

## Establishing leadership in the development of education policy at the University of Melbourne

The PFPC Director, Professor Geoff Stevens, was elected President of the Academic Board, University of Melbourne. The Board has as its primary responsibility "the supervision and development of all academic activities of the University, including the maintenance of high standards in teaching and research".

In August 2008 Professor Geoff Stevens was elected President of the University of Melbourne's Academic Board. Geoff has been serving as Pro Vice Chancellor and Vice President of the Academic Board for the last two years and begins his role as President in January 2009. In this position he becomes a member of the Senior Executive of the University.

Geoff has a distinguished reputation within the University, the country and overseas. At the University of Melbourne he has developed a leading international group in separation processes particularly in solvent extraction and ion exchange; he is the secretary general of the international solvent extraction society and has a range of international projects in this area. He is responsible for an Antarctic research program applying his knowledge of separations technology to clean up the Antarctic waste dumps, supervising chemical engineering students in very successful work in Antarctica during the

summer months. The value of this work has been identified by industrial partners who are now funding clean-up projects in Alaska and in northern Canada.

His work on tissue engineering is of equal significance and he has established a work program with the Bernard O'Brien Institute in Melbourne where he is a member of their Board of Directors and a Lead Researcher in a start-up company that has emanated from his joint work with them. This work has received national publicity on numerous occasions and clearly illustrates how an eminent chemical engineer, in collaboration with the medical community, can make a huge impact.

In addition, he leads a program in the CRC for Greenhouse Gas Technologies (CO2CRC) and was instrumental in developing the capture and separation part of the bid. This has been very successful and is now in the process of building two demonstration scale plants to test new technology developed in this program.

Geoff has strong international linkages with leading Centres around the world including MIT, University of Minnesota, University of Munich, Leeds University and Imperial College London and has spent considerable time at each of these as Visiting Professor. He has an Adjunct Chair at Kanazawa Institute of Technology in Japan and spends two weeks each year there. He was also appointed the Shell Distinguished Chair in Chemical Engineering at Tsinghua University



in China to help develop their research profile. Geoff is a Fellow of the Institute of Chemical Engineers and also a Fellow of the Australian Academy of Technological Sciences and Engineering.

Geoff's appointment comes as Australian Research Council (ARC) funding to the Particulate Fluids Processing Centre ends. The Centre will continue to function as an entity with Geoff leading the team. The Centre will evolve as we move towards the next round of ARC funding but the core focus is to remain one of the world's leading multidisciplinary research centres in interfacial science and engineering.

Throughout his career Geoff has demonstrated the highest standards in teaching and research and is an excellent choice for academic leadership in the University of Melbourne. The PFPC congratulates Geoff on his election to President of the Academic Board.

# The PFPC launches the inaugural International Seminar on Advanced Materials

Held in conjunction with the Centre's 2008 Science Board meeting, the International Seminar on Advanced Materials featured presentations from distinguished international visitors and our local materials engineering leadership.

On July 14, 2008 almost 100 participants from the PFPC and beyond, gathered to hear the latest in Advanced Materials Research. Professor Tom Healy, chair of the PFPC Science Board, instigated and launched the day-long conference where three of our international Science Board members presented Tewkesbury lectures, Professor Aibing Yu spoke on his research and PFPC members presented the latest research taking place within the Centre.

Professor T. Alan Hatton, Ralph Landau Professor in the Department of Chemical Engineering, Massachusetts Institute of Technology (MIT), USA, delivered the first Tewkesbury Lecture of the day. The P.W. Tewkesbury Bequest Fund supports the visits of internationally eminent scholars to the School of Engineering at the University of Melbourne. Professor Hatton addressed the topic of nano-based magnetic materials and high gradient magnetic separations for chemical and biological processing. This technology has applications for separating and collecting waste in a variety of processes.

The second of our Tewkesbury Fellows, Professor Kazue Kurihara, Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Tohoku University, Japan, spoke to the audience on her work promoting science to young researchers and

to women. She felt this was very important to building a future of strong research in Japan and her words resonated with many in the Melbourne audience.

Professor Kurihara shared some insight into her research on measuring the properties of liquids confined in a nanometer scale gap between solid surfaces. Her group have recently focussed on the development of a new method, the resonance shear measurement, for rheology (the study of deformation and flow of material) and tribology (the science of interacting surfaces in relative motion) on the nano-scale.



Professor Kazue Kurihara

Professor Brian Vincent, head of the Polymer and Colloid Group at the University of Bristol, UK, was our third Tewkesbury Fellow. He rounded out the talks for the day with a discussion on microgels to deliver substrates under controlled release conditions. Professor Vincent is also interested in core-shell particles as a vehicle for delivery mediated by triggers such as mechanical pressure.

Joining our Science Board for the 2008 meeting, Professor Aibing Yu, the Scientia Professor and Director of the Lab for

Simulation and Modelling of Particulate Systems (Simpas) at the University of New South Wales presented his research on discrete particle computer simulation. We heard about the structure of Simpas and how they take a multiscale approach to modelling. The researchers at the laboratory are modelling in complex particle systems aiming to improve existing technologies. With a focus towards application in mineral processing, Simpas are performing industrial scale simulation.

A cross-section of materials-related research from within the PFPC was showcased during the International Seminar on Advanced Materials. The Centre's research in the area of advanced ceramics was discussed by Associate Professor George Franks. George described how it is possible to save money on processing costs if the ceramic object is made as close to the final shape as possible. He and his group have been exploring this by gel casting ceramic foams.

We heard how Dr Rachel Caruso's team are using templating technology to fabricate porous inorganic structures via sol-gel chemistry. The structures that Rachel produces have many and varied applications ranging from dye-sensitised solar cells to lithium ion batteries to bone replacement materials.

The realities of a global warming future were brought home to us by Professor Geoff Stevens describing how we, in Victoria, need to reduce our CO<sub>2</sub> emissions by 95.4% by 2050. The audience saw how changing to renewable sources of energy will not be enough to reduce our carbon emissions, we will have to capture and sequester CO<sub>2</sub>. Geoff described how the researchers in his group, who are also part of the CO<sub>2</sub>CRC,

was reducing the cost of CO<sub>2</sub> separation from combustion products using absorption technologies.

Professor Robert Lamb's group are making non-stick, or more waterproof, surfaces. Superhydrophobic surfaces have self-cleaning properties, for example they are non-adhesive towards ice, snow and biological foulants. Rob explained that, perhaps counter intuitively, if you roughen a waterproof surface you can make a surface superwaterproof. Rob's group are achieving this by using durable and transparent thin films prepared by packing aggregates of nano-scale particulates onto surfaces.

The PFPC contributes significantly to research into tissue engineering. Dr Andrea O'Connor outlined some of the work she is doing with Professor Kerry Landman's group where they are modelling cell migration involved in wound healing and tissue growth. Andrea talked about the focus on tailoring biomaterials to prevent immune reactions by the body and to encourage optimal tissue regeneration. She talked about the controlled release systems they are developing to enhance tissue growth and control differentiation.

The International Seminar ended with a poster session where students representing

a variety of PFPC research areas displayed their work to the Science Board and to other PFPC members. This gave visitors to the Centre an opportunity to talk to some of our student members and our students the chance to network and gain feedback from the participants at the International Seminar.

The day was enjoyed by all who attended and allowed us to hear the latest in materials research. Plans are underway to repeat the International Seminar in 2009 to foster further collaboration and knowledge exchange between the PFPC and international leaders in the field.

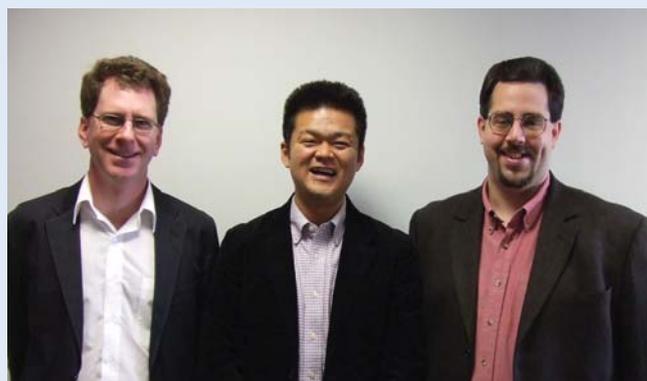
## The PFPC co-sponsors the Core-to-Core Young Researchers Symposium, Australia

The PFPC, Australian Mineral Science Research Institute (AMSRI) and Japan Society for the Promotion of Science (JSPS) Core-to-Core Fund sponsored the Young Researchers Symposium in August 2008. The two day symposium is part of a series of an ongoing collaborative program between Kyoto University, the University of Melbourne, Leeds University, the University of Florida, the University of Erlangen, the Max Planck Institute-Mainz and the Swiss Federal Institute of Technology known as the Core-to-Core Program.

This year, organised by Associate Professor Jun Oshitani from Okayama University,

Associate Professor George Franks and Ms Patricia Mackay from Melbourne, five researchers from Japanese universities travelled to Melbourne to take part in the symposium. The visiting researchers spent a morning touring PFPC laboratories to get an idea of the scope of research and the Centre's research facilities. In the afternoon the visitors met for discussion with some of the younger University of Melbourne academics.

The second day consisted of a series of lectures from the group of visiting and



Symposium organisers Associate Professors George Franks and Jun Oshitani with PFPC researcher Dr Ray Dagastine

Australian experts in the areas of colloids, surface chemistry, mineral processing, advanced materials and polymers. The aim of the meeting was to foster stronger ties between young researchers in the participating institutions.

# NEWS FEATURE

## Focus on the PFPC collaborative network

Former students of PFPC members have moved on to varied and interesting jobs. Many have remained valued collaborators with the Centre. In this edition of the PFPC News we profile two members of the extended PFPC family, Professor Calum Drummond and Dr Rob Hayes.

A valued member of the Centre's Advisory Board and a former student of leading PFPC members, Professor Calum Drummond undertook his BSc (Hons) degree in Physical Chemistry under the supervision of Professor Tom Healy. He remained under Tom's guidance, with co-supervision from Professor Franz Grieser (now one of the Deputy Directors of the PFPC) for his PhD studies. After completing his PhD, in 1987, Calum took up a position in the Industrial Chemicals Program in Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Applied Organic Chemistry.

In 1990 Calum gained a continuing CSIRO appointment and was also awarded a prestigious Queen Elizabeth II Fellowship from the Australian Research Council (ARC). The QEII fellowship scheme encourages research in Australia by postdoctoral graduates of "exceptional promise and proven capacity for original work". Taking a leave of absence from CSIRO, Calum spent the first year of his fellowship at the Department of Applied Mathematics at the Australian National University before returning to CSIRO to complete his fellowship.

Calum worked as a Project Leader first in

the CSIRO Division of Chemicals and Polymers then, when promoted to Principal Research Scientist, in the Division of Molecular Science. In 1999 he was promoted to Senior Principal Research Scientist and in 2004 to Chief Research Scientist.

In 2001 Calum was seconded from CSIRO for 3.5 years to be the inaugural Vice President Research at CAP-XX Pty Ltd. CAP-XX is a Sydney-based company that designs and manufactures the world's most advanced supercapacitors – high power energy storage devices that enable the development of new power solutions for next-generation portable electronic devices. As Vice President Research, Calum was responsible for all research and intellectual property activities, and part of the manufacturing operations.

Calum is currently Chief of CSIRO Materials Science and Engineering. Here he leads a Division of approximately 550 scientists and engineers with an annual budget of around \$110 million. The Division focus is on physical sciences (chemistry and physics) and engineering advanced materials with an emphasis on delivering outcomes for the Australian manufacturing sector. Calum is also convenor of the CSIRO Advanced Materials Network comprising over 300 scientists and engineers in 12 Divisions.

In addition, he holds an ARC Federation Fellowship at CSIRO Molecular and Health Technologies (CMHT). Federation Fellowships are highly distinguished awards granted to outstanding Australian researchers. At CMHT Calum leads a



Professor Calum Drummond

research group of about 16 scientists, including 7 PhD students and 5 post-doctoral fellows. His research focus is on manipulating nano-scale molecular and surface interactions to develop new nano-structured products with application to medical imaging, therapeutic drug delivery and energy storage devices.

Calum has won many research awards and prizes. He has been an author of over 170 publications including 4 invited book chapters, over 90 refereed ISI journal papers, 9 patents, 9 conference proceeding papers, 5 technical/professional society journal papers and 54 CSIRO reports (mainly commercial-in-confidence reports for companies). The PFPC is privileged to have Professor Calum Drummond as a member of our Advisory Board.

Dr Rob Hayes completed a BSc (Hons) at Melbourne University in 1983 under the supervision of Professor Franz Grieser. He then continued his study in the field of Colloid and Surface Science at the University of South Australia where he completed a MAppSci in Mineral Processing.

Rob travelled to the UK to complete his PhD at Brunel University in 1988 before returning to Australia to work as a Research Fellow at the Ian Wark Research Institute at the University of South Australia. He was promoted to Senior Research Fellow and remained at the Wark for 10 years. During this time he worked on both applied and fundamental aspects of Interfacial Chemistry.

In 1999 Rob joined the Corporate Research Laboratory of Philips Electronics in Eindhoven, The Netherlands, where he led the Colloid and Interfacial Chemistry Clusters. His major focus was on new

applications in the fledgling electrowetting device field where two new carriers for technology were proposed - switchable lenses and electronic paper. In September 2000 he demonstrated the first optical switch



Dr Rob Hayes

based on electrowetting. This invention was further developed prior to public announcement with a cover article in Nature in September 2003, "Video-speed electronic paper based on electrowetting."

The overwhelming interest in commercialisation of this electrowetting display technology, a more efficient alternative to LCD's, ultimately led to the birth of Liquavista, an independent spin-off from Philips Electronics in April 2006. Rob founded the company and currently holds the position of Chief Scientific Officer in this venture-capital backed start-up. He is now located in Hong Kong overseeing the China-based manufacturing activities of the company. He has more than 80 publications in internationally refereed journals and 20 patents or patent applications to date. Much of Rob's work complements research within the Centre and we look forward to closer collaboration with Rob in the future.

### **Congratulations to Dave Dunstan on his promotion to Professor**

Professor Dave Dunstan completed his PhD "Dielectric Response of Colloidal Dispersions" in 1989 under the supervision of Professors Tom Healy and Lee White. Tom and Lee, together with Professor David Boger were the Director and Deputy Directors respectively of the Advanced Minerals Products Centre (AMPC) which was renewed as the PFPC.

Dave took up a postdoctoral position working on Semiconductor Photophysics at Uppsala University, Sweden, with Professor

Mats Almgren. He then moved to the US to work with Professor Jacob Israelachvili at the University of California Santa Barbara and then with Professor Dudley Saville at Princeton University.

In 1993 Dave returned to Melbourne as a Senior Research Fellow with the CRC for Bioproducts. He was appointed as a Senior Lecturer in 1999 in the Department of Chemical and Biomolecular Engineering and was promoted to Reader in 2003. Dave also serves as Associate Dean (Graduate Studies) in the University of Melbourne School of Engineering and leads the Complex Fluids Group researching the

behaviour of polymers within complex fluids. In June this year Dave received his well deserved promotion to full Professor.



Professor Dave Dunstan

# PFPC Postgraduate Students

Every second Tuesday the PFPC gathers to hear seminars delivered by our students.

Our seminar committee works hard to organise this series. The four committee members are profiled below.

## Nathan Nicholas

For my undergraduate degree I did a Bachelor of Engineering/Science here, at the University of Melbourne, specialising in Chemical Engineering and Chemistry. During my studies I was always most interested in the inorganic and minerals aspects of the course work and so for my PhD I decided to continue down that path.

The topic of my PhD is loosely titled "Control of Crystal Morphology" and is a collaboration between Professor William Ducker (who recently left the PFPC and the University of Melbourne to take up a position in the Department of Chemical Engineering, Virginia Tech, USA) and Associate Professor George Franks. More specifically I am investigating how and why certain small, foreign molecules, when introduced into a crystal growth system, affect the crystal growth habit.

The model system I am studying is zinc oxide (ZnO) as it has relatively mild growth conditions, and it is known that molecules like citrate and hexamine influence the growth rates of different crystal faces. Furthermore on the more engineering side of things, shape specific ZnO has commercial applications such as replacing gallium nitride (GaN) in light emitting diodes (LED) or use in piezoelectric devices.



## Ellie Button

I grew up in Tasmania and after some time working as a bartender in the UK I found myself in Melbourne. I completed my BSc (Hons) at the University of Melbourne in 2005 having studied mainly mathematics and physics.

I began work on my PhD with Professor John Sader in 2006. My project aims to mathematically model and understand the physical mechanisms behind a particularly interesting fluid mechanical phenomenon. I am investigating the thin film flow generated when a liquid jet impacts normally on the underside of a large horizontal plate. The liquid spreads radially to an abrupt unspecified point and then falls of its own accord. From this point it either falls as threads or coalesces to form a water bell.

As part of my research I have conducted experiments with Professor Graeme Jameson at the University of Newcastle; this has been an exciting challenge for someone with a limited experimental background. An important aspect of my work is testing the validity of the theoretical models by comparison with experimental results. It was

during a summer undergraduate research project in 2004 that I first encountered the water bells. At that time it was actually a friend of mine who was studying them, but I was so intrigued by their simple beauty that I had to get involved!

Outside the office I enjoy travelling and playing cricket.



## Melissa Leung

I obtained my bachelor degree in biotechnology and biochemistry from the University of Melbourne. With my great interest in biomedical research I then conducted my honours project, which was titled "DNA Ligands for Cancer Radioimmunotherapy and PET Imaging", at the Bio21 Molecular Science and Biotechnology Institute and the Peter MacCallum Cancer Centre under the supervision of Associate Professor Jonathan White and Associate Professor Roger Martin respectively. The project involved synthesising a series of DNA minor groove binding Hoechst dye derivatives. These ligands were conjugated to tumour targeting proteins and the protein-ligand conjugates were purified.

I am now doing my PhD in Professor Frank Caruso's Nanostructured Interfaces and Material Science group, within the Department of Chemical and Biomolecular Engineering. My project focuses on designing and preparing targeted drug delivery vehicles to improve the therapeutic qualities of existing drugs. My aim is to maximise the uptake of the therapeutic agent at the target sites as well as to minimise the side effects on other healthy tissues and cells. My goal is to encapsulate an anti-thrombotic drug into biocompatible, nano-micrometre-scaled, multilayered, antibody-functionalised, degradable polymer capsules. With the collaboration of the Baker Heart Research Institute current studies involve biofunctionalisation of the capsules and cell targeting. This project provides me with the opportunity to participate in an interesting field of research, nanomedicine, which combines biomedical science with nanotechnology.



# Visitors



## William McMaster

I pursued undergraduate studies here at the University of Melbourne, earning both a BA and a BSc (Hons). During my Honours year, I was part of Dr Rachel Caruso's group in Chemistry and have stayed on within the Caruso Group to undertake my PhD. I am now in my third year.

My PhD focuses upon materials chemistry, particularly involving templating techniques and sol-gel chemistry. Combination of the two enables synthesis of novel materials with controlled architecture and known chemical composition. For Honours I researched metal-doped titanium dioxide, but for my PhD I chose to move into the area of biomaterials. My thesis has the provisional title of "Hydroxyapatite Structures as 'Synthetic' Bone."

Hydroxyapatite is a biologically active phase of calcium phosphate, and is an idealised form of bone mineral. My research involves sol-gel synthesis of hydroxyapatite on porous organic scaffolds. Thus far the sol-gel method has been optimised and different templates employed. Currently the calcination step – for template removal – is being refined. *In vitro* testing of selected materials will commence shortly. For the remainder of my PhD, increasing the 'bone-like' nature of my hydroxyapatite materials will be a key challenge. As part of my research I make extensive use of scanning electron microscopy, x-ray diffraction, thermogravimetric analysis, and gas sorption.

Outside of the lab, I am a demonstrator in the Chemistry teaching labs, and I play the trumpet in the orchestra and concert band of the Engineering Music Society.

## Extended Visits

### Associate Professor Khosrow Rostami

Biotechnology Centre, Iranian Research Organisation for Science and Technology (IROST), Tehran, Iran  
August 2007 – July 2008

### Dr Michal Arbel Haddad

Nuclear Research Center, Negev, Israel  
September 2007 – September 2008

### Mr Kensuke Karasu

Tokyo Institute of Technology, Japan  
November 2007 – May 2008

### Associate Professor Kazuhiko Nishi

Department of Chemical System Engineering, Graduate School of Engineering, Yokohama National University, Japan  
February – August 2008

### Dr Sambandam Anandan

National Institute of Technology, Trichy, India  
May – July 2008

### Associate Professor Jun Oshitani

Okayama University, Japan  
May – September 2008

### Ms Leticia Hosta-Rigau

Universitat de Barcelona, Spain  
June 2008 – March 2009

### Ms Mathilde Evrard

Ecole Nationale Supérieure des Ingénieurs en Arts Chimiques et Technologiques, Toulouse, France  
July – September 2008

### Dr Francesca Cavalieri

Università degli Studi di Roma "La Sapienza", Italy  
July – November 2008

### Ms Susan Bernal

Universidad del Valle, Columbia  
July 2008 – July 2009

## Short Term Visits

### Dr John Forsythe

Department of Materials Engineering, Monash University, Australia  
July 2008

### Professor Nicolas Alonso Vante

Université de Poitiers, France  
July 2008

### Dr Patrick Hartley

CSIRO Molecular and Health Technologies, Australia  
July 2008

### Professor T Alan Hatton

Department of Chemical Engineering, Massachusetts Institute of Technology, USA  
July 2008

### Professor Kazue Kurihara

Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Tohoku University, Japan  
July 2008

### Mr Mark Pascoe

International Water Centre, Australia  
July 2008

### Professor Brian Vincent

University of Bristol, UK  
July 2008

### Professor Aibing Yu

Scientia Professor and Director, Lab for Simulation and Modelling of Particulate Systems (Simpas), University of New South Wales, Australia  
July 2008

### Professor Richard Buscall

MSACT Consulting, UK  
July-August 2008

### Professor Dr Hans-Jürgen Butt

Max Planck Institute for Polymer Research, Germany  
July-August 2008

### Mr Tim Bowser

GlaxoSmithKline, Australia  
August 2008

### Professor Calum Drummond

Chief, CSIRO Materials Science and Engineering, Australia  
August 2008

### Professor Graeme Jameson

Department of Chemical Engineering, University of Newcastle, Australia  
August 2008

### Professor Wayne Morrison

Bernard O'Brien Institute of Microsurgery, Australia  
August 2008

### Professor Brij Moudgil

ERC for Particle Science & Technology, Florida, USA  
August 2008

### Professor John Ralston

Ian Wark Research Institute, University of South Australia, Australia  
August 2008

### Dr Brian Smith

BHP Billiton, Australia  
August 2008

### Dr Ian Mackinnon

Executive Director, Engineering and Environmental Science, Australian Research Council  
August 2008

### Professor Colin Pleas

School of Mathematics, University of Southampton, UK  
August 2008

### Dr Gema Antequera-Garcia

University of Vigo, Spain  
August 2008

### Associate Professor Yasuhisa Adachi

University of Tsukuba, Japan  
August 2008

### Assistant Professor Kenji Iimura

University of Hyogo, Japan  
August 2008

### Associate Professor Koreyoshi Imamura

Okayama University, Japan  
August 2008

### Mr Tomonori Fukasawa

University of Tsukuba, Japan  
August 2008

# Contact Details

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The Particulate Fluids Processing Centre is a Special Research Centre of the Australian Research Council

## Publications

### Book Sections

Perera, J. M., and Stevens, G. W. (2008) "The use of emulsion liquid membrane systems in chemical and biotechnological separations." *Handbook of Membrane Separations: Chemical, Pharmaceutical, Food, and Biotechnological Applications*, A. K. Pabby, S. H. S. Rizvi, and A. M. Sastre, eds., CRC Press, Taylor & Francis Group, USA, 709-740.

### Journal Articles

Anderson, C. J., Pas, S. J., Arora, G., Kentish, S. E., Hill, A. J., Sandler, S. I., and Stevens, G. W. (2008). "Effect of pyrolysis temperature and operating temperature on the performance of nanoporous carbon membranes." *Journal of Membrane Science*, 322, 19-27.

Bell, J. L., Sarin, P., Provis, J. L., Haggerty, R. P., Driemeyer, P. E., Chupas, P. J., van Deventer, J. S. J., and Kriven, W. M. (2008). "Atomic structure of a cesium aluminosilicate geopolymer: A pair distribution function study." *Chemistry of Materials*, 20(14), 4768-4776.

Brotchie, A., Ashokkumar, M., and Grieser, F. (2008). "Sonochemistry and sonoluminescence under simultaneous high- and low-frequency irradiation." *Journal of Physical Chemistry C*, 112(22), 8343-8348.

Brotchie, A., Grieser, F., and Ashokkumar, M. (2008). "Sonochemistry and sonoluminescence under dual-frequency ultrasound irradiation in the presence of water-soluble solutes." *Journal of Physical Chemistry C*, 112(27), 10247-10250.

Chau, T. T., Dagstine, R. R., Grieser, F., Chan, D. Y. C., and Stevens, G. W. (2008). "Direct force measurement at liquid-liquid interfaces." *Solvent Extraction Research and Development-Japan*, 15, 1-10.

Dass, C. R., Friedhuber, A. M., Khachigian, L. M., Dunstan, D. E., and Choong, P. F. M. (2008). "Biocompatible chitosan-DNAzyme nanoparticle exhibits enhanced biological activity." *Journal of Microencapsulation*, 25(6), 421-425.

Duthie, X., Kentish, S., Pas, S. J., Hill, A. J., Powell, C., Nagai, K., Stevens, G., and Qiao, G. (2008). "Thermal treatment of dense polyimide membranes." *Journal of Polymer Science Part B: Polymer Physics*, 46(18), 1879-1890.

Gooding, A. K., Gomez, D. E., and Mulvaney, P. (2008). "The effects of electron and hole injection on the photoluminescence of CdSe/CdS/ZnS nanocrystal monolayers." *ACS Nano*, 2(4), 669-676.

Grassia, P., Usher, S. P., and Scales, P. J. (2008). "A simplified parameter extraction technique using batch settling data to estimate suspension material properties in dewatering applications." *Chemical Engineering Science*, 63(7), 1971-1986.

Guo, W. L., He, Y. H., Ashokkumar, M., and Grieser, F. (2008). "Sonochemical synthesis of single crystal Pd nanoparticles in aqueous solution." *Materials Research Innovations*, 12(1), 52-54.

Gupta, J. K., Tjipto, E., Zelikin, A. N., Caruso, F., and Abbott, N. L. (2008). "Characterization of the growth of polyelectrolyte multilayers formed at interfaces between aqueous phases and thermotropic liquid crystals." *Langmuir*, 24(10), 5534-5542.

Harris, N., Ford, M. J., Mulvaney, P., and Cortie, M. B. (2008). "Tunable infrared absorption by meta nanoparticles: The case for gold rods and shells." *Gold Bulletin*, 41(1), 5-14.

Hornig, G., Northcott, K., Snape, I., and Stevens, G. (2008). "Assessment of sorbent materials for treatment of hydrocarbon contaminated ground water in cold regions." *Cold Regions Science and Technology*, 53(1), 83-91.

Hu, M., Novo, C., Funston, A., Wang, H. N., Staleva, H., Zou, S. L., Mulvaney, P., Xia, Y. N., and Harland, G. V. (2008). "Dark-field microscopy studies of single metal nanoparticles: understanding the factors that influence the linewidth of the localized surface plasmon resonance." *Journal of Materials Chemistry*, 18(17), 1949-1960.

Johnston, A. P. R., and Caruso, F. (2008). "Stabilization of DNA multilayer films through oligonucleotide crosslinking." *Small*, 4(5), 612-618.

Kaggwa, G. B., Kilpatrick, J. I., Sader, J. E., and Jarvis, S. P. (2008). "Artifact-free dynamic atomic force microscopy reveals monotonic dissipation for a simple confined liquid - art. no. 011909." *Applied Physics Letters*, 93(1), 11909-11909.

Lees, E. E., Gunzburg, M. J., Nguyen, T. -L., Howlett, G. J., Rothacker, J., Nice, E. C., Clayton, A. H. A., and Mulvaney, P. (2008). "Experimental determination of quantum dot size distributions, ligand packing densities, and bioconjugation using analytical ultracentrifugation." *Nano Letters*, 8(9), 2883-2890.

Landman, K. A., Simpson, M. J., and Pettet, G. J. (2008). "Tactically-driven nonmonotone travelling waves." *Physica D-Nonlinear Phenomena*, 237(5), 678-691.

Lilley, C. R., and Sader, J. E. (2008). "Velocity profile in the Knudsen layer according to the Boltzmann equation." *Proceedings of the Royal Society A-Mathematical Physical and Engineering Sciences*, 464(2096), 2015-2035.

Lokar, W. J., and Ducker, W. A. (2008). "Approximate prediction of adhesion between two solids immersed in surfactant solution based on adsorption to an isolated solid." *Colloids and Surfaces a-Physicochemical and Engineering Aspects*, 322(1-3), 256-260.

Manera, M. G., Spadavecchia, J., Buso, D., Fernandez, C. D., Mattel, G., Martucci, A., Mulvaney, P., Perez-Juste, J., Rella, R., Vasaneli, L., and Mazzoldi, P. (2008). "Optical gas sensing Of TiO2 and TiO2/Au nanocomposite thin films." *Sensors and Actuators B-Chemical*, 132(1), 107-115.

Manor, O., Vakarelski, I. U., Tang, X. S., O'Shea, S. J., Stevens, G. W., Grieser, F., Dagstine, R. R., and Chan, D. Y. C. (2008). "Hydrodynamic boundary conditions and dynamic forces between bubbles and surfaces - art. no. 024501." *Physical Review Letters*, 101(2), 4501-4501.

Park, J., Kim, I., Shin, H., Lee, M. J., Kim, Y. S., Bang, J., Caruso, F., and Cho, J. (2008). "Integrated catalytic activity of patterned multilayer films based on pH-induced electrostatic properties of enzymes." *Advanced Materials*, 20(10), 1843-1848.

Sindhunata, Provis, J. L., Lukey, G. C., Xu, H., and Van Deventer, J. S. J. (2008). "Structural evolution of fly ash based geopolymers in alkaline environments." *Industrial & Engineering Chemistry Research*, 47(9), 2991-2999.

Stella, A., Mensforth, K. H., Bowser, T., Stevens, G. W., and Pratt, H. R. C. (2008). "Mass transfer performance in Karr recirculating plate extraction columns." *Industrial & Engineering Chemistry Research*, 47(11), 3996-4007.

Wang, X., Mitchell, D. R. G., Prince, K., Atanacio, A. J., and Caruso, R. A. (2008). "Gold nanoparticle incorporation into porous titania networks using an agarose gel templating technique for photocatalytic applications." *Chemistry of Materials*, 20, 3917-3926.

Wang, Y. J., Bansal, V., Zelikin, A. N., and Caruso, F. (2008). "Templated synthesis of single-component polymer capsules and their application in drug delivery." *Nano Letters*, 8(6), 1741-1745.

Webber, G. B., Edwards, S. A., Stevens, G. W., Grieser, F., Dagstine, R. R., and Chan, D. Y. C. (2008). "Measurements of dynamic forces between drops with the AFM: novel considerations in comparisons between experiment and theory." *Soft Matter*, 4(6), 1270-1278.

Wynn, K. K., Fulton, Z., Cooper, L., Silins, S. L., Gras, S., Archbold, J. K., Tynan, F. E., Miles, J. J., McCluskey, J., Burrows, S. R., Rossjohn, J., and Khanna, R. (2008). "Impact of clonal competition for peptide-MHC complexes on the CD8(+) T-cell repertoire selection in a persistent viral infection." *Blood*, 111(8), 4283-4292.

Yang, J., Stevens, G. W., and O' Connor, A. J. (2008). "Adsorption of lysozyme and trypsin by modified MCM-41 with post-synthesis hydrothermal treatment and hydrophobic functionalisation." *Journal of the Australian Ceramic Society*, 44(1), 1-6.

Yap, H. P., Hao, X. J., Tjipto, E., Gudipati, C., Quinn, J. F., Davis, T. P., Barner-Kowollik, C., Stenzel, M. H., and Caruso, F. (2008). "Synthesis, multilayer film assembly, and capsule formation of macromolecularly engineered acrylic acid and styrene sulfonate block copolymers." *Langmuir*, 24(16), 8981-8990.

Yates, P. D., Franks, G. V., and Jameson, G. J. (2008). "Orthokinetic heteroaggregation with nanoparticles: effect of particle size ratio on aggregate properties." *Colloids and Surfaces A*, 326, 83-91.

Zhang, H. G., Provis, J. L., Feng, D. W., and van Deventer, J. S. J. (2008). "The role of sulfide in the immobilization of Cr(VI) in fly ash geopolymers." *Cement and Concrete Research*, 38(5), 681-688.

### Refereed Conference Papers

Boger, D. V., and Hart, B. C. (2008). "Making an unsustainable industry more sustainable." *PASTE 2008: Proceedings of the Eleventh International Seminar on Paste and Thickened Tailings*, A. Fourier, R. Jewell, P. Slatyer and A. Paterson, eds., Kasane, Botswana, Africa, 3-15.

Boger, D. V., Scales, P. J., and Sofra, F. (2008). "Paste and thickened tailings and the impact on the development of new rheological techniques." *PASTE 2008: Proceedings of the Eleventh International Seminar on Paste and Thickened Tailings*, A. Fourier, R. Jewell, P. Slatyer and A. Paterson, eds., Kasane, Botswana, Africa, 225.

### Patents

Abdul Hamid, Z. A., Blencowe, A., Qiao, G. G., and Stevens, G. "Crosslinked hydrogel." Australian Provisional Patent 2008903301, 27/06/2008.

### Publicity

Zeobond Pty Ltd evolving out of the Geopolymer Group led by Professor Jannie van Deventer was featured on the ABC television programme "Catalyst", 22 May 2008. <http://www.abc.net.au/catalyst/stories/2244816.htm>

They were also featured in the May edition of *Materials Australia* magazine.

Professor Peter Scales was interviewed for the Melbourne University Up Close Podcast, "Episode 41: Drinking the Same Water Twice - Potable Water from Waste", 6 June 2008.

<http://upclose.unimelb.edu.au/transcript/137>

An interview with Professor Frank Caruso in *The Australian* newspaper on 18<sup>th</sup> June 2008 (<http://www.theaustralian.news.com.au/story/0,25197,2387969-8-27703,00.html>) appeared in tandem with the launch of the Australian Research Council's book, *Outcomes: Results of Research in the Real World 2008*. The work of Frank's group is featured in the article "Right on Target". <http://www.research-outcomes.com.au/>

One of the group, Elvira Tjipto appeared in Channel 10's children's science television programme "Scope" presenting a story on Liquid Crystals, 11 August 2008. <http://www.csiro.au/scope/episodes/e131.htm>

Professor Paul Mulvaney gave an interview to ABC Radio Hobart on the dangers of nanotechnology.