FACULTY OF SCIENCE

THE UNIVERSITY OF SYDNEY

SCHOOL OF CHEMISTRY

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EMISSIONS TRADING SCHEME, CARBON SEQUESTRATION, RENEWABLES, BIO/GEO - **HELP!**

BY PROFESSOR THOMAS MASCHMEYER

What is going on – climate scientists in a conspiracy after all? Glaciers melting – or not? Do we need to listen anymore? Was the climate change debate just a fashion – now it is over, and we can all worry about something else? Do we still need solutions?

Human-induced climate change: Over the last few months, particularly during the lead up to Copenhagen and its subsequent failure to reach any kind of consensus in the debate about climate change and what to do about it, the discussion about whether climate change is human-induced or not has been fed by many vested interests. Regrettably it appears a small number of scientists were not completely impartial – but then we all know about the Bell curve and the statistical inevitability of outliers.

What is important is to realise that some people are hijacking the debate on human-induced global warming, spruiking flawed logic – thereby, intentionally or not, misleading the public dramatically and detrimentally.

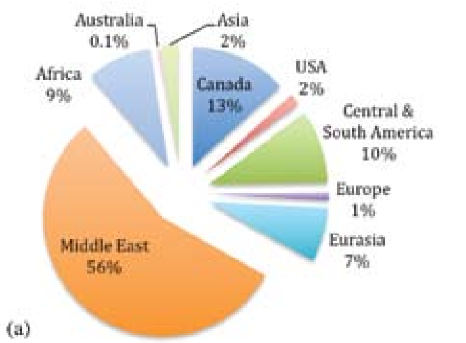
For a simple system it is possible to make statements with 100% certainty (e.g. your arm is broken). However, for complex systems (be they the climate, the economy or health outcomes), demanding the same degree of certainty is inherently impossible and, therefore, utterly meaningless.

Complex systems can be dealt with rationally only by models that align with data from the past and present. These models allow predictions to be made but, if applied responsibly, they will always cover a *range* of outcomes with probabilities attached to them.

It is futile and disingenuous to pretend that the general public should be able to critically evaluate these highly complex models: if one's child is very sick, does one entrust the diagnosis to one's own internet research, to the local politician/professional lobbyist or to one's highly trained and experienced GP/hospital emergency ward staff?

All of the world's Academies of Science state unequivocally that the overall predictions arrived at by climate modelling and their associated probabilities require immediate and extensive action. Whose opinions should then form the basis from which we act in the best long-term interests of our children? That is the real choice and responsibility of the public – and that is its power.

Australian technologies offer solutions: In my previous piece in ChemNEWS, (Issue 5, 2004), I wrote that one of my



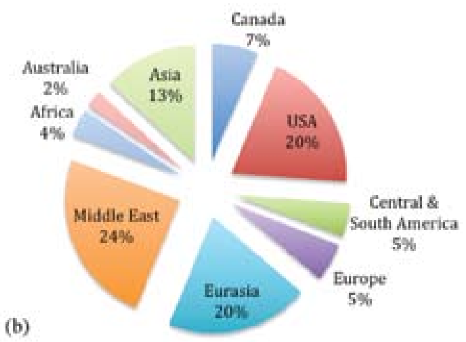


Figure 1: *(a) Proven Barrels of Crude Oil, including Tar Sands, TOTAL = 1342 bn, (b) Combined Barrels of Oil from Proven Oil and Upgraded Lignite Reserves, TOTAL = 3059 bn.*

aims in returning to Australia was to try and help develop technologies that can address, at least to some degree, the real issues of CO_2 emissions and climate change in an environment that excels at finding solutions, harking back to that 'Australian pioneer spirit'. It is with great pleasure that I am able to report that this endeavour has been not entirely unsuccessful. My involvement with the Australian start-up Ignite Energy Resources (IER) and its catalytic hydrothermal reactor technology (Cat-HTR) is starting to bear fruit.

In terms of fossil reserves, power generation, transport fuels and climate change it is possible to identify at least four serious issues:

(a) the increased need for electricity generation without increasing (preferably decreasing) the carbon footprint,

(b) Peak Oil – i.e. the certain disappearance of easily extracted high quality fossil crude oils within 40-50 years,

(c) the need for *renewable* liquid transport fuels (aeroplanes will never fly on batteries!) and

(d) a proven carbon sequestration strategy that can be implemented immediately.

IER's technologies address each and all of these areas.

(a) Electricity/Carbon emissions:

The worst CO_2 offender is brown coal (lignite). However, globally about 1 billion tonnes are used per year. The trend is upward – not downward and it is impossible to simply switch off that much power in an instant. So, realistically, making the use of lignite more efficient is the best short to medium term option. Given it is so inefficient in the first place, this problem represents a great opportunity to make a substantial global difference quickly.

By applying IER's catalytic hydrothermal reactor technology (Cat-HTR), co-developed with my group's input (via various consultancy, testing and research agreements) and economically evaluated by the University's Chemical Engineering department, one tonne of as-mined, low energy lignite (50% moisture content) can be converted into 330 kg of high grade (very low moisture and oxygen) coal dust, suitable for injection into high efficiency boilers. Additionally as a 'by-product', close to one barrel of non-conventional crude oil is being generated for each tonne lignite processed. This oil can be refined in existing refineries to conventional fuels!

A key innovation is the catalytic de-oxygenation of the coal and oil under supercritical aqueous conditions.

Why is this exciting – are we not dancing with the devil? Brown coal power stations are so inefficient because the coal is inherently very wet – similar to putting a wet log onto a campfire, the flame temperature does not become very hot. This means the steam that can be generated is only of relatively low quality, reducing the so-called Carnot efficiency of the steam turbines. By changing to the high grade coal made with IER's Cat-HTR technology, it is possible to dramatically improve the efficiency of the power generation – reliable estimates show that overall CO_2 emission reductions of around 40% are possible (including the CO_2 emitted due to IER's processing of the brown coal). About 17% of Australia's CO_2 emissions derive from brown coal power stations; here is a solution with which to reduce these emissions, yielding an Australia-wide CO_2 emission reduction of 7%. It is a solution ready now and the first commercial demonstration coal-upgrading/oil-producing plant is being planned. Should this technology be applied globally, its emission reduction effect would be equivalent to 'turning off' Australia three times over – every year – while still producing the same amount of power!

However, there is also the 'by-product': IER's non-conventional crude oil.

(b) Peak Oil:

Its medium distillate fraction is energy-rich (38 MJ/kg) and oxygen-poor (6-8 wt%). Uniquely, it is stable, does not polymerise (gum-up) and contains extremely low levels of toxic polyaromatics (close to detection limits). Its characteristics are not too dissimilar to those of conventional crude oils. It is therefore storable, can be pumped as well as blended with other crude oil sources to be upgraded into conventional transport fuels in *existing* refineries with a little catalyst tweaking (to take into account the slightly higher oxygen content of the IER oils, their much lower molecular weights and the virtual absence of polyaromatics as compared to fossil crude oils). This changes the world's potential oil supply in a very dramatic fashion and based on current confirmed lignite reserves plus 50% of estimated lignite resources (together referred to as upgraded lignite reserve), the relative proportions of oil-reserves are summarised in Figure 1.

Clearly, this scenario would have profound impacts beyond the scope of this article, suffice to note that the time to reach peak oil would be increased by a factor of 2 more and the energy mix available to the world's major geo-political regions would be much changed with clear consequences within that framework (3 day's average cost of the Iraq-Afghanistan war would suffice to build the first world-scale "lignite to IER oil to diesel" refinery, producing about a billion dollar's worth of refined fuel annually, see Figure 2).

However, one still has to deal with the fact that this oil is non-renewable and that one needs to sequester carbon as much as possible.

(c) Renewable transport fuels:

Young, low grade, abundant and cheap lignite deposited by ancient forests is, for obvious reasons, quite similar to biomass. A variation of IER's Cat-HTR technology can also be applied to any form of biomass and it is possible to generate stable bio-oils of similar character to the lignite-derived ones. These bio-oils are now fully RENEWABLE crude oil replacements as they can also be further upgraded in conventional refineries!

Of course, it is important not to solve one problem by simply generating a bigger one. Food/feed-versus-fuel is a common issue raised, as are further land degradation and pressures on fresh water usage, especially in countries like Australia. Although land degradation and stressed water supplies are clearly issues right now, food staple prices currently track 1:1 with crude oil prices, due to the fossil oil and gas reserves needed in the production of fertiliser and the fuels needed for the planting, harvesting, processing and final distribution of food crops. Harvest failures add another dimension and are, in part, affected by climate change. Therefore, for the oil industry to label biofuels as the reason for food price rises is disingenuous – oil price, future's market speculation and harvest failure are the reasons at this point in time.

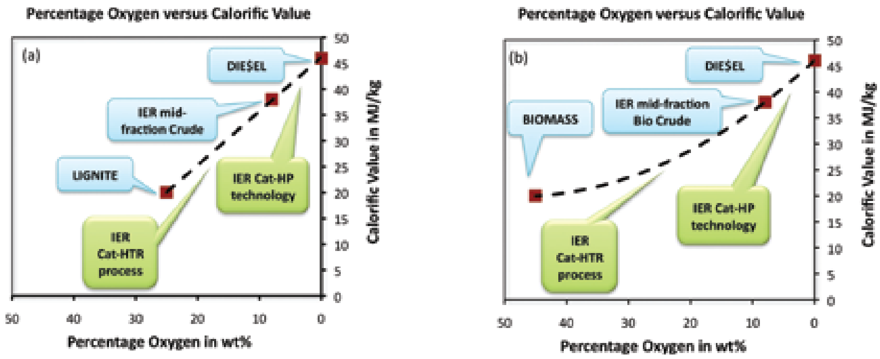


Figure 2: *IER process technology, (a) lignite and (b) biomass conversion to stable crude oils and upgraded conventional fuels.*

Fortunately, it is possible to side-step these issues due to the great flexibility of IER's Cat-HTR process. It is possible to transform not just biomass waste from, e.g. agriculture or the forestry industry, but also from grassy plants and most excitingly aqueous plants of the angiosperm family (duckweed being a typical exponent). Such plants thrive in environments that do not compete with traditional land or water use and represent a truly sustainable resource feedstock for renewable liquid second generation transport fuels.

This means the trillions of dollars and the many decades of time that would be needed to switch our economies to some 'yet-to-be-discovered' completely new technological solution to deal with the disappearance of fossil crude oil (of which we globally use 1,000 barrels a second!) in about 40-50 years are not necessary. The solution is here right now – and it is an Australian one!

(d) CO_2 bio-sequestration:

However, burning any carbon-based energy carrier does, of course, produce CO_2. In addition, there is already more of it in the atmosphere than is good for us. IER's Carbon Bridge approach relies on a brown-coal-based biological organic fertiliser system that is already being applied to more than 300,000 hectares of Victorian farmland. Combining brown coal, some biological additives and much lower than conventional amounts of as-mined phosphorous yields a non-synthetic, organically certified fertiliser system that results in very significant improvements in soil carbon content due to accelerated plant growth.

By comparison, making synthetic fertiliser via ammonia from natural gas (Haber-Bosch process) is a hugely CO_2-intensive procedure. The low carbon soils of Australia are particularly well-suited to the Carbon Bridge approach that uses unproductive underground carbon resources (lignite) and applies them productively to top-soil as biological fertiliser, increasing CO_2 sequestration and improving soil carbon content (significantly above that of the fertiliser added). This methodology is working on Australian farms right now and can occur on a very large scale. Proven and low-cost, it has a clear advantage over costly and untried purpose-built (rather than simple re-injection into existing wells) CO_2 geo-sequestration technologies.

Therefore, we have (all-Australian) solutions, dealing with the four issues raised, using the entire existing infrastructure, minimising the barriers to action. This means significant CO_2 gains can start to be derived already over the next few years – we need not endure decades of uncertainty and inaction.

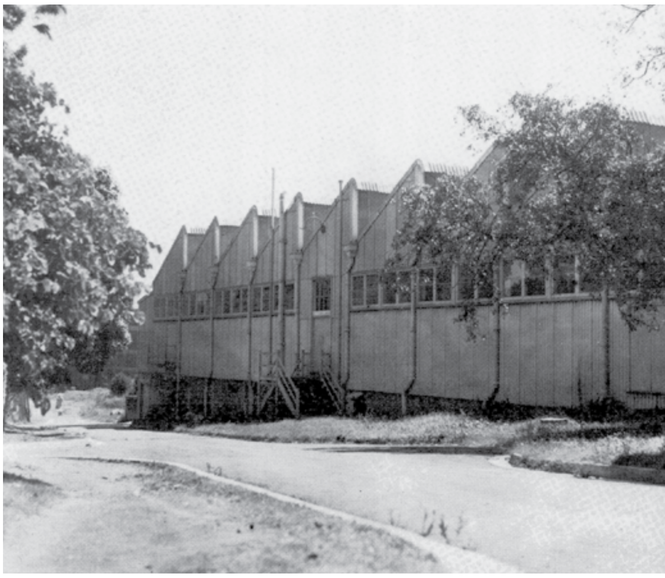
I gratefully acknowledge the ARC, the University of Sydney (my three DVC-Rs, two HOSs and especially my former Dean Prof. David Day for giving me constant encouragement and a long leash) as well as my group and partner-in-crime, A/Prof. Tony Masters, for the flexibility which enabled me, alongside my usual academic duties, to spend some of my time in that technology-transfer wasteland between academia and business. That area of potential professional suicide where we fear to venture, as the risks are too high, the operational money too tight and where the chances of failure vastly outstrip those of success.

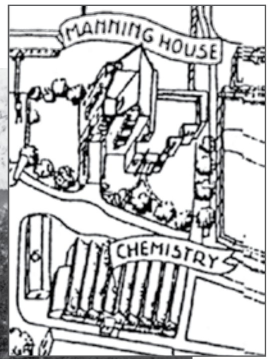
Let's hope the solutions proposed here will prove to be a statistical outlier on the right side of the Bell curve! ♦

Jim Eckert writes about

"ALIENS", THE TRAMSHEDS AND THE START OF A NEW ERA

Chemistry at Sydney University in the 1940s





Shortly after the outbreak of the Second World War, Dr Victor Trikojus was arrested by Australian security forces and interned for 3 months. Recognised as a leader in the new field of medical organic chemistry, Trikojus was, at the time of his arrest, chairman of the Drugs Sub-Committee of the Australian Association of Scientific Workers, a group by then heavily involved in War work.

On appeal, a tribunal agreed to his release, provided that he surrendered his chairmanship of the Drugs Committee and reported fortnightly to the Aliens Registration Office at Parramatta Police Station – even though he had been born and gone to school in Sydney and was a graduate of Sydney University with a D Phil from Oxford. His pre-War professional contact with colleagues in Germany must have played a part.

In a letter of support, the Vice-Chancellor of Sydney University, Sir Robert Wallace, noted that Trikojus had been detained "on what grounds no one knows" and assured authorities that within the University most believed him to be "a perfectly loyal Australian citizen". Nevertheless, the Commonwealth Government did not lift all restrictions imposed on him under National Security Regulations until October 1944. These were tense times and it often took a while for common sense to prevail. Through all this, Trikojus still managed to make important contributions to the War effort. By War's end, he had been offered and had accepted the Chair of Biochemistry at Melbourne University.

In the photo below, taken in 1935, Trikojus sits on the extreme right. Earlier, he had introduced the young John Cornforth to biological organic chemistry through vacation work in his lab. Others in the photo are, left to right, James Mills, Tom Iredale, George Burrows, Charles Fawsitt, John Earl and David Mellor.

As the War drew to a close, universities across Australia were bracing for a big surge in student numbers; and at Sydney University, Fawsitt in Chemistry wisely used 1945 to help organise the construction of a large fibro-cement building opposite Manning which came to be known as the Tramsheds, to provide prac facilities for first year students. Total enrolments at Sydney peaked in 1948 (at almost 11,000 compared with fewer than 4,000 pre-War), boosted by the influx of returned servicemen. By then, over 2,000 were doing Chem I prac every week in the Tramsheds, seen in the photo above and in the inset, from a map of the University grounds drawn in the early 1950s.

The Tramsheds served Chemistry until the undergraduate labs in the present building opened in 1958. The space is now occupied by two of the University's least successful post-War buildings – the Christopher Brennan and the Mungo MacCallum – "built", as Trevor Howells notes in *University of Sydney Architecture*, "at a time when budgets were stretched and accommodation requirements great", Howells has this to say about the Mungo MacCallum: "The juxtaposition of its over-burnt and misshapen clinker brickwork to the finely chiselled sandstone of the Quadrangle must rank as one of the most ill-judged architectural decisions ever built at the University."

So maybe it's just as well that the Transient Building near by is still standing. What a wonderfully inappropriate name! This was built at the same time as the Tramsheds and, Howells comments, was also "intended for a brief life". Over the years, however, it "has proved to be curiously flexible". If it survives much longer, he writes, "it may yet attract heritage listing".

In 1946, R.J.W. Le Fèvre arrived in Sydney with his wife Cathie and their two children, to take over from Fawsitt. Le Fèvre had been here before, briefly during the War. In September 1939 he was released from his position as Reader at University College London and, early in 1941, was posted to RAF Command, Singapore as a chemical adviser. A year later, he was one of a group of RAF personnel that managed to get clear on perhaps the last friendly ship to leave Java before the Japanese occupation.

Reaching Australia, Le Fèvre was temporarily assigned to the RAAF and spent the next 19 months travelling from one end of this country to the other, along the way fitting in visits to most Australian universities, including Sydney. He was back in the UK by the end of 1943 and, in 1945, became Head of the Chemistry Department of the Royal Aircraft Establishment at Farnborough. This was the position he held when invited, in 1946, to be what was initially called Director of Chemistry at Sydney University.

University authorities were well aware that Chemistry at Sydney was deeply divided. There were separate departments – of Chemistry under Fawsitt and Organic Chemistry, Pure and Applied, under Earl – and relations between the two professors had been strained for a long time. With Fawsitt's retirement and then, in 1948, Earl's, Le Fèvre was given the task of heading a unified School of Chemistry. It was the beginning of a new era, even if, for years to come, the School would be far from unified at a personal level.

Le Fèvre made a point of encouraging research and, working in close collaboration with his wife Cathie, he led by example. By 1950, when the photo below was taken, the School was growing in numbers and stature. Le Fèvre stands third from the left at the front with Cathie on the extreme left. Next to Le Fèvre is Fawsitt and alongside him, Visiting Professor Alexander Todd, the eminent UK organic chemist who would go on to win the Nobel Prize for Chemistry in 1957 for his work on nucleotides and nucleotide co-enzymes.

Sources:

Ever Reaping Something New. A Science Centenary. Eds. D. Branagan and H.G. Holland, University of Sydney (1985). The 1935 photo from this book, shown here in part, was provided by John Anderson, a former student of George Burrows.

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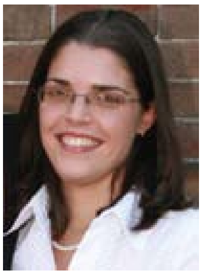


SCIENCE MEETS PARLIAMENT 2010

BY DR DEANNA D'ALESSANDRO

This year marks the 25th anniversary of the Federation of Australian Scientific and Technological Societies (FASTS), and was the occasion of the 11th Science meets Parliament which was held on March 9-10th in Canberra. The event attracted approximately 150 scientists, and through RACI sponsorship I was able to attend and contribute to the vital process of promoting science to our parliamentary representatives.

The first day focused on the policy making process and included discussions on: how to deliver our message, how to influence scientific policy and dealing with journalists. Notable speakers included the Minister for Innovation, Industry, Science and Research, Senator the Hon Kim Carr and acclaimed science presenter Robyn Williams AM (The Science Show, ABC). We also contributed to the "Research Workforce Strategy" which will underpin significant reform agendas for higher education and innovation in Australia.

Highlights of the second day included forums on biodiversity and nuclear medicine, and a televised address at the National Press Club by bestselling author Chris Mooney (*The Republican War on Science*). Throughout the day, delegates met with politicians and their advisors, which proved to be constructive for both sides.

My positive experience should serve as encouragement for more Early Career Researchers to become involved in the future. We *can* and *do* have the potential to impact policy decisions, and it is as much *our* responsibility to clearly articulate our concerns as it is the duty of parliamentarians to represent our best interests. Empowering scientists with the knowledge on how to influence scientific policy is integral to fostering a stronger and more vibrant future for Australian science. ♦

TALL POPPY AWARDS

Associate Professor Sébastien Perrier (below left) and Dr Tim Schmidt (below right) have become the School's latest Young Tall Poppy Science awardees. These prestigious Awards aim to recognise the achievements of Australia's outstanding young scientific researchers and communicators and are the initiative of the Australian Institute of Policy and Science. Our previous Award holders include Professor Cameron Kepert, Professor Thomas Maschmeyer, Professor Kate Jolliffe and Dr Peter Rutledge.

SECOND THOUGHTS

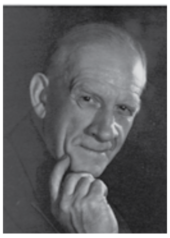
It seems like the whole University is going a bit green. The 2011-2015 Green Paper (http://sydney.edu.au/green_paper) was released last month and we are currently in the midst of a formal consultation period in which feedback on some of the suggestions and preferred options is being sought. The posse of authors – the Vice-Chancellor and his Deputies – have produced a sweeping discussion paper that ranges from administrative organisation to philosophical considerations of the University's purpose and strategy for its achievement.

In this green paper, the Vice-Chancellor has expressed our strategic purpose as follows: *"We aim to create and sustain a university in which, for the benefit of both Australia and the wider world, the brightest researchers and the most promising students, whatever their social or cultural background, can thrive and reach their full potential."* Almost half of the paper is devoted to two chapters "The Most Promising Students" and "The Brightest Researchers," and I am pleased to see a strong case for undergraduate education in a research-active environment. I have written before about such a relationship between teaching and research, which I believe is a great strength of the Chemistry School.

Much space is devoted to the question of identifying the most promising students, particularly in the context of the federal government's social inclusion objectives. This includes a radical proposal for an Australian Tertiary Admission Rank (ATAR) bonus of up to five points that would target students matriculating to the university from identified disadvantaged schools, and this has recently garnered some attention in the press. Although possibly a blunt instrument, the bonus proposal is based on progression and retention rate data which suggest that, while the ATAR may measure performance, it does not measure everything that we would call 'promise.'

Less public attention has been paid to some other creative proposals in the green paper, including developing partnerships with our local, inner-city community and schools. There may be some exciting possibilities for targeted expansion of our school outreach program, or other new ways of engaging with promising high school students.

Professor Greg Warr
Head of School



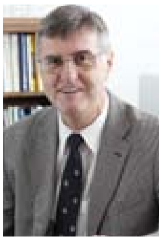
Professor Robert Robinson

1912—2012: 100 YEARS OF ORGANIC CHEMISTRY

BY PROFESSOR MAX CROSSLEY

In late 2012, 100 years of Organic Chemistry as a formal discipline at The University of Sydney will be celebrated.

On 31st October 1912, the Senate of The University of Sydney appointed a 26 year old Englishman to be the inaugural Professor of Pure and Applied Organic Chemistry in the University. It was both an auspicious and an inspired choice: auspicious because it heralded the development of organic chemistry as a major branch of Science within the University, and inspired because the 26 year old was Robert Robinson, later Sir Robert Robinson FRS OM, winner of the 1947 Nobel Prize for Chemistry. He was recognised for his investigations of fundamental questions such as aromaticity and of the formation of complicated structures within the living plant, particularly the biogenesis of complex alkaloids.



Professor Max Crossley

Robinson returned to Britain in 1915 to take up the Chair in Organic Chemistry at the University of Liverpool. He subsequently became Director of Research of British Dyestuffs Corporation and in turn held Professorships at University of St. Andrews, Manchester University, the University of London and at Oxford University from 1930 until 1955.

Organic Chemistry at The University of Sydney has thrived over the century. Many hundreds of honours, graduate students and post-doctoral fellows have been trained in Organic Chemistry and have contributed to important developments in Science. The successes of some of these graduates will be highlighted in forthcoming issues of this Newsletter.

A one-day reunion of the extended Organic Chemistry family is planned for Saturday, 3rd November 2012. We hope that many former members and their families will be able to attend. Planned activities include a lunchtime barbecue, short talks from some former graduates of Organic Chemistry, a laboratory tour (which was your bench?), a display of posters of recent research and of historic memorabilia including the actual Nobel Prize diploma presented by King Gustav V of Sweden to Sir Robert Robinson in 1947.

Put the date in your diary now and watch out for further information. If you wish to receive regular updates regarding the reunion or have any further queries please email us at **organic.reunion@chem.usyd.edu.au.** ♦

KICKSTART CHEMISTRY PROGRAM FOR HIGH SCHOOL STUDENTS

The School of Chemistry has been involved in a training program for students in their final year of high school for the past 10 years. Originally the program was meant as a way high school students could experience chemistry at a university level but it was soon discovered the high schools were in need of a better form of practical laboratory work than their schools could provide.

With the new syllabus commencing in schools in 2000 many of the high school teachers felt overwhelmed with the new format and so the School of Chemistry ran a high school teachers workshop. The various workshops addressed many areas of the new syllabus and one in particular was the new experiments that had to be performed in the labs. One particular topic, Chemical Monitoring and Management is a compulsory topic for the Higher School Certificate and has a high degree of challenging experiments that was beyond the majority of high school laboratories.

Dr Jeanette Hurst (pictured right) ran the Teachers workshop on this topic and was inundated with requests from teachers to be able to bring their high school classes along. Jeanette set up the workshop to run during the term when most schools would be doing the topic, i.e. May to July or Term 2.

Each year these workshops have been a great source of practical experience by allowing the students to perform five experiments in one two hour session. The main advantage is that the students are given demonstrations of analytical equipment, namely Atomic Absorption, Ultraviolet, Infrared and Mass spectrometers as well as doing Gas Chromatography and Electron Microscopy.

Students come from schools as far away as Murwillumbah, Lord Howe Island, Cowra, Bathurst and Canberra. The numbers of students and schools coming has been increasing every year with nearly 100 schools and over 2000 students attending each year. The popularity of the workshops is very high and places are booked up well in advance. ♦

NICKEL NANOCARPETS MAKE NEW SELF-CLEANING SURFACES

BY DR CHIARA NETO

My group has recently developed a simple and inexpensive method to make super-hydrophobic nanocarpets using nickel. The technology could be used to make surfaces which lubricate flow, i.e. have a reduced drag to flow, and have self-cleaning properties, with potential application in microfluidic devices or as smart coatings that protect surfaces from fouling and rust.

The inspiration for the technology came from the engineered topography and surface chemistry of the lotus leaf. When a lotus leaf emerges from a muddy pond, its leaves are completely dry - non-wetted by water - and clean. The water-repellent properties of the leaves, known as superhydrophobicity, come from their physical structure. The surface of the leaf is covered with micro-scale bumps, and these bumps are in turn covered with nano-hairs. The combination of the waxy exterior of the leaf and this nano-engineered physical structure causes air pockets to become trapped on the surface of the leaf, and this makes it completely non-wetting to water (because water and air don't mix). The self-cleaning property derives from the fact that when a water droplet comes in contact with these surfaces it rolls off the surface, rather than sliding off, carrying with it any dirt or dust, and cleaning it in the process.

Superhydrophobic surfaces have been studied for a decade now, but their fabrication is often expensive or requires complicated machinery. My group can fabricate superhydrophobic surfaces by electrodepositing nanowires through a nano-scale template that allows nickel nanowires to grow perpendicularly to the substrate and in a rigid, dense array. The template is then removed, leaving behind a surface that we call a "nanocarpet". The nanocarpet is then coated with a hydrophobic thin layer, which delivers the superhydrophobic properties. The nanowires are 200 nm in diameter and can be fabricated in different lengths, typically they are several micrometers long (so a high aspect ratio is quickly achieved). A potential use of superhydrophobic surfaces is as anti-fouling coatings on the hull of a ship, because a pillow of air would exist between the boat and the marine environment, preventing the approach and attachment of barnacles or other foulants.

These nanocarpets could be produced out of any metal, and we have shown that hydrophobised platinum nanocarpets also work well. However, nickel is a more interesting material to work with because it has magnetic properties. The orientation of nickel nanowires can be changed using a magnetic field, which could give us the ability to switch the wettability of the nanocarpet simply by applying a small magnetic field. ♦

More information available on Phys. Chem. Chem. Phys. 2009, 11, 9537.

ELECTRONIC NEWSLETTER

As part of the School's efforts towards a greener future, we'd like to reduce the number of paper copies of this Newsletter we mail out. If you would like to help us in this effort by electing to receive ChemNEWS electronically, please email Anne (anne.woods@sydney.edu.au).

DONATE ON-LINE

Rather than sending out a paper copy of our donations form, we are adopting an on-line system for donations to the following funds:

Inorganic Fund
Cornforth Fund
Hush Fund

TO DONATE ON-LINE VISIT:

http://alumni.chem.usyd.edu.au/Donations.html to find the on-line donation links. It is also possible to download a donation form that can be mailed to the School in the usual way.

The School of Chemistry would like to take this opportunity to thank Alumni and Friends for their very generous donations. Your support continues to make a profound impact on our visitors program.

SCHOOL OF CHEMISTRY

THE UNIVERSITY OF SYDNEY

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