis to give an overview of protein composition in biological samples. To study a particular food's effect on the body – physiological or nutritional activity – the food item is traditionally administered to cultured cells or animals and the response of selected diagnostic markers is recorded. Alternatively, any changes to the whole proteome that can be seen as a reaction to the treatment reduce the chance to overlook any unexpected beneficial reactions or toxic side-reactions. As a result, the process of identifying bioactive food items or components, which affect metabolism and health, should be largely accelerated.

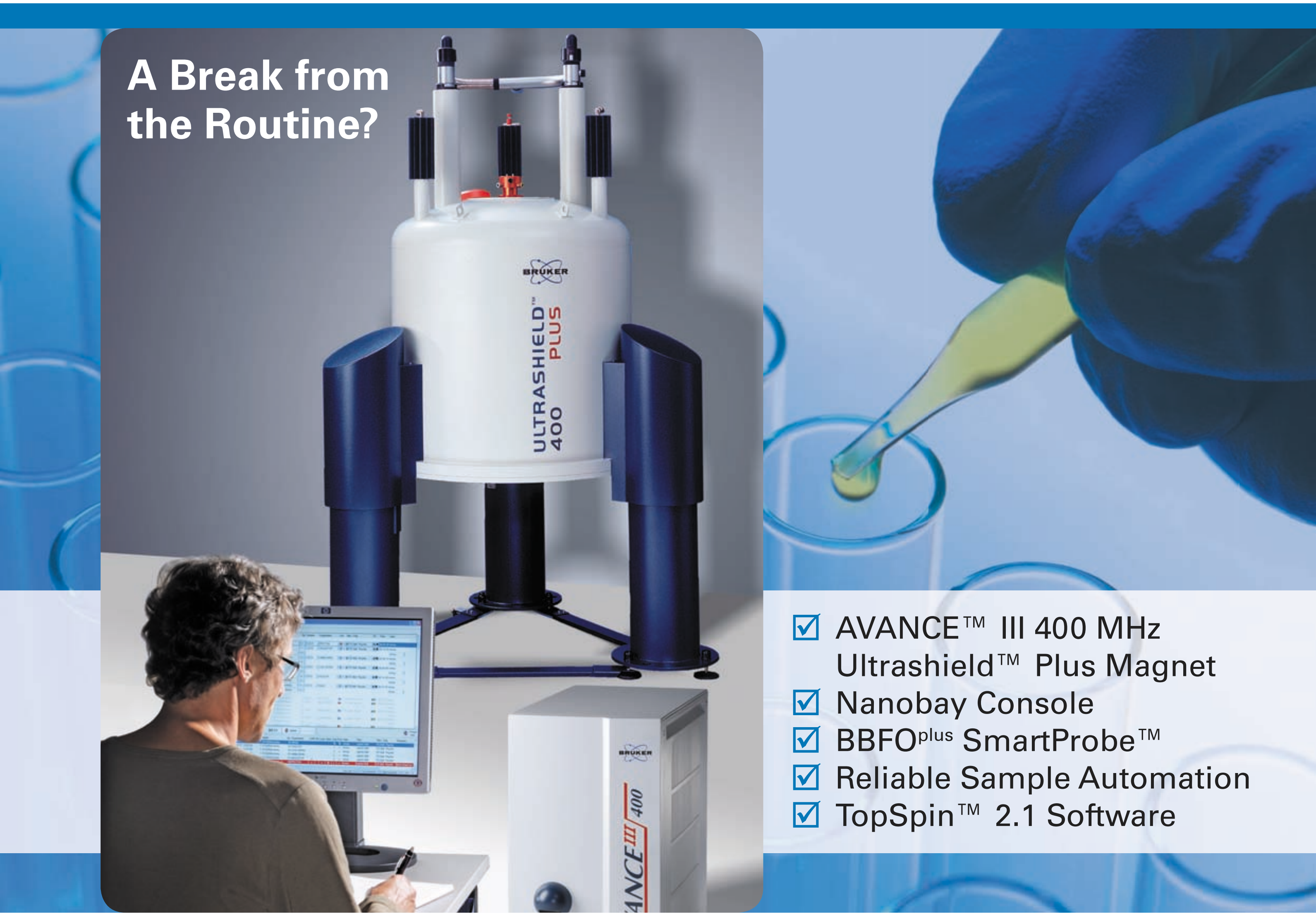
Another hot topic in food science is authentication. With the growing global market, food adulteration is an emergent problem. In some cases, detecting the replacement of valuable ingredients or whole foods by cheaper substitutes can be difficult for food control. Particularly if a new food adulteration problem is arising, there is the need to react quickly and to create a reliable analytical solution. By comparing the proteome of the original ingredient with the substitute, the proteins that are only expressed in the substitute can be quickly and efficiently identified and further used as markers for food adulteration. Finally, proteome analysis is applied in food science to systematically reveal the effect of food processing on food proteins, to identify food allergens and to develop a means to improve food quality.

To understand complex interactions between food production, composition and their effects on the human body, it seems that proteomics researchers have the method and technique bases covered. Now, the challenge for scientists is to find a way to handle and interpret the complex data generated.

Read more in Monika Pischetsrieder and Rainer Baeuerlein's tutorial review 'Proteome research in food science' in issue 9, 2009 of Chemical Society Reviews.

Reference

M Pischetsrieder and R Baeuerlein, *Chem. Soc. Rev.*, 2009, DOI: 10.1039/b817898b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Interview

Riding high

Philip Mountford on jockeying, bribing techniques and the challenges ahead for chemistry. Interview by Amaya Camara-Campos

Philip Mountford

Philip Mountford is a professor of chemistry at the University of Oxford, UK. His research interests centre on the synthesis, bonding and reactivity of organometallic compounds of the transition metals and lanthanides.

I have heard you used to ride horses, how did you end up as a chemistry professor?

I rode a lot as a child and teenager, so after my A-levels I took up a position in a horse racing yard as an assistant. After a year or so I didn't quite make the grade for the big stage so I decided to go to university. I am sure my racing background helped in the interview. I already had my A-level grades and so the interviewer asked, half jokingly, if I had any tips, not really expecting a serious answer. But as it happened I had been with somebody the day before who had a hot tip, I passed that on and the horse won. Sure enough, a few days later I got an offer to read chemistry!

Why did you specialise in inorganic chemistry and catalysis?

I was initially most interested in organic chemistry but it was Dr Peter Pye who really inspired my interest in transition metal organometallic chemistry. I don't think we really covered much catalysis back in 1985, but all these fascinating metal-mediated transformations really grabbed me. In my group, I like to think we make interesting compounds with some sort of raison d'être: could be an unusual molecular or electronic structure or some sort of stoichiometric or catalytic transformation.

What are the challenges ahead for catalysis?

I think that improving selectivity (in the way nature can), efficiency, using non-toxic solvents and cheaper (and/or more abundant) metals are some of the main targets. This is really with regard to known reactions. I think there are transformations waiting to be discovered which we haven't really dreamed of . In that regard, there is a role for blue-skies exploratory studies. This is harder and harder to get funding for nowadays – which is ironic since our past successes are built more or less on this paradigm.

Are the current global economic problems affecting funding in the UK?

I think we are already seeing the effect of the recession from an industrial funding point of view. The present (perceived or real) difficulties in gaining government funding stem from other reasons. I think we all recognise that, whatever the colour of the next UK government, there will be significant public sector cut-backs which must surely impact on the funds available to research councils. I also suspect – from a chemistry point of view – we will see more research funding focussed towards immediate or medium-term industrial or technological goals. This is not unreasonable of course, but we must continue to 'horizon-scan' as well as being a technological arm of the government.

Which is your favourite metal to work with?

That's quite difficult. I worked a lot with tungsten as a graduate student and research fellow (my first serious encounter with a metal). My group has worked with many metal-organic compounds, and I think they would expect me to say titanium as we have used it very successfully. But I have a sneaking admiration for samarium which, as a fairly large early lanthanide, is a bit of a wild thing but can be pinned down with the right ligands.

What makes a good researcher?

I think there are several sorts of 'good' researcher. You need the dedicated, systematic types who are able to really drill down into a problem for months and years with focus and dedication. Then you need the 10-ideas-a-day types who set the agenda and make a sort of creative tension which us mere mortals can feed off for years as they disappear over the horizon. If I look at the successful academics in my area, I see people who are focussed, hard-working, receptive to ideas and able to inspire students and co-workers to try their best and share in a common vision.

What are your views about the current world food crisis and how can chemistry help the situation?

The food crisis seems to me as much a societal and political problem as an agricultural one. You see waste and abuse of food (often shipped all around the world as we ignore the rich seasonal variations in our own countries) in many 'developed' countries, but yet ruinous governments in others where much more could be done to solve local problems. Chemistry can help in so many ways: pest-control for crops; improved fertilizers; GM; medicines against cattle infection. These seem to me the more obvious impacts but, also, since the food crisis is amplified by man-made climate change, efforts channelled by chemists towards the better use of energy and reduced CO_2 emissions could also indirectly help.

Do you still ride horses today?

Actually I don't ride any more. Between my children, my wife, keeping up with friends and then the day job, I don't have much time for serious hobbies. I do cycle to work every day as regular exercise.

Your favourite food?

Chocolate!

Essential elements

New journal *Chemical Science*

The recent ACS Fall 2009 National Meeting in Washington was the occasion for the release of some exciting news for researchers from across the chemical sciences: invitations were distributed, an audience gathered, a few words were spoken and then the ribbon was cut, revealing the news that in 2010 a new journal – *Chemical Science* – would join the RSC portfolio.

Editorial director, James Milne, describes this new venture as a milestone in the development of the RSC publishing portfolio. ‘During recent years, RSC journals have attracted significant growth in submissions, while impact factors have increased to lead the field. The launch of *Chemical Science* will truly complement RSC Publishing’s world renowned communications and review flagship titles.’

David MacMillan cuts the ribbon to reveal RSC’s new journal, *Chemical Science*

At the forefront of the most exciting developments, and helping to define the important areas by publishing the most significant cutting-edge research, *Chemical Science* will be a dedicated home for findings of exceptional significance from across ALL the chemical sciences.

Editor-in-chief David MacMillan of Princeton, US, will lead a dynamic international team of associate editors who will drive the scientific development and make decisions on the content. ‘I am extremely honoured and excited to be working with the RSC on the launch and development of *Chemical Science*,’ he says. ‘This is an opportunity to bring forward a very new type of journal and a new way of disseminating edge publications from the world of chemistry. I look forward to being part of this new approach to publishing the world’s most pioneering studies in the chemical sciences.’

Free access to Chemical Science will be available – find out more at www.rsc.org/chemicalscience

MedChemComm coming soon

MedChemComm, a new, peer-reviewed journal from RSC Publishing was announced recently at the 3rd International Symposium on Advances in Synthetic and Medicinal Chemistry in Kiev, Ukraine, and the ACS Fall 2009 National Meeting and Exposition in Washington DC, US. Launching in mid 2010, the journal will focus on medicinal chemistry research, including new studies related to biologically-active chemical or biochemical entities that can act as pharmacological agents with therapeutic potential or relevance.

The new journal will be owned by RSC Publishing and will be the official journal of the European Federation for Medicinal Chemistry (EFMC). It will complement the existing RSC Publishing portfolio of bioscience journals, providing authors in the field with a dedicated subject-specific publication. Monthly issues will contain a mix of vibrant and concise research and review articles.

The co-editors-in-chief will be Gregory Verdine, Harvard University, US, and Anthony Wood, Pfizer, UK. Wood comments: ‘*MedChemComm* is very important, especially when one considers the mission of the journal is to emphasise the role of chemistry as a powerful vehicle to conceptualise new understanding of biological systems and processes. It is a means to design new tools to modulate these selectively by exploring multiple modalities of intervention.’

Free access to MedChemComm will be available for 2010 and 2011. Find out more at www.rsc.org/medchemcomm

Further news...

October sees the publication of the 100th issue of the *Journal of Environmental Monitoring* (*JEM*). Editor Harp Minhas, announced it a milestone event, as the journal undergoes a significant change in its subject approach. Minhas explains: ‘The impact of environmental research is of special concern to our readers. From now on all submitted articles will provide a statement explaining how the research impacts the environment directly and how the work provides insight into environmental processes.’ www.rsc.org/jem

In a separate journal development, new titles *Nanoscale* and *Analytical Methods* have published their first articles online, just months after the initial launch announcement in March.

Nanoscale, a collaborative venture with the National Center for Nanoscience and Technology, Beijing, China, publishes experimental and theoretical work across the breadth of nanoscience and nanotechnology, while *Analytical Methods* will appeal to scientists with an interest in the latest research methods demonstrating the link between fundamental and applied analytical science.

Read the articles for free at www.rsc.org/methods and www.rsc.org/nanoscale. Register for free online access to all Nanoscale and Analytical Methods content throughout 2009 and 2010 at www.rsc.org/free_access_registration

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