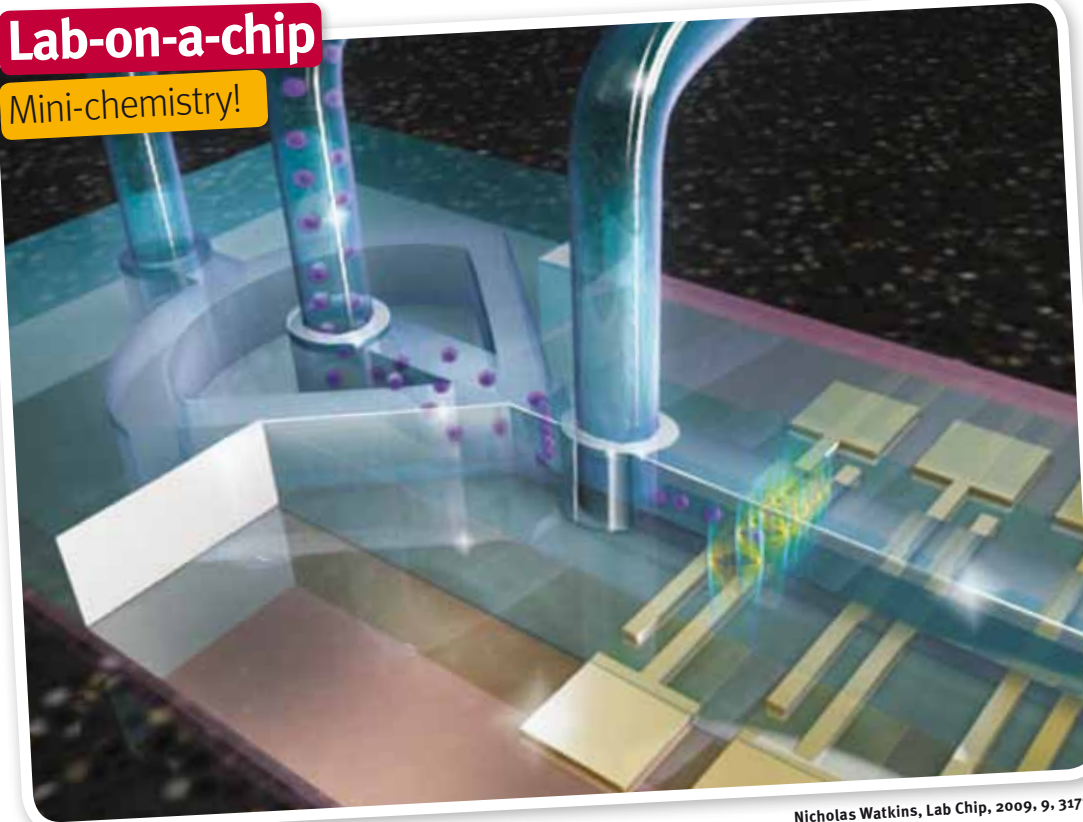


Lab-on-a-chip

Mini-chemistry!



Nicholas Watkins, Lab Chip, 2009, 9, 3177

CAREERS SPOT

Chemists are always trying to discover new methods in which science can be carried out in a cheaper and more reproducible way. By

miniaturising computer chips, it has been possible to do more and more complex calculations; likewise, chemists have been trying to reduce the scale of their experiments so that they are more efficient and can do more great chemistry! Much of this “mini-chemistry” is being used in miniature devices such as blood glucose sensors and pregnancy tests.

The future of this area of chemistry is looking to provide lots of gadgets that will help in our everyday lives. Scientists are trying to create new diagnostics tools for cancer screening and biosensing, intelligent materials that could tell us if a drink is too hot or has gone off, and faster ways of creating molecules for drug discovery.

Lab-on-a-chip is a classic example of chemistry overlapping with lots of other science subjects. Whether it is being used in medical applications, or in biological or material sciences, it is chemists who are pushing the boundaries to bring this all together. Maybe you are interested in how chemistry overlaps with other sciences and the career options this produced? Maybe you would like to work on new and exciting science areas such as lab-on-a-chip? At the RSC we offer lots of information about courses that might be able to help you achieve these aims:

<http://www.rsc.org/Membership/join/AccreditedCourses/index.asp>

Why don't you have a look and see if anything takes your fancy?

Welcome
to issue 39



It's Christmmass!!! I hope you are all looking forward to it as much as I am! It's a time of the year when lots of fun things are happening and hopefully you might receive a present or two.

My favourite presents have always been gadgets. Whether they did something clever or just entertained me, I was never short of something to mess with during the festive season. This is something that lots of chemists have in common because there are lots of gadgets in chemistry too!

This month's issue concentrates on mini-gadgets and all of the things that they could do to solve the latest chemical challenges. This area of chemistry is often termed “Lab-on-a-Chip”. Have a read and see if you can find chemistry gadgets you often use without knowing!

Mike Bonne – Editor

Dates for your diary

ChemNet Events:

► NOW CONFIRMED

Meet the Universities 2010

Royal Horticultural Halls,
London

Saturday 3rd July 2010,

Reserve the date in your diary now – it's a great opportunity to find out more about how chemistry can fit into your future!



Look out in the new year for the latest ChemNet events. Visit:

www.rsc.org/chemnet
for the full list

Electronic Paper

Electronic displays are an essential part of our daily lives; they are part of our computers, televisions, mobile phones, and many other complex electronic products. But what would be the possibilities if these images could be displayed in a different way? This technology might provide an alternative to already existing electronic display products. Could a product or item that currently has a static image have a moving picture instead? Would it be possible to make an 'intelligent material' that could tell us something about its surroundings? If this can be achieved at low cost, what would this material look like and what might it be made of? Where might it be used?

Scientists have recently suggested that we could have moving digital graphics on paper! The use of paper as a substrate has received a lot of attention due to its recent application in medical testing. These tests are called 'diagnostics' - devices or substances used for the detection and monitoring of diseases or other medical conditions. These tests are designed so that they can be done simply and accurately by individuals with limited or no training. Work on improving the performance of paper-based diagnostics mimic more complex Lab-on-a-Chip systems in a cheap and more sustainable way is an new and exciting area.

How many times have you burnt your mouth on a drink or on piece of food that was too hot? Researchers at Harvard University in Boston, US have recently designed a new

type of paper that can be used as an electronically control display, "electronic paper". This has been achieved by using micro-patterned electrically conductive wires (wires the same width as a hair) on paper. This combination of materials allows a clever operation: as current flows through the wires, messages and pictures that are pre-printed on the underlying paper may be revealed. By using this technology on paper cups for hot drinks, indicators of when the drink is at the right temperature might be realised making burnt mouths a thing of the past.

Other examples of electronic paper are blood glucose (for diabetics) and pregnancy test devices. Part of the Clearblue® Easy Digital Pregnancy test uses electronic paper technology to reduce errors in user interpretation of intensities of bands. The flexibility of paper also makes it ideal for use in applications that need to be compact or folded. The demonstration of flexible and foldable displays could match the capabilities of electronic ink products (used in the Kindle book reader from Amazon) and compete directly with currently rigid technologies. Suggestions have even been made to have TV adverts on the cereal boxes of the future!

There are a variety of new functions and applications that can be expected from electronic paper systems all of which can extend Lab-on-a-Chip research into new ground.

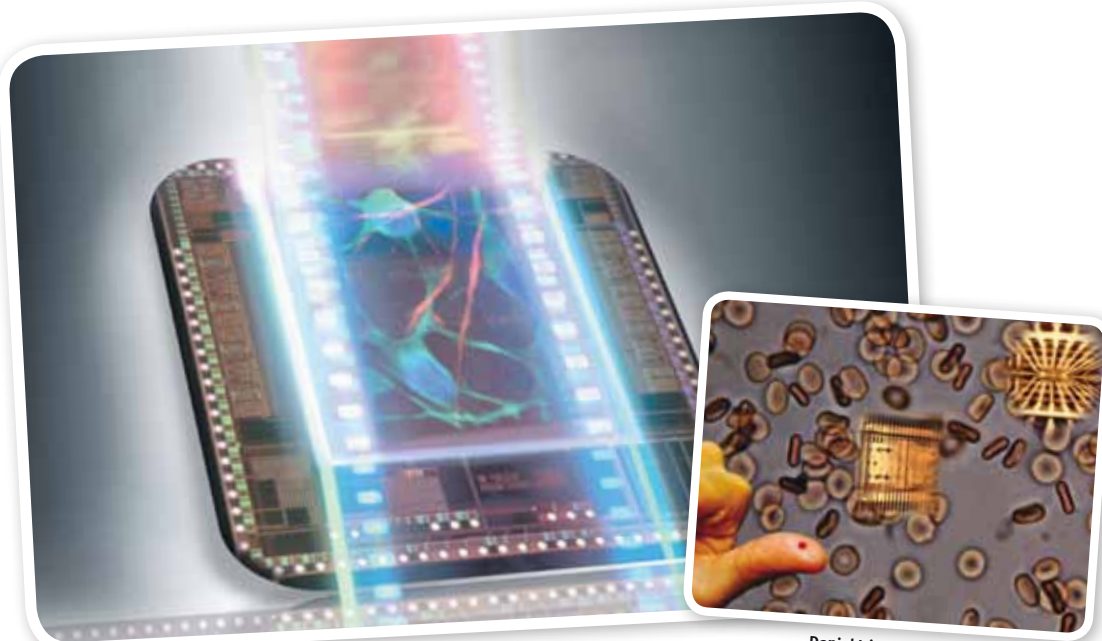
Chemistry Friends

Do you use social networking?
Are you on Facebook?

Well why don't you join the RSC's latest innovation, MyRSC. Go to the website at <http://my.rsc.org/> and get networking with your fellow ChemNet buddies.

You can look for the latest events, talk about revision or stay in contact with the people you meet in chemistry, or even meet some new ones who share your love of chemistry. We're going to be building this area up in the future and we want you to be part of our community. Give it a go!

MyRSC Online Community



Lab Chip, 2009, 9, 2614

Daniel Irimia, Lab Chip, 2009, 9, 2875

Careers: Spin-out sense

Craig Banks is passionate about his research. In his short academic career he has already co-founded a spin-out firm to make cannabis detectors, as Yfke Hager finds out



Curriculum vitae

Age 29

Work experience

2007-Present

Lecturer in Chemistry and Materials, School of Biology, Chemistry and Health Science, Manchester Metropolitan, UK

2006-2007

Lecturer in analytical chemistry, School of Biomedical and Natural Sciences, Nottingham Trent University, UK

2006

Research and development scientist, Schlumberger Cambridge Research, Cambridge, UK

2004-2006

Post-doctoral research assistant, Physical and Theoretical Chemistry Laboratory, University of Oxford, UK

Education

2004 PhD physical chemistry, University of Oxford

2001 BSc(Hons) applied chemistry, Coventry University

Hobbies

Squash, guitar, cycling

'...we met up with investors, who invested half a million pounds.'

Speaking to Craig Banks, it quickly becomes clear why this young chemist has achieved so much in such a short period of time. As newly minted chemistry researchers are increasingly being snapped up by industry, some would argue that it takes sheer dedication and a love of research to carve out a career in academia these days. Banks possesses the determination that characterises successful academics.

With only months to go before policemen start roaming the streets wielding a handheld cannabis sensor that he helped develop, it comes as no surprise that Banks was initially attracted to chemistry 'because of its application to real life.' As an undergraduate at Coventry University, UK, Banks was inspired to pursue a career in research after watching his professors in action in the lab. Banks went on to Oxford University where he developed enough original applied research to produce six patents, and co-founded a spin-out company. He has also found time to write a book on voltammetry with Prof. Compton, which offers insights into the design and analysis of experiments in the field of analytical chemistry.

Practical focus Juggling work

Banks has wide-ranging research interests, spanning the fundamental study of carbon nanotubes (particularly their electrochemical properties), sono-electrochemistry and nanotechnology. But the key to his success, perhaps, is his focus on practical applications in these fields. 'I moved into nanotechnology during my PhD, and then I gradually moved on to drug detection using electrochemical sensing,' Banks says. By branching out into nanotechnology, he was able to make significant advances in the functionalisation and miniaturisation of drug sensors.

Commercial chemistry

Banks' research efforts on cannabis detection were rewarded recently when he and Compton co-founded the spin-out company OxTox. The company will produce hand-held cannabis sensors to be used by police officers at the roadside to detect people driving under the influence of drugs, much like the breathalyser test for alcohol. Banks and Compton designed and built an electrochemical sensor that tests saliva samples and only produces a signal when the specific target drug is present. 'It's very sensitive, portable and cheap,' Banks says. The University of Oxford has its own technology transfer company, Isis Innovation, which has worked with Compton to protect the intellectual property created in his research group. 'We decided to patent protect [the sensor] and Isis saw a gap in the market. They got the ball rolling and we met up with investors, who invested half a million pounds,' Banks says. 'It was very exciting, and a completely different experience from lab work.' He anticipates that the sensors will be out on the streets within the next six to twelve months.

Before embarking on an academic career, Banks decided to gain some industrial experience at Schlumberger Cambridge Research, where he developed sensors for toxic gases based on electrochemistry. 'This gave me a greater understanding of research and development conducted in an industrial environment, compared with my experience of academic-only research,' he says. Since this time, Craig has gone on to have a successful academic career at both Nottingham Trent University and Manchester Metropolitan.

Chemistry on the web

► Lab-on-a-Chip YouTube Channel

<http://www.youtube.com/user/labonachipVideos>

Have a look at these cool videos! All of the videos on this YouTube channel have been made by real-life scientists from around the world. My personal is the dancing micro-droplets – it could be straight off strictly come dancing! Check out this direct link:

<http://www.rsc.org/suppdata/LC/b7/b710928h/b710928h-1.mov>

► Lab-on-a-Chip Journal

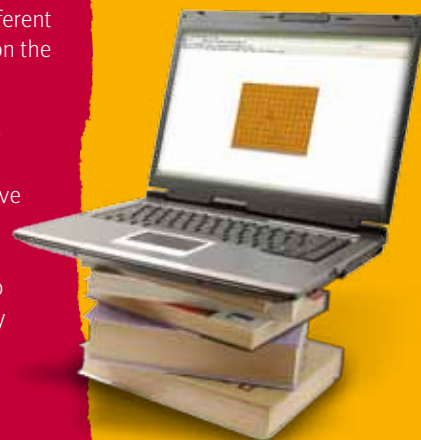
<http://www.rsc.org/Publishing/Journals/lc/Index.asp>

This is the RSC's very own journal that covers all the latest developments in Lab-on-a-Chip technologies. It has lots of interesting information and links on the journal home page. Some of the articles are pay-per-view but if you want more information there is lots of free stuff on wiki's.

Website of the month:

<http://www.rsc.org/suppdata/LC/b7/b710928h/b710928h-1.mov>

Have you been watching Strictly Come Dancing recently? Well, here is the chemistry version! Watch these chemicals do the waltz.

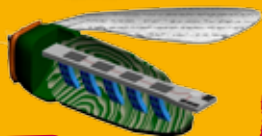


Win stuff

Paper is an extremely useful material that will be with us for years to come in low and high applications. But what is the chemical substance that paper is made of? Send your answer by email to us with your name and ChemNet membership number.

Closing date 10th December. Two winning entries will each receive a copy of *Elegant Solutions*, showcasing 10 of the best chemical experiments of all time. The winners of last month's competition are Monica Chand from Wednesbury and Matt Pullen from Hertford. Well done to you both!

For a chance to **WIN**, email us at: chemnet@rsc.org



Cool Chemistry

Recently, US military scientists have demonstrated using lab-on-a-chip technology to create remote-controlled moths!

These Franken-moths (half moth, half machine) could be used to carry intelligence systems such as microphones and cameras into enemy territory to act as spies.

I wonder what Q and James Bond would make of this cool little gadget? Check out this video:

<http://www.youtube.com/user/labonachip>
Videos#p/u/23/eS7XDilolc

WARNING!

this is a real life experiment so for those of you who are a little bit squeamish, think twice before looking at these Franken-moths!

Cutting-edge Chemistry

An on-chip operation

US scientists have speeded up worm microsurgery to improve our understanding of animal behaviour.

Hang Lu and Kwanghun Chung from the Georgia Institute of Technology, Atlanta, designed a high throughput microfluidic system that can handle and operate on a worm known as *Caenorhabditis elegans*.

"This makes for a complete and compelling story - very exciting"

- Aaron Wheeler, University of Toronto, Canada

Neuroscientists are keen to understand how cells in the brain contribute to an organism's behaviour. By destroying individual neurons using a laser beam (laser ablation) then monitoring the organism's behaviour, they can infer the function of each neuron. They often use *C. elegans* as a model organism because it is see-through and its anatomy is well known. But *C. elegans* has a short lifespan and the slow ablation methods currently used mean that worms of different ages are used, which introduces variation into the study.

Lu and Chung's device has two sets of worm-loading channels that operate at the same time. Worms enter and exit at one set, while imaging and laser ablation are performed at the other. A constant pressure directs the worms to the channels, which only fit one worm at a time. Valves are used to position them and when properly loaded, both ends of the channels are closed. The worms are then immobilised by cooling to enable accurate neuron ablation. After ablation,

the worm is released from the channel. The process takes only 20 to 30 seconds, much less than the half hour it can take to ablate neurons manually.

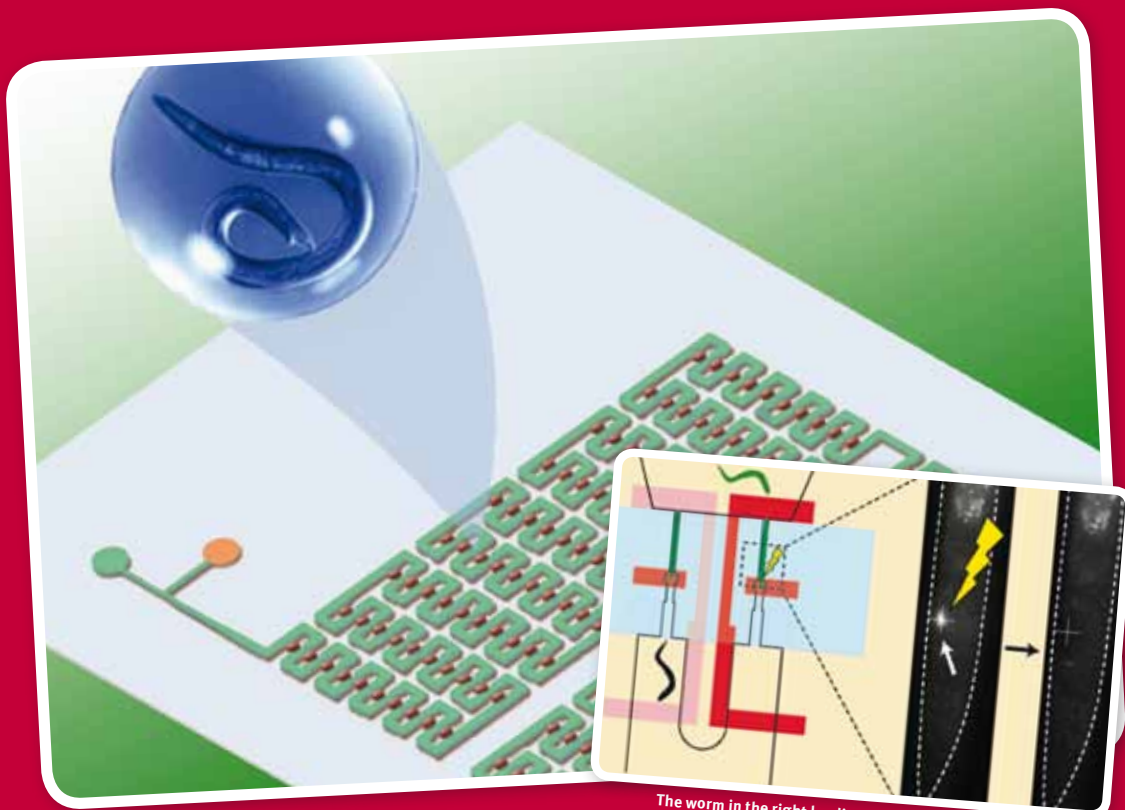
'Unlike much of the work in this field, which is proof-of-principle, the authors actually collected worms post-surgery and carried out behavioural assays. This makes for a complete and compelling story - very exciting,' says Aaron Wheeler, an expert in microfluidics at the University of Toronto, Canada.

Lu and Chung say they will use this type of system for many applications in development and behavioural neuroscience in model organisms. *'The challenge is to make these microfluidic chips and the off-chip components even easier to use such that the technology can be popularised and make an impact in biological and medical research,'* Lu comments.

Article by: Michael Brown

For more stories like this featuring the latest research from RSC journals, visit Chemical Technology on the web:

www.rsc.org/highlightschemtechnol



The worm in the right loading channel is ablated while another worm is loaded in the left loading channel