



# ChemNEWS



Spring 2007  
Issue 11



Newsletter of the University of Sydney Chemistry Alumni

## Skirting around the Transition State

by A/Prof Scott Kable



The concept of the “transition state” (TS) is one of the cornerstones of chemistry. It can be defined informally as the transient structure at the highest point of the minimum energy pathway from reactant to product. Reaction mechanisms are described with reference to this structure (e.g. 3-centre elimination, or  $S_N2$  mechanisms). The TS is also closely associated with the activation energy in chemical kinetics, and a whole family of kinetic theories, e.g. TS theory and RRKM theory, use the concept of the TS as a central tenet.

*Molecular reaction dynamics* (MRD) is the study of the molecular level mechanism of elementary chemical and physical processes. In the same way that statistical thermodynamics underpins a deep understanding of thermodynamics, so too does MRD underpin kinetics and mechanisms of reaction. One of the current challenges in MRD is to understand more complex reaction mechanisms, ones that cannot be modelled by the family of TS theories. For example, in a photochemical reaction, several different electronic states can give rise to the same set of chemical products. The rate of formation of these products, particularly the temperature dependence of the rate is a very sensitive function of which electronic potential energy

*Cont'd on page 2*

## Hydrogen Storage Gets a Boost

by Prof Cameron Kepert

As the availability of fossil fuels and their impact on the environment receive ever increasing attention, there is a global push towards the development of energy systems that make use of alternative forms of chemical energy. Of the many interesting possibilities, the hydrogen molecule holds a place of particular prominence due to its very clean combustion. In the proposed *Hydrogen Economy*, this well-known gas becomes the centre of an energy cycle that could be employed in the powering of anything from buildings to cars to mobile phones.

### *Hydrogen as a Carrier of Energy*

On paper, hydrogen appears to be the ideal energy carrier; it is the only stable molecule for which all of its electrons are valence electrons (giving it an energy density more than three times that of fossil fuels), it consists of one of the most readily available

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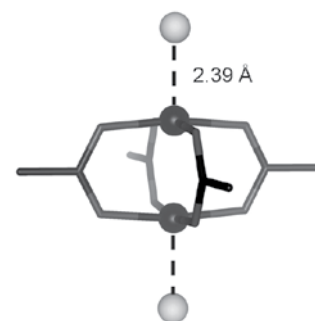


Figure 1. Binding of hydrogen to bare metal sites; copper atoms are drawn as black spheres and the  $H_2$  molecules are represented as grey spheres.

Cont'd from page 1 (Scott Kable's "Skirting around the Transition State")

surface(s) dominate the reaction.[a] Other examples of non-TS reactions occur when several chemical reaction pathways are open over a similar energy regime. In these cases, the reaction flux is not just the sum of the individual pathways, but we are learning that the different pathways actually interfere with each other. Again, the result is that the rate of reaction cannot be modelled with current theory. More intriguing, perhaps is that a whole new family of reaction mechanisms might have been discovered in one recent study.

#### Discovery of the "Roaming Atom" Mechanism

In 2004, two groups, led by Profs Suits (experimental) and Bowman (theory) demonstrated very clearly the existence of a mechanism which they dubbed the "roaming atom" mechanism.[b] In  $\text{H}_2\text{CO}$  photodissociation, there are at least two reaction pathways on the ground electronic state; one leading via homolytic C-H bond cleavage to produce  $\text{H} + \text{HCO}$ , and the other via a well-known asymmetric 3-centre TS leading to  $\text{H}_2 + \text{CO}$ . In this TS

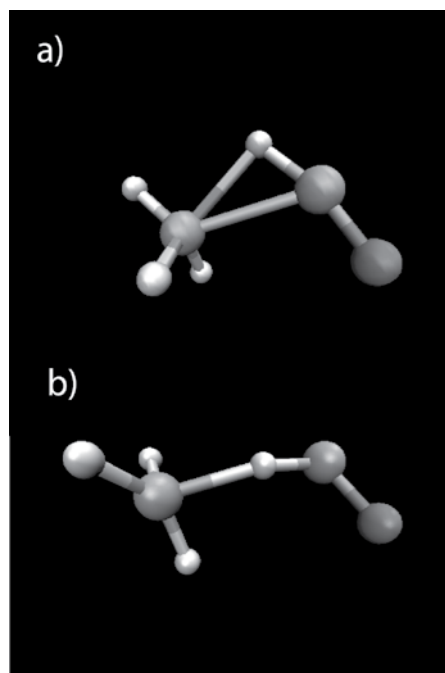


Figure 1: a) Example of the conventional TS for photodissociation of  $\text{CH}_3\text{CHO}$  to  $\text{CH}_4 + \text{CO}$ ; and b) an example of non-TS ("roaming") structure in the same reaction. Both structures calculated by Heazlewood and Jordan.

mechanism, the  $\text{CO}$  and  $\text{H}_2$  fragments are highly rotationally excited, but with relatively little vibrational energy. Suits' experiments, showed a second very clear dynamical signature in the product state distributions – very cold  $\text{CO}$ , coupled with enormously vibrationally excited  $\text{H}_2$ . Quasi-classical trajectory (QCT) calculations on an accurate potential energy surface (PES) performed by the Bowman group showed clearly that this second dynamical signature was produced by interference with the  $\text{H}+\text{HCO}$  channel – a mechanism presaged by Moore some 10 years earlier. In this mechanism, the  $\text{H}$  atom tries to leave the reactant along this barrierless reaction coordinate; however at very long distance from the  $\text{HCO}$  core it finds that it doesn't quite have enough energy. It then goes on a long excursion (so-called "roaming") around the periphery of the  $\text{HCO}$  until some long time later it encounters the other  $\text{H}$ -atom and reacts with it in a kind of intramolecular abstraction reaction. This mechanism is counter-intuitive to our long-held view of reaction dynamics and violates one of the fundamental tenets of transition state theory, which is that all reactions trajectories proceed via the TS.

#### "Roaming in Acetaldehyde"

Last year we published experimental evidence of two dynamical signatures in the photodissociation of acetaldehyde.[c] Although this study lacked the high level theoretical support that accompanied the  $\text{H}_2\text{CO}$  study, the similarities in the signatures were so striking that we hypothesized the presence of another "roaming"-type mechanism. We surmised that it was the  $\text{CH}_3$  group that was roaming around the  $\text{HCO}$ , again abstracting the hydrogen to form extremely hot  $\text{CH}_4$ , but very cold  $\text{CO}$ . We also added to the characterisation of the roaming signature the observation that the TS mechanism in  $\text{CH}_3\text{CHO}$  produces  $\text{CO}$  fragments that recoil in the plane of the  $\text{C-C-O}$  heavy atom framework, while the roaming mechanism produces randomly aligned  $\text{CO}$ . This signature was subsequently confirmed, both experimentally and theoretically in  $\text{H}_2\text{CO}$ .

The acetaldehyde experiments would represent the first observation of a moiety other than a  $\text{H}$ -atom in a "roaming" mechanism, and as such would be a crucial step in understanding how prevalent such a mechanism might be in chemistry at-large. Our experimental study, however, lacked the theoretical underpinning of the  $\text{H}_2\text{CO}$  study and only reported details of the  $\text{CO}$  fragment (not the  $\text{CH}_4$ ). Consequently, our hypothesis is being tested by experimental and theoretical groups both at Sydney, and overseas. Both Bowman (Emory) [d] and Jordan (Sydney) [e] groups have prepared *ab initio* PESs by quite different methods and both show evidence for non-TS mechanisms (Fig 1), similar in concept to what was proposed in our earlier work. Harding, *et al.*, in a theoretical study, reported that roaming might be important in the reverse reaction:  $\text{HCO} + \text{CH}_3 \rightarrow \text{CH}_3\text{CHO}$ . [f]

Experimentally, we have recently measured the  $\text{CH}_3+\text{HCO}$  channel on the ground state [e], which is an essential pre-requisite for roaming. Two European groups have measured the  $\text{CO}$  distribution using ion imaging, which is the analogous experiment to Suits' work on  $\text{H}_2\text{CO}$ . Finally, Osborn and co-workers have measured the internal energy of the  $\text{CH}_4$  by IR luminescence. [e] These experiments show that methane produced from photolysis of acetaldehyde is extremely hot, and exhibits two dynamical features, which have been ascribed to the conventional TS mechanism and to the roaming channel. The final nail in the coffin comes from comparing the experimental  $\text{CH}_4$  and  $\text{CO}$  internal distributions with the recent theory (Fig 2), which shows remarkable agreement.

#### Conclusions

In this article I have described the discovery and characterisation of a different type of reaction mechanism, which does not proceed via the TS. It is too early to know whether the inclusion of roaming will account for some of the discrepancies in TS theory rate calculations until the energy and temperature dependence of roaming

has been characterised. However, it is clear that experiments and theory of molecular reaction dynamics are uncovering hitherto unrecognised aspects of fundamental chemical reactivity and mechanisms.

- HM Yin, SH Kable, X Zhang and JM Bowman, *Science*, 311, 1440 (2006).
- D Townsend, SA Lahankar, SK Lee, D Chambreau, AG Suits, X Zhang, J Rheinecker, LB Harding, and JM Bowman, *Science*, 306, 1158 (2004).
- PL Houston and SH Kable, *Proc. Nat. Acad. Sci., USA*, 103, 16079 (2006).
- JM Bowman, private communication, to be submitted to *Chem. Phys. Lett.*
- BR Heazlewood, *Honours thesis*, Univ. of Sydney.
- LB Harding, SJ Klippenstein and AW Jasper, *Phys Chem Chem Phys*, (advance article, 2007). ♦

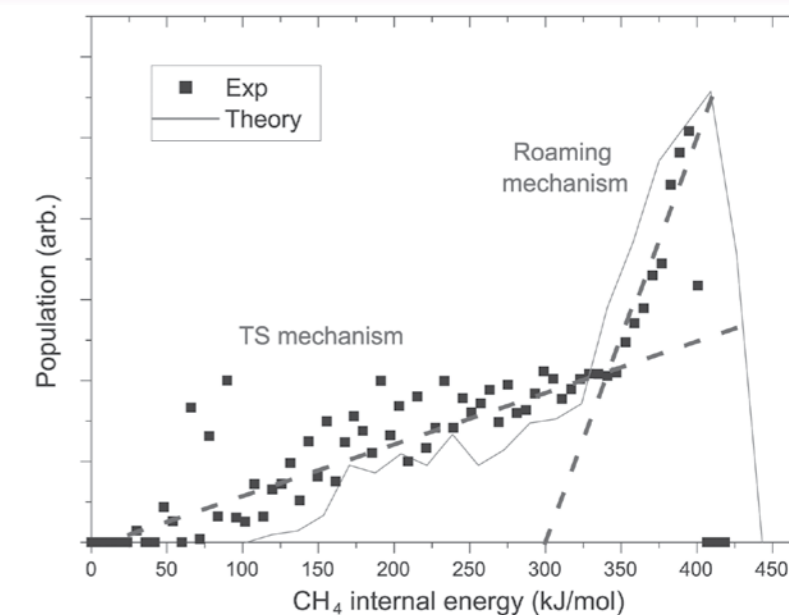


Figure 2: Internal (vibrational) energy deposited into  $\text{CH}_4$  following 308 nm photodissociation of  $\text{CH}_3\text{CHO}$ . Symbols are data from IR luminescence experiments, while the grey line is from Bowman QCT calculations. [d] Two distinct distributions are evident, which are characteristic of the traditional TS mechanism and the new "roaming" mechanism.

Cont'd from page 1 (Cameron Kepert's "Hydrogen Storage Gets a Boost")

chemical elements on earth, and its combustion produces a greenhouse gas that is rapidly self-regulating in the atmosphere. Three significant obstacles need to be overcome, however, before the *Hydrogen Economy* becomes a reality: 1) the efficient production of hydrogen gas, 2) its safe and efficient storage, and 3) the development of reliable and efficient fuel cell technologies.

#### Storing Hydrogen

One of the features that makes hydrogen particularly attractive as a fuel – its very low mass – also means it is very difficult to store efficiently. As a gas at room temperature its energy per volume is 3000 times less than that of common liquid fuels. Converting hydrogen to a liquid to improve volumetric density requires cooling below minus 240 °C and incurs a 30 % energy cost. Compression has proved to be a more feasible option, as seen in a number of prototype hydrogen vehicles. However, neither of these storage techniques offer significant

promise to meet the practical targets defined recently of 6 wt. % and 45 g/L of hydrogen in its storage vessel.

#### Chemical Storage

There are two distinct chemical approaches for the storage of hydrogen:

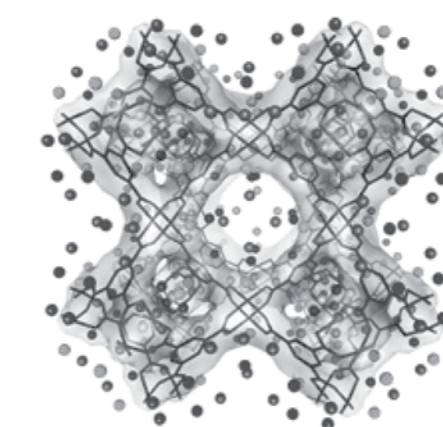


Figure 2. Hydrogen loading in a molecular framework; the framework is drawn as sticks with a transparent surface and the hydrogen molecules are represented as grey spheres.

1) in chemical compounds that release hydrogen gas upon heating, such as metal hydrides, or 2) on the surface of

materials that have very high surface areas. Systems based on the former approach currently face a number of challenges, which include high chemical reactivity, high heat flow requirements, high desorption temperatures, low reversibility, and slow kinetics.

The storage of *molecular*  $\text{H}_2$  on surfaces using intermolecular interactions rather than chemical bonding allows for the rapid and highly reversible storage of  $\text{H}_2$  at much lower temperatures. Whilst this approach overcomes the hurdles mentioned above, a whole new set of challenges apply. One of the foremost of these is the maximisation of surface area, with 1  $\text{m}^2$  of surface typically able to sorb only 0.02 mg of  $\text{H}_2$  as a monolayer. For the many materials that have been studied for this purpose, which include carbon nanotubes, the storage capacities achieved to date are well below that required technically – only about 2 to 3 wt.% – due to the comparatively low surface areas achievable.

In recent years a new class of material, nanoporous coordination

Jim Eckert writes about

## The Chemistry Building

The photo on the right, showing the space where the Chemistry Building now stands, was taken shortly before work began, in November 1955, to clear the site. And below, Chemistry's Head of School, Professor R.J.W. Le Fèvre, is seen speaking at a ceremony held in October 1956 when a plaque was unveiled by NSW Premier J.J. Cahill to commemorate the founding of the new building.

Planning had started in 1951 following an announcement by the Vice-Chancellor that an anonymous donation of £100,000 had been "given and accepted on the sole condition that it is used for the building of a first wing of the new Chemistry School, and in the hope that it will stimulate other donors".

Professor Le Fèvre, acknowledging the gift, wrote: "Final completion of a new Chemistry School must be regarded as a somewhat long-range project, necessarily dependent upon the provision of funds. Nevertheless,



however distant the goal, the gratitude of all chemists will go out to an unknown friend, wherever and whoever he may be!" Or rather "she". The "unknown friend", it later emerged, was Mrs Brightie Phillips.

The State Government soon weighed in with the promise of further funds – the final cost would be something like £1.5 million – and the NSW Government Architect's Department, responding to a request from the University Senate, proceeded to develop a detailed scheme in close consultation with Professor Le Fèvre and his colleagues. The structure was to be T-shaped, with the top of the T formed by a block of undergraduate laboratories, running almost due east-west, and, at

right-angles and pointing north, a block of research labs and offices. Both blocks would have five levels and, to the west of the T and attached to it, there would be a group of lecture theatres, two large ones each seating 340 and two smaller ones each holding up to 170. Which, as you know, is how it turned out.

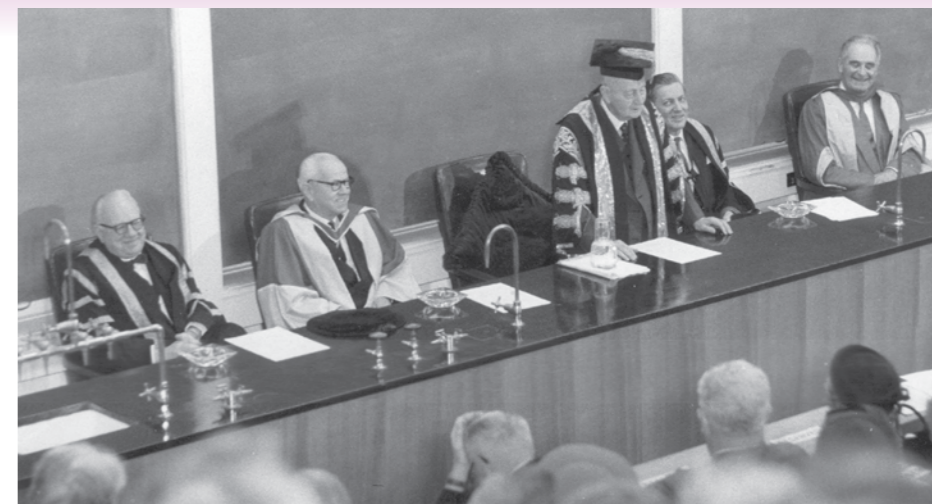
Describing the plans not long before construction started, Professor Le Fèvre paid tribute to Senior Designing Architect Harry Rembert and his colleague Charles Weatherburn. Also heavily involved in the planning were Peter Webber and Ken Woolley, at that time beginning to make their way in the profession. Much thought had been given, the Prof said, to designing a building that would "harmonize or blend with its neighbours" – the CSIRO Standards Laboratory (now Madsen) on one side and the Old Medical School (now the Anderson Stuart) on the other. In the end, however, it was decided that any attempt to match their ornate styles would be "both costly and painful to the architects". Le Fèvre conceded that the new building "will undoubtedly strike some observers as abruptly contemporary" but expressed the hope that "this contrast of styles" would be softened in time by the growth of trees planted in front of Chemistry.

The building was notable architecturally as one of the earliest

structures in Australia with a curtain wall (a non-load-bearing skin, usually of glass, that encloses the framework of a building). Le Fèvre pointed out: "Very few internal walls will be of solid construction; breeze blocks, or glass and light-weight partitions will be used as far as possible", allowing for "maximum future flexibility". It was a far-sighted arrangement.

The photo below was taken in April 1957. The undergraduate laboratories were ready for the start of the 1958 academic year and, by early 1959, the whole School had moved across from Science Road. The building was formally opened in June the following year, at a gathering addressed by the NSW Premier, by then R.J. Heffron, the Chancellor, Sir Charles Bickerton Blackburn and Professor Le Fèvre (photo above).

In recent years, Chemistry at Sydney University has managed to survive – flourish even – by expanding into Madsen next door, by adding a block to the western side of the research and office wing but mainly by taking advantage of the flexibility built into the original design. In ChemNEWS Issue 10 (Autumn 2007), the Head of School Professor Greg Warr wrote: "Most research and teaching laboratories in the School have been refurbished or



renovated over the past decade to make better use of the existing space." He continued: "Although the fabric of the building has changed only little [since its opening], the internal structure of the School, the teaching program and the range and nature of research activities certainly have."

The Chemistry Building has recently been reviewed, for the most part favourably, in Trevor Howells' comprehensive and entertaining guide *University of Sydney Architecture*: Notwithstanding some "unfortunate" later additions, "this was a genuinely innovative building, designed to meet and anticipate the functional requirements of science ... but it is also a building" the review adds "which celebrates the

human and the poetic". The visitor's attention is drawn, in particular, to "the broad, sensuously curved canopy" at the front entrance, to the concrete columns in the lecture-theatre foyer, "sheathed in humanising wood", and to the two mosaics in the courtyard undercroft, based on microscope images and signed (with their initials) by Design Architects Webber and Woolley.

I'm amazed. To me, it was just the place where I worked.

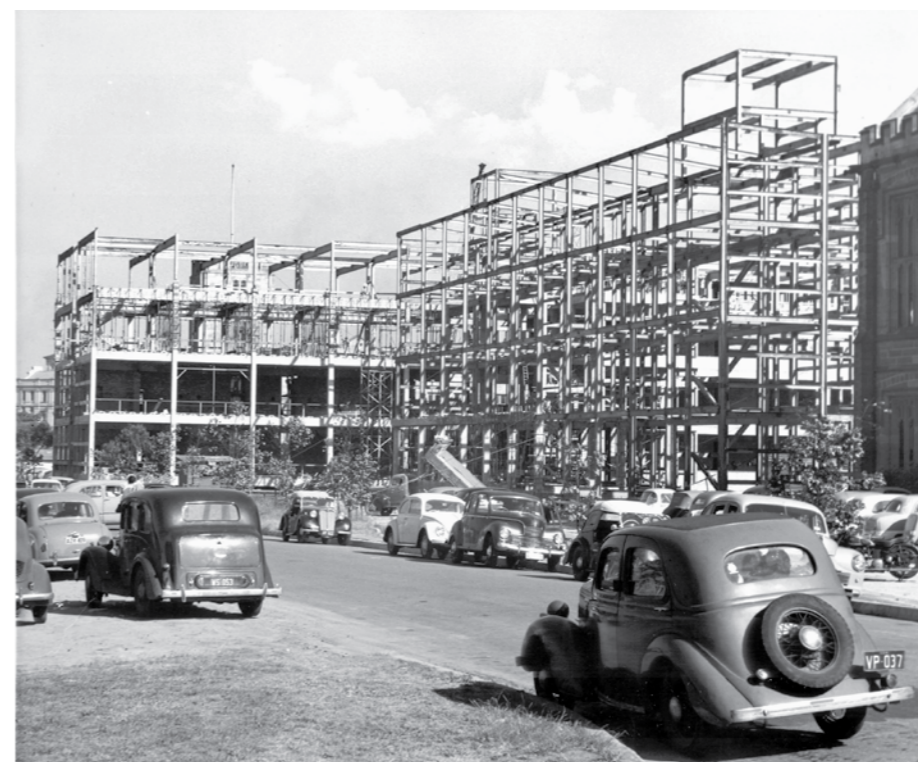
The photos reproduced here came from the University Archives – my thanks to Reference Archivist Julia Mant. Thanks also to Charles Weatherburn, now aged 91, for sharing his memories of the project and the people.

References were:

R.J.W. Le Fèvre, reporting in a series of articles on the planning and construction of the building: *Proc. Roy. Aust. Chem. Inst.*, 18(5) (1951), 85; 22(6) (1955), 106; 27(8) (1960), 332; *Chem. and Ind.*, (1951), 415; (1953), 736; (1957), 551; *The Gazette, University of Sydney*, (1957), 197; *Nature*, 187(4740) (1960), 833.

H.G. Holland in W.F. Connell, G.E. Sherington, B.H. Fletcher, C. Turney and U. Bygott, *Australia's First. A History of the University of Sydney*, Vol.2, 1940-1990, Hale and Iremonger (1995), pages 254-259.

T. Heneghan in Trevor Howells, *University of Sydney Architecture*, The Watermark Press (2007), pages 82, 3. ♦



from petra



Professor Greg Warr  
Head of School

## Crowded House

I've been spending time at my daughters' primary school recently doing chemistry demonstrations for some junior grades. (My new picture shows that I've made an impression. If you can remember, the experiments shown are chemiluminescence and the catalytic decomposition of  $H_2O_2$ .) The teachers always thank me afterwards, but it's unnecessary because the bright and enthusiastic questions the children have are all the thanks anyone could want. I don't need a class survey to know what they think. When was the last time undergraduates actually squealed with delight when they saw an experiment demonstrated?

The School warmly welcomes Dr Chiara Neto, Dr Chris McErlean and A/Prof. Sébastien Perrier, who have recently joined the academic staff. Sébastien is a synthetic polymer chemist from Leeds University who will take over as Director of the Key Centre for Polymer Colloids. Chiara's and Chris' research will be featured in the next issue of ChemNEWS. Welcome also to our new deputy laboratory manager, Ms Gemma Thompson.

I am delighted to announce

that Emeritus Professor Noel Hush has been awarded the 2007 Welch Prize in Chemistry. This prestigious award cites Noel's "fundamental work on the theory of homogeneous and heterogeneous electron transfer and contributions in the area of molecular electronics" which encompasses some of his earliest theoretical work as well as his current collaborative research in the School. During July we had a camera crew with us for a few days preparing a video to be shown at the presentation in the US in October.

In my last column I mentioned how our building was filling up despite our best efforts to make better use of existing space. A new Materials Laboratory has recently been finished, with growing rooms for molecular framework materials. Likewise the laser laboratories in the Madsen building. The last of the 1958 laboratories are due for renovation this summer, and it is time to think seriously about a new building. I don't think that £1.5M would go very far today.

Professor Greg Warr  
Head of School

## Kate Jolliffe Wins Biota Award



Dr Kate Jolliffe has been awarded the 2006 Biota Award for Medicinal Chemistry by the RACI. This is awarded each year to the chemist with less than 12 years of professional experience since completing their most recent qualifications, judged to be responsible for the best drug design and development paper, patent or commercial in-confidence report published in the preceding calendar year, concerning small molecules (less than 1,000 Da) as potential therapeutic agents.

The award was given for Kate's work on the development of new antifungal agents with a novel mode of action, a project that she is investigating in collaboration with Professor Tania Sorrell and coworkers at Westmead Hospital.

With the increasing occurrence of invasive fungal infections and the emergence of fungal strains that are resistant to current therapies, new antifungal agents are urgently needed. The group at Westmead have recently identified a new fungal virulence factor, fungal phospholipase B (PLB1), as a potential drug target but little is known about the structure of this enzyme.

Together with Dr Fred Widmer, a chemist in the group at Westmead, Kate has developed a number of compound classes designed to inhibit fungal PLB1. Four different compound classes with strong antifungal activity have been identified. Structure-activity relationship studies of these molecules have shown that in at least one class, antifungal activity is correlated with PLB1 inhibition, indicating that this may be the antifungal mode of action for these compounds (C. K. L. Ng, D. Obando, F. Widmer, L. Wright, T. C. Sorrell and K. A. Jolliffe, *Journal of Medicinal Chemistry*, 2006, 49, 811-816.).

The compounds developed by Kate and her group are simple to synthesise and are active against a broad spectrum of fungi, with antifungal activity comparable to some of the drugs in current clinical use. As such, they are promising new antifungal agents and patents have been filed on two of the compound classes. ♦

Cont'd from page 3 (Cameron Kepert's "Hydrogen Storage Gets a Boost")

frameworks, have shown great promise in this area. The low density molecular construction of these materials leads to unprecedented surface areas, the highest to date being 4500 m<sup>2</sup> per gram. These materials have recently been shown to surpass the specified targets, with uptakes up to 7.5 wt.%. With this exciting achievement comes a technological cost: this extent of storage is only possible at very low temperatures and/or very high pressures (-196 °C and 50 atm of H<sub>2</sub> pressure in that case). The origin of this limitation lies in the weakness of the interaction between the hydrogen gas molecule and the surface.

### Maximising the Hydrogen Surface Interaction

If H<sub>2</sub> is to be stored effectively at non-extreme conditions it follows that we need to maximise not just surface area, but the affinity of that surface for the H<sub>2</sub> molecule. Here, nanoporous coordination frameworks again offer unique potential, due to the fact that highly specific surface functionalities can be achieved by design. In recent work, we have used neutron powder diffraction to determine

the location of dihydrogen within a framework material that contains bare copper metal sites.<sup>1</sup> We established that these sites are capable of interacting directly to an intact hydrogen molecule – the first time that this special type of interaction has been identified in a framework material (figure 1). Once these sites are filled, the remainder of the pore surface is loaded (figure 2). We have subsequently shown that this framework takes up 6.6 wt.% of H<sub>2</sub> at low temperature.

### Tuning the Hydrogen Surface Interaction

For practical storage technologies in which hydrogen is stored and released at ambient conditions, calculations and simulations have shown that the optimal energy of the hydrogen interaction is 15-25 kJ.mol<sup>-1</sup>; this falls between that of conventional chemical bonding (50 to 250 kJ.mol<sup>-1</sup>) and dispersion forces (~ 5 kJ.mol<sup>-1</sup>). We and others have shown that the binding energy at bare metal sites is approximately 10 kJ.mol<sup>-1</sup> – double that of conventional surfaces, and well on the way to accessing this ideal energy range. Based on our understandings of metal-hydrogen chemistry, we have good cause to anticipate higher interaction

energies through the use of other types of bare metal sites. Further, there are many other surface features that may be tuned to optimise the H<sub>2</sub>-framework interaction; these include pore curvature, the incorporation of other special functional groups, and the inclusion of charged species into the pores.

### Concluding Remarks

Fascinating challenges lie ahead both in the design of materials with high surface areas and high hydrogen affinities, and in carrying these developments through to the generation of practical hydrogen storage technologies. Following the recent official opening of the OPAL research reactor at Lucas Heights on April 20<sup>th</sup>, 2007, it is appropriate to note that neutron scattering – the premier tool for investigating hydrogen in materials – will play a pivotal role in these developments.

1. VK Peterson, Y Liu, CM Brown and CJ Kepert. Neutron powder diffraction study of D<sub>2</sub> sorption in Cu<sub>3</sub>(1,3,5-benzenetricarboxylate)<sub>2</sub>. *J. Am. Chem. Soc.*, 128, 15578-15579, 2006. See also <http://pubs.acs.org/cen/news/85/i01/8501notw8.html>. ♦

## 2007 Alumni Scholarship Winner

Mr Benjamin Yap

Benjamin Yap graduated from the University of Sydney in 2004 with a BSc(Hons) degree majoring in Medicinal Chemistry. After graduation, Ben attended the ICPP-3 conference in New Orleans, USA and travelled around the world before returning to the School of Chemistry to work as a research assistant for a short period of time. Ben is currently pursuing a PhD in organic chemistry under the supervision of Professor Max Crossley and Professor Neil Hunter, with the aid of an Alumni Scholarship.

Ben's research is directed towards the targeted inhibition of *P. gingivalis* (*Microbiol. Aust.*, 2005, 122). The black-pigment Gram-negative bacterium *P. gingivalis* is an important etiological agent of adult periodontal disease and has been reported to display an absolute requirement for either hemin or hemoglobin as growth factors. Nitroimidazole antibiotics currently used to treat the disease offer

poor selectivity resulting in undesirable side effects. In this work, porphyrin-antibiotic conjugates that are recognized by HA2 receptors of the gingipains and are highly selective inhibitors of *P. gingivalis* have been designed, synthesized, evaluated and patented (PCT Int. WO2006005137).

Ben is currently working on the design, synthesis and biological evaluation of novel targeted anti-microbial porphyrin analogues with the aspiration for a library of new drugs to treat periodontal disease. In July 2006, Ben attended the ICPP-4 conference in Rome, Italy and then continued on to Oxford, UK. Over there, Ben spent 4 months under the supervision of Professor Ben Davis at the Chemistry Research Laboratory, with the aid of a Joan R. Clark Scholarship, working on Se-S chemistry with the aim of linking the porphyrin-antibiotic conjugates to proteins for improved drug delivery. ♦



Mr Benjamin Yap  
Postgraduate Student

# News in Brief

## Congratulations to:

Dr Peter Rutledge, Lecturer, who has been awarded the Royal Australian Chemical Institute (RACI) Organic Chemistry Division lectureship for Recently Appointed Staff.

Professor Peter Lay, FAA, who has been elected as a Fellow of the Australian Academy of Science.

Dr Craig Marshall, who has been awarded the J.G. Russell Award of the Australian Academy of Science. This award, which signifies the community's regard for talented young researchers, contributes to the infrastructure costs of research.

Mr Dominik Konkolewicz on winning the best poster prize at SCM-3, the International Symposium on Separation and Characterization of Macromolecules.

Stephen Rowlings, PhD Student, for his prize student poster (Physical Chemistry) at the Organic & Physical Chemistry Conference in Adelaide.

Emeritus Professor Noel Hush who has been awarded the 2007 Welch Award in Chemistry in recognition of his contributions to understanding electron transfer and molecular electronics.

Associate Professor Scott Kable, Dr Adrian George, Mr Justin Read and Dr Simon Barrie (ITL) on receiving the 2007 Vice-Chancellor's Award for Support of the Students Experience for their work on the ACELL project, Advancing Chemistry by Enhancing Learning in the Laboratory.

Ms Natasha Sciortino for the student seminar prize and Mr Sam Duyker for the student poster prize at CRYSTAL XXV, the 25th Meeting of the Society of Crystallographers in Australia and New Zealand.

Dr Tim Schmidt, who was part of a consortium of researchers at UNSW, Sydney and the Institute of Solar Energy, Madrid who were successful at attracting a total of USD1.8M funding from the Global Climate and Energy Project for their proposal **Hot Carrier Solar Cell: Implementation of the Ultimate PV Converter.**

Professor Trevor Hambley on his election as President-Elect for the Society of Biological Inorganic Chemistry.

Mr Stephen Butler on winning the best poster prize at ICHC21, the International Congress for Heterocyclic Chemistry.

Dr Gregory Sandala who shared the Dean's Prize for the PhD thesis from the Research School of Chemistry, Australian National University.

Associate Professor Scott Kable, Mr Justin Read, Dr Simon Barrie (ITL), Associate Professor Mark Buntine (U. Adelaide) and Dr Ian Jamie (Macquarie U.) on receiving a 2007 Carrick Institute Citation for Outstanding Contributions to Student Learning for their work on the ACELL project.

Mr Adam Cawley on receiving the Manfred Donike Medal for excellence in Sports Anti-Doping Research. This was awarded by the World Association of Anti-Doping Scientists and sponsored by Agilent Technologies.

David Sangster. The Polymer Division of the Royal Australian Institute has renamed its biennial achievement award "The David Sangster Polymer Science Achievement Award". David is "an elder statesman of the Australasian polymer science community who has made exemplary contributions to the field of polymer radiation chemistry and emulsion polymerisation and has nurtured many generations of research students at the University of Sydney."

## Donations

The School of Chemistry would like to thank the following people for their generous donations from Oct 06 to Sept 07:-

Alpha Chemicals (Aust) Pty Ltd	Nell & Hermon Slade Trust
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Professor Peter Lay	Mr Ian Wilson
Mr Christian Liedvogel	

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