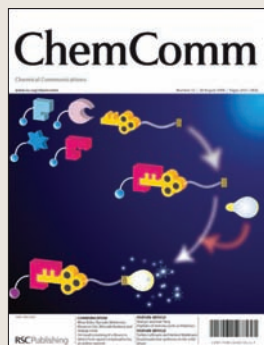


# Chemical Biology

## A quick fix for damaged genes



Chemists in Japan are a step closer to repairing damaged DNA inside living cells. Using UV light they can mutate cytosine into uracil at specific sites on the DNA backbone.

K Fujimoto *et al*  
*Chem. Commun.*, 2006, 3223

## Tweezing out the truth



Illuminating the state-of-the-art in optical tweezer research, scientists in the US explain how laser beams can be used to trap and move small biological objects.

Y Kimura and P R Bianco  
*Analyst*, 2006, **131**, 868

## Diagnosis from protein patterns



Researchers have discovered patterns of cell proteins that can indicate cancer. Identifying these could lead to earlier diagnosis and faster treatment for patients, says a scientist in the US.


G R Whiteley  
*Mol. BioSyst.*, 2006, **2**, 358

## Relaxing times for DNA bases



UV-induced skin cancers have a known link to DNA damage. Now scientists in France say that the damage can be better understood by looking at how DNA components relax after exposure to light.

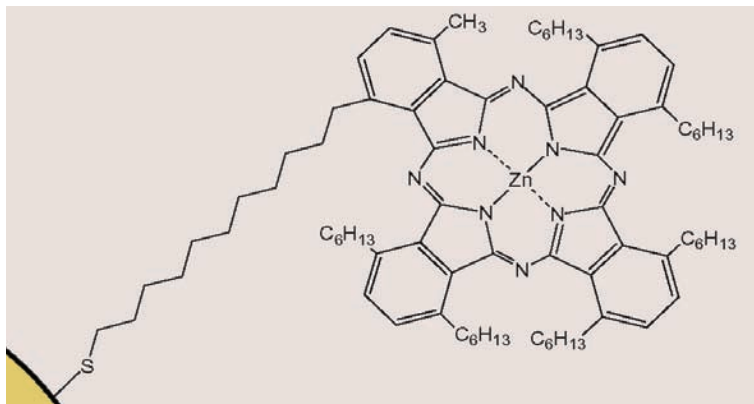
C Canuel *et al*  
*Phys. Chem. Chem. Phys.*, 2006,  
DOI: 10.1039/b606437j

 See [www.rsc.org/chembiology/](http://www.rsc.org/chembiology/) for full versions of these articles

# Research highlights

Nanoparticle Trojan horse improves toxicity of anticancer drug

## Gold delivery kills cancer cells



**The photoactive phthalocyanine drug is tethered to a gold nanoparticle**

Scientists in the UK have found a way to target cancer with gold.

David Russell and co-workers at the University of East Anglia have designed a system that delivers a light sensitive drug to cancer cells. The system uses gold nanoparticles, to which the drug and another molecule, called a phase transfer agent, can be bound. This drug-nanoparticle complex can be used to kill cancer cells in a process called photodynamic therapy (PDT).

PDT is an established cancer treatment that is available in

several countries. It uses the combination of a photoactive drug (a photosensitiser) and light. When stimulated by visible light the drug damages the target cancer cells, leaving healthy tissue unharmed.

Russell's system used a cancer drug based on a phthalocyanine molecule. These molecules are more specific to cancer tissue than others commonly used in PDT. However, this type of drug is not water soluble, making it more difficult to deliver it to target sites, said Russell. Using a phase

transfer agent can help overcome this problem by making the drug-nanoparticle complex soluble in water, he explained.

On irradiating with red light, the phthalocyanine drug produces an active form of oxygen, singlet oxygen, which is toxic to cells. The group found that the drug-nanoparticle complexes produced 50 per cent more singlet oxygen than the drug alone.

Russell showed that the drug-nanoparticle complexes were taken up by cervical cancer cells *in vitro*. These cancer cells then died by apoptosis, or cell suicide. 'While our results are very encouraging, the next key phase of the work is to take the *in vitro* study to the *in vivo* environment. To do this we are collaborating with a PDT group in Padova,' said Russell.

David Phillips, a PDT expert from Imperial College London, UK, said, 'This is a very useful, novel means of getting photosensitisers into cells, and in this case, the use of the gold nanoparticles enhances the singlet oxygen yield, so is a real bonus.'  
Katherine Vickers

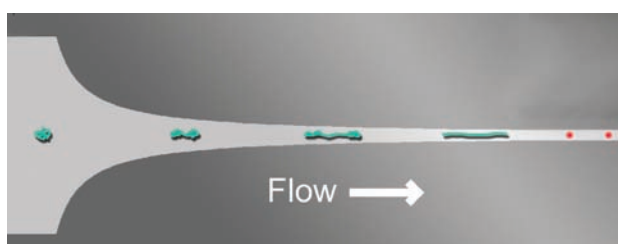
**Reference**  
M E Wieder *et al*, *Photochem. Photobiol. Sci.*, 2006, **5**, 727

High-throughput device to unravel the secrets of DNA

## Simple stretch for biowarfare detector

A device that stretches DNA is being used to develop a detector for biowarfare agents. Jonathan Larson and a team at US Genomics, US, say that characterising DNA, or DNA mapping, could become faster and more cost-effective thanks to their invention.

The team stretch the DNA by forcing it to flow through a long microfluidic funnel. The extended DNA molecules are easier to analyse than the original DNA, which is coiled in its native state. Huge tracts of DNA can be examined rapidly in this way, using conventional detection methods, explained Larson. The approach 'is elegant in its simplicity,' he said.



'Nothing other than a microchip and DNA are required.'

'The ultra-high throughput of our approach is inspiring new applications for DNA mapping,' said Larson. He explained how the company has recently been awarded \$23M by the US department of homeland security's advanced research projects agency. It was

**DNA is stretched as it flows through a long microfluidic funnel**

**Reference**  
J W Larson *et al*, *Lab Chip*, 2006, DOI: 10.1039/b602845d

awarded the funding to develop a detection system for biowarfare agents based on the DNA stretching approach. 'Within fifteen minutes the system will analyse approximately one million long DNA fragments collected from biomaterial in the air.' It will be like 'searching for the needle in the haystack,' said Larson.

Larson said the team have already developed their work by improving the stretching efficiency, increasing throughput and making changes to sample preparation. Collectively, these improvements are 'a big step forward' toward fielding robust, sensitive, and high throughput systems for DNA analysis, he said.  
Katherine Davies

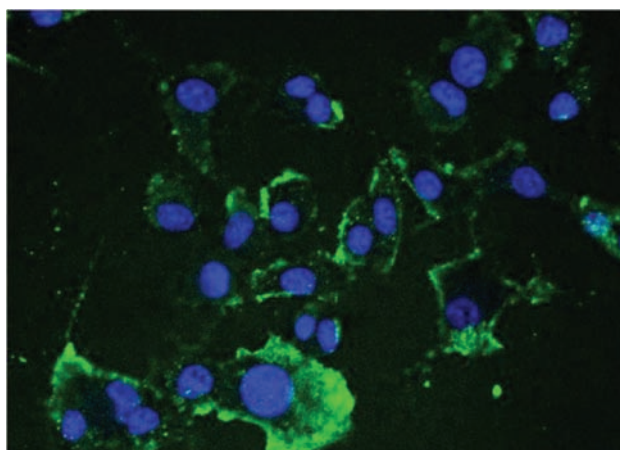
## Protein adopts different forms on flat and bumpy surfaces

# The rough and the smooth

Nerve cells don't like to lie on bumpy surfaces any more than we do, say researchers in the US. Jenna Rickus at Purdue University says the discovery could be useful for scientists designing biomedical devices.

Tumour cells attached to a silica surface can be transformed into nerve cells or neurons in a process called differentiation. Rickus and co-workers discovered that this works very well on thin films of silica but much less so on bulk material, even though the chemistry of both materials is the same. The answer, they say, lies in differences in the surface topography

The researchers examined a protein called fibronectin that helps to glue the tumour cells to the surfaces. Fibronectin can exist in two states; in one state it has a globular shape and in the other it is straightened out into a fibre-like structure. Cells bind to the surfaces and transform into neurons only when fibronectin is in the



straightened state.

The researchers found that fibronectin is straightened on thin films, but globular on bulk silica. According to the researchers, this is due to the surface of the bulk material being comparatively rough. The features of the bulk surface are around the same, or larger, size as fibronectin and 'the

### Cells bind to the smooth surfaces of thin films

**Reference**  
S S Jedlicka *et al*, *J. Mater. Chem.*, 2006, **16**, 3221

protein may find it favourable to settle into the valleys,' said Rickus. In contrast, Rickus continued, thin films are much smoother, allowing fibronectin to unfold.

Understanding how neurons differentiate on artificial surfaces is important in the development of medical devices, said Rickus. She herself is currently collaborating with her colleague Pedro Irazoqui to build an implant to treat epilepsy, which uses neurons to stop a seizure before it manifests. Our work shows that if bulk silica is to be a carrier for nerve cells its surface properties must be altered, Rickus explained.

The researchers also point out the importance of their work in a more general light. They say their results show how surface properties can influence the behaviour of biological molecules and cells. Designers of biological interfaces will benefit from a better understanding of these effects, said Rickus.

*Danièle Gibney*

## Aquatic plant aids study into the effects of increasing UV radiation

# Double trouble for liverwort



Cadmium build-up and the depletion of the ozone layer are causing irreparable damage to plants, say researchers in Spain.

Javier Martínez-Abaigar and colleagues from the Universidad de La Rioja have found that a plant's ability to repair DNA damage caused by UV-B radiation is impaired by cadmium build-up. Repair of DNA damage is essential for plants to survive.

Martínez-Abaigar's team studied the responses of an aquatic plant

called liverwort to the individual and combined effects of cadmium and UV radiation. They found that both triggered the plant to produce increased amounts of antioxidants, but that the plant produced the highest levels when the effects were combined. DNA damage was provoked specifically by UV-B radiation, whereas cadmium had modest effects in this respect, said Martínez-Abaigar. However, the strongest DNA damage was recorded in the presence of both

### Cadmium impairs plant's ability to fix UV damage

**Reference**  
S Otero *et al*, *Photochem. Photobiol. Sci.*, 2006, **5**, 760

UV-B and cadmium.

Cadmium is released into soils through weathering of minerals, but it is also released artificially, for example from fertilisers and during waste incineration. When plants grow in these soils they take up the metal and it accumulates. Cadmium is known to be toxic to plants but this research shows that it also intensifies the effects of UV-B radiation, said Martínez-Abaigar.

The team will continue to use aquatic plants to study the effects of UV-B radiation. Over the past 25 years levels of UV-B radiation have increased as the ozone layer has depleted, said Martínez-Abaigar, and studies such as this are 'increasingly important. Predicted changes show the ozone layer will remain vulnerable to further depletion in the near future.'

*Elinor Richards*

## Sex, love and our chemical nature

A new book published by the RSC, *Lust and Love: Is it more than chemistry?* examines the age old questions of why people fall in love and what makes people attractive.

Providing a fascinating insight into these questions, through the eyes of science, it explores the way we feel and behave from first meetings to long term partnerships.

Written by a husband and wife team, the book was a popular best seller in Germany. Rolf Froböse explains why they decided to write it, “*Love is as harmless as a spoon of hydrochloric acid on an empty stomach*”, the French writer Charles Baudelaire (1821-1867) once said. We don’t agree with him but – as chemists and scientific journalists – we wanted to find out why people



fall in love and how the famous “chemistry between people” works.’

Drawing on all areas of science including chemistry, biochemistry, neurology, psychiatry, psychology, physics and medicine, the book takes a light-hearted approach to the subject using fictional characters for illustration.

‘The readers will find some

answers to a lot of burning questions and we also present the most interesting results from international researchers, who could enlighten the science behind love, desire and passion,’ adds Froböse.

From physical attraction to emotional connections this fascinating book is a must read for young and old. *Find out more at [www.rsc.org/lustandlove](http://www.rsc.org/lustandlove)*

## And finally....

A new edition of the popular textbook *Nucleic Acids in Chemistry and Biology* has just been released. Thoroughly revised and updated it is now in its 3rd edition.

Written by leading experts in the field the book includes DNA and RNA structure, genes and genomes, RNA structure and function, covalent interactions, reversible interactions and physical and structural techniques applied to nucleic acids.

Complete with illustrations and worked examples, this comprehensive book is ideal for graduates and people who require an introduction to the field of nucleic acids.



*Find out more at [www.rsc.org/books/nucleicacids](http://www.rsc.org/books/nucleicacids)*

## Molecular BioSystems in the spotlight

News that the National Library of Medicine has selected *Molecular BioSystems*, the RSC’s chemical biology journal, for indexing and inclusion in their MEDLINE database brought the journal’s first year of publication to a highly successful conclusion. Visibility of the journal in the community is certain to increase as a result, as the MEDLINE database is searched by researchers and health professionals worldwide through search engines such as PubMed.

This latest news follows the announcement that 3D visualisation of complex protein structures has become a simple click-through process for the journal’s readers. Anyone can view and appreciate key biomolecular structures in three dimensions, whatever their level of expertise.

The PDB identification code of the molecule is used to generate an image using FirstGlance in Jmol. The resulting image is viewed in a free online applet

– enabling you to rotate the molecule, customise the view and zoom in to specific areas of interest. One of the views displays colour-coded amino acid sidechains and nucleotide bases. Guidance and explanations are always visible on screen, whatever the view you have selected or operation you are performing.

*For more on this, and the other online features available to authors and readers, visit [www.molecularbiosystems.org](http://www.molecularbiosystems.org)*

*Chemical Biology* (ISSN: 1747-1605) 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 *Organic & Biomolecular Chemistry*, *Molecular BioSystems*, *Natural Product Reports* and *Photochemical & Photobiological Sciences*. *Chemical Biology* can also be purchased separately. 2006 annual subscription rate: £199; US \$364.

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](mailto:sales@rsc.org)

**Editor:** Celia Clarke

**Associate editors:** Neil Withers, Nicola Nugent

**Essential elements:** Sarah Day, Valerie Simpson, Michele Zraggen

**Publishing Assistant:** Kate Nussey

**Publisher:** Graham McCann

Apart from fair dealing for the purposes of research or private study for non-commercial purposes, or criticism or review, as permitted under the Copyright, Designs and Patents Act 1988 and the copyright and Related Rights Regulations 2003, this publication may only be reproduced, stored or transmitted, in any form or by any means, with the prior permission of the Publisher or in the case of reprographic reproduction in accordance with the terms of licences issued by the Copyright Licensing Agency in the UK. US copyright law is applicable to users in the USA.

The Royal Society of Chemistry takes reasonable care in the preparation of this publication but does not accept liability for the consequences of any errors or omissions.

Royal Society of Chemistry: Registered Charity No. 207890.

RSC Publishing