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# vice-chancellor's

It is my pleasure to congratulate Director Peter Gray and the AIBN team on another year of outcomes, including a series of model achievements in network-building, collaboration and leveraging.

The 2009 score sheet features the launch of a facilities cluster valued at \$30 million, funded by the Australian and Queensland governments and UQ. The cluster comprises the Biologics Facility, the Metabolomics Facility and the Queensland Node of the Australian National Fabrication Facility – all part of national groupings. As both a workplace for more than 30 UQ scientists and engineers and a resource for public and private sector researchers, it fosters teamwork and knowledge exchange among university researchers and their counterparts in industry.

Furthermore, the cluster gives small, medium and large businesses a new way to benefit from - and contribute to - national and global progress driven by research and development, while helping ensure AIBN inquiry is relevant to contemporary industry priorities. Such connections also help identify gaps in national capability, such as the chasm between the fundamental discovery of potential biopharmaceuticals and biologics, and the ability to prepare clinical grade material for human trials. With University support, Professor Gray and AIBN colleagues addressed this gap, leading to the establishment of Biopharmaceuticals Australia Pty Ltd, soon to be built within the Translational Research Institute Queensland on the Princess Alexandra Hospital site.

In 2009, AIBN launched the Industrial Affiliates Program as part of its work to smooth the business world's runway into research. The program is a sure way for companies to avoid 'reinventing the wheel' by enjoying tailored access to experts who target solutions in health, the environment and industrial processes. The \$30 million facilities cluster was a catalyst for the program, but participating companies have access to a range of other AIBN labs, where the focus is in areas such as hydrogen storage, drug delivery, photocatalysts, antibody engineering, biosensors and tissue engineering.

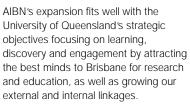
The Industrial Affiliates Program is the latest stage in a structure of AIBN corporate and philanthropic networks, which includes: a \$17.5 million donation from The Atlantic Philanthropies; a research alliance with Dow Chemicals; and partnerships with the likes of Unilever, Intel and Amyris Biotechnologies Inc, as well as many Australian-based companies of smaller scale.

AIBN proves beyond doubt that highquality applied research is compatible with outstanding fundamental research. It marries the two so people and organisations using the products of discovery can be certain they arise from investigations that are independent, ethical and peer reviewed.

Professor Paul Greenfield AO VICE-CHANCELLOR THE UNIVERSITY OF QUEENSLAND

# DIRECTOR'S **MESSAGE**

In 2009, the Australian Institute for Bioengineering and Nanotechnology (AIBN) again expanded its intellectual capacity and capabilities, enabling researchers to effectively and efficiently prosecute their leading-edge research and contribute toward elegant, long-term solutions for many substantial problems in the broad areas of health, the environment and energy.



It was particularly gratifying to note that AIBN researchers were awarded more than \$7.1 million in new funding by the Australian Research Council in 2009.

Additionally, the Australian Stem Cell Centre provided more

than \$3 million in funding to understand the processes of cellular reprogramming, and how to produce stem cells in clinically relevant quantities.

I congratulate Professors Mark Kendall, Michael Monteiro, Chengzhong Yu and Kirill Alexandrov (an AIBN joint appointment with the Institute for Molecular Bioscience), and Dr Annette Dexter who were awarded prestigious Australian Research Council Future Fellowships; Drs Simon Corrie, Zhen Li and Chenghua Sun, who were awarded Queensland Government Smart Future Fellowships; and Dr Zhi Ping Xu, who was awarded a UQ Foundation Research Excellence Award.

It was pleasing and indicative of AIBN's considerable international reputation that one of our Future Fellows, Professor Yu, joined AIBN from Fudan University in China to take up the award. The year also saw the formation of the Centre for Biomarker Research and Development, the first such centre established under the auspices of the institute. Headed by Professor Matt Trau and announced on 18 May 2009 by the Honourable Stephen Robertson, Queensland Minister for Natural Resources, Mines and Energy and Trade, the centre will focus on early diagnosis and tailored treatment of disease.

Critical to AIBN's research efforts is a motivated and dynamic student body and I am pleased to report that 11 of the Institute's research higher degree students submitted their theses in 2009 with four degrees being awarded. The remaining seven students are expected

to graduate in 2010.

In addition to research training, AIBN delivers various continuing professional development courses. The longest running of these is the Biologics and Biopharmaceuticals Course delivered by Associate Professor Stephen Mahler. The course discusses the utility of biologics and biopharmaceuticals as drugs, the regulatory environment, and various commercialisation strategies. The course was delivered to government bodies, private companies and universities in Australia and abroad. There are indications that demand will remain high in 2010.

Complementing this learning opportunity is a newly developed course delivered in conjunction with members of the Nanobiotechnology Center from Cornell University, one of the premier Ivy League universities in the United States.

AIBN is committed to realising the long-term benefits of interacting with industry and the wider community and is consequently expanding its existing industrial and community engagement activities.

Industrial links give AIBN researchers the opportunity to progress their life's passion beyond the confines of the bench, and expose their research to the competition and validation of the market place. Engagement with industry has the potential to open new revenue streams at a time when competition for the available Australian research dollar is becoming increasingly fierce.

The Institute's industrial engagement occurs in various guises, such as collaborative partners in the Australian Research Council's Linkage Project Grant scheme, industry sponsorship of PhD scholarships, short-term contract research agreements, continuing professional development courses, and the newly developed Industrial Affiliates Program (IAP). More information about the IAP initiative, which capitalises on the unique facilities and expertise found at AIBN, can be found later in this report.

Further supplementing these industry links is AIBN's commitment to engaging with the wider community that supports it. This involves AIBN Group Leaders and research students visiting Queensland primary and secondary schools to discuss the basic principles of their research, and participating in the important community discussions surrounding the emerging technologies of nanotechnology and bioengineering.

Because of these high-quality achievements in 2009, and in previous years, all staff and students can look forward to the Institute Review in mid-2010. The review will be conducted by a distinguished panel of national and international experts in the fields of bioengineering and nanotechnology.

The review is a rare occasion for the institute to obtain an impartial and objective assessment of its strengths and weaknesses, as well as important insights into how it benchmarks locally, nationally and internationally.

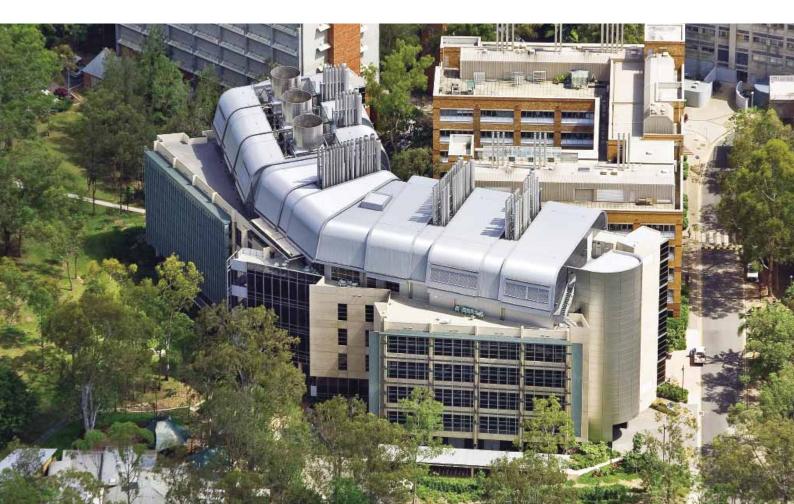
I anticipate that AIBN will benefit considerably from this review in terms of acknowledging past achievements, recognising the institute's strengths, identifying future challenges and targeting strategic directions for pursuit.

I congratulate Professor Max Lu, who was appointed The University of Queensland's Deputy Vice Chancellor – Research in 2009. This appointment reflects Max's abilities, both as an administrator and as a researcher. Fortunately for the institute, Max is maintaining his research involvement, albeit in a substantially reduced capacity and we gratefully acknowledge and thank him for his contributions to AIBN in the previous years.

It is appropriate that I acknowledge the contributions of all AIBN's researchers, support staff and students, who now number more than 360 individuals, and I particularly thank the AIBN Executive Team for their wise counsel over the previous 12 months. I thank the members of AIBN's Scientific and Commercialisation Committee who give freely and generously of their time to ensure AIBN fully maximises its considerable research and commercial potential. I also appreciate the contribution of Euan Murdoch who, as head of the Queensland Government Review Committee, provided invaluable support during 2009.

Finally, on behalf of the institute, I acknowledge the Senior Executive of UQ, who have been and remain, extremely supportive of AIBN and its endeavours.

Professor Peter Gray AIBN DIRECTOR



# AIBN SCIENTIFIC AND COMMERCIALISATION

The Scientific and Commercialisation Committee met again in 2009 to assess AIBN's research direction and commercialisation activities and provide important feedback to the Institute Director.

This meeting involved discussions with Group Leaders and participation and attendance at the AIBN Symposium. Among the SACC's specific

responsibilities are:

- identifying future strategic opportunities for collaboration, and cross disciplinary foci for the institute; and
- 2. providing advice on research direction.

The last of these responsibilities was particularly well served by the AIBN Symposium. This all-day event was an opportunity for AIBN staff and students to learn about the research and experience of keynote speakers Professor Harold Craighead, Director, Nanobiotechnology Centre, Cornell University; and Dr Ian Nisbet, Managing Director and CEO, Xenome Ltd; and that of their AIBN colleagues.

Presentations were made by students and early and mid-career researchers and the institute heard from the University's Deputy Vice Chancellor (Academic) Professor Deborah Terry, under whose wing AIBN sits in UQ's organisational structure.

The event was a vital exercise in strengthening the 'multidisciplinarity' of the institute with speakers selected by a competitive process.

The SACC comprises the following members and the institute acknowledges their generous contributions in 2009:

- Professor Chunli Bai, Senior Vice President, The Chinese Academy of Science, China;
- Dr Barry Buckland, CEO BiologicB LLC, Pennsylvania, USA, Visiting Professor, University College London.
- Dr Peter Farrell AM, Executive Chairman of the Board, ResMed;
- Professor Craig Hawker, Director Materials Research, University of California, Santa Barbara, USA;
- Professor Chris Lowe, Director Institute of Biotechnology, University of Cambridge, UK;
- Dr Susan Pond AM, Adjunct Professor, Dow Sustainability Program United States Study Centre; Board Member, Commercialisation Australia;

Director, Australian Academy of Technological Sciences and Engineering;

Board of Trustees, Australia's Virtual Herbarium;

Board of Governors, Centenary Institute.

- Professor Mihail Rocco, Chair National Nanotechnology Initiative, National Science Foundation, USA; and
- Dr Daniel Syrdal, previously Heller Ehrmann Attorneys, Seattle, USA.

### 2009 HIGHLIGHUS

### **AIBN** ENGAGES WITH INDUSTRY

### Robust partnerships are the keystone of AIBN's mission to engage with industry.

The institute is achieving its mission through varied means, including individual contacts, its Industrial Affiliates Program and the National Research and Development Infrastructure – a \$30 million cluster of facilities that AIBN Director, Professor Peter Gray, says will "build more bridges between the public and private research sectors, expand national capabilities, develop new industries and promote Australian innovation".

The Industrial Affiliates Program (IAP) is an opportunity for industry to gain access to cutting-edge research and technology and for AIBN to ensure its research is industrially relevant.

Dr Stuart Hazell, AIBN IAP Coordinator, says the program is about developing long-term relationships that allow industry to work with AIBN researchers to test ideas and concepts and build engagement between AIBN and industry. It enables companies to nominate appropriately qualified staff for adjunct staff appointments as AIBN Industrial Fellows. "It's a win-win scenario; not just industry funding academic research," he said.

There are three levels of membership, designed to cater for small, medium and large companies:

Industrial Affiliate: This is the premium level of engagement with AIBN. Companies receive the greatest level of flexibility when interacting with institute researchers, which means more opportunities to benefit from AIBN's ideas, know-how and capabilities. Industrial Affiliate is most suited to organisations looking to aggressively drive their R&D activities in areas where access to state-of-the-art facilities and know-how is critical.

Industrial Member: This membership has a high level of engagement with AIBN and opportunities to interact directly with groups and facilities within the institute. It is most suited to small-to-medium enterprises needing to augment in-house activities with access to knowledge and facilities. Industrial Associate: This is an entry-level membership designed to give companies an introduction to the breadth and depth of AIBN. Industrial Associates have opportunities to interact with AIBN research and discuss the range of services and capabilities available.

Dr Hazell says the level of engagement offered by the IAP is deeper than a simple arrangement to use AIBN facilities and/or researchers for one-off projects. While the program has only been operating since November 2009, Dr Hazell's ambitious goal is to have 20 affiliates by July 2010.

Wacol-based Very Small Particle Company Pty Ltd (VSPC) has been working with University of Queensland researchers for more than a decade and has now signed up as an Industrial Affiliate. Chief Technical Officer Peter Talbot said VSPC needed to understand and characterise nanomaterials and could not operate without AIBN's assistance. "We'd be blind without AIBN; it's integral to what we do."

VSPC commercialises research its scientists have worked on in collaboration with AIBN in two specific fields, energy and the environment.





In both areas, nanotechnology has had a massive impact. For example, VSPC is developing alternative energy collection and storage through rechargeable batteries and photovoltaic cells. It is working with major industrial manufacturers to make products that are cleaner and more efficient.

Dr Talbot said the AIBN relationship was complementary. "Small companies like ours don't have the resources and equipment. We gain access to library databases and people with current research knowledge," he said. VSPC, being in the commercial arena, can use its industry networks to help AIBN target its research to areas of direct industrial applicability.

Becoming an Industrial Affiliate added a new dimension to a long-standing relationship, Dr Talbot said.

Brisbane-based contract drug manufacturer PharmaSynth, a subsidiary of Progen Pharmaceuticals, joined the IAP because it gives the company access to services it does not have in-house.

PharmaSynth CEO Les Tillack said the ability to access AIBN's molecular biology facilities meant an expanded range of services was available to its clients. AIBN's proximity, relatively attractive costs and the IAP's streamlining of the ability to work with academics were positives for PhamaSynth. "AIBN is keen to work with industry, and we can use AIBN in our marketing. It's a well-known, wellrespected brand, so the relationship is useful to us," Mr Tillack said.

The ability for PharmaSynth staff to engage in continuing professional development through the adjunct staff program, seminars and greater involvement with AIBN academics was another plus.

The National Research and Development Infrastructure (NRDI) is another dimension of AIBN's industry engagement. Professor Gray said NRDI supplied specialist facilities to companies that did not have the inhouse capability to engage in high-level research.

NRDI, funded by the Queensland and Australian governments through the National Collaborative Research Infrastructure Strategy, services three specific areas – biologics, metabolomics and nanofabrication. Biologics is a new class of human therapeutics, developed using biotechnology and genetic engineering. Metabolomics is the study of the paths through which biomolecules are dealt with in cellular metabolism; ie, cells' nutrient processing. The Queensland node of the Australian National Fabrication Facility at AIBN provides equipment and expertise for patterning polymer and glass substrates for drug delivery and fabricating nanoelectronics.

The infrastructure enables globally competitive research in those three fields, by giving Australian researchers access to internationally acknowledged expertise and equipment.

Professor Gray said the infrastructure was available to all Australian research organisations, including business.

The IAP, combined with the availability of facilities like NRDI, help build strong links between industry and AIBN.

They also support a platform of the Queensland Government's *Toward Q2 Strategy* – a blueprint for developing tomorrow's Queensland with long-term targets for 2020. A key element of the strategy is innovative partnerships between industry and educational institutions.

### NANO TECHNOLOGY PLUS BIOMARKERS REVOLUTIONISE MOLECULAR-BASED MEDICINE

The pace of change in genetics and molecular-based medicine is advancing faster than the computer revolution.



In computer science, the term "Moore's law" demonstrates that, in essence, computing power doubles approximately every two years. AIBN's Professor Matt Trau says the same principle applies to nanotechnology developments in biotechnology, but the advances are even quicker.

For example, a decade ago, it cost \$3 billion and took 10 years to sequence the first human genome. Thanks to the rapid development of nanotechnology, in 2010 several companies are launching nanotechnology-based products that will sequence a human genome for less than \$100 in under an hour.

Professor Trau says that advance alone is set to revolutionise modern medicine through the inexpensive availability of personalised genomes, enabling therapies to be individualised to patients.

"The next generation of advances in this field will come at the interface between nanotechnology and biomarkers," Professor Trau said. Rather than just measuring people's background DNA sequences, a new generation of nanotechnologies is being developed to 'read' biomarkers in the body (for example, in blood or biopsied tissue) that will detect the 'real-time' onset and progression of diseases such as cancer.

"Such technologies have great potential in disease management and it is anticipated doctors will use biomarkers to monitor and treat diseases at their earliest stages, when they are more manageable and outcomes are significantly more favourable," Professor Trau said. "The potential use of these technologies in early diagnosis and treatment could lead to a cure at a fraction of the cost of current treatments for late-stage disease, for example, chemotherapy."

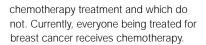
Early detection is a major weapon against cancer and can give a patient a 90 percent chance of surviving beyond five years. Without early diagnosis, the statistics fall to only a 10 percent to 20 percent chance of survival.

During 2009, AIBN established the Centre for Biomarker Research and Development, headed by Professor Trau, which combines varied disciplines to work together on applications in preventive and personalised medicine.

The centre combines AIBN's innovative nanotechnology researchers with molecular biology and clinical research leaders to focus on discovering, validating and using molecular-based biomarkers in medicine. The biomarkers can come from a broad range of molecular classes, for example, DNA, RNA, proteins, and chemically modified versions of DNA, such as methylated DNA.

Nanotechnology can dramatically escalate the pace at which technology can move from the laboratory to clinical trials. Through the team's multidisciplinary aspect, the centre brings in the clinical perspective from oncologists, pathologists and other specialists, so nanotechnology researchers know what's needed in the medical field.

In breast cancer research, Professor Trau aims to use a combination of novel biomarkers and nanotechnology to find out which women respond to



But, once the centre's researchers can identify changes in the DNA in cancerous cells, they can identify those for whom the treatment will be effective. Professor Trau says breast cancer may actually be five or six different diseases, which explains why chemotherapy is ineffective for a large group of cancer sufferers.

"We now have the tools to look at all the molecules present in a diseased cell. We can scan the whole genome to compare cancerous and non-cancerous cells," Professor Trau said. "What's frequently needed is to miniaturise these tools into inexpensive platforms that can be used by doctors in the clinic or at the bedside.

"Nanotechnology has a powerful role to play, but needs to be fully integrated with the latest advances in molecular biology and fully informed by the most urgent needs in clinical research and medicine. Often, we just need an inexpensive 'plug and play' technique to read biomarkers quickly and at less cost," Professor Trau said.

The centre has important international links and is working with researchers globally, including the joint 2001 Nobel laureate, Dr Lee Hartwell, from the USbased Fred Hutchinson Cancer Research Centre, who heads the International Biomarker Consortium. Other international collaborators include Harvard University's Dana Farber Cancer Research Centre and the UK's Institute for Cancer Research.



## SWINE FLU CANDIDATE VACCINE

The successful production of a candidate vaccine against the  $H_1N_1$  "swine flu" virus in Australia was the first step in an AIBN project to ensure adequate quantities of vaccine could be available quickly if a pandemic broke out.



AIBN Group Leader Professor Anton Middelberg said his research team successfully produced the  $H_1N_1$ candidate vaccine in mid-2009, after receiving the genetic construct from US firm Protein Sciences Corporation (PSC).

Before modern biotechnology, vaccines were developed by growing live viruses in embryonated eggs, a procedure that has many limitations. "Not all viruses, for example  $H_1N_1$ , grow easily in eggs. It is a slow, time-consuming process with some uncertainty," Professor Middelberg said.

The key active component of a virus is a hemagglutinin (HA) protein, but the protein is different for every influenza virus. PSC used the DNA sequence of the  $H_1N_1$  protein to make an artificial copy of it, which was purified to become the vaccine.

Last year UQ signed a landmark research agreement with PSC to bring the technology to Australia, with a focus on collaborative research into better manufacturing methods.

Professor Middelberg said AIBN's ability to replicate the vaccine in Australia was a breakthrough, because it demonstrated that the genetic material was sufficiently robust to be transported from overseas and could be revived to make vaccine using very different processing. That was a positive if a pandemic occurred, because "we'd need to make the vaccine everywhere, using infrastructure that might vary between locations".

"That we were able to get the technology into the country and have a vaccine two weeks later underlines the skills base of people at AIBN," Professor Middelberg said. "This vaccine has been produced using the latest cell culture vaccine technology and contains no egg protein." AIBN is now seeking funding to see how quickly it could develop a range of vaccines to respond to new threats and increase the yields to get better coverage for the Australian population.

Using the "old-fashioned 20<sup>th</sup> century technique" of growing viruses in eggs meant it took three to six months to deliver the first vaccine. Using cell culture technology has reduced the time frame to two to three months. AIBN's focus now is new technology, using bacteria instead of cell culture and nanotechnology processes, to reduce the time required to two weeks.

"PSC's technology offers the best current technology able to make vaccine quickly," Professor Middelberg said.

By using imported technology which has already been through clinical trials with PSC's FluBlok and PanBlok vaccine products, and deploying AIBN's resident capabilities and infrastructure, Australia will soon be able to produce vaccines very quickly. Because there is extensive clinical trial data available from the US, approval and registration processes with Australia's Therapeutic Goods Authority might be accelerated, Professor Middelberg said.

The batches of H<sub>1</sub>N<sub>1</sub> vaccine made at AIBN would be used for research purposes only as they were not registered for clinical use in Australia. Connecticut-based PSC was awarded a \$45 million US Government contract to develop the FluBlok vaccine. Dr Manon Cox, PSC Chief Operating Officer, said more than 5,000 people had received FluBlok in clinical tests, which showed the medicine worked and was safe.

The FluBlok vaccine contained three times more HA protein than Australia's normal seasonal vaccine, and could therefore provide enhanced protection for those at risk of severe influenza.

Once AIBN has demonstrated the ability to produce large quantities of vaccines quickly, there would no longer be a need to stockpile vaccines. "We could produce vaccines as needed, delivering first to people working in essential services and then the broader population," Professor Middelberg said.

"Once the vaccine can be made quickly when a new virus emerges, or when one changes, we can turn manufacturing on and off as needed. That means we can choose to make vaccine just for those at risk of severe illness, saving valuable taxpayer funds."



### **UNIVERSITY** RESEARCH ARMS SIGN MOU

An international linkage established in 2009 between AIBN and America's Cornell University aims to develop new products and techniques that can ultimately produce new medicines, develop new biofuels and improve human health and quality of life.



UQ's AIBN and Cornell's Nanobiotechnology Center (NBTC) have signed a memorandum of understanding (MOU) that combines the strengths of the sandstone and Ivy League universities to increase the pace of discovery and development of new products and processes.

The first concrete example of collaboration between the research partners was a joint Cornell-AIBN two-day workshop in December 2009, titled *NanoBioTechnology – The cutting edge of healthcare, materials and security.* 

The workshop overviewed the science and technology that underpin the convergence of nanotechnology and biotechnology, which can lead to breakthroughs at the leading edge of diverse industrial and research fields.

AIBN Director Professor Peter Gray said the workshop, which included three presenters from Cornell, was the first in a series. He said both organisations stand to enhance their mutual interests in biomolecular devices and analysis, cell and tissue engineering, cell surface interaction and nanomaterials.

- "AIBN and NBTC both have highly interdisciplinary research environments and the combination of biology, nanotechnology and engineering within these organisations has the potential to change our lives," Professor Gray said.
- "For example, scientific breakthroughs occurring in the fields of stem cells and tissue regeneration are opening up many new opportunities for treating disease but, for the potential to be realised, we need to learn how to target new treatments to just the right part of the body, and how to grow very complex cells in a controlled fashion.
- "This MOU will establish new partnerships, enable joint funding opportunities, promote the sharing of ideas, techniques and skills, and develop new research directions," he said.

The collaboration will also give AIBN researchers the opportunity to work with other global experts in their field.

Professor Anton Middelberg, an AIBN Group Leader and a program coordinator for the nanobiotechnology workshop, said Cornell's NBTC and UQ's AIBN were centres of excellence in the field and both had "critical mass" in bioengineering and nanotechnology.

"There's a lot of infrastructure and expertise in both and we're addressing similar biomedical problems in different ways. We see things from different angles, but there's a natural meeting of the minds, which makes it easy to cut through and address detailed science and technology issues," he said.

Professor Middelberg expects the benefits of the synergistic relationship to expand as the relationship matures and there is a greater transition of personnel between AIBN and NBTC.

# **FUTURE IS CLEAR FOR AIBN'S LATEST FELLOWS**

Four AIBN researchers were awarded prestigious Future Fellowships by the Australian Research Council.

Professors Mark Kendall, Michael Monteiro and Chengzhong Yu and Dr Annette Dexter were all successful, as was joint Institute for Molecular Bioscience and AIBN appointment Professor Kirill Alexandrov.

AIBN Director Professor Peter Gray welcomed the announcement and congratulated the AIBN Future Fellows.

- "These awards are designed to provide opportunities for mid-career researchers with four-year fellowships worth up to \$894,200," he said.
- "It was particularly pleasing that one of our successful applicants, Professor Chengzhong Yu, joined AIBN from Fudan University in China to take up this fellowship.
- "Three of the fellowships will support research projects developing new methods of drug and vaccine delivery,

and new materials for high efficiency separation and purification."

- Professor Yu's research focuses on novel nanoporous and nano-materials for biotechnology, clean energy and environment protection applications.
- "I am interested in strategies to understand the fundamental structureproperty correlations and to design functional nanostructured composites in biomaterials, bio-analysis, proteomics, drug delivery, catalysis, photo-catalysis, and environmental chemistry," he said.
- "This work can be used to develop new tools to genetically engineer treatments for acquired and inherited diseases."
- Dr Annette Dexter is developing environmentally friendly surfactants, which are chemicals essential for making oil-water mixtures.
- "Surfactants are used in applications



ranging from drug delivery to the extraction of crude oil however, chemical surfactants are toxic and can accumulate in the environment," Dr Dexter said.

- "This research will develop biodegradable surfactants that can be switched on and off as required and are not toxic to living organisms.
- "One of many potential applications is in vaccines, for use in remote Aboriginal communities, against skin infections from scabies and streptococcus, which can lead to kidney failure and heart disease.

"A non-damaging skin cream based on our research could treat short-term discomfort and deliver a vaccine to prevent long-term health consequences," she said.

Professors Michael Monteiro and Mark Kendall are both developing novel technologies to deliver drugs and therapies more effectively.

Professor Monteiro has combined polymer and dendrimer technologies to develop a macromolecule in which the active component is encapsulated for delivery in the body. Importantly, the macromolecule can be tailored to suit the physiological characteristics at the site of action.

Professor Kendall is developing a nanopatch to substitute for the traditional needle and syringe that delivers vaccines, genes and drugs more efficiently and cheaply. The nanopatch delivers its vaccine payload to the outer layer of the skin which is richly populated by immune cells and promotes a greater immune response using less vaccine.

### AIBN RESEARCH

AIBN has moved beyond traditional boundaries by adopting a multidisciplinary approach to current problems in the three broad areas of health, energy and the environment.

This is possible due to the unique capabilities of AIBN researchers who have backgrounds in the disciplines of engineering, chemistry, biology and computational science. The institute's multidisciplinary teams conduct world-class research at the interface of the biological, chemical and physical sciences with research programs focusing on:

- Delivery of therapeutic agents using polymer chemistry, virus-like particles and needle-free transdermal technologies;
- Using metabolic engineering to produce new bioproducts from cells;
- Combining stem-cell biology and novel scaffolds for regenerative medicine;

- Developing nanomaterials for orthopaedic applications, enzyme encapsulation and biosensors; and
- Developing high-performance hydrogen storage materials, photocatalysts for environmental remediation and novel membranes for water desalination and recycling.

The institute's 19 Group Leaders are internationally acknowledged for their research excellence and have proven track records in attracting competitive grant funding and fellowships.

The following pages outline just some of the research interests of AIBN's Group Leaders in the broad areas of health, energy and the environment.



### Energy tops global concerns; AIBN seeks solutions

Nobel laureate Professor Richard Smalley, who was awarded the 1996 chemistry prize for discovering a new form of carbon, later identified the top 10 problems facing humanity in the next 50 years.

Energy was rated the top priority by the former US Professor of Chemistry, Physics and Astronomy, who died in 2005.

AIBN researchers are working on a range of research projects aimed at tackling Professor Smalley's highest priority.

According to UQ's Deputy Vice-Chancellor (Research) and AIBN Group Leader Professor Max Lu, the world will continue to rely heavily on fossil fuels over the next 50 years, while oil production is believed to be close to peak. He says coal reserves will last another 200 years, but the environmental toll of current extraction methods and the conversion to electricity is high. While 'clean coal' technologies, such as carbon capture and sequestration, are being developed and will slow the output of greenhouse gas emissions, it is critical to focus on renewable energies, which currently account for less than 7.5 percent of the nation's energy sources.

AIBN researchers are exploring ways to better capture and exploit solar power by developing new photocatalytic technologies that could assist Australia to reach the Federal Government's target of using 20 percent renewable energy by 2020.

Examples of this work can be found at the UQ-based ARC Centre of Excellence for Functional Nanomaterials, led by Professor Lu, where researchers are developing novel materials to store hydrogen, nano-electrodes to improve fuel cell performance, supercapacitors for storage and discharge of electricity, more efficient photocatalysts to improve solar cell performance for hydrogen generation, and hydrogen production from biomass.

The abundance of hydrogen in the environment, and the production of water when converted to electricity that can be reused to produce more hydrogen, makes it an attractive proposition for renewable energy research.

Critical to developing hydrogen fuel cell-powered cars is the capacity to safely store hydrogen, an efficient fuel cell to convert the hydrogen to electricity, and a supercapacitor to store and rapidly release charge for acceleration. That is where nanoparticle-based storage materials are important and Professor Lu's team has developed several candidate materials using nanotechnology that have promising properties for high-capacity hydrogen storage and fast release suitable for use in vehicles.







Professor Lu's work also includes improving dye-sensitised Grätzel cells, which are based on titanium dioxide ( $TiO_2$ ) and could replace traditional silicone-based solar cells. Grätzel cells are considerably more efficient than traditional solar cells and will better enable us to harness the sun's power to extract hydrogen from water for use in fuel cells.

Professor Lu and Associate Professor Lianzhou Wang, from the School of Chemical Engineering, have led the development of a new class of layered materials, patented and trademarked as Lightanate, which can be manufactured in various forms. For example, nanoparticles can be dispersed in water and it can be used as a thin coating over glass or ceramic. Because it is more efficient at harvesting light and more effective as a photocatalyst than the current industrial benchmark, it has the potential to impact on emerging clean energy technologies.

Professor Lu's colleagues Professor Sean Smith and Associate Professor Shizhang Qiao have successfully synthesised highquality anatase titanium dioxide (TiO<sub>2</sub>) single-crystal nanosheets with 64 percent (001) facets, which improve the material's ability to capture solar energy.

The nanosheet exhibits superior photoreactivity due to its ability to harness both UV and visible light and it generates charge at five times the rate of the current, commercially available, TiO<sub>2</sub> benchmark.

The work builds on theoretical studies led by Professor Smith and Dr Chenghau Sun in 2008 that indicated the (001) surface of anatase TiO<sub>2</sub> crystals was much more reactive than the thermodynamically more stable (101) surface and that the (001) surfaces may be the dominant source of active sites. Professor Smith is also simulating hydrogen storage in novel carbon and/ or light metal-based nanostructured and nanocomposite materials. His team is computationally exploring the hydrogen storage potential of nanostructured materials based on carbon, magnesium and other light elements. Professor Smith's computational approach is a second point of attack in developing efficient hydrogen storage, which is crucial in the move to the clean energy supply of a hydrogen economy.

Professor Lu says progress to date has been exciting, but there remain considerable research and economic obstacles to the move to a hydrogen economy. However, he is confident AIBN research will play an important role in future commercial outcomes.

### Health benefits abound through AIBN research



AIBN scientists are making significant advances in medical research that will see the development of new drugs and delivery methods and potential cures for diseases.

#### A new research facility,

Biopharmaceuticals Australia Pty Ltd, to be housed within the Translational Research Institute – Queensland, will be an important development in allowing AIBN Group Leader and Director Professor Peter Gray to advance work his team is doing with monoclonal antibodies. The antibodies are based on the body's own proteins and are finding increasing application as anti-cancer therapeutics.

The \$354 million Translational Research Institute – Queensland is a new medical research powerhouse, based at Brisbane's Princess Alexandra Hospital. It will speed the rate at which research is translated into better patient outcomes.

Professor Gray said a study eight years ago identified the lack of facilities to produce clinical-grade recombinant biopharmaceuticals, but the new facility, destined for completion in 2012, would address that.

#### MAJOR BREAKTHOUGH

Associate Professor Steve Mahler has been collaborating for almost a decade with drug company CBio Ltd, on developing recombinant protein biologic drugs. This work includes Associate Professor Mahler's contributions to drug candidate XToll reaching phase Ila clinical trials in humans. The drug could be used to fight rheumatoid arthritis and, potentially, other diseases.

Of particular interest are monoclonal antibodies, which are a major class of biopharmaceuticals, accounting for 30 percent of all new biologics in clinical development.

Associate Professor Mahler's research focuses on isolating monoclonal antibodies from large, immunoglobulin gene libraries against selected disease targets, using phage display technology, which is a method for high-throughput screening of protein interactions.

The antibodies are subsequently produced in mammalian cells on large scale for further testing and, ultimately, human clinical trials.



#### DUMB-BELL STRUCTURES

Group Leader Dr Krassen Dimitrov and his team are developing ways to identify diseases like malaria and dengue fever more accurately and with higher sensitivity. The research has resulted in the discovery and synthesis of nano dumb-bell structures that can be used for labelling and detecting individual biomarker molecules associated with the diseases.

During 2009, the research project advanced to develop the methodology of incorporating antibodies into the dumb-bells, aiding detection of protein biomarkers. The nanodumb-bell diagnostics approach will allow more targeted treatments. For example, in many developing countries, large parts of the population are treated for malaria, although they may not have the disease, thus creating greater resistance to treatment. The ability to rule out treatment for those who do not require it is a substantial cost saving.

The research has reached the proof-ofconcept stage and will soon move to prototype development.

AIBN's Professor Matt Trau also is working with biomarkers through AIBN's new Centre for Biomarker Research and Development, which will seek to further integrate AIBN's work with other national and international research.

#### TAILORED NANOPARTICLES

A unique thermoplastic polyurethane (TPU) comprising tailored nanoparticles, which can improve the performance and life of golf balls and mining screens, also has significant potential health benefits.

AIBN Group Leader Associate Professor Darren Martin said the same technology he is currently trialling with global TPU suppliers has potential to better protect products like Cochlear implants for people with hearing loss.

Funding for two PhD students to work on medical applications of the biomedical TPU nanocomposites began in 2009, but Associate Professor Martin said it would be two to three years before current in-vitro testing would be completed and in-vivo work started.

The technology has great potential for future medical device designs, for example cardiovascular and orthopaedic implants. With significant research being conducted at AIBN on the toxicology of nanoparticles, Associate Professor Martin said the team would be "well ahead of the curve" once a biomedical TPU nanocomposite was able to be commercialised.

### TEXTURE-MODIFIED FOODS

AIBN Group Leader Professor Peter Halley has been working with industry partners RSL-Care, which provides retirement living and aged care services in Queensland and New South Wales, and clinical company Two Short Giraffes Pty Ltd on an ARC-Linkage funded project to develop a chewing and swallowing model for the smart design of texture-modified foods.

The end goal is a safe, appetising food for people in aged care, many of whom suffer from dysphagia, a reduced ability to swallow.

Like many AIBN R&D projects, the research incorporates a multidisciplinary team, including food scientists, chemical engineers, speech pathologists and nutritionists. The project brings together the science of food texture and rheology (the study of materials' flow properties), into a practical use to develop foods that are palatable and safe for disphagia patients.

#### TISSUE ENGINEERING

AIBN scientists are working on an innovative project that could give people with knee injuries the ability to grow back their own damaged tissues.

Group Leader Professor Justin Cooper-White and his team are using tissue engineering to develop a material that could replace damaged menisci, the two pads of cartilaginous tissue that disperse energy in the knee joint between the lower leg bone and the thigh bone.

Meniscal tissue has poor inherent regenerative capacity, due to a lack of resident stem cells and low blood supply, so is susceptible to injury among people involved in high-intensity sports, like football, basketball and skiing. Children, too, have suffered meniscal tissue injuries, which can lead to an early onset of osteoarthritis.

Professor Cooper-White's group will begin large animal trials in 2010 of new generation cell-loaded biomaterials that allow cartilage regeneration. They take mesenchymal stem cells (for example, from bone marrow) and grow them within an engineered scaffold that prompts the cells to convert to fibrochondrocyte cells, the dominant cell type in the meniscus. They can eventually be implanted into the knee.

"We're developing a patient-specific treatment using patient-derived stem cells," Professor Cooper-White said.

The same research is leading the team to a potential cure for spondylosis, which is degenerative osteoarthritis of the intervertebral disc cartilage, for which fibrochondrocyte cells are also the dominant cell type.

#### MICROFLUIDIC DEVICES

Microfluidic device design and validation is another field the Cooper-White group is working in. A major limitation in tissue engineering is the lack of an intrinsic blood supply to the tissue before implantation. AIBN scientists have developed a microdevice that allows creation of 3D vessel networks and, in 2010, will start implanting networks into scaffolds that can tie into the host blood vessel network.

A separate microdevice has been developed that allows researchers to create a virgin surface on which to study cell migration, which can lead to detecting potential migration rate differences between diseased and normal cells.

### Environment benefits from AIBN research

New technologies for water and air purification, self-cleaning coatings and natural pest control methodologies are just a few of the myriad environmentally beneficial projects AIBN scientists are researching.

Nanocomposite particles that can be added to conventional thermoplastic polyurethane (TPU) rubbers to improve their performance are moving closer to commercialisation.

Research conducted by AIBN Group Leader Associate Professor Darren Martin has resulted in TPU materials that are stronger, tougher and more durable than currently available TPU technology and have potential for improving products ranging from golf balls to mining equipment.

Associate Professor Martin and his team continued trials with major global TPU suppliers and end users in 2009 and the next stage will be moving towards licensing agreements with suppliers.

The team also is working with mining screen manufacturers to develop more abrasion-resistant screens used to classify minerals. Associate Professor Martin said that could result in cost savings for mining companies, but the technology also had significant environmental benefits.

"If we can develop stronger, tougher materials that can do the same job as traditional TPU, we're reducing the petrochemical footprint," he said.

"Major suppliers have been trialling our nanoadditives in their TPUs, which they then test, and we've had some very favourable test results."

Start-up company TenasiTech Pty Ltd is responsible for commercialising the technology, which has application for a wide variety of end users, including a coating for golf balls to make them more scuff resistant.

#### **BIO-BASED POLYMERS**

Replacing traditional, petroleum-based plastics with biopolymers is a means of reducing the plastics industry's carbon footprint.

AIBN Group Leader Professor Peter Halley has been working in the field for many years using starch-based bioplastics, but during 2009 broadened the research to other biomaterials. For example, lignin, an organic substance found in plants, is the second most renewable carbon source, after cellulose. Professor Halley's team has extracted lignin from sugarcane and modified it for use as a coating on cardboard packaging for perishables, which can replace traditional wax coatings. The product is trademarked by the Cooperative Research Centre for Sugar Industry Innovation through Biotechnology as Barrecote. It has environmental advantages over wax and means the cardboard is more easily recycled. Barrecote has now progressed to industry trials.

Professor Halley's team is also working with bioplastics innovator Plantic Technologies Ltd on water-resistant starch that is still biodegradable. That would allow development of bioplastics for much wider applications, such as manufacturing containers to hold fluids or products that are exposed to rain.

Another of Professor Halley's projects is developing degradable polyethylene (PE) for agriculture. Adding certain amounts and types of pro-degradant to traditional PE resin can ensure the product breaks down within a specific time frame in various environments.

Current work is to develop photodegradable agricultural films that can assist crops to grow better, through retaining moisture and temperature, but then degrade once the crop sprouts. In-field tests are being conducted at a small-scale model site at UQ's Pinjarra Hills facility. On-farm tests are being conducted with an industry partner, stretch film manufacturer Integrated Packaging, through a Cooperative Research Centre for Polymers funded project. The project illustrates the diversity of scientific input to many AIBN R&D efforts, with chemists, chemical and material engineers, agronomists, agricultural scientists, environmental toxicology scientists and an agricultural modeller working with AIBN's industry partner.

A new project, launched in co-operation with UQ's Advanced Wastewater Management Centre, Swedish company AnoxKaldnes and Veolia Environmental Services Australia, is working on extracting naturally-occurring, plantbased polyhydroxy-alkanoate (PHA) polymers from the waste wastewater treatment process stream.

Professor Halley's team is measuring the properties of the extracted PHA polymer to determine potential uses. The polymer may be a bio-based substitute for polyethylene terephthalate, which is used for a range of products, from soft drink bottles to electronic equipment casings.





### **BIOLOGICAL PEST CONTROL**

AIBN Group Leader Dr Steve Reid is working on baculovirus biopesticides that can replace potentially harmful chemical pesticides.

While chemical pesticides in the past were relatively cheap to manufacture in commercial quantities, people are now becoming more aware of side effects, for example, litigation over spray drift, water contamination, pests developing chemical resistance, and dangers to human health. As environmental and health regulations become more stringent, it gets harder to register chemical pesticides.

Dr Reid said baculovirus biopesticides were very safe and very specific in the organisms they targeted. Baculoviruses are less vulnerable to sunlight and conditions in the hosts gut than traditional viruses, as they form a protective protein coating. They are also stable, so can remain in soil for many years, which reduces the amount of spraying required.

The research team has already manufactured a product formulated by Agrichem and registered for use on Australian crops to combat *heliothis* caterpillars under the trade name Heliocide.

However, cost effectiveness and reliability of supply are two issues that hamper commercial production of baculovirus biopesticides. Dr Reid's team is tackling both those areas in its most recent research.

Mass rearing of caterpillars so they can be infected with the baculovirus is labour intensive, but Dr Reid is now using mammalian cell technology on insect cells to allow bioreactor cell production.

Current yields need to increase at least four or even eight times to allow economic commercialisation, unless a mass, global market was guaranteed. Dr Reid's team is therefore finding ways to develop a cheaper bioreactor culture media. The team is working with Group Leader Professor Lars Nielsen to improve the quality of yeast extracts in the bioreactor broth.

"We're looking for the knowledge to give the baculovirus an outrageously unfair advantage to grow in genetically modified cells," Dr Reid said. Genomics can help the scientists develop better tools to identify key genes in the host cells that limit virus yields. Understanding the overall cell metabolism can assist in developing the optimal energetic state of the host insect cells so they produce optimum virus levels.

### **STUDENTS & TRAINING**

# 2009 **RHD REPORT**

The total number of AIBN research higher degree (RHD) students who have completed their studies swelled from two to six in 2009.

The institute warmly congratulates Andrew Rowlands, Katie Ladewig, Kylie Varcoe and Yap Pang Chuan who were all awarded PhDs in 2009. AIBN also notes that Kaiyin Hu, Yunyi Wong, Wendy Chen and Kwok Cheung were awarded their degrees in early 2010, with Esteban Marcellin, Wadcharawadee Noohom and Peter Stickler expected to graduate later this year.

Andrew, Kylie and Pang, along with Akshat Tanksale who was awarded his PhD in late 2008, formed the initial cohort of students who started studying in 2004/05 and their graduations effectively symbolise the maturation of the AIBN Graduate Program.

Not only does AIBN acknowledge the intellectual efforts and contributions of all its students, their supervisors and behind-the-scene administrators; it welcomes the rich social and cultural contributions the student body makes to the institute.

Importantly, the size of AIBN's student body increased by almost 25 percent in 2009 with the enrolment of 26 new RHD students.

Worthy of note was the commencement of Thi Bich Trinh Tran and Nghia Truong Phuoc who were each awarded a highly competitive UQ Vietnam-Australia 35 Year Commemorative Research Higher *Degree Scholarship.* These scholarships enable Trinh and Nghia to undertake their PhD studies with the Reid and Monteiro groups, respectively.

AIBN students were also enthusiastic participants in UQ's Three-Minute Thesis Competition, which required students to present a compelling three-minute oration on their thesis topic and its significance, in language appropriate to a non-specialist audience with only a single powerpoint slide to assist. AIBN congratulates Holly Corbett and Peter Stickler, who progressed to the University's semi-final round.

The achievements of AIBN students in 2009 were many and varied, ranging from prestigious travel grants to commercialisation prizes and speaking awards at conferences. The institute congratulates David Thomson, David Wang, Annie Chen, Nani Wibowo, Jakov Kulis, and Drew Titmarsh. More information relating to their achievements can be found in the appendices of this Report.

Administratively, the University's new Candidature Progression and Development Policy, which came into effect on April 2009, had a profound effect on the AIBN's Graduate Program. The policy introduced two new milestones: mid-candidature review and thesis review, at which students are expected to demonstrate their progress toward completion of a high-quality thesis. The institute's implementation of the

policy involved consultation with AIBN

students and Group Leaders and the Postgraduate Administration Officer Fiona McLeod ensured that teething problems were minimised. To ensure this new policy is having the desired outcomes, AIBN is undertaking a review in 2010 to ensure that administration and academic outcomes are optimised.

AIBN commends the 13 students who successfully completed their Confirmation of Candidature milestone in 2009, which requires that they demonstrate the capability to meet AIBN's high intellectual expectations of its student body.

The Graduate Program looks forward to welcoming a new cohort of students in 2010 and celebrating the achievements of those students completing their studies over the next 12 months.

Michael Montiero DIRECTOR, GRADUATE STUDIES

### **AIBN** OPPORTUNITIES FOR UNDERGRADUATE STUDENTS

AIBN is committed to providing opportunities for undergraduate students to experience the breadth and depth of its research environment. The institute has two programs, the Summer Internship and Winter School.

Now in its third year, the AIBN Summer Internship Program is designed to provide undergraduate students with highly prized research experience not readily available in their bachelor level studies.

Students additionally obtain career mentoring and exposure to the best equipment and latest techniques through AIBN's unparalleled research facilities.

In 2009, the program received more than 50 applications for the 19 available research projects from high-achieving



The 2009 Winter School cohort

students keen to avail themselves of these opportunities.

Students had the option of increasing the duration of the internships from the standard eight weeks to 10 or 12 weeks. Additionally, the internship could, in certain circumstances, be used to obtain credit toward the students' undergraduate degrees.

Three students enrolled for second internships with the institute and that an intern from previous years, Jacinda Bax, has started an honours project under the supervision of Professor Matt Trau.

The AIBN Winter School caters for interstate and Queensland students who do not attend UQ and provides them with the opportunity to visit AIBN and, through a series of lectures and workshops, gain exposure to the institute's research environment and facilities.

In 2009, AIBN hosted six students in the Winter School. They participated in a series of seminars from AIBN researchers, and attended the AIBN Symposium.

AIBN is looking forward to growing both these schemes in 2010, particularly in light of UQ's extensive commitment to providing undergraduate students with research experience as part of their degree programs.

# APPENDICES

1



### GROUP LEADER:

Professor Julie H Campbell Professor Campbell's Group has discovered that peritoneal macrophages can transdifferentiate into smooth muscle-like cells and that grafts of hollow, smooth-muscle organs (arteries,

bladder, vas deferens and uterus) can be grown from these cells in the peritoneal cavity for autologous transplantation. The group's research is now concentrating on the pathways through which the transcription accurs

which this transdifferentiation occurs and their regulatory factors. The group continues to investigate the mechanisms of vascular disease and potential therapeutic strategies.

Professor Campbell has research projects in:

- 1. gene array analysis of the foreign body response;
- macrophages as progenitors of myofibroblasts and their potential as a therapeutic target for fibrotic disease;
- regulation of myofibroblast differentiation using lentiviral delivery of shRNA to knockdown genes for candidate growth factors;
- antibody-directed delivery of antirestenotic agents using inorganic nanoparticles (collaboration with Professor Max Lu, Dr Gordon Xu and Dr Anita Thomas);
- the mechanism by which oestrogen mediates its atheroprotective effects on the vasculature;
- the complement system in vascular disease and tumour growth (collaboration with Professor Steve Taylor and Dr Trent Woodruff, SBMS); and
- 7. tissue engineering the kidney.

### Cell biology and tissue engineering

#### KEY PUBLICATIONS FOR PAST FIVE YEARS

- Worth NF, Berry CL, Thomas AC and Campbell JH. (2005) S18886, a selective TP receptor antagonist, inhibits development of atherosclerosis in rabbits. *Atherosclerosis* 183: 65-73.
- Hoenig M, Campbell GR, Rolfe BE, Campbell JH. (2005) Tissue engineered blood vessels – alternative to autologous grafts? *Arterioscler Thromb Vasc Biol* 25:1128-1134.
- Armstrong SR, Campbell GR, Campbell JH, Little MH. (2005) Establishment of metanephros transplantation in mice highlights contributions by both nephrectomy and pregnancy to developmental progression. *Nephron, Exp Nephrol* 101:155-164.
- Knoner G, Rolfe BE, Campbell JH, Parkin SJ, Heckenberg NR, Rubinstein-Dunlop H. (2006) Mechanics of cellular adhesion to artificial artery templates. *Biophys J* 91:3085-96.
- Campbell GR, Turnbull G, Xiang L, Haines M, Armstrong S, Rolfe BE, Campbell JH. (2008) The peritoneal cavity as a bioreactor for tissue engineering visceral organs: bladder, uterus and vas deferens. *J Tiss Eng Regen Med* 2:50-60
- Gu Z, Thomas AC, Xu Z Pi, Campbell JH, Lu G. (2008) In vitro sustained release of LMWH from MgAI-layered double hydroxide nanohybrids. *Chem Mater* 20:3715-3722
- Moran CS, Cullen B, Campbell JH, Golledge J. (2009) Interaction between angiotensin II, osteoprotegerin, and peroxisome proliferator-activated receptorgamma in abdominal aortic aneurysm. J Vasc Res 46:209-217.
- Lutton C, Sugiyama S, Wullschleger ME, Williams R, Campbell JH, Crawford R, Goss B. (2009) Transplanted abdominal granulation tissue induced bone formation - an in vivo study in sheep. *Connect Tissue Res* 50:256-62.

- 9. Golledge J and Campbell JH. (2009) Peroxisome proliferator-activated receptor ligands reduce aortic dilatation in a mouse model of aortic aneurysm. *Atherosclerosis* (in press, accepted October 2009)
- Mooney JE, Rolfe BE, Osborne GW, Sester DP, van Rooijen N, Campbell GR, Hume DA, Campbell JH. (2010) Cellular plasticity of inflammatory myeloid cells in the peritoneal foreign body response. *Am J Pathol* 2010 Jan;176(1):369-80. Epub 2009 Dec 11.
- Stickler P, De Visscher G, Mesure L, Famaey N, Martin D, Campbell JH, Van Oosterwyck H, Meuris B, Flameng W. (2010) Cyclically stretching developing tissue in vivo enhances mechanical strength and organisation of vascular grafts. *Acta Biomater* 2010 Jan 30. [Epub ahead of print]
- Le SJ, Gongora M, Zhang B, Grimmond S, Campbell GR, Campbell JH, Rolfe BE. (2010) Gene expression profile of the fibrotic response in the peritoneal cavity. *Differentiation* (in press)

# Smart surfaces, scaffolds and diagnostic microdevices for stem cell expansion, tissue engineering and biofluid characterisation

### GROUP LEADER:

Professor Justin Cooper-White

Professor Cooper-White and his team are focused on providing fundamental insights into complex, polymer-based structures and systems, and tailoring their interactions with biological systems.

These insights then enable the design of novel polymer-based systems to invoke control over stem-cell behaviours. Projects currently underway include investigations into:

- 1. engineering surfaces for stem-cell attachment and phenotype control;
- tailored polymeric scaffolds for drug delivery and stem cell based tissue engineering;
- cell-based diagnostic microdevices for mapping cellular microenvironments, in particular cell-surface, cell-cell and cell-scaffold interactions;
- microfluidic devices for manufacturing functional microparticles/ nanoparticles and probing complex fluid behaviour in these microdevices; and
- microfluidic device platforms for biofluid for example, saliva characterization and bioassay development.

#### KEY PUBLICATIONS FOR PAST FIVE YEARS

- Croll T, O'Connor AJ, Stevens GW, Cooper-White JJ. (2006) A Blank slate? Layer-by-layer deposition of hyaluronic acid and chitosan onto various surfaces, *Biomacromolecules*, 7 (5): 1610-1622,
- Rondeau E, Cooper-White JJ. (2008) Biopolymer Microparticle and Nanoparticle Formation within a Microfluidic Device. *Langmuir* 24(13), 6937-6945
- Rowlands AS, George PA, Cooper-White J. (2008) Directing osteogenic and myogenic differentiation of MSCs: interplay of stiffness and adhesive ligand presentation. *American Journal of Physiology. Cell Physiology* 295(4), C1037-44.
- George PA, Doran MR, Croll TI, Munro TP, Cooper-White JJ. (2009) Nanoscale presentation of cell adhesive molecules via block copolymer self-assembly. *Biomaterials*, 30(27) 4732-4737.
- Chau L, Doran M, Cooper-White JJ. (2009) A novel multishear microdevice for studying cell mechanics. *Lab on a Chip*, 9(13) 1897-1902.





### Single-molecule technologies for diagnostics

### GROUP LEADER: Dr Krassen Dimitrov

The Dimitrov Laboratory is working to develop new diagnostic technologies involving single-molecule nanolabels that can be used for accurate and sensitive determination of marker molecules associated with disease and found in small amounts of biological samples.

These nanolabels are translocated with magnetic forces through a nanometersized electronic sensor, for digital readout. The group is developing the technology with a specific focus on diagnostics for tropical infectious diseases such as malaria and dengue fever.

Future applications include such varied fields as biomedical research, forensics, agribusiness, and biosurveillance.

### KEY PUBLICATIONS FOR PAST FIVE YEARS

- Geiss GK, Bumgarner RE, Birditt B, Dahl T, Dowidar N, Dunaway DL, Fell HP, Ferree S, George RD, Grogan T, James JJ, Maysuria M, Mitton JD, Oliveri P, Osborn JL, Peng T, Ratcliffe AL, Webster PJ, Davidson EH, Hood L, Dimitrov K. (2008) Direct multiplexed measurement of gene expression with color-coded probe pairs. *Nature Biotechnology*, 26, 317.
- 2. Babic B, Ghai R, Dimitrov K. (2008) Magnetophoresis of flexible DNAbased dumbbell structures. *Applied Physics Letters* 92, 053901.

AWARDS AND PRIZES Nominated in 2009 for the 2010 ENI Award for Energy Research

### Materials development and characterisation

### GROUP LEADER:

Professor John Drennan

The main body of Professor Drennan's research relates to understanding the relationship between microstructural characterisation and the physical properties of materials. A central focus of the work is developing improvements in the conduction of oxygen ions in materials, which has application in solid oxide fuel cells.

Tight microstructural control at the atomic level is proving to be a key factor in developing a new range of materials that have longer operating life and better properties.

The expertise of Professor Drennan and his group in this area has led to projects involving other refractory systems.

The group is turning its attention to materials for extreme environments and developing a novel system for protecting critical components in hypersonic scram jets – a serious challenge for materials science.

In addition, the group is examining the development of "zinc oxide (ZnO) soaps" in artist's paints. This phenomenon can be devastating to an art work, resulting in the formation of large, unsightly protrusions, which can crack and severely damage the painting. Researchers are examining, through very detailed microstructutral analysis, the mechanism responsible for this phenomenon.

Funded through an Australian Research Council Industry Linkage project with major galleries across Australia and several in the USA and Asia, the project is examining the first stages of deterioration of ZnO particles at the atomic level with a view to developing curatorial protocols to minimise damage.

### KEY PUBLICATIONS FOR PAST FIVE YEARS

 Ou DR, Mori T, Ye F, Kobayashi T, Zou J, Auchterlonie G, Drennan J. (2006) Oxygen vacancy ordering in heavily rare-earth doped ceria. *Applied Physics Letters*, 89, 171911

- Ye F, Mori T, Ou DR, Zou J, Auchterlonie G, Drennan J. (2007) Compositional and Valent State Inhomogeneities and Ordering of Oxygen Vacancies in Terbium-doped Ceria. *Journal of Applied Physics*, 101, (11) Art. No. 113528.
- Yuan P, Liu N, Zhao LZ, Zhou XF, Zhou L, Auchterlonie G, Yao XD, Drennan J, Lu GQ, Zou J, Yu CZ. (2008) Solving Complex Concentric Circular Mesostructures by Using Electron Tomography. *Angewandte Chemie-International Edition*, 47, (35) 6670-6673.
- Yuan P, Zhou XF, Wang HN, Liu NA, Hu YF, Auchterlonie G, Drennan J, Yao XD, Lu GQ, Zou J, Yu CZ. (2009) Electron-Tomography Determination of the Packing Structure of Macroporous Ordered Siliceous Foams Assembled from Vesicles. Small, 5(3):377-382.
- Yan M, Mori T, Zou J, Drennan J. (2009) Effect of Grain Growth on Densification and conductivity of Ca-Doped CeO<sub>2</sub> Electrolyte. J American Ceramic Society 92 (11): 2745-2750.

### Rapid selection of cells producing novel biopharmaceuticals

### GROUP LEADER:

### **Professor Peter Gray**

Professor Gray and his team are focused on engineering mammalian cells to improve their efficiency and utility in the production of monoclonal antibodies, which are increasingly being used as biopharmaceuticals.

By combining genetic engineering with antibody sensitivity, it is now possible to target an almost infinite range of foreign molecules by cloning the gene coding for the antibody into a host cell.

Due to the structural complexity of antibodies, the host cell has to be a mammalian cell developed to grow in a bioreactor.

Professor Gray's research is reducing some of the 'bottlenecks' present when mammalian cells are used to produce biopharmaceuticals, such as:

- developing transient protein expression systems which will allow researchers to rapidly produce larger amounts of protein needed for initial characterisation and testing;
- developing high throughput approaches that allow the rapid selection of clones which stably express high levels of the desired biopharmaceutical; and
- using modern 'omics' approaches to gain better understanding of cellular metabolism that will allow maximal protein expression by mammalian cell cultures.

The research approaches used to gain a greater understanding of mammalian cell processes are now being applied to the development of bioprocesses based on embryonic stem cells.

The challenge is to accurately define the physical and chemical environment that allows the controlled proliferation and subsequent differentiation of the cells, and then translate those conditions into processes which can be scaled up to produce the number of cells required for clinical testing.

### KEY PUBLICATIONS FOR PAST FIVE YEARS

- Jones M, Seldon T, Smede M, Linville A, Chin DY, Barnard R, Mahler S, Munster D, Hart D, Gray P, Munro T. (2010) A method for the rapid, ligation-independent reformatting of recombinant monoclonal antibodies. *Journal of Immunological Methods*, 354 (1-2): 85-90.
- Pilbrough W, Munro T, Gray P. (2009) Intraclonal Protein Expression Heterogeneity in Recombinant CHO Cells. PLoS ONE (accepted 23-10-09) http://dx.plos.org.
- Ladewig K, Niebert M, Xu ZP, Gray P, Lu GQ. (2009) Efficient siRNA delivery to mammalian cells using layered double hydroxide nanoparticles. *Biomaterials*, in press;DOI:10.1016/j. biomaterials.2009.10.058.
- Prowse A, Wolvetang E, Gray P. (2009) A rapid, cost-effective method for counting human embryonic stem cell numbers as clumps. *Biotechniques*, 47(1): 599-606.
- Prowse A, Osborne G, Gray P, Wolvetang E. (2009) Multiplexed staining of live human embryonic stem cells for flow cytometric analysis of pluripotency markers. *Stem Cells Dev*, 18(8): p.1135-40.
- Vari F, Munster D, Hsu JL, Rossetti T, Mahler S, Gray P, Turtle, C, Prue R, Hart D. (2008) Practical blood dendritic cell vaccination for immunotherapy of multiple myeloma. *British Journal of Haematology*. 143 (3), 374-377.
- Gray P, Pilbrough W, Codamo G, Munro T. (2008) Speeding up the production of recombinant proteins by CHO cells. *J Biotechnol* 136(S1), S8.
- Xu ZP, Niebert M, Porazik K, Walker TL, Cooper HM, Middelberg APJ, Gray PP, Bartlett PF, Lu GQ. (2008) Subcellular Compartment Targeting of Layered Double Hydroxide Nanoparticles. J Control Release 130(1), 86-94.
- Sleiman RJ, Gray PP, McCall MN, Codamo J, Sunstrom NA. (2008) Accelerated cell line development using two-color fluorescence activated cell sorting to select highly expressing antibody-producing clones. *Biotechnol Bioeng* 99(3):578-87.



- Prowse ABJ, McQuade LR, Bryant KJ, Marcal H, Gray PP. (2007) Identification of Potential Pluripotency Determinants for Embryonic Stem Cells Following Proteomic Analysis. *Journal of Proteome Research*, 6 (9), 3796- 3807.
- Huang EP, Marquis CP, Gray PP. (2007) Development of Super-CHO protein-free medium based on statistical design. J Chem Technol Biotechnol, 82(5), 431-441.
- Sleiman RJ, Gray PP, Sunstrom NA. (2006) Splitting the difference: when near enough is not good enough. *Cytometry Part A* 69(5), 426-426.
- Xu ZP, Stevenson GS, Lu CQ, Bartlett PF, Gray PP. (2006) Stable suspension of layered double hydroxide nanoparticles in aqueous solution. J Am Chem Soc 128(1), 36-7.
- 14. Mahler SM, Leong S, Gilbert A, Yang F, Van Dyk D, Gray PP Roeth P. (2006) Purification of a chimeric monoclonal antibody from CHO clarified supernatant using Gradiflow™ preparative electrophoresis. J Chem Technol and Biotechnol 81, 445-453.
- Catzel D, Chin D, Stanton PG, Gray PP, Mahler SM. (2006) Fractionation of follicle stimulating hormone charge isoforms by preparative electrophoresis technology. *Journal* of Biotechnology 122, 73-85.
- Prowse ABJ, McQuade LR, Bryant KJ, Van Dyk DD, Tuch BE, Gray PP. (2005) A proteome analysis of conditioned media from human neonatal fibroblasts used in the maintenance of human embryonic stem cells. *Proteomics*; 5(4):978-89.



### Biofluids characterisation and biopolymer processing

### GROUP LEADER:

#### **Professor Peter Halley**

The research interests of the Halley Group span two major research areas:

- 1. biofluids characterisation; and
- 2. biopolymer processing.

Biofluids characterisation incorporates novel material and flow characterisation (rheology) for a variety of projects, including:

- design of texture-modified foods for aged care;
- 2. cystic fibrosis sputum diagnostics; and
- 3. novel techniques for predicting swallowing of foods and tablets.

The group has strong interactions with the disciplines of chemical engineering, pharmacy, biochemistry, food science, and speech pathology, and links with various hospitals.

The biopolymer processing area of research focuses on understanding and optimising the processibility of a wide range of biopolymers, such as starch, lignin, polyhydroxyalkanoates (PHA), polylactic acid (PLA) and biopolymer nanocomposites, which includes starch, polyurethane and polyester nanocomposites. The work aims to develop smart, functional biopolymer systems for biomedical, drug delivery and high-value industrial applications.

The group has successfully:

- initiated three new projects investigating water resistant starch, texture modified foods and PHA polymers from waste;
- published a book discussing reactive processing;
- published and patented work on biopolymers and degradable polymers; and
- maintained strong links with relevant industries in biofluids and biopolymers.
- The group has research projects in:
- novel texture-modified foods for aged care for increased nutrition;
- water-resistant starch polymers for smart food packaging applications;

- 3. PHA polymers from waste streams;
- 4. PHA/lignin composites from sugar cane;
- 5. rheology of TPU nanocomposites; and
- 6. supercritical CO<sub>2</sub> processing of starch nanocomposites.

### KEY PUBLICATIONS FOR PAST FIVE YEARS

- P Halley and G George, Chemorheology; from fundamentals to reactive processing. Cambridge University Press, London, May 2009, 442pp.
- Zhao RX, Torley P, Halley PJ. (2008) Emerging biodegradable materials: starch- and protein-based bionanocomposites, *Journal of Materials Science*, 43 9 p3058-3071.
- Chaléat CM, Halley PJ, Truss RW. (2008) Properties of a plasticised starch blend. Part 1: Influence of moisture content on fracture properties. *Carbohydrate Polymers*, 71, 4, p535-543.
- Russo M, Strounina E, Waret M, Nicholson T, Truss R, Halley PJ. (2007) A study of water diffusion into a high amylose starch blend: The effect of moisture content and temperature. *Biomacromolecules*, 8, 1, p296-301.
- Finnigan B, Jack K, Campbell K, Halley P, Truss R, Casey P, Cookson D, King S, Martin D. (2005) Segmented polyurethane nanocomposites: Impact of controlled particle size nanofillers on the morphological response to uniaxial deformation. *Macromolecules*, 38, 17, p7386-7396.

### AWARDS AND PRIZES

2009 UQ Award for Programs that Enhance Learning

### Targeting the skin for needle-free, minimally-invasive vaccine delivery and diagnostics for disease

### GROUP LEADER:

Professor Mark Kendall

The Kendall Group focuses on physical methods for:

- delivery of biomolecules and stimuli to key immune response-inducing cells located in the skin; and
- 2. extracting important biomolecules for diagnostics purposes.

The ultimate goal of this research is to dramatically improve the cost and efficiency of vaccination and treatment of major diseases such as malaria and influenza. To achieve this goal, the group is:

- developing needle-free gene and drug delivery and extraction technologies to and from the skin;
- 2. investigating micro-nanoprojection array patch (nanopatch) technology;
- measuring the key biological and mechanical properties of skin; and
- 4. assessing clinical application.

This multidisciplinary research spans biomedical engineering (fluid mechanics; micro-nanofabrication; solid mechanics), diagnostics (multi-photon microscopy) and dermatology and vaccinology.

The group has the following research projects:

- Micro-nanoprojection patches for minimally-invasive and targeted delivery of genes and drugs to skin cells;
- Micro-nanoprojection patches for targeted gene and drug delivery to the skin and improved DNA vaccines;
- Micro-nanoprojection patches for improved sampling in diagnosis of disease;
- Multi-photon microscopy for in vivo imaging following delivery of drugs and vaccines to skin;
- MPM non-invasive imaging of biological interactions following drug delivery with micro-nanoprojection patches; and
- Measurement of mechanical properties in skin at cellular and subcellular scales.

### AWARDS AND PRIZES

2009 Future Summit Australian Leadership Award Winner

### KEY PUBLICATIONS FOR PAST FIVE YEARS

- Fernando GJP, Chen X, Prow TW, Crichton ML, Fairmaid EJ, Roberts MS, Frazer IH, Brown LE, Kendall MAF. (2010) Potent Immunity to Low Doses of Influenza Vaccine by Probabilistic Guided Micro-Targeted Skin Delivery in a Mouse Model. *PLoS ONE* 5(4): e10266. doi:10.1371/ journal.pone.0010266.
- Crichton ML, Ansaldo A, Chen X, Prow TW, Fernando GJP, Kendall MAF. (2010) The effect of strain rate on the precision of penetration of short densely-packed microprojection array patches coated with vaccine. *Biomaterials* 2010 31(16):4562-4572.
- Chen X, Prow TW, Crichton ML, Jenkins DWK, Roberts MS, Frazer IH, Fernando GJP, Kendall MAF. (2009) Dry-coated microprojection patches for targeted delivery of immunotherapeutics to the skin. J Control Release 2009;139(3):212-220.
- Kendall MAF, Chong Y. Cock A. (2007) The mechanical properties of the skin epidermis in relation to targeted gene and drug delivery. *Biomaterials* 28: 4968-4977.
- Kendall MAF, Mitchell TJ, Costigan G, Armitage M, Lenzo JC, Thomas JA, Von Garnier C, Zosky GR, Turner DJ, Stumbles PA, Sly PD, Holt PG, Thomas WR. (2006) Down regulation of IgE allergic responses in the lung by epidermal biolistic microparticle delivery. *Allergy and Clinical Immunology Journal*, 117:2, 275-282.





### GROUP LEADER:

Professor Max Lu

Professor Lu is UQ's Deputy Vice-Chancellor (Research), the foundation Director and current Research Director of the Australian Research Council Centre of Excellence for Functional Nanomaterials.

The research interests of Professor Lu and his team lie in the synthesis and molecular engineering of nanomaterials, such as inorganic nanoparticles, carbons, nanoporous materials and membranes.

The team is developing many innovative applications of these materials in the areas of clean energy and environmental technologies, and in biomedical fields.

Specifically, Professor Lu's team has research projects in the areas of:

- visible light photocatalysts for solar and hydrogen energy generation and storage;
- nanoparticles and mesoporous carriers for drug and vaccine delivery;
- nanostructured materials for high-density supercapacitors and batteries; and
- 4. efficient catalysts and processes for renewable energy.

### Functional nanomaterials

### KEY PUBLICATIONS FOR PAST FIVE YEARS

- Yang HG, Liu G, Qiao SZ, Sun CH, Jin YG, Smith SC, Zou J, Cheng HM, Lu GQ. (2009) Solvothermal Synthesis and Photoreactivity of Anatase TiO2 Nanosheets with Dominant {001} Facets. *Journal of the American Chemical Society*, 131, (11), 4078-4083.
- Wang LZ, Tang FQ, Ozawa K, Chen ZG, Mukherj A, Zhu YC, Zou J, Cheng HM, Lu GQ. (2009) A General Single-Source Route for the Preparation of Hollow Nanoporous Metal Oxide Structures. Angewandte Chemie-International Edition, 48, (38), 7048-7051.
- Liu G, Yang HG, Wang XW, Cheng LN, Pan J, Lu GQ, Cheng HM.(2009) Visible Light Responsive Nitrogen Doped Anatase TiO2 Sheets with Dominant {001} Facets Derived from TiN. *Journal of the American Chemical Society*, 131, (36), 12868-12869.
- Hulicova-Jurcakova D, Puziy AM, Poddubnaya OI, Suarez-Garcia F, Tascon JMD, Lu GQ. (2009) Highly Stable Performance of Supercapacitors from Phosphorus-Enriched Carbons. *Journal of the American Chemical Society*, 131, (14), 5026-5027.
- Zhang L, Qiao SZ, Jin YG, Chen ZG, Gu HC, Lu GQ. (2009) Magnetic hollow spheres of periodic mesoporous organosilica and Fe3O4 nanocrystals: Fabrication and structure control. Advanced Materials, 20, (4), 805-809.
- Yang HG, Sun CH, Qiao SZ, Zou J, Liu G, Smith SC, Cheng HM, Lu GQ. (2008) Anatase TiO2 single crystals with a large percentage of reactive facets. *Nature*, 453, (7195), 638-641.
- Xu ZP, Niebert M, Porazik K, Walker TL, Cooper HM, Middelberg APJ, Gray PP, Bartlett PF, Lu GQ. (2008) Subcellular compartment targeting of layered double hydroxide nanoparticles. *Journal of Controlled Release*, 130, (1), 86-94.

- Wang DW, Li F, Liu M, Lu GQ, Cheng HM. (2008) 3D aperiodic hierarchical porous graphitic carbon material for high-rate electrochemical capacitive energy storage. *Angewandte Chemie-International Edition*, 47, (2), 373-376.
- Tanksale A, Beltramini JN, Dumesic JA, Lu GQ. (2008) Effect of Pt and Pd promoter on Ni supported catalysts – A TPR/TPO/TPD and microcalorimetry study. *Journal of Catalysis*, 258, (2), 366-377.
- Liu G, Zhao YN, Sun CH, Li F, Lu GQ, Cheng HM. (2008) Synergistic effects of B/N doping on the visible-light photocatalytic activity of mesoporous TiO2. Angewandte Chemie-International Edition, 47, (24), 4516-4520.

### AWARDS AND PRIZES

- Honorary Vice-Chancellor's Visiting Fellow, University of New South Wales
- Invited Panelist, Australia Future Summit, Melbourne, 18–19, May 2009

# Research and development of biologic medicines; production of recombinant proteins with industrial applications

### Associate Professor Stephen Mahler

The principal theme for Associate Professor Mahler and his team is the discovery and development of biologic medicines.

Research activities include a balanced mix of basic and applied research with specialisations in applied immunology, proteomics and bioengineering. Some highlights of Associate Professor Mahler's research include:

- isolation of promising monoclonal antibodies from large immunoglobulin gene libraries using high throughput selection techniques against selected targets associated with cancer, infectious disease and various receptors;
- investigation of the immunomodulator Chaperonin 10 (Cpn10) for the treatment of diseases associated with inflammation. This is biologic medicine and an anti-inflammatory agent is now in phase II clinical trials for treating rheumatoid arthritis; and
- production of recombinant phytases for *myo*-inositol breakdown and phosphate release to produce recombinant phytase enzymes for addition to animal feeds to facilitate the bioavailability of phosphate, which will result in larger livestock and less pollution of groundwater.

#### KEY PUBLICATIONS FOR PAST FIVE YEARS

- De Leon EJ, Yuan FF, Pearson H, Marquis C, Mahler SM. (2009) Evidence of heterogeneity in the antibody response against the platelet antigen 3a; recognition of an 11-mer peptide carrying the HPA-3a polymorphic determinant. *Vox Sanguinis* 96: 252-255.
- Wang XS, Shao B, Heinecke J, Mahler SM, Stocker R. (2009) Detection of methionine sulfoxidecontaining, oxidised apolipoprotein A-I in HDL and plasma by ELISA J. Lipid Research d 50, 586-594.
- Marcal H, Wanandy NS, Sanguanchaipaiwong V, Woolnough CE, Lauto A, Mahler SM, Foster LJR. (2008) BioPEGylation of polyhydroxyalkanoates: Influence on properties and satellite stem sell cycle. *Biomacromolecules* 9, 2719–2726.
- Vari F, Munster DJ, Hsu JL, Rossetti TR, Mahler SM, Gray PP, Turtle, CJ, Prue RL, Hart DNJ (2008) Practical blood dendritic cell vaccination for immunotherapy of multiple myeloma. *British J Haematology* 143, 374-377
- Marçal H, Sarris M, Raftery M, Bhasin V, McFarland C and Mahler SM (2008) Expression proteomics of olfactory ensheathing cells. J Chem Technol and Biotechnol 83, 473-481.
- Dinnes DM, Marcal H, Raftery M, Labow RS, Mahler SM. (2008) The macrophage-biomaterial interface: A proteomic analysis of the conditioned medium J Chem Technol and Biotechnol 83: 482-495.
- Dinnes DM, Marcal H, Santerre JP, Mahler SM, Labow RS. (2007) Material surfacesaffect the protein expression patterns of human macrophages: a proteomic approach. *Journal of Biomedical Materials Research* 80, 895-908.
- Catzel D, Chin D, Stanton PG, Gray PP, Mahler SM. (2006) Fractionation of follicle stimulating hormone charge isoforms by preparative electrophoresis technology. *Journal of Biotechnology* 122, 73-85.





#### GROUP LEADER:

Associate Professor Darren Martin

Associate Professor Martin and his research team has an excellent track record of research and innovation in thermoplastic polyurethane (TPU) systems, polymer nanocomposites and nanotoxicology.

### Polymer nanocomposites and nanotoxicology

A strong focus of the current research is developing polymer nanocomposites with enhanced mechanical or biological performance. Pivotal to this research success is strong cooperation in the areas of:

- nanoparticle preparation and colloid science;
- 2. polymer science and technology; and
- nanoparticle toxicology (including novel and robust labelling methodologies).

Associate Professor Martin was recently appointed Chief Scientific Officer for TensasiTech Pty Ltd, a startup company commercialising polyurethane nanocomposites for applications ranging from mining screens to golf ball covers and medical device components.

Current research projects within the group include:

- polymer nanocomposites for industrial applications;
- 2. polymer nanocomposites for Cochlear Ltd implant components;
- toxicology of synthetic clay, metal oxide and carbon nanomaterials; and
- new polymers and composites based on renewable spinifex (an Australian indigenous desert grass species).

#### KEY PUBLICATIONS FOR PAST FIVE YEARS

- Musumeci A, Martin D, Xu ZP, Minchin R, Smith S, Schiller T. (2010) Synthesis and Characterisation of Dual Radiolabelled Layered Double Hydroxide Nanoparticles for use in *In vitro* and *In vivo* Nanotoxicology Studies. *The Journal of Physical Chemistry Part C*, 114(2), p734-740.
- Musumeci A, Gosztola D, Schiller T, Dimitrijevic NM, Mujica V, Martin D, Rajh T. (2009) SERS of semiconducting nanoparticles (TiO2 hybrid composites). JACS Communication, 131 (17).
- Smart S, Cassady A, Lu GQ, Martin, D. (2006) The Biocompatibility of Carbon Nanotubes: A Review. *Carbon*, 44, p1034-1047 (Special issue on toxicology of carbon nanomaterials).
- McNally T, Pötschke P, Halley P, Murphy M, Martin D, Steven E EJ. Bell J, Brennan GP, Bein D, Lemoine P, Quinn JP. (2005) Polyethylene multiwalled carbon nanotube composites. *Polymer*, Volume 46, Issue 19, 8222-8232.
- Finnigan B, Jack K, Campbell K, Halley P, Truss R, Casey P, Cookson D, King S, Martin D. (2005) Segmented Polyurethane Nanocomposites: Impact of Controlled Size Nanofillers on the Morphological Response to Uniaxial Deformation. *Macromolecules*, 38 (17), p7386-7396.

## Biomolecular engineering

## GROUP LEADER:

## Professor Anton PJ Middelberg

Professor Middelberg and his research team focuses on designing and processing engineered proteins and peptides to develop new functional products and new manufacturing methods. The work brings together bioengineering and nanotechnology, with application in vaccines and biopharmaceuticals, and bio-renewable sustainable materials.

Professor Middelberg and his group address global opportunities such as:

- developing new vaccine technologies that change the way we combat infectious and chronic diseases, including influenza and arthritis;
- understanding how biopharmaceuticals behave in solution and manufacturing processes, in order to devise new processes to recover products from complex suspensions; and
- using bio-inspired approaches to deliver new bio-inspired, manufactured materials, such as customised surfactants, self-assembling peptides and nanostructured materials, from sustainable resources.

Professor Middelberg's research brings together knowledge from engineering and the physical and life sciences.

The group has research projects in:

- 1. protein and nanoparticle technology for new vaccines;
- the aggregation of virus-like particle vaccines;
- 3. vaccine nano-emulsions;
- recovery and modification of biopharmaceuticals;
- design and bioprocessing of sustainable biosurfactants, including pepfactants, and;
- 6. Nanomaterial manufacture through biomolecular templating.

## KEY PUBLICATIONS FOR PAST FIVE YEARS

- Chuan YP, Fan YY, Lua LHL, Middelberg APJ. (2010) Virus assembly occurs following a pHor Ca<sup>2+</sup>- triggered switch in the thermodynamic attraction between structural protein capsomeres. *J R Soc Interface* 7, 409-421.
- Zhao C, Middelberg APJ. (2009) Microfluidic mass-transfer control for the simple formation of complex multiple emulsions. *Angew Chem Int Ed*, 48(39), 7208-7211.
- Hartmann BH, Kaar W, Yoo IK, Lua LHL, Falconer RJ, Middelberg APJ. (2009) The chromatography-free release, isolation and purification of recombinant peptide for fibril selfassembly. *Biotechnol Bioeng*, 104(5), 973-985. (front cover).
- Malcolm AS, Dexter AF, Katakdhond JA, Karakashev SI, Nguyen AV, Middelberg APJ. (2009) Tuneable control of interfacial rheology and emulsion coalescence. *ChemPhysChem*, 10(5), 778-781. (front cover).
- Pease L, Lipin DI, Tsai DH, Zachariah M, Lua LHL, Tarlov M, Middelberg APJ. (2009) Quantitative characterisation of virus-like particles by asymmetrical flow field flow fractionation, electrospray differential mobility analysis, and transmission electron microscopy. *Biotechnol Bioeng*, 102(3), 845-855.

## AWARDS AND PRIZES

Public Lecture Presenter, UQ Research Week "Engineering an end to influenza?"





## GROUP LEADER:

Professor Michael Monteiro Professor Monteiro's research focuses on synthesing complex polymer architectures. These tailor-made polymer architectures have the capacity to selfassemble into nanostructures, such as rods, vesicles, spheres or donuts. The nanostructure confers important characteristics that can be applied in drug delivery and tissue regeneration.

In one example a new, self-adjuvanting vaccine was created through the selfassembly of a dendrimer consisting of epitopes covalently bound to a polymeric core. Incorporating certain polymers into these structures is proving useful for siRNA delivery. Other work by Professor Monteiro and his team has demonstrated that highly dense nanoparticles can denature specific serum proteins, which induces the activation of certain biochemical pathways.

Custom-made polymer architectures designed by Professor Monteiro's group have also been used as nanoreactors. The team has developed a completely new way of conducting polymerisations in water by creating the desired nanoenvironment using custom-made nanoreactors.

## Designer polymer nanoreactors for use in biomedical applications and environmentally friendly organic reactions

This new water-based methodology has been driven by increased demand for environmentally-friendly and economically-competitive polymeric materials for use in coatings, biomedical and electronic industries.

It is envisaged that this methodology will expand the range of structures available to materials scientists.

The group's project include:

- nanoreactors for polymer and organic reactions in water;
- 2. customised nanostructures for drug and vaccine delivery; and
- nanotoxicology of these designer nanostructures.

- Whittaker MR, Urbani CN, Monteiro MJ. (2006) Synthesis of 3-Miktoarm Stars and 1st Generation Mikto Dendritic Copolymers by "Living" Radical Polymerisation and "Click" Chemistry. J Am Chem Soc, 128, (35), 11360-11361.
- Percec V, Guliashvili T, Ladislaw JS, Wistrand A, Stjerndahl A, Sienkowska MJ, Monteiro MJ, Sahoo S. (2006) Ultrafast Synthesis of Ultrahigh Molar Mass Polymers by Metal-Catalysed Living Radical Polymerisation of Acrylates, Methacrylates, and Vinyl Chloride Mediated by SET at 25 °C. J Am Chem Soc, 128, (43), 14156-14165.
- Bell CA, Smith SV, Whittaker MR, Whittaker AK, Gahan LR, Monteiro MJ. (2006) Surface-functionalised polymer nanoparticles for selective sequestering of heavy metals. *Advanced Materials* (2006), 18(5), 582-586.

- Monteiro MJ. (2010) Nanoreactors for Polymerisations and Organic Reactions. *Macromolecules*, 43(3), 1159-1168.
- Liang M, Lin IC, Whittaker MR, Minchin RF, Monteiro MJ, Toth I. (2010) Cellular Uptake of Densely Packed Polymer Coatings on Gold Nanoparticles. ACS Nano, 4(1), 403-413.
- Kulis J, Bell CA, Micallef AS, Jia ZF, Monteiro MJ. (2009) Rapid, Selective, and Reversible Nitroxide Radical Coupling (NRC) Reactions at Ambient Temperature. *Macromolecules* 42(21), 8218-8227.

## Systems and synthetic biology

## GROUP LEADER:

## Professor Lars Nielsen

Systems biology provides the means of answering intricate questions about complex biological systems. The questions considered by the Nielsen Group are very diverse, but generally inspired by some practical applications. For example:

- What controls the molecular weight of hyaluronic acid, a high value, medical biopolymer produced by streptocci?
- 2. How do we efficiently convert stem cells into white and red blood cells for use in blood transfusions?
- Why does transgenic sugar cane produce plastic efficiently in one type of leaf cells, but not the other?
- 4. How do we efficiently engineer *E coli* and yeast to produce fuels and chemicals from sucrose?

The common challenge for all these problems lies in formulating the question in such a way that it will yield a meaningful answer when using the appropriate mathematical, statistical and analytical tools. A key focus of Professor Nielsen's team is to develop the engineering frameworks and tools required to meet this challenge.

With an applied focus, the proof is ultimately that the understanding gained can be used to synthesise better systems and processes. In addition to various in-house model systems, Professor Nielsen's group works closely with Australian and international companies and academic groups exploring the potential of the novel strategies developed.

The group has research projects in the areas of:

- developing a microbial strain capable of producing high molecular weight hyaluronic acid (HA);
- 2. developing in vitro methods for costeffective biopesticide production;
- developing biological replacements for materials currently produced from petrochemical feedstocks;

- 4. producing plastics from sugar cane;
- 5. expanding neutrophils from stemcells for therapeutic purposes; and
- modelling and analysis of mammalian cell metabolism using genome scale models and metabolomics.

- Timmins NE, Harding FJ, Smart C, Brown MA, Nielsen LK. (2005) Method for the generation and cultivation of functional 3-dimensional mammary constructs without exogenous extracellular matrix material. *Cell & Tissue Research* 320, 207-210.
- Sheikh K, Förster J, Nielsen LK. (2005) Modeling Hybridoma Cell Metabolism Using a Generic Genome-Scale Metabolic Model of *Mus musculus. Biotechnology Progress* 21, 112-121.
- Blank LM, McLaughlin RL, Nielsen LK. (2005) Stable production of hyaluronic acid in *Streptoccus zooepidemicus* chemostats operated at high dilution rate. *Biotechnology & Bioengineering* 90, 685-693.
- Peng JC, Thomas R, Nielsen LK. (2005) Generation and maturation of DC for clinical application under serum-free conditions. *Journal of Immunotherapy* 28, 599-609.
- Petrasovits LA, Purnell MP, Nielsen LK, Brumbley SM. (2007) Production of polyhydroxybutyrate in sugar cane. *Plant Biotechnology Journal* 5:162-172.
- Quek L-E, Nielsen LK. (2008) On the reconstruction of the *Mus musculus* genome-scale metabolic network model. *Genome Informatics* 21, 89-100.
- Quek L-E, Wittmann C, Nielsen LK, Krömer JO. (2009) OpenFLUX: Efficient Modelling Software for 13C-Based Metabolic Flux Analysis. *Microbial Cell Factories* 8, 25.

- Chen W, Marcellin E, Hung J, Nielsen LK. (2009) Hyaluronan molecular weight is controlled by UDP-Nacetylglucosamine concentration in *Streptococcus zooepidemicus. J Biol Chem* 284, 18007-18014.
- Timmins NE, Palfreyman E, Marturana F, Dietmair S, Luikenga S, Lopez G, Fung YL, Minchinton R, Nielsen LK. (2009) Clinical Scale *Ex vivo* Manufacture of Neutrophils from Hematopoietic Progenitor Cells. *Biotechnol Bioeng.* 104, 832-840.
- 10.de Oliveira Dal'molin CG, Quek LE, Palfreyman RW, Brumbley SM, Nielsen LK. (2010) AraGEM – a Genome-Scale Reconstruction of the Primary Metabolic Network in *Arabidopsis thaliana. Plant Physiol* 152, 579–589.

## Production of baculovirus biopesticides – a systems biology approach

## GROUP LEADER:

## Dr Steven Reid

The Reid Group has a process patent on a procedure for producing baculoviruses using fermentation. The lead product is a baculovirus targeting the *Helicoverpa* pest species, the subjugation of which is responsible for a \$US3.2 billion a year market in traditional chemical pesticides.

A baculovirus product manufactured by the Reid Group and formulated by Bioflexus has been registered for use on Australian crops to combat heliothis caterpillars (more widely known as the cotton bollworm), under the trade name of Heliocide. The Reid Group is undertaking further research to increase current fermentation yields, which will enable the manufacture and evaluation in the niche Australian market.

Currently the group is collaborating with Professor Lars Nielsen to use a systems biology approach using transcriptomic and metabolomic techniques in an effort to understand how the virus interacts with host cells in culture. The group anticipates further increases in yield, making it cost effective in broader markets, both nationally and internationally.

Specific research projects include:

- developing a Heliothis BACMID system for manipulation of the H.arm virus genome (gene knockouts). This system will be used to generate altered viruses for further transcriptomic and metabolomic studies;
- the use of real-time PCR to quantify virus binding kinetics to enable optimisation of early process steps for the manufacture of virus in vitro; and
- developing sample extraction procedures and appropriate HPLC/ GC-MS techniques for quantifying intracellular metabolite levels for infected and non-infected cells in culture, which will enable the group's metabolomic studies.

- Chan L, Reid S, Nielsen LK. (2010) The kinetics of virus production from cell culture. *Wiley Encyclopedia of Industrial Biotechnology*. (in press).
- Pedrini MRS, Chan LCL, Nielsen LK, Reid S. (2006) In vitro production of Helicoverpa armigera singlenucleocapsid nucleopolyhedrovirus. *Brazilian Archives of Biology and Technology*, 49: (Special Issue): 35-41.
- Pedrini MRS, Christian P, Nielsen LK, Reid S, Chan LCL. (2006) Importance of virus-medium interactions on the biological activity of wild-type Heliothine nucleopolyhedroviruses propagated via suspension insect cell cultures. *J Virol Methods*, 136, 267-272.
- Pedrini MRS, Nielsen LK, Reid S, Chan LCL. (2005) Properties of a Unique Mutant of *Helicoverpa Armigera* Single – Nucleocapsid Nucleopolyhedrovirus that Exhibits a Partial Many Polyhedra and Few Polyhedra Phenotype on Extended Serial Passaging in Suspension Cell Cultures. *In Vitro Cell Dev Biol-Animal*, 41, 289-297.

## Computational molecular science

## GROUP LEADER:

## Professor Sean Smith

The research of Professor Smith and his team applies theoretical and computational studies at the molecular scale to gain enabling insights that will facilitate progress towards new technologies in electronics, sustainableenergy and biomolecular/biomedical applications. His laboratory conducts computational explorations of:

- 1. chemical kinetics;
- 2. catalysis;
- 3. complexation/association phenomena and transport within:
  - a. nanostructured materials;
  - b. proteins;
  - c. hybrid nano-bio systems; and
  - d. gaseous environments.

This research is performed at the atomistic level, including advanced applications of solid state and molecular electronic structure theory, molecular dynamics, quantum dynamics and kinetics theories.

These studies are invariably conducted in an interdisciplinary context, in close collaboration with experimental, and other theoretical groups. They also require state-of-the-art highperformance computing facilities for their implementation.

The Smith Group has research projects in:

- computational studies of light metal hydride hanocomposite materials for hydrogen storage;
- 2. fluorescent proteins: photophysics, mechanism and dynamics;
- simulation of layered-doublehydroxide (LDH) Nanoparticle-DNA interactions for gene delivery applications;

- simulation of biological dendrimer-DNA interactions for gene gelivery applications;
- computational studies of C and BN nanotube and nanoribbon reactivity and functionalisation;
- 6. quantum dynamical studies of H transport in confined systems; and
- computational kinetics and quantum dynamical studies of elementary reactions for combustion and atmospheric chemistry.

- Du AJ, Zhu ZH, Smith SC. (2010) Multifunctional Porous Graphene for Nanoelectronics and Hydrogen Storage: New Properties Revealed by First Principle Calculations. J Amer Chem Soc. (accepted February 2010).
- Li Z, Cheng L, Sun Q, Zhu Z, Riley MJ, Aljada M, Cheng Z, Wang X, Qiao S, Smith SC, Lu GQ. (2010) Diluted Magnetic Semiconductor Nanowires Prepared by Solution-Liquid-Solid Method. *Angew Chem Int Ed*, accepted (Jan 2010).
- Du AJ, Chen Y, Zhu ZH, Amal R, Lu GQ, Smith SC. (2009) Dots versus Antidots: Computational Exploration of Structure, Magnetism and Half-metallicity in Boron-Nitride Nanostructures. J Amer Chem Soc, 131, 17354-17359.
- Yang HG, Liu G, Qiao SZ, Sun CH, Jin YG, Smith SC, Zou J, Cheng HM, Lu GQ. (2009) Solvothermal Synthesis and Photoreactivity of Anatase TiO2 Nanosheets with Dominant {001} Facets. J Amer Chem Soc, 131, 4078-4083.
- Du AJ, Chen Y, Zhu ZH, Lu GQ, Smith SC. (2009) C-BN Single Walled Nanotubes from Hybrid Connection of BN/C Nanoribbons: Prediction by Ab Initio Density Functional Calculations. J Amer Chem Soc, rapid communication, 131, 1682-1683 (2009).



- Yao XD, Lu GQ, Li L, Sun CH, Du AJ, Smith SC, Zhu ZH. (2009) Lithium-Catalysed Dehydrogenation of Ammonia Borane within Mesoporous Carbon Framework for Chemical Hydrogen Storage. Advanced Functional Materials, 19, 265-271.
- Yang HG, Sun CH, Qiao SZ, Zhou J, Smith SC, Cheng HM, Lu GQ. (2008) Anatase TiO<sub>2</sub> single crystals with a large percentage of {001} facets. *Nature*, 453, 638-641.
- 8. Du A, Smith SC, Lu GQ. (2007) Formation of Single Walled Carbon Nanotube Via the Interaction of Graphene Nanoribbons: *ab initio* Density Functional Calculations. *Nano Lett*, 7, 3349-3354.
- Yao X, Wu CZ, Du AJ, Zou J, He Y, Zhu ZH, Wang P, Cheng HM, Smith SC, Lu GQ. (2007) Metallic and Carbon Nanotube-Catalyzed Coupling of Hydrogenation in Magnesium. J Amer Chem Soc, 129, 15650-15654.
- Du A, Smith SC, Yao XD, Lu GQ. (2007) Hydrogen Spillover Mechanism on a Pd-doped Mg Surface as Revealed by ab initio Density Functional Calculations. *J Amer Chem Soc*, 129, 10201-10204.



## Nanotechnology, biomarkers and the next generation molecular diagnostics

## GROUP LEADER: Professor Matt Trau

The use of biomarkers (molecules which indicate the onset and status of disease) is emerging as one of the most promising strategies for disease management. In nearly all forms of cancer, early diagnosis can lead to a cure at a fraction of the cost of currently ineffective treatments for late stage disease. Soon, physicians will routinely use a combination of nanotechnology and molecular biomarkers to monitor, personalise and treat diseases at their earlier stages. It is predicted that the development of new biomarker diagnostic technologies will simultaneously improve survival rates and quality of life, while significantly reducing health care costs.

Professor Trau and his team are developing a range of nanoscaled biosensors for genomics, proteomics, epigenetics, drug screening and diagnostics. Successful development of biomarkers for use in the clinic, or for point-of-care applications, requires input from a wide range of disciplines, including medicine, molecular biology and nanotechnology. In 2009, Professor Trau founded the Centre for Biomarker Research and Development within AIBN to accelerate such multi-disciplinary interactions and connect AIBN researchers with similar international efforts

Core research projects within the centre currently include:

- nano-scaled biosensors for Epigenetic readout in breast cancer;
- nano-devices for next-generation protein capture in diagnostics; and
- 3. single molecule readouts via elastic nanopores.

- Connolly A, Trau M. (2010) Isothermal Detection of DNA by Beacon Assisted Detection Amplification (BAD AMP). Angewandte Chemie (International Ed.), 122, 2780-2782.
- Corrie SR, Sova P, Lawrie GA, Battersby BJ, Kiviat NB, Trau M. (2009) Development of a Multiplexed Bead-based Assay for Detection of DNA Methylation in Cancer-Related Genes. *Molecular Biosystems*, 5(3), 262-268.
- Marcon L, Spriet C, Meehan TD, Battersby BJ, Lawrie GA, Heliot L, Trau M. (2009) Synthesis and Application of FRET Nanoparticles in the profiling of a protease. *Small*, 5 (18), 2053-2056
- Chen A, Kozak D, Battersby BJ, Forrest RM, Scholler N, Trau M. (2009) Antifouling Surface Layers for Improved Signal-to-Noise of Particle-Based Immunoasays. *Langmuir*, 25 (23), 13510–13515.
- Corrie SR, Vogel R, Keen IJ, Jack K, Kozak, D, Lawrie GA, Battersby BJ, Fredericks P, Trau M. (2008) A Structural Study of Hybrid Organosilica Materials for Colloid-Based DNA Biosensors. *Journal of Materials Chemistry* (front cover article), 18, 523-529.
- Johnston APR, Battersby BJ, Lawrie GA, Trau M. (2005) Porous functionalised silica particles: a potential platform for biomolecular screening. *Chem Commun* 7, 848-850.

## Polymer chemistry

## GROUP LEADER:

Professor Andrew Whittaker

Professor Whittaker and his team are working to develop novel polymeric materials for application in:

- biomaterials for diagnosis and treatment of disease;
- photolithography for the manufacture
  of integrated circuits; and
- molecular imaging agents for disease identification using nuclear magnetic resonance imaging.

This research is underpinned by extensive expertise in polymer synthetic chemistry, polymer physical chemistry, interactions with biological systems and magnetic resonance technology.

The group's biomaterials research is targeting various applications including:

- polymers for use as tissue implants;
- improved drug delivery; and
- improved medical diagnosis.

This is in addition to projects shedding light on drug delivery, the fundamentals of hydrogel polymer networks, surface modification and biosensors.

Using immersion and ultra-violet immersion lithography, the group is also investigating the challenges facing the microelectronics industries as it struggles to incorporate nanometre-sized features on integrated circuits.

## RESEARCH PROJECTS

Current projects include:

- polymers for 193 nm immersion lithography;
- 2. polymers for EUV lithography;
- block copolymers for healing of line edge roughness;
- 4. polymers for artificial vitreous;
- 5. artificial blood vessels;
- 6. dental bone repair;
- 7. molecular imaging agents;
- 8. hybrid imaging agents;
- 9. ultrasound contrast agents;
- 10. diffusion in hydrogels;
- 11. novel hydrogel networks; and
- 12. spinal cord repair.

- Liu H, Blakey I, Conley WE, George GA, Hill DJT, Whittaker AK. (2008) Application of quantitative structure property relationship to the design of high refractive index 193i resist. *Journal of Micro/Nanolithography, MEMS and MOEMS*, 7(2), 023001/1-023001/11.
- Zainuddin L, Tri T, Park Y, Chirila TV, Halley PJ, Whittaker AK. (2008) The behavior of aged regenerated Bombyx mori silk fibroin solutions studied by 1H NMR and rheology. *Biomaterials*, 29(32), 4268-4274.
- Kealley CS, Rout MK, Dezfouli MR, Strounina E, Whittaker AK, Appelqvist IAM, Lillford PJ, Gilbert EP, Gidley MJ. (2008) Structure and Molecular Mobility of Soy Glycinin in the Solid State. *Biomacromolecules*, 9(10), 2937-2946.
- Peng H, Xiao Y, Mao X, Chen L, Crawford R, Whittaker AK. (2008) Amphiphilic Triblock Copolymers of Methoxy-poly(ethylene glycol)b-poly(L-lactide)-b-poly(L-lysine) for Enhancement of Osteoblast Attachment and Growth. *Biomacromolecules*, 10(1), 95-104.
- Peng H, Blakey I, Dargaville B, Rasoul F, Rose S, Whittaker AK. (2009) Synthesis and Evaluation of Partly Fluorinated Block Copolymers as MRI Imaging Agents. *Biomacromolecules*, 10(2), 374-381.
- Mimouni A, Deeth HC, Whittaker AK, Gidley MJ, Bhandari BR. (2009) Rehydration Process of Milk Protein Concentrate Powder monitored by Static Light Scattering. *Food Hydrocolloids*, 23(7), 1958-1965.
- Mimouni A, Deeth HC, Whittaker AK, Gidley MJ, Bhandari BR. (2010) Investigation of the microstructure of milk protein concentrate powders during rehydration: alterations during storage. *Journal of Dairy Science*, 93(2), 463-472.



- Mao X, Peng H, Ling J, Friis T, Whittaker AK, Crawford R, Xiao Y. (2009) Enhanced human bone marrow stromal cell affinity for modified poly(-lactide) surfaces by the upregulation of adhesion molecular genes. *Biomaterials*, 30(36), 6903-6911.
- Thurecht KJ, Blakey I, Peng H, Squires O, Hsu S, Alexander C, Whittaker AK. (2010) Functional Hyperbranched Polymers: Toward Targeted in Vivo 19F Magnetic Resonance Imaging Using Designed Macromolecules. Journal of the American Chemical Society, 132(15), 5336-5337.
- Blakey I, Thurecht KJ, Whittaker AK. (2010) High-pressure realtime 129Xe NMR: monitoring of surfactant conformation during the self-assembly of reverse micelles in supercritical carbon dioxide. *Chemical Communications* (*Cambridge, United Kingdom*) 46(16), 2850-2852.



## GROUP LEADER:

Associate Professor Ernst Wolvetang

Associate Professor Wolvetang's research is focused on developing human pluripotent stem-cell based therapies and disease models.

Because human pluripotent stem-cells can be cultured indefinitely and are able to generate every cell type of the human body, they are the cell type of choice for stem-cell-based regenerative medicine, and a discovery platform for understanding the molecular basis of human disease and development.

Current research activities in the Wolvetang Group concentrate on two main areas:

- elucidating the role of specific signalling pathways and the microenvironment in controlling the behaviour of human pluripotent cells to enable safer and more efficient stem cell expansion and differentiation; and
- generating species and patient specific induced pluripotent cells (iPS) to understand the molecular basis of disease and cellular therapy.

# Human pluripotent stem cells for regenerative medicine

Specific projects in these areas include:

- developing novel cell reprogramming technologies;
- generating Down's syndrome iPS cells to understand Alzheimer's disease;
- understanding the epigenetic effects of culture conditions;
- elucidating BMP-SMAD signalling in human stem cells;
- 5. metabolomic analysis of human embryonic stem cells; and
- 6. developing smart surfaces for stem cell expansion and differentiation.

By combining cutting-edge molecular analysis and cell biology tools, the group will gain an in-depth understanding of the molecular machinery controlling human pluripotent stem cells and consequently be able to unlock the potential of these cells for application in regenerative medicine and drug development.

- Wolvetang E, Herszfeld D, Langton –Bunker E, Chung T, Filipczyk A, Houssami S, Koh K, Laslett AL, Michalska A, Nguyen L, Reubinoff BE, Tellis I, Auerbach JM, Ording CJ, Looijenga LHJ, Pera MF. (2006) CD30 is a survival factor and a biomarker for transformed human pluripotent stem cells. *Nature Biotech*, 24(3), 351-7.
- Grandela C, Pera MF, Wolvetang E. (2007) p53 is required for etoposideinduced apoptosis of human embryonic stem cells. *Stem Cell Research*, 1(2), 116-128.
- Hannan NRF and EJ Wolvetang. (2008) Adipocyte differentiation in human embryonic stem cells transduced with Oct4 shRNA lentivirus. *Stem Cells and Development*, 18(4), 653-60.
- Hannan N, Jamshidi P, Pera MF, Wolvetang EJ. (2009) BMP -11 and Myostatin Maintain Human Embryonic Stem Cells in Feeder Free Cultures. *Cloning and Stem Cells*, 11(3), 427-35.

- Prowse ABJ, Wolvetang EJ, Gray PP. (2009) A rapid, cost effective method for counting human embryonic stem cell numbers as clumps. *Biotechniques*, 47(1), 599-606.
- Prowse ABJ, Wilson J, Osborne GW, Gray PP, Wolvetang EJ. (2009) Multiplexed staining of live human embryonic stem cells for flow cytometric analysis of pluripotency markers. *Stem Cells and Development*, 18(8), 1135-40.
- Wolvetang EJ, Pera MF, Zuckerman KS. (2007) Gap-junction mediated transport of shRNA between human embryonic stem cells. *Biochem Biophys Res Comm*, 363(3), 610-5.
- Doran MR, Frith JE, Prowse ABJ, Fitzpatrick J, Wolvetang E, Munro T, Gray P, Cooper-White J. (2010) Defined high protein content surfaces for stem cell culture. *Biomaterials* (in press).
- Davidson KC, Daly R, Wolvetang EJ, et al . Wnt signaling in human embryonic stem cells. (2007) Book chapter: *Cytometry part A*, 69A(5), 412-412.
- Pebay A, Wong R, Pitson SM, Wolvetang E, Peh GS, Filipczyk A, Koh KL, Tellios I, Nguyen LT, Pera MF. (2005) Essential roles of sphingosine-1-phosphate and platelet-derived growth factor in the maintenance of human embryonic stem cells. *Stem Cells*, 23 (10), 1541-1548.

## Nanomaterials for biotechnology, energy and environmental protection

## GROUP LEADER:

## Professor Chengzhong Michael Yu

Professor Yu and his team have an excellent track record of research and innovation in the synthesis and characterisation of novel nanoporous and nano-materials with various compositions, adjustable structures and controlled morphologies, with tailored functions for biotechnology, clean energy and environment protection.

## **RESEARCH PROJECTS**

- 1. a robust nanomaterial platform for advanced delivery and therapeutics;
- nanoporous materials for biocatalysis, bio-separation and bioanalysis;
- 3. biomaterials for bone repair and dental applications; and
- advanced nanomaterials for sustainable environment and energy applications.

## KEY PUBLICATIONS FOR PAST FIVE YEARS

- Zhu J, Tang JW, Zhao LZ, Zhou XF, Wang YH, Yu CZ. (2010) Ultrasmall, well-dispersed, hollow siliceous spheres with enhanced endocytosis properties. *Small*, 6(2), 276-282.
- Qian K, Wan JJ, Huang XD, Yang PY, Liu BH, Yu CZ. (2010) A smart glycol-directed nanodevice by rationally designed macroporous materials. *Chem Eur J*, 16, 822-828.
- Yuan P, Liu N, Zhao LZ, Zhou XF, Zhou L, Auchterlonie GJ, Yao XD, Drennan J, Lu GQ, Zou J, Yu CZ. (2008) Solving Complex Concentric Circular Mesostructures Using Electron Tomography. *Angew Chem-Int Edit*, 2008, 47(35), 6670.
- Yang S, Zhou X, Yuan P, Yu M, Xie S, Zou J, Lu GQ, Yu CZ. (2007) Siliceous Nanopods via a Compromised Dual Templating Approach. *Angew Chem-Int Edit*, 46(45), 8579-82.



 Tang J, Zhou X, Zhao D, Lu GQ, Zou J, Yu CZ. (2007) Hard Sphere Packing and Icosahedral Assembly in the Formation of Mesoporous Materials. *J Am Chem Soc*, 129(29), 9044.

## New technologies for protein research

## GROUP LEADER:

Professor Kirill Alexandrov (joint appointment with Institute for Molecular Bioscience)

Professor Alexandrov and his group are interested in understanding the mechanics and thermodynamics of the molecular machinery underlying intracellular vesicular transport. The group uses cell biology and biophysical methods, such as fluorescent spectroscopy and microscopy, X-ray crystallography, protein engineering and protein semi-synthesis, to elucidate the role of individual proteins and protein assemblies in this process.

Many of the problems the group is trying to address are technically challenging and cannot be resolved with the currently available methodologies. To overcome these technical hurdles, they develop new methods of protein expression, isolation and derivatisation. The ultimate goal of this work is to rapidly reconstruct and structurally characterise complex protein assemblies in vitro, and develop novel tools for analysis in vivo. Professor Alexandrov has research projects in:

- Proteome-wide analysis of protein prenylation and its variation in human diseases;
- Development of approaches for recombinant production and biophysical analysis of multi-subunit protein complexes;
- Quantitative analysis of protein:protein protein:small molecule interactions using a novel in vitro translation system; and
- Development of high-yield eukaryotic protein expression systems based on protozoan Leishmania tarentolae.

## KEY PUBLICATIONS FOR PAST FIVE YEARS

1. Mureev S, Kovtun O, Nguyen, UTT, Alexandrov K. (2009) Speciesindependent translational leaders enable the rapid development of novel cell-free expression systems. *Nature Biotechnology*, 27, 747-752.

- Nguyen UT, Guo Z, Delon, C, Wu Y, Deraeve C, Fränzel B, Bon RS, Blankenfeldt W, Goody RS, Waldmann, H, Wolters D, Alexandrov K. (2009) Analysis of the eukaryotic prenylome by isoprenoid affinity tagging. *Nature Chemical Biology*, 4: 227-235.
- Wu Y, Tan K-T, Waldmann H, Goody RS, and Alexandrov K. (2007) Quantitative analysis of the interaction of prenylated Rab proteins with REP and GDI explains the requirement for both regulators in Rab function. *PNAS*, 104, 12294-12299.
- Rak A, Pylypenko O, Niculae A, Pyatkov K, Goody RS, Alexandrov K. (2004) Structure of the Rab7:REP-1 complex: insights into the mechanism of Rab prenylation and choroideremia disease. *Cell*, 117, 749-760.

## AIBN 2009 COMMENCING STUDENTS' RESEARCH HIGHER DEGREE PROJECTS

Name	RHD	Project Title	Principal Advisor
Michele Bruschi	PhD	Metabolic engineering of hyaluronic acid (HA) production to obtain high molecular weight polymers in continuous processes	Prof Lars Nielsen
Xiaojing (Wendy) Chen	PhD	Structure-function correlations of PEGylated human lectin galectin-2	Dr Lizhong He
Jakov Kulis	PhD	Development of ultrafast, selective and reversible atom transfer nitroxide coupling reactions	Prof Michael Monteiro
Peng Li	PhD	Control preparation of inorganic nanocrystal suspensions as the micronutrient foliar fertilisers	Dr Gordon Xu
Sean Muir	PhD	Solar-assisted borohydide production and utilisation for improved hydrogen storage	Prof Max Lu
Ramkumar Palanisamy	PhD	Nono biosensor based epigenetic signature readout system	Prof Matt Trau
Sandy Budi Hartono	PhD	Synthesis, functionalisation and application of magnetic nanoparticle (MN) and carbon nano tube (CNT) for biomedical treatment	Dr Shizhang Qiao
Alexandra Depelsenaire	PhD	Micronanopatch needle-free vaccine delivery to skin	Prof Mark Kendall
Shui Liu	PhD	Haematopoitic cell engineering for optimised production of blood products	Prof Lars Nielsen
Veronica Martinez Salazar	PhD	Improving mammalian cell culture processes using a systems approach	Prof Lars Nielsen
Hoang Quan Nguyen	PhD	Transriptomics study of baculovirus insect cells to identify gene-based strategies for improving virus yields	Dr Steve Reid
Phuong Thi Mac Nguyen <sup>#</sup>	PhD	Synthesis of unique mesoporous graphite carbons and their application to fundamental problems in adsorption science	Dr Shizhang Qiao
Huey Wen Ooi	PhD	Design delivery-novel hydrogels for drug delivery from precisely structured networks	Prof Andrew Whittaker
Azlin Fazlina Osman	PhD	Thermoplastic polyurethane nanocomposites for biomedical applications	A/Prof Darren Martin
Nghia Truong Phuoc	PhD	Polymeric dendrimers for siRNA delivery	Prof Michael Monteiro
Sooa Lim	PhD	Phosphor-proteome of E coli	Prof Lars Nielsen
Gillian Osmond	PhD	Deterioration processes of modern artists' oil paints and implications for the conservation of 20th century paintings	Prof John Drennan
Yian Zhu	PhD	Novel hybrid inorganic nanoparticles for effective siRNA delivery to neurons	Dr Gordon Xu
Tuan Anh Huu Nguyen <sup>#</sup>	PhD	Tailoring nano-crystal suspension for extended ion supply to hydrophobic and hydrophilic leaf surfaces	Prof Anh Nguyen
Erika Fiset	PhD	Preparation of carbon electrodes with optimised pore structure and surface chemistry for next generation supercapacitors	Dr Denisa Jurcakova
Miriem Santander Borrego	PhD	Synergisms of topography and chemistry for development of bioengineered cell constructs for the surgical restoration of the ocular surfaces	Prof Andrew Whittaker
Yosephine Andriani	PhD	Next generation nanocomposite insulation materials for cochlear electrode arrays	A/Prof Darren Martin
Eid Alosime	PhD	Novel antimicrobial photopatterned hybrid polymeric surfaces by grafting techniques	Prof Andrew Whittaker
Thi Bich Trinh Tran	PhD	Metabolomics study of baculovirus infected insect cells to identify metabolite based strategies for improving virus yields	Dr Steve Reid
Hoai Huynh	PhD	Optimisation of batch media for the production of baculoviruses to control caterpillar and mosquito pests	Dr Steve Reid
Khaled Omar Sebakhy	PhD	Living radical polymerisation for biomedical applications	Prof Michael Monteiro

# Changed from AIBN to another School in 2009

## GRANTS

Туре	Scheme	Lead AIBN Investigator	Other Chief Investigators	Project Title	Duration	2009 income
Australian Competitive Grant Income	ARC Discovery Projects	Prof Andrew Whittaker	Dr Kevin Jack, Dr Hui Peng	Designed delivery novel hydrogels for drug delivery from precisely-structured networks	2009-2011	\$154,000
Australian Competitive Grant Income	ARC Discovery Projects	Prof Michael Monteiro	Prof Virgil Percec	Designer nanoreactors: an environmentally friendly solution for polymer synthesis	2009-2011	\$160,000
Australian Competitive Grant Income	ARC Discovery Projects	Prof Michael Monteiro	A/Prof Nigel McMillan	Engineered polymer nanoparticles: a potent weapon against cancer	2009-2011	\$140,000
Australian Competitive Grant Income	ARC Discovery Projects	Dr Simon Corrie	Prof Mark Kendall, Prof Christopher Anderson	Non-invasive diagnosis using micropatches that sample biomarkers from skin	2009-2011	\$180,000
Australian Competitive Grant Income	ARC Discovery Projects	Prof Kirilll Alexandrov		Novel approaches for structural and functional analysis of the protein complex cog, a tether that controls intra-golgi trafficking	2009-2012	\$180,000
Australian Competitive Grant Income	ARC Discovery Projects	Prof Justin Cooper-White	A/Prof Janet Patterson- Kane, A/Prof Stephen Mahler, Dr Gary Peter Brooke	Stem cell-based interface tissue engineering	2009	\$140,000
Australian Competitive Grant Income	ARC Discovery Projects	Dr Idriss Blakey	Prof Traian Chirila, Dr David Hill, Dr Craig Hawker	Generation of peptidomimetic surfaces for biomaterials applications	2008-2010	\$190,000
Australian Competitive Grant Income	ARC Discovery Projects	Prof Max Lu	Prof Perry Bartlett, Mr Zhi Xu, Dr Helen Cooper, Prof Dongyuan Zhao	Novel hybrid inorganic nanoparticles for effective sirna delivery to neurons	2008-2011	\$319,963
Australian Competitive Grant Income	ARC Discovery Projects	A/Prof Darren Martin	Prof Paul Memmott, Dr Susanne Schmidt, Prof Richard Hyde, Dr Rod Fensham	Towards novel biomimetic building materials: evaluating aboriginal and western scientific knowledge of spinifex grass	2008-2012	\$175,000
Australian Competitive Grant Income	ARC Future Fellowships	Prof Kirilll Alexandrov		High throughput engineering of genetically encodable fluorescent sensors of intracellular signalling networks	2009-2013	\$111,400
Australian Competitive Grant Income	ARC Future Fellowships	Prof Mark Kendall		Optimising the body's immune response with a nanopatch that delivers biomolecules to the skin	2009-2013	\$111,400
Australian Competitive Grant Income	ARC Future Fellowships	Prof Michael Monteiro		Transformer 3d nanostructures: stimuli responsive polymers	2009-2013	\$111,400
Australian Competitive Grant Income	ARC Future Fellowships	Prof Chengzhong (Michael) Yu		Novel synthesis and bio- applications of functional macroporous ordered siliceous foams	2009-2012	\$98,600
Australian Competitive Grant Income	ARC Future Fellowships	Dr Annette Dexter		Designed peptides as functional surfactants	2009-2012	\$85,800
Australian Competitive Grant Income	ARC Linkage Infrastructure and Equipment	Prof Michael Monteiro		Mass spectrometry for advanced molecular and macromolecular and environmental characterisation (UNSW lead institution)		
Australian Competitive Grant Income	ARC Linkage Projects	Prof Peter Halley	Prof Bhesh Bhandari	A novel rheological and chewing and swallowing model for the smart design of texture modified foods	2008-2010	\$159,000
Australian Competitive Grant Income	ARC Linkage Projects	Prof Andrew Whittaker	Dr Idriss Blakey, Dr Kevin Jack, Prof John Drennan, Dr Todd Ross Younkin	Advanced lithographic solutions using block copolymers: integrating self assembly and lithography	2009-2011	\$517,354
Australian Competitive Grant Income	ARC Linkage Projects	Prof Max Lu	Dr Xiangdong Yao, A/Prof Lianzhou Wang	An integrated system for high- efficiency hydrogen assisted electricity generation from solar energy	2009-2011	\$242,000
Australian Competitive Grant Income	ARC Linkage Projects	A/Prof Stephen Mahler	Prof Maree Smith, Dr Bruce Wyse, Dr Trent Woodruff, Prof Paul Marie Gerard Curmi, Dr Dean Naylor, Dr Richard Brown	Development of chaperonin 10-based second generation biopharmaceuticals for treatment of inflammatory diseases	2008-2010	\$90,000
Australian Competitive Grant Income	ARC Linkage Projects	Prof Andrew Whittaker	Dr Idriss Blakey, Dr Heping Liu, Dr Paul Zimmerman	Double exposure photoresists for the 32 and 22 nm lithographic nodes	2008-2011	\$496,817
Australian Competitive Grant Income	ARC Linkage Projects	Dr Steve Reid	Prof Lars Nielsen	In vitro production of baculovirus biopesticides - a systems biology approach	2009-2011	\$250,000

Туре	Scheme	Lead AIBN Investigator	Other Chief Investigators	Project Title	Duration	2009 income
Australian Competitive Grant Income	ARC Linkage Projects	Prof Max Lu	Prof Victor Rudolph, Dr Ronggang Ding, Dr Guo Xiong Wang	Nano- and micro-scale engineering of MoS2-based catalyst for conversion of syngas to ethanol	2009-2012	\$100,000
Australian Competitive Grant Income	ARC Linkage Projects	Prof Peter Halley	Prof Paul Lant, Mr Steven Pratt, Dr Alan Werker	Next generation bioplastics: production of pha bioplastics from organis waste	2009-2011	\$87,500
Australian Competitive Grant Income	ARC Linkage Projects	Prof John Drennan	Prof Jane Hunter, A/ Prof Robyn Sloggett, Ms Nicole Tse, Prof Carl H Schiesser, Dr Stephen Best, Dr Thomas Learner, Mr Andrew Durham, Ms Zanita Anuar	The twentieth century in paint (ARC Linkage Project administered by University of Melbourne)	2009-2011	\$69,579
Australian Competitive Grant Income	ARC Linkage Projects	Prof Max Lu	Dr John Zhu	Development of a novel one step process for gas conversion to liquid	2008-2011	\$296,000
Australian Competitive Grant Income	ARC Linkage Projects	Prof Max Lu	Dr Shizhang Qiao, Dr Brenton Peters, Dr Michael Kennedy	Porous silica-based nanocapsules for targeted and controlled release of biocides	2008-2011	\$223,727
Australian Competitive Grant Income	Australian Nuclear Science and Technology Organisation	Dr Lizhong He		The physical states of pharmaceutical proteins and self-assembled peptides (AINSE research fellowship)	2008-2011	\$109,995
Australian Competitive Grant Income	Australian Research Council - Discovery Projects	Prof Max Lu	Dr Lianzhou Wang, A/ Prof Jin Zou, Prof Serge Kaliaguine	Charge-driven self-assembly of nanocomposites of ionic polymers and oxide nanoparticles	2006-2010	\$200,000
Australian Competitive Grant Income	Australian Research Council - Discovery Projects	Prof Anton Middelberg	Dr Annette Dexter	Microfluidic studies of stimuli- responsive emulsions	2007-2009	\$170,000
Australian Competitive Grant Income	Australian Research Council - Discovery Projects	Prof Mark Kendall	Prof Michael Roberts	Micro-nanoprojection patches for minimally-invasive and targeted delivery of genes and drugs to skin cells: from concept to technology platform	2007-2009	\$245,000
Australian Competitive Grant Income	Australian Research Council - Discovery Projects	Prof Sean Smith		Quantum unimolecular reaction dynamics: from isolated molecules to protein- embedded chromophores	2007-2009	\$77,000
Australian Competitive Grant Income	Australian Research Council - Discovery Projects	Prof Anton Middelberg	Dr Samuel Peter Mickan, Dr Hwee-Lin Lua	Terahertz spectroscopy of mass-manufactured viral vaccines	2007-2009	\$161,136
Australian Competitive Grant Income	Australian Research Council - Discovery Projects	Prof Julie Campbell	Mr Tristan Croll, Dr Michael Doran	Tissue engineering the meniscus: combining novel biomimetic hybrid scaffolds with adult stem cells	2007-2010	\$140,000
Australian Competitive Grant Income	Australian Research Council - Discovery Projects	Prof Justin Cooper-White	A/Prof Malcolm R Davidson, Prof Gareth Huw McKinley	Micro process plants - non-newtonian flow and particle synthesis in confined geometries	2005-2009	\$190,000
Australian Competitive Grant Income	Australian Research Council - Linkage International	Prof Andrew Whittaker	Dr Idriss Blakey, Prof Steven Melvyn Howdle, Dr Kristofer James Thurecht	Development of novel detergents for green solvent systems and their self- assembly into nanostructures	2007-2009	\$10,000
Australian Competitive Grant Income	Australian Research Council - Linkage International	A/Prof Peter Halley	Prof Dr Luc Averous, A/ Prof Darren Martin, A/Prof Bhesh Bhandari, Dr Peter Torley, A/Prof Eric Pollet	Functionable renewable plastics: developing novel polysaccharide, protein and natural polyester based polymer nanocomposites	2007-2009	\$10,000
Australian Competitive Grant Income	Australian Research Council - Linkage Projects	Prof Andrew Whittaker	A/Prof Bhesh Bhandari, Prof Mike Gidley, Dr Hilton Deeth	The molecular mechanism of protein instability in dairy powder systems	2007-2010	\$349,000
Australian Competitive Grant Income	Australian Research Council - Linkage Projects	Prof Max Lu	Dr Zhonghua Zhu	Hydrogen production by non-thermal plasma assisted catalytic pyrolysis of natural gas	2005-2009	\$40,737
Australian Competitive Grant Income	Australian Research Council - Linkage Projects	Prof Max Lu	Dr Yinghe He, Mr Xiangdong Yao	Nanostructured magnesium- base composites for high- density hydrogen storage	2006-2009	\$105,000
Australian Competitive Grant Income	NHMRC Fellowship Grant	Prof Julie Campbell		Senior principal research fellowship application	2006-2010	\$158,675
Australian Competitive Grant Income	NHMRC Project Grant	Prof Kirilll Alexandrov	Dr Daniel Abankwa	Understanding changes in the mammalian prenylome induced by statins and prenyltransferase inhibitors	2009-2011	\$181,250
Australian Competitive Grant Income	NHMRC Project Grant	Prof Julie Campbell	Dr Anita Thomas, Dr Zhiping Xu, Prof Max Lu	Antibody-directed delivery of anti-restenotic agents using inorganic nanoparticles	2009-2011	\$104,750

Туре	Scheme	Lead AIBN Investigator	Other Chief Investigators	Project Title	Duration	2009 income
Australian Competitive Grant Income	NHMRC Project Grant	Prof Mark Kendall	Dr Germain Fernando, Prof Lorena Brown, Prof Ian Frazer, Dr Dexiang Chen	Nanopatch immunisation against pandemic influenza: improved immune responses at a reduced dose	2009-2011	\$163,750
Australian Competitive Grant Income	NHMRC Project Grant	A/Prof Darren Martin	Prof Rodney Minchin, Prof Michael Roberts, Dr Suzanne Smith, A/ Prof Michael Monteiro, Prof Lawrence Gahan, Dr Martin Joseph Svehla, Dr Ajay Devidas Padsalgikar, Dr Tony McNally, Dr Tijana Rajh, Prof Juergen Lademann	The toxicology of nanomaterials	2009-2013	\$255,000
Australian Competitive Grant Income	NHMRC Project Grant	Prof Julie Campbell	Dr Matthew Sweet, Prof David Fairlie, Dr Allison Pettit, Dr Martin Stoermer, Dr Ian Ross	Towards selective targeting of HDACs for anti-inflammatory applications	2009-2011	\$186,250
Australian Competitive Grant Income	NHMRC Project Grant (All Project Grants)	Prof Mark Kendall	Dr Sarah Waters, Prof Ian Frazer	MPM non-invasive imaging of biological interactions following drug delivery with micro-nanoprojection patches	2007-2009	\$122,750
Australian Competitive Grant Income	NHMRC Project Grant (All Project Grants)	Prof Julie Campbell	Dr Sharon Ricardo, Prof Melissa Little	Transplanted metanephroi as functional kidneys	2008-2010	\$98,500
Australian Competitive Grant Income	NHMRC Urgent Research - H <sub>1</sub> N <sub>1</sub> Influenza 09	Prof Mark Kendall	Prof Lorena Brown, Mr Stirling Edwards, Dr Germain Fernando, Prof Ian Frazer, Dr Deborah Middleton	Nanopatch immunisation against pandemic Novel A (H,N,) influenza virus 09: potent immunity at a reduced dose	2009	\$179,472
Contract Research and Other Industry Income	Aramco Overseas Company BV	Prof Max Lu	Prof Joao Diniz da Costa, Dr Jorge Beltramini	Liquid fuels to hydrogen conversion process using membrane reactors	2009-2011	\$127,385
National and International Grant Income	Australian Institute Nuclear Science & Engineering	A/Prof Darren Martin	Anthony Musumeci	Tailored nanoparticles for nanotoxicological studies	2007-2009	\$8,341
National and International Grant Income	Australian Institute of Nuclear Science and Engineering	A/Prof Darren Martin		Radiolabelling of industrially- relevant nanoparticles for use in nanotoxicology investigations - towards in- vivo studies	2009	\$7,920
National and International Grant Income	Australian Institute of Nuclear Science and Engineering	Dr Annette Dexter	Prof Anton Middelberg	X-ray reflectivity of absorbed peptides: control of adsorption by designed peptide surfactants	2009	\$1,480
National and International Grant Income	Australian Stem Cell Centre	Prof Peter Gray	Prof Justin Cooper-White, A/Prof Ernst Wolvetang	Bioreactor program	2009-2011	\$346,465
National and International Grant Income	Australian Stem Cell Centre	Prof Peter Gray	Prof Justin Cooper-White, A/Prof Ernst Wolvetang	Bioreactor program	2008-2010	\$359,473
National and International Grant Income	Australian Stem Cell Centre	Prof Lars Nielsen	Dr Nicholas Timmins, Dr Sia Athanasas-Platsis, Flavia Marturana, Penny Buntine	Ex vivo generated allogeneic neutrophils for anti-infective supportive care in acute leukaemia	2008-2010	\$140,368
National and International Grant Income	Australian Stem Cell Centre	A/Prof Ernst Wolvetang		Novel methods of reprogramming	2009-2011	\$97,262
National and International Grant Income	Australian Stem Cell Centre	Prof Lars Nielsen		Production of neutrophils	2009-2011	\$231,158
National and International Grant Income	Australian Stem Cell Centre	A/Prof Ernst Wolvetang	Prof Nicholas Fisk, Dr Liza-Jane Raggatt	Primitive iPS-derived MSC for bone repair	2009-2011	\$66,257
National and International Grant Income	Australian Stem Cell Centre	A/Prof Ernst Wolvetang		Safe and efficient expansion of genetically stable hESC	2009-2011	\$167,923
National and International Grant Income	Australian Stem Cell Centre	A/Prof Ernst Wolvetang		Safe and efficient expansion of genetically stable hESC under defined conditions	2008-2010	\$191,034
National and International Grant Income	Cancer Australia	Prof Matt Trau	A/Prof Melissa Brown, Dr Glenn Francis, Dr Kymberley Vickery, Dr Bronwyn Battersby	Nanoscaled biosensors: reading epigenetic signatures to improve breast cancer detection and treatment	2008-2011	\$110,000
National and International Grant Income	Centre for Low Emission Technology	Prof Max Lu	A/Prof Joao Diniz da Costa, Dr Mikel Duke, Dr Jorge Beltramini, Dr Michael Macrossan	Proof-of-concept engineering systems for membranes and catalytic membrane reactors (CMR) in coal gasification (cLET project)	2005-2009	\$110,000
National and International Grant Income	CRC for Sugar Industry Innovation through Biotechnology	Prof Lars Nielsen	Dr Jens Kroemer, Yiting Chen, Dr Claudia Vickers	High molecular weight hyaluronic acid	2008-2009	\$22,000

Туре	Scheme	Lead AIBN Investigator	Other Chief Investigators	Project Title	Duration	2009 income
National and International Grant Income	CRC for Sugar Industry Innovation through Biotechnology	Dr Steve Brumbley	Prof Lars Nielsen	The production of PHB/PHAs in plants	2006-2009	\$372,077
National and International Grant Income	CSIRO Flagships Collaboration Fund	Prof Max Lu	Dr Lianzhou Wang, A/Prof Joao Diniz da Costa	Flagship collaboration research fund: advanced membrane technologies for water treatment	2007-2010	\$216,021
National and International Grant Income	Department of Innovation, Industry, Science and Research	Prof Lars Nielsen		National collaborative research infrastructure strategy - capability area 5.1 Evolving Biomolecular Platforms	2007-2011	\$145,855
National and International Grant Income	Department of Innovation, Industry, Science and Research	Prof Justin Cooper-White		National collaborative research infrastructure strategy - capability area 5.4 Fabrication	2007-2011	\$1,400,000
National and International Grant Income	Department of Innovation, Industry, Science and Research	Prof Peter Gray		National Collaborative Research Infrastructure Strategy - Capability Area 5.5 Biotechnology Products	2007-2011	\$852,888
Contract Research and Other Industry Income	Dow Chemical Australia Limited	Prof Lars Nielsen		Evaluation of fermentation targets	2009	\$227,282
National and International Grant Income	Foundation Jerome Lejeune	A/Prof Ernst Wolvetang		The generation of primary ds neurons from induced pluripotent cells	2008-2009	\$25,335
National and International Grant Income	Inner Wheel Australia Incorporated	Dr Michael Doran	Prof Kerry M Atkinson, Prof Lars Nielsen, Dr Gary Peter Brooke	Defining the oxygen and redox conditions for human cord blood stem cell expansion	2009	\$65,000
National and International Grant Income	National Breast Cancer Foundation	Prof Matt Trau	Prof John Forbes, A/ Prof Susan Clark, A/Prof Melissa Brown, Dr Glenn Francis, A/Prof Alexander Dobrovic, Prof Rodney Scott, Dr Bronwyn Battersby, Dr Kymberley	Novel strategies for prediction and control of advanced breast cancer via nanoscaled epigenetic-based biosensors	2008-2013	\$1,100,000
National and International Grant Income	NHMRC Training (Post Doctoral) Fellowship	Dr Bei Cheng		How does oestrogen affect blood vessels	2009	\$23,523
Contract Research and Other Industry Income	Program for Appropriate Technology in Health	Prof Mark Kendall	Dr David Koelle	Micro-nanoprojections (Nanopatches) for HSV-2 DNA vaccine delivery to mice	2009	\$43,940
National and International Grant Income	Queensland Government - NCRIS Support	Prof Lars Nielsen		National Collaborative Research Infrastructure Strategy - Capability Area 5.1 Evolving Biomolecular Platforms	2007-2011	\$125,000
National and International Grant Income	Queensland Government - NCRIS Support	Prof Peter Gray		National Collaborative Research Infrastructure Strategy - Capability Area 5.5 Biotechnology Products	2007-2011	\$611,500
National and International Grant Income	Queensland Government Smart State Fellowships	Prof Mark Kendall		Micro-nanoprojection patches for targeted gene and drug delivery to the skin	2007-2010	\$110,000
National and International Grant Income	Queensland Government Smart State National and International Research Alliance Program	Dr Krassen Dimitrov	Prof Karl Bohringer, Dr Daniel Schwartz	Molecular diagnostics platform with electronic readout of nanobarcodes	2008-2011	\$143,000
National and International Grant Income	Queensland Government Smart State National and International Research Alliances Program	Prof Andrew Whittaker	Prof Maree Smith, Dr Elizabeth Coulson, Dr Mark Stephen Kindy, Dr Stephen Rose, Prof Ian Brereton, Dr Jonathan Chalk	Alzheimer's disease: novel MRI biomarkers for clinical diagnosis and translational studies	2009-2012	\$148,133
National and International Grant Income	Queensland Government Smart State National and International Research Alliances Program	Prof Andrew Whittaker	Dr Firas Rasoul, Dr Anne Symons, Dr Craig Jon Hawker, Prof Karen Lynn Wooley, Prof Julie Campbell, Prof Traian Chirlia, Prof David M Haddleton, A/Prof Stephen Rose, Prof Steven Melvyn Howdle	International biomaterials research alliance	2007-2011	\$476,039
National and International Grant Income	Queensland Government Smart State National and International Research Alliances Program	Prof Mark Kendall	Prof lan Frazer, Prof Michael Roberts	International needle-free vaccination alliance (INVax)		\$454,861
National and International Grant Income	Queensland Government Smart State National and International Research Alliances Program	Prof Lars Nielsen	Prof Sang Yup Lee	Korea-Australia bio-product alliance	2009-2012	\$584,691

Туре	Scheme	Lead AIBN Investigator	Other Chief Investigators	Project Title	Duration	2009 income
National and International Grant Income	Queensland Government Smart State National and International Research Alliances Program	Prof Matt Trau	Prof Leland (Lee) Hartwell, Prof Kenneth D. Stuart, Prof Nancy B. Kiviat	Novel nanotechnology platforms for disease biomarker diagnostics	2007-2010	\$687,500
National and International Grant Income	Queensland Government Smart State National and International Research Alliances Program	Prof Max Lu	Prof Sean Smith, Dr Zhonghua Zhu, Prof Joao Diniz da Costa, A/ Prof Lianzhou Wang, Prof Xinhe Bao, Prof Hui-Ming Cheng, Prof Can Li	Queensland-China alliance in nanometerials for clean energy technologies (OCANCET)	2009-2012	\$429,000
National and International Grant Income	Queensland State Government - Queensland International Fellowships	Dr Zhen Li		Fluorescent semiconductor nanowires	2009	\$38,500
National and International Grant Income	Queensland State Government - Queensland International Fellowships	Dr Chenghua Sun		Fundamental study of hydrogen production from water	2009	\$34,100
National and International Grant Income	Queensland State Government - Queensland International Fellowships			Function and mechanism in the far-red fluorescent protein hcred: a computational study	2009	\$38,500
National and International Grant Income	Queensland State Government - Smart Futures Fellowship	Dr Simon Corrie		Micropatches for non-invasive disease diagnostics	2009-2011	\$55,000
National and International Grant Income	Queensland State Government - Smart Futures Fellowship	Dr Zhen Li		Multifunctional magnetic nanomaterials: robust contrast agents for detection and treatment of cancers	2009-2011	\$55,000
National and International Grant Income	Queensland State Government - Smart Futures Fellowship	Dr Chenghua Sun		Computer-aided synthesis of high-peformance titanium dioxide for solar cells and photocatalysts	2009-2011	\$55,000
National and International Grant Income	Seattle Biomedical Research Institute	Prof Matt Trau	Prof Gerard Cangelosi	Accelerated molecular probe pipeline	2009	\$83,169
National and International Grant Income	The Cancer Council of Queensland	Prof Mark Kendall	Prof Michael Roberts, Prof Hans Soyer, Karsten Koenig, Dr Owen Jepps, Dr Glenn Francis, Dr Greg Siller, Dr John Auld, Mark Jones, Prof David Wilkinson	Assessment of topically treated non-melanoma skin cancers by sequential optical biopsies using multiphoton microscope	2008-2009	\$75,428
Contract Research and Other Industry Income	UniQuest Pty Ltd	Prof Max Lu	A/Prof Lianzhou Wang	Proof of concept experimental plan for the lightanate technologies	2009-2010	\$254,670
National and International Grant Income	Wesley Research Institute Limited	Prof Julie Campbell	Dr Barbara Rolfe	Cellular mechanisms of peritoneal sclerosis	2009	\$101,959
Contract Research and Other Industry Income	UniQuest Pty Ltd	Prof Peter Halley		Plantic Techologies	2008-2010	\$2,513
Contract Research and Other Industry Income	UniQuest Pty Ltd	A/Prof Darren Martin		TenasiTech	2006-2010	\$30,181
Contract Research and Other Industry Income	UniQuest Pty Ltd	Dr Annette Dexter		Pepfactants Pty Ltd	2009	\$112,919
Contract Research and Other Industry Income	UniQuest Pty Ltd	Prof Lars Nielsen	Esteban Marcellin Wendy Chan	High molecular weight hyaluronic acid	2009	\$34,784

## AIBN PUBLICATIONS 2009

## BOOKS

Halley, P. J., and George, P. A. (2009) Chemorheology of Polymers: from fundamental principles to reactive processing, Cambridge University Press, Cambridge U.K.

## **BOOK CHAPTERS**

- Johnston-Hall, G. M., Monteiro, M.J. (2009) Influence of molecular weight distribution (MWD) on k<sub>i</sub> and the onset of the gel effect using the RAFT-CLD-T method, in *Controlled/Living radical polymerisation: Progress in RAFT, DT, NMP* & OMRP (Matyjaszewski, K., Ed.), pp 19-35, American Chemical Society New York, USA.
- Marcellin, E., Chen, W., and Nielsen, L. K. (2009) Microbial hyaluronic acid biosynthesis in *Microbial Production of Biopolymers and Polymer Precursors: Applications and Perspectives* (Rehm, B. H. A., Ed.), pp 163-180, Caister Academic Press, Norfolk, UK.
- Middelberg, A. P. J. (2009) Engineering materials from the bottom up - Overview, in Advances in chemical engineering: Engineering aspects of self-organising materials (Koopmans, R. J., Ed.), pp 1-8, Elsevier, Amsterdam.
- Quek, L.-E., and Nielsen, L. K. (2009) Metabolic engineering of mammalian cells, in *The Metabolic Pathway Engineering Handbook - Fundamentals* (Smolke, C. D., Ed.), pp 26-21, CRC Press, Boca Raton FL.

## JOURNAL ARTICLES

- Altmann, N., Halley, P. J., and Nicholson, T. M. (2009) Extension of Group Interaction Modelling to predict chemorheology of curing thermosets, *Korea-Australia Rheology Journal 21*, 91-102.
- Asthana, A., Kim, K. O., Perumal, J., Kim, D. M., and Kim, D. P. (2009) Facile single step fabrication of microchannels with varying size, *Lab on a Chip 9*, 1138-1142.
- Averous, L., and Halley, P. J. (2009) Biocomposites based on plasticised starch, *Biofuels Bioproducts & Biorefining-Biofpr 3*, 329-343.
- Battersby, B., and Trau, M. (2009) Biosensing cancer biomarkers, *Tce*, 30-31.
- Battersby, S., Smart, S., Ladewig, B., Liu, S. M., Duke, M. C., Rudolph, V., and da Costa, J. C. D. (2009) Hydrothermal stability of cobalt silica membranes in a water gas shift membrane reactor, *Separation and Purification Technology* 66, 299-305.

- Battersby, S., Tasaki, T., Smart, S., Ladewig, B., Liu, S. M., Duke, M. C., Rudolph, V., and da Costa, J. C. D. (2009) Performance of cobalt silica membranes in gas mixture separation, *Journal of Membrane Science 329*, 91-98.
- Bergbrede, T., Chuky, N., Schoebel, S., Blankenfeldt, W., Geyer, M., Fuchs, E., Goody, R. S., Barr, F., and Alexandrov, K. (2009) Biophysical analysis of the interaction of Rab6a GTPase with its effector domains, *J Biol Chem 284*, 2628-2635.
- Blakey, I., Lan, C., Goh, Y.-K., Lawrie, K. J., Chuang, Y. P., E. Zimmerman, P.A., and Whittaker, A. K. (2009) Non-CA resists for 193nm immersion lithography: Effects of chemical structure on sensitivity Advances in Resist Materials and Processing Technology XXVI 7273, 1 - 9.
- Bleimling, N., Alexandrov, K., Goody, R., and Itzen, A. (2009) Chaperone-assisted production of active human Rab8A GTPase in Escherichia coli, *Protein Expr Purif 65*, 190-195.
- Budihartono, S., Qiao, S. Z., Jack, K., Ladewig, B. P., Hao, Z. P., and Lu, G. Q. M. (2009) Improving Adsorbent Properties of Cage-like Ordered Amine Functionalised Mesoporous Silica with Very Large Pore for Bio-adsorption, Langmuir 25, 6413-6424.
- Burey, P., Bhandari, B. R., Rutgers, R. P. G., Halley, P. J., and Torley, P. J. (2009) Confectionery Gels: A Review on Formulation, Rheological and Structural Aspects, *International Journal of Food Properties 12*, 176-210.
- Chau, L., Doran, M., and Cooper-White, J. (2009) A novel multishear microdevice for studying cell mechanics, *Lab on a Chip* 9, 1897-1902.
- Chaudhary, A. L., Torley, P. J., Halley, P. J., McCaffery, N., and Chaudhary, D. S. (2009) Amylose content and chemical modification effects on thermoplastic starch from maize Processing and characterisation using conventional polymer equipment, *Carbohydrate Polymers* 78, 917-925.
- Chen, A., Kozak, D., Battersby, B. J., Forrest, R. M., Scholler, N., Urban, N., and Trau, M. (2009) Antifouling Surface Layers for Improved Signal-to-Noise of Particle-Based Immunoassays, *Langmuir* 25, 13510-13515.
- Chen, S. L., Xu, Z. P., Zhang, Q., Lu, G. Q., Hao, Z. P., and Liu, S. (2009) Studies on adsorption of phenol and 4-nitrophenol on MgAl mixed oxide derived from MgAllayered double hydroxide, *Separation & Purification Tech 67*, 194-200.
- Chen, W. Y., Marcellin, E., Hung, J., and Nielsen, L. K. (2009) Hyaluronan Molecular Weight Is Controlled by UDP-N-acetylglucosamine Concentration in Streptococcus zooepidemicus, *Journal of Biological Chemistry 284*, 18007-18014.

- Chen, X. F., Prow, T. W., Crichton, M. L., Jenkins, D. W. K., Roberts, M. S., Frazer, I. H., Fernando, G. J. P., and Kendall, M. A. F. (2009) Dry-coated microprojection array patches for targeted delivery of immunotherapeutics to the skin, *Journal* of Controlled Release 139, 212-220.
- Chen, Z. G., Zou, J., Liu, G., Li, F., Cheng, H. M., Sekiguchi, T., Gu, M., Yao, X. D., Wang, L. Z., and Lu, G. Q. (2009) Long wavelength emissions of periodic yardglass shaped boron nitride nanotubes, *Appl. Phys. Lett.* 94, 3.
- Chen, Z. G., Zou, J., Wang, D. W., Yin, L. C., Liu, G., Liu, Q. F., Sun, C. H., Yao, X. D., Li, F., Yuan, X. L., Sekiguchi, T., Lu, G. Q., and Cheng, H. M. (2009) Field Emission and Cathodoluminescence of ZnS Hexagonal Pyramids of Zinc Blende Structured Single Crystals, *Adv. Funct. Mater.* 19, 484-490.
- Cheung, K., Hunter, J., and Drennan, J. (2009) MatSeek: An Ontology-Based Federated Search Interface for Materials Scientists, *IEEE Intell. Syst. 24*, 47-56.
- Cho, P. S., Cho, Y. H., Park, S. Y., Lee, S. B., Kim, D. Y., Park, H. M., Auchterlonie, G., Drennan, J., and Lee, J. H. (2009) Grain-Boundary Conduction in Gadolinia-Doped Ceria: The Effect of SrO Addition, *J. Electrochem. Soc.* 156, B339-B344.
- Chu, T. S., Han, K. L., Hankel, M., Balint-Kurti, G. G., Kuppermann, A., and Abrol, R. (2009) Nonadiabatic effects in the H+H-2 exchange reaction: Accurate quantum dynamics calculations at a stateto-state level, J. Chem. Phys. 130, 9.
- Chuan, Y. P., Fan, Y. Y., Lua, L. H., and Middelberg, A. P. (2010)Virus assembly occurs following a pH- or Ca2+-triggered switch in the thermodynamic attraction between structural protein capsomeres, *J R Soc Interface* 7, 409-421. Epub 22 Jul 2009.
- Connolly, A. R., Palanisamy, R., and Trau, M. (2010) Quantitative considerations for suspension array assays, *Journal of Biotechnology* 145, 17-22. Epub 15 Oct 2009.
- Corrie, S., Sova, P., Lawrie, G., Battersby, B., Kiviat, N., and Trau, M. (2009) Development of a multiplexed bead-based assay for detection of DNA methylation in cancer-related genes, *Molecular Biosystems 5*, 262-268.
- Dai, Y. C., Qian, G. R., Cao, Y. L., Chi, Y., Xu, Y. F., Zhou, J. Z., Liu, Q., Xu, Z. P., and Qiao, S. Z. (2009) Effective removal and fixation of Cr(VI) from aqueous solution with Friedel's salt, *J. Hazard. Mater.* 170, 1086-1092.
- de Leon, E. J., Yuan, F. F., Pearson, H., Marquis, C. P., and Mahler, S. M. (2009) Evidence of heterogeneity in the antibody response against the platelet antigen 3a; recognition of an 11-mer peptide carrying the HPA-3a polymorphic determinant, *Vox Sang* 96, 252-255.
- Deng, Z. J., and et al. (2009) Differential plasma protein binding to metal oxide nanoparticles, *Nanotechnology 20*, 455101.

- Deng, Z. J., Mortimer, G., Schiller, T., Musumeci, A., Martin, D., and Minchin, R. F. (2009) Differential plasma protein binding to metal oxide nanoparticles, *Nanotechnology 20*, 9.
- Doran, M. R., Markway, B., Clark, A., Athanasas-Platsis, S., Brooke, G., Atkinson, K., Nielsen, L., and Cooperwhite, J. J. (2009) Membrane Bioreactors Enhance Microenvironmental Conditioning and Tissue Development, *Tissue Eng Part C Methods.*
- Doran, M. R., Markway, B. D., Aird, I. A., Rowlands, A. S., George, P. A., Nielsen, L. K., and Cooper-White, J. J. (2009) Surface-bound stem cell factor and the promotion of hematopoietic cell expansion, *Biomaterials* 30, 4047-4052.
- Du, A. J., Chen, Y., Zhu, Z. H., Amal, R., Lu, G. Q., and Smith, S. C. (2009) Dots versus Antidots: Computational Exploration of Structure, Magnetism, and Half-Metallicity in Boron-Nitride Nanostructures, *Journal of the American Chemical Society* 131, 17354-17359.
- Du, A. J., Chen, Y., Zhu, Z. H., Lu, G. Q., and Smitht, S. C. (2009) C-BN Single-Walled Nanotubes from Hybrid Connection of BN/C Nanoribbons: Prediction by ab initio Density Functional Calculations, *Journal of the American Chemical Society* 131, 1682-+.
- Du, A. J., Smith, S. C., Sun, C. H., Li, L., Yao, X. D., and Lu, G. Q. (2009) First Principle Study of Hydrogenation of MgB2: An Important Step Toward Reversible Hydrogen Storage in the Coupled LiBH4/MgH2 System, J. Nanosci. Nanotech 9, 4388-4391.
- Du, A. J., Sun, C. H., Zhu, Z. H., Lu, G. Q., Rudolph, V., and Smith, S. C. (2009) The effect of Fe doping on adsorption of CO2/N-2 within carbon nanotubes: a density functional theory study with dispersion corrections, *Nanotechnology* 20, 4.
- Du, A. J., Zhu, Z. H., Chen, Y., Lu, G. Q., and Smith, S. C. (2009) First principle studies of zigzag AlN nanoribbon, *Chem. Phys. Lett.* 469, 183-185.
- Du, A. J., Zhu, Z. H., Sun, C. H., Chen, Y., Lu, G. Q., and Smith, S. C. (2009) Half metallicity in a zigzag double-walled nanotube nanodot: An ab initio prediction, *Chem. Phys. Lett.* 468, 257-259.
- Feng, J. Y., Hu, X. J., Yue, P. L., and Qiao, S. Z. (2009) Photo Fenton Degradation of High Concentration Orange II (2mM) Using Catalysts Containing Fe: A Comparative Study. Separation and Purification Technology 67, 213-217.
- Frankcombe, T. J., and Smith, S. C. (2009) Numerical solution methods for large, difficult kinetic master equations, *Theor. Chem. Acc.* 124, 303-317.
- Ghafor, W. A., Halley, P. J., Hill, D. J. T., Martin, D. J., Rasoul, F., and Whittaker, A. K. (2009) Photochemistry of Low-Density Polyethylene-Montmorillonite Composites, *Journal of Applied Polymer Science 112*, 381-389.

- Golledge, J., Cullen, B., Rush, C., Moran, C. S., Secomb, E., Wood, F., Daugherty, A., Campbell, J. H., and Norman, P. E. (2009) Peroxisome proliferator-activated receptor ligands reduce aortic dilatation in a mouse model of aortic aneurysm, *Atherosclerosis*.
- Hannan, N. R., Jamshidi, P., Pera, M. F., and Wolvetang, E. J. (2009) BMP-11 and myostatin support undifferentiated growth of human embryonic stem cells in feeder-free cultures, *Cloning Stem Cells* 11, 427-435.
- Hartmann, B. M., Kaar, W., Yoo, I. K., Lua, L. H., Falconer, R. J., and Middelberg, A. P. (2009) The chromatography-free release, isolation and purification of recombinant peptide for fibril selfassembly, *Biotechnol Bioeng 104*, 973-985.
- Hartono, S. B., Qiao, S. Z., Jack, K., Ladewig, B. P., Hao, Z. P., and Lu, G. Q. (2009) Improving Adsorbent Properties of Cage-like Ordered Amine Functionalised Mesoporous Silica with Very Large Pores for Bioadsorption, *Langmuir 25*, 6413-6424.
- He, C., Li, J. J., Cheng, J., Li, L. D., Li, P., Hao, Z. P., and Xu, Z. P. (2009) Comparative Studies on Porous Material-Supported Pd Catalysts for Catalytic Oxidation of Benzene, Toluene, and Ethyl Acetate, *Ind. Eng. Chem. Res.* 48, 6930-6936.
- He, L., Malcolm, A. S., Dimitrijev, M., Onaizi, S. A., Shen, H. H., Holt, S. A., Dexter, A. F., Thomas, R. K., and Middelberg, A. P. (2009) Cooperative tuneable interactions between a designed peptide biosurfactant and positional isomers of SDOBS at the air-water interface, *Langmuir 25*, 4021-4026.
- Hong, J. S., and Cooper-White, J. (2009) Drop formation of Carbopol dispersions displaying yield stress, shear thinning and elastic properties in a flow-focusing microfluidic channel, *Korea-Australia Rheology Journal 21*, 269-280.
- Hu, Q., Li, J. J., Hao, Z. P., Li, L. D., and Qiao, S. Z. (2009) Dynamic adsorption of volatile organic compounds on organofunctionalised SBA-15 materials, *Chem. Eng. J.* 149, 281-288.
- Hu, Q., Li, J. J., Qiao, S. Z., Hao, Z. P., Tian, H., Ma, C. Y., and He, C. (2009) Synthesis and hydrophobic adsorption properties of microporous/mesoporous hybrid materials, *J. Hazard. Mater.* 164, 1205-1212.
- Hulicova-Jurcakova, D., Kodama, M., Shiraishi, S., Hatori, H., Zhu, Z. H., and Lu, G. Q. (2009) Nitrogen-Enriched Nonporous Carbon Electrodes with Extraordinary Supercapacitance, *Adv. Funct. Mater.* 19, 1800-1809.
- Hulicova-Jurcakova, D., Puziy, A. M., Poddubnaya, O. I., Suarez-Garcia, F., Tascon, J. M. D., and Lu, G. Q. (2009) Highly Stable Performance of Supercapacitors from Phosphorus-Enriched Carbons, *Journal of the American Chemical Society*, 5026-5027.

- Hulicova-Jurcakova, D., Seredych, M., Lu, G. Q., and Bandosz, T. J. (2009) Combined Effect of Nitrogen- and Oxygen-Containing Functional Groups of Microporous Activated Carbon on its Electrochemical Performance in Supercapacitors, Adv. Funct. Mater. 19, 438-447.
- Hulicova-Jurcakova, D., Seredych, M., Lu, G. Q., Kodiweera, N., Stallworth, P. E., Greenbaum, S., and Bandosz, T. J. (2009) Effect of surface phosphorus functionalities of activated carbons containing oxygen and nitrogen on electrochemical capacitance, *Carbon* 47, 1576-1584.
- Jack, K. S., Velayudhan, S., Luckman, P., Trau, M., Grondahl, L., and Cooper-White, J. (2009) The fabrication and characterisation of biodegradable HA/ PHBV nanoparticle-polymer composite scaffolds, *Acta Biomaterialia* 5, 2657-2667.
- Jasieniak, M., Suzuki, S., Monteiro, M., Wentrup-Byrne, E., Griesser, H. J., and Grondahl, L. (2009) Time-of-Flight Secondary Ion Mass Spectrometry Study of the Orientation of a Bifunctional Diblock Copolymer Attached to a Solid Substrate, *Langmuir 25*, 1011-1019.
- Ji, G., Morniroli, J. P., Auchterlonie, G. J., Drennan, J., and Jacob, D. (2009) An efficient approach to characterise pseudomerohedral twins by precession electron diffraction: Application to the LaGaO3 perovskite, *Ultramicroscopy 109*, 1282-1294.
- Jin, X., Balasubramanian, V. V., Selvan, S. T., Sawant, D. P., Chari, M. A., Lu, G. Q., and Vinu, A. (2009) Highly Ordered Mesoporous Carbon Nitride Nanoparticles with High Nitrogen Content: A Metal-Free Basic Catalyst, *Angew. Chem.-Int. Edit.* 48, 7884-7887.
- Jin, Y. G., Qiao, S. Z., Xu, Z. P., da Costa, J. C. D., and Lu, G. Q. (2009) Porous Silica Nanospheres Functionalised with Phosphonic Acid as Intermediate-Temperature Proton Conductors, *J. Phys. Chem. C* 113, 3157-3163.
- Jin, Y. G., Oiao, S. Z., Xu, Z. P., Yan, Z. M., Huang, Y. N., da Costa, J. C. D., and Lu, G. Q. (2009) Phosphonic acid functionalised silicas for intermediate temperature proton conduction, *J. Mater. Chem.* 19, 2363-2372.
- Joachimsthal, E. L., Reeves, R. K., Hung, J., Nielsen, L. K., Ouwerkerk, D., Klieve, A. V., and Vickers, C. E. (2009) Production of bacteriocins by Streptococcus bovis strains from Australian ruminants, *J Appl Microbiol.*
- Johnston-Hall, G., Harjani, J. R., Scammells, P. J., and Monteiro, M. J. (2009) RAFT-Mediated Polymerisation of Styrene in Readily Biodegradable Ionic Liquids, *Macromolecules* 42, 1604-1609.
- Johnston-Hall, G., and Monteiro, M. J. (2009) Termination in Semi-Dilute and Concentrated Polymer Solutions, *Aust. J. Chem. 62*, 857-864.

- Kaar, W., Hartmann, B. M., Fan, Y., Zeng, B., Lua, L. H. L., Dexter, A. F., Falconer, R. J., and Middelberg, A. P. J. (2009) Microbial Bio-Production of a Recombinant Stimuli-Responsive Biosurfactant, *Biotechnology and Bioengineering 102*, 176-187.
- Kithva, P. H., Grondahl, L., Kumar, R., Martin, D., and Trau, M. (2009) An organic matrix-mediated processing methodology to fabricate hydroxyapatite based nanostructured biocomposites, *Nanoscale 1*, 229-232.
- Knibbe, R., Drennan, J., and Love, J. G. (2009) Effect of alumina additions in YSZ on the microstructure and degradation of the LSM-YSZ interface, *Solid State Ion. 180*, 984-989.
- Kozak, D., Surawski, P., Thoren, K. M., Lu, C. Y., Marcon, L., and Trau, M. (2009) Improving the Signal-to-Noise Performance of Molecular Diagnostics with PEG-Lysine Copolymer Dendrons, *Biomacromolecules* 10, 360-365.
- Kulis, J., Bell, C. A., Micallef, A. S., Jia, Z. F., and Monteiro, M. J. (2009) Rapid, Selective, and Reversible Nitroxide Radical Coupling (NRC) Reactions at Amibient Temperature, *Macromolecules* 42, 8218-8227.
- Ladewig, K., Niebert, M., Xu, Z. P., Gray, P. P., and Lu, G. Q. (2010) Controlled preparation of layered double hydroxide nanoparticles and their application as gene delivery vehicles, *Applied Clay Science* 48, 280-289. Epub 26 Nov 2009.
- Ladewig, K., Niebert, M., Xu, Z. P., Gray, P. P., and Lu, G. Q. M. Efficient siRNA delivery to mammalian cells using layered double hydroxide nanoparticles, *Biomaterials 31*, 1821-1829. Epub 17 Nov 2009.
- Ladewig, K., Xu, Z. P., and Lu, G. Q. (2009) Layered double hydroxide nanoparticles in gene and drug delivery, *Expert Opin. Drug Deliv.* 6, 907-922.
- Lashtabeg, A., Drennan, J., Knibbe, R., Bradley, J. L., and Lu, G. Q. (2009) Synthesis and characterisation of macroporous Yttria Stabilised Zirconia (YSZ) using polystyrene spheres as templates, *Microporous Mesoporous Mat.* 117, 395-401.
- Lee, O., Hill, D. J. T., Le, T., Rasoul, F., and Whittaker, A. K. (2009) Studies of the copolymerisation of acrylic acid with n-butyl vinyl ether, *Polymer International* 58, 348-353.
- Lestari, S., Maki-Arvela, P., Beltramini, J. N., Lu, G. Q., and Murzin, D. (2009) Toward the next generation of biofuels: A critical review in transforming triglycerides and fatty acids to biofuels, *ChemSusChem 2*, 1109-1119.
- Lestari, S., Maki-Arvela, P., Bernas, H., Simakova, O., Sjoholm, R., Beltramini, J., Lu, G. Q. M., Myllyoja, J., Simakova, I., and Murzin, D. Y. (2009) Catalytic Deoxygenation of Stearic Acid in a Continuous Reactor over a Mesoporous Carbon-Supported Pd Catalyst, *Energy Fuels 23*, 3842-3845.

- Lestari, S., Maki-Arvela, P., Simakova, I., Beltramini, J., Lu, G. Q. M., and Murzin, D. Y. (2009) Catalytic Deoxygenation of Stearic Acid and Palmitic Acid in Semibatch Mode, *Catal. Lett.* 130, 48-51.
- Leung, A., Trau, M., and Nielsen, L. K. (2009) Assembly of multilayer PSS/ PAH membrane on coherent alginate/ PLO microcapsule for long-term graft transplantation, *Journal of Biomedical Materials Research Part A 88A*, 226-237.
- Li, E., Xu, Z. P., and Rudolph, V. (2009) MgCoAl-LDH derived heterogeneous catalysts for the ethanol transesterification of canola oil to biodiesel, *Appl. Catal. B-Environ. 88*, 42-49.
- Li, J. J., Hu, Q., Tian, H., Ma, C. Y., Li, L. D., Cheng, J., Hao, Z. P., and Qiao, S. Z. (2009) Expanding Mesoporosity of Triblock-Copolymer-Templated Silica Under Weak Synthesis Acidity, *Journal of Colloid and Interface Science 339*, 160-167.
- Li, J. J., Mu, Z., He, C., Hu, Q., Li, L. D., Cheng, J., Hao, Z. P., and Qiao, S. Z. (2009) Promoted and Controllable Self-Assembly of Hydrolysed Siloxane and Triblock Copolymer under Organic Polyhydroxy Acids, *Ind. Eng. Chem. Res.* 48, 6308-6314.
- Li, L., Zhu, Z. H., Wang, S. B., Yao, X. D., and Yan, Z. F. (2009) Chromium oxide catalysts for COx-free hydrogen generation via catalytic ammonia decomposition, *Journal of Molecular Catalysis a-Chemical 304*, 71-76.
- Li, X., Zhu, Z. H., Chen, J. L., De Marco, R., Dicks, A., Bradley, J., and Lu, G. Q. (2009) Surface modification of carbon fuels for direct carbon fuel cells, *J. Power Sources 186*, 1-9.
- Lim, M., Zhou, Y., Guo, Y. N., Sun, C. H., Wood, B., Wang, L. Z., Hulicova-Jurcakova, D., Zou, J., Rudolph, V., and Lu, G. O. M. (2009) Visible-light photoresponsive heterojunctions of (Nb-Ti-Si) and (Bi/Bi-o) nanoparticles, *Electrochem. Commun.* 11, 509-514.
- Lim, M., Zhou, Y., Wang, L. Z., Rudolph, V., and Lu, G. Q. (2009) Development and potential of new generation photocatalytic systems for air pollution abatement: an overview, Asia-Pac. J. Chem. Eng. 4, 387-402.
- Lim, M., Zhou, Y., Wood, B., Wang, L. Z., Rudolph, V., and Lu, G. Q. (2009) Highly Thermostable Anatase Titania-Pillared Clay for the Photocatalytic Degradation of Airborne Styrene, *Environ. Sci. Technol.* 43, 538-543.
- Lin, C. X., Qiao, S. Z., Yu, C. Z., Ismadji, S., and Lu, G. Q. (2009) Periodic mesoporous silica and organosilica with controlled morphologies as carriers for drug release, *Microporous Mesoporous Mat. 117*, 213-219.
- Lin, C. X., Yuan, P., Yu, C. Z., Qiao, S. Z., and Lu, G. Q. (2009) Cooperative selfassembly of silica-based mesostructures templated by cationic fluorocarbon/ hydrocarbon mixed-surfactants, *Microporous Mesoporous Mat. 126*, 253-261.

- Lipin, D. I., Raj, A., Lua, L. H., and Middelberg, A. P. (2009) Affinity purification of viral protein having heterogeneous quaternary structure: modeling the impact of soluble aggregates on chromatographic performance, *J Chromatogr A 1216*, 5696-5708.
- Liu, G., Lu, H. F., Chen, Z. G., Li, F., Wang, L. Z., Watts, J., Lu, G. Q., and Cheng, H. M. (2009) Ti-Zr-O Nanotube Arrays with Controlled Morphology, Crystal Structure and Optical Properties, *J. Nanosci. Nanotechnol.* 9, 6501-6510.
- Liu, G., Sun, C. H., Cheng, L. N., Jin, Y. G., Lu, H. F., Wang, L. Z., Smith, S. C., Lu, G. Q., and Cheng, H. M. (2009) Efficient Promotion of Anatase TiO2 Photocatalysis via Bifunctional Surface-Terminating Ti-O-B-N Structures, *J. Phys. Chem. C* 113, 12317-12324.
- Liu, G., Sun, C. H., Yan, X. X., Cheng, L., Chen, Z. G., Wang, X. W., Wang, L. Z., Smith, S. C., Lu, G. Q., and Cheng, H. M. (2009) lodine doped anatase TiO2 photocatalyst with ultra-long visible light response: correlation between geometric/electronic structures and mechanisms, *J. Mater. Chem.* 19, 2822-2829.
- Liu, G., Wang, L. Z., Sun, C. H., Chen, Z. G., Yan, X. X., Cheng, L., Cheng, H. M., and Lu, G. Q. (2009) Nitrogen-doped titania nanosheets towards visible light response, *Chem. Commun.*, 1383-1385.
- Liu, G., Wang, L. Z., Sun, C. H., Yan, X. X., Wang, X. W., Chen, Z. G., Smith, S. C., Cheng, H. M., and Lu, G. Q. (2009) Band-to-Band Visible-Light Photon Excitation and Photoactivity Induced by Homogeneous Nitrogen Doping in Layered Titanates, *Chem. Mat.* 21, 1266-1274.
- Liu, G., Wang, X. W., Chen, Z. G., Cheng, H. M., and Lu, G. Q. (2009) The role of crystal phase in determining photocatalytic activity of nitrogen doped TiO2, *Journal of Colloid and Interface Science 329*, 331-338.
- Liu, G., Wang, X. W., Sun, C. H., Wang, L. Z., Cheng, H. M., and Lu, G. Q. (2009) Enhanced Photoactivity of Oxygen Deficient Anatase TiO2 Sheets with Dominant (001) Facets, *J. Phys. Chem. C* 113, 21784-21788.
- Liu, G., Wang, X. W., Wang, L. Z., Chen, Z. G., Li, F., Lu, G. Q., and Cheng, H. M. (2009) Drastically enhanced photocatalytic activity in nitrogen doped mesoporous TiO2 with abundant surface states, *Journal of Colloid and Interface Science 334*, 171-175.
- Liu, G., Yan, X. X., Chen, Z. G., Wang, X. W., Wang, L. Z., Lu, G. Q., and Cheng, H. M. (2009) Synthesis of rutileanatase core-shell structured TiO2 for photocatalysis, *J. Mater. Chem.* 19, 6590-6596.
- Liu, G., Yang, H. G., Sun, C. H., Cheng, L., Wang, L. Z., Lu, G. Q., and Cheng, H. M. (2009) Titania polymorphs derived from crystalline titanium diboride, *Cryst Eng Comm* 11, 2677-2682.

- Liu, G., Yang, H. G., Wang, X. W., Cheng, L. N., Pan, J., Lu, G. Q., and Cheng, H. M. (2009) Visible Light Responsive Nitrogen Doped Anatase TiO2 Sheets with Dominant (001) Facets Derived from TiN, *Journal of the American Chemical Society 131*, 12868-12869.
- Liu, Y. O., Cong, H. T., Wang, W., Sun, C. H., and Cheng, H. M. (2009) AlN nanoparticle-reinforced nanocrystalline Al matrix composites: Fabrication and mechanical properties, *Materials Science and Engineering a-Structural Materials Properties Microstructure and Processing 505*, 151-156.
- 100. Lonsdale, D. E., Whittaker, M. R., and Monteiro, M. J. (2009) Self-Assembly of Well-Defined Amphiphilic Polymeric Miktoarm Stars, Dendrons, and Dendrimers in Water: The Effect of Architecture, Journal of Polymer Science Part a-Polymer Chemistry 47, 6292-6303.
- 101. Lu, T., Yao, X. D., Lu, G. Q., and He, Y. H. (2009) Controlled evolution from multilamellar vesicles to hexagonal mesostructures through the addition of 1,3,5-trimethylbenzene, *Journal of Colloid and Interface Science 336*, 368-373.
- Lutton, C., Sugiyama, S., Wullschleger, M. E., Williams, R., Campbell, J. H., Crawford, R., and Goss, B. (2009) Transplanted abdominal granulation tissue induced bone formation - an in vivo study in sheep, *Connect Tissue Res* 50, 256-262.
- 103. Ma, C. Y., Dou, B. J., Li, J. J., Cheng, J., Hu, Q., Hao, Z. P., and Qiao, S. Z. (2009) Catalytic oxidation of benzyl alcohol on Au or Au-Pd nanoparticles confined in mesoporous silica, *Appl. Catal. B-Environ. 92*, 202-208.
- Malcolm, A. S., Dexter, A. F., Katakdhond, J. A., Karakashev, S. I., Nguyen, A. V., and Middelberg, A. P. (2009) Tuneable control of interfacial rheology and emulsion coalescence, *Chemphyschem 10*, 778-781.
- 105. Mao, X. L., Peng, H., Ling, J. Q., Friis, T., Whittaker, A. K., Crawford, R., and Xiao, Y. (2009) Enhanced human bone marrow stromal cell affinity for modified poly (L-lactide) surfaces by the upregulation of adhesion molecular genes, *Biomaterials* 30, 6903-6911.
- Marcellin, E., Gruber, C. W., Archer, C., Craik, D. J., and Nielsen, L. K. (2009)
   Proteome analysis of the hyaluronic acidproducing bacterium, Streptococcus zooepidemicus, *Proteome Science* 7.
- Marcon, L., Spriet, C., Meehan, T. D., Battersby, B. J., Lawrie, G. A., Heliot, L., and Trau, M. (2009) Synthesis and Application of FRET Nanoparticles in the Profiling of a Protease, *Small 5*, 2053-2056.
- Marschall, R., Bannat, I., Feldhoff, A., Wang, L. Z., Lu, G. Q., and Wark, M. (2009) Nanoparticles of Mesoporous SO3H-Functionalised Si-MCM-41 with Superior Proton Conductivity, *Small 5*, 854-859.
- Meng, B., Tana, X. Y., Menga, X. X., Qiao, S. Z., and Liu, S. M. (2009) Porous and dense Ni hollow fibre membranes, *J. Alloy. Compd.* 470, 461-464.

- Miller, E., and Cooper-White, J. (2009) The effects of chain conformation in the microfluidic entry flow of polymersurfactant systems, *Journal of Non-Newtonian Fluid Mechanics* 160, 22-30.
- Mimouni, A., Deeth, H. C., Whittaker, A. K., Gidley, M. J., and Bhandari, B. R. (2009) Rehydration process of milk protein concentrate powder monitored by static light scattering, *Food Hydrocolloids 23*, 1958-1965.
- Minchin, R. F., and Martin, D. J. (2010) Minireview: Nanoparticles for Molecular Imaging--An Overview, *Endocrinology* 151, 474-481. Epub 16 Dec 2009.
- 113. Mooney, J. E., Rolfe, B. E., Osborne, G. W., Sester, D. P., van Rooijen, N., Campbell, G. R., Hume, D. A., and Campbell, J. H. (2010) Cellular plasticity of inflammatory myeloid cells in the peritoneal foreign body response, *Am J Pathol* 176, 369-380. Epub Dec 11 2009.
- Mureev, S., Kovtun, O., Nguyen, U. T., and Alexandrov, K. (2009) Speciesindependent translational leaders facilitate cell-free expression, *Nat Biotechnol 27*, 747-752.
- 115. Musumeci, A., Gosztola, D., Schiller, T., Dimitrijevic, N. M., Mujica, V., Martin, D., and Rajh, T. (2009) SERS of Semiconducting Nanoparticies (TiO2 Hybrid Composites), *Journal of the American Chemical Society 131*, 6040-+.
- 116. Nguyen, U. T., Guo, Z., Delon, C., Wu, Y., Deraeve, C., Franzel, B., Bon, R. S., Blankenfeldt, W., Goody, R. S., Waldmann, H., Wolters, D., and Alexandrov, K. (2009) Analysis of the eukaryotic prenylome by isoprenoid affinity tagging, *Nat Chem Biol* 5, 227-235.
- 117. Noohom, W., Jack, K. S., Martin, D., and Trau, M. (2009) Understanding the roles of nanoparticle dispersion and polymer crystallinity in controlling the mechanical properties of HA/PHBV nanocomposites, *Biomedical Materials 4.*
- Onaizi, S. A., He, L., and Middelberg, A. P. (2009) Rapid screening of surfactant and biosurfactant surface cleaning performance, *Colloids Surf B Biointerfaces 72*, 68-74.
- 119. Ou, D. R., Mori, T., Ye, F., Miyayama, M., Nakayama, S., Zou, J., Auchterlonie, G. J., and Drennan, J. (2009) Microstructural Characteristics of SDC Electrolyte Film Supported by Ni-SDC Cermet Anode, *J. Electrochem. Soc.* 156, B825-B830.
- Ou, D. R., Mori, T., Ye, F., Zou, J., and Drennan, J. (2009) Direct-currentinduced transformation at the interface between platinum anode and holmiumdoped ceria electrolyte, *J. Appl. Phys. 105*, 5.
- Ouyang, D., Shah, N., Zhang, H., Smith, S. C., and Parekh, H. S. (2009) Reducible Disulfide-Based Non-Viral Gene Delivery Systems, *Mini-Rev. Med. Chem. 9*, 1242-1250.
- 122. Ouyang, D., Zhang, H., Herten, D. P., Parekh, H. S., and Smith, S. C. (2009) Flexibility of Short-Strand RNA in Aqueous Solution as Revealed by Molecular Dynamics Simulation: Are A-RNA and A'-RNA Distinct Conformational Structures?, Aust. J. Chem 62, 1054-1061.

- 123. Pan, F. S., Jia, H. P., Qiao, S. Z., Jiang, Z. Y., Wang, J. T., Wang, B. Y., and Zhong, Y. R. (2009) Bioinspired fabrication of high performance composite membranes with ultrathin defect-free skin layer, *Journal of Membrane Science 341*, 279-285.
- Pascual, S., and Monteiro, M. J. (2009) Shell-crosslinked nanoparticles through self-assembly of thermoresponsive block copolymers by RAFT polymerisation, *European Polymer Journal 45*, 2513-2519.
- Peng, H., Blakey, I., Dargaville, B., Rasoul, F., Rose, S., and Whittaker, A. K. (2009) Synthesis and Evaluation of Partly Fluorinated Block Copolymers as MRI Imaging Agents, *Biomacromolecules 10*, 374-381.
- 126. Peng, H., Xiao, Y., Mao, X. L., Chen, L., Crawford, R., and Whittaker, A. K. (2009) Amphiphilic Triblock Copolymers of Methoxy-poly(ethylene glycol)-b-poly(Llactide)-b-poly(L-lysine) for Enhancement of Osteoblast Attachment and Growth, *Biomacromolecules* 10, 95-104.
- Pilbrough, W., Munro, T. P., and Gray, P. (2009) Intraclonal protein expression heterogeneity in recombinant CHO cells, *PLoS One 4*, e8432.
- 128. Png, G. M., Falconer, R. J., Fischer, B. M., Zakaria, H. A., Mickan, S. P., Middelberg, A. P., and Abbott, D. (2009) Terahertz spectroscopic differentiation of microstructures in protein gels, *Opt Express 17*, 13102-13115.
- Prowse, A., Wolvetang, E., and Gray, P. (2009) A rapid, cost-effective method for counting human embryonic stem cell numbers as clumps, *Biotechniques* 47, 599-606.
- Prowse, A. B., Wilson, J., Osborne, G. W., Gray, P. P., and Wolvetang, E. J. (2009) Multiplexed staining of live human embryonic stem cells for flow cytometric analysis of pluripotency markers, *Stem Cells Dev 18*, 1135-1140.
- Puttick, S., Irvine, D. J., Licence, P., and Thurecht, K. J. (2009) RAFT-functional ionic liquids: towards understanding controlled free radical polymerisation in ionic liquids, *J. Mater. Chem.* 19, 2679-2682.
- 132. Qiao, S. Z., Hu, Q. H., Haghseresht, F., Hu, X. J., and Lu, G. Q. M. (2009) An Investigation on the Adsorption of Acid Dyes on Bentonite Based Composite Adsorbent, *Separation and Purification Technology* 67, 218-225.
- 133. Qiao, S. Z., Lin, C. X., Jin, Y. G., Li, Z., Yan, Z. M., Hao, Z. P., Huang, Y. N., and Lu, G. Q. (2009) Surface-Functionalised Periodic Mesoporous Organosilica Hollow Spheres, *J. Phys. Chem. C* 113, 8673-8682.
- Quek, L. E., Wittmann, C., Nielsen, L. K., and Kromer, J. O. (2009) OpenFLUX: efficient modelling software for C-13based metabolic flux analysis, *Microbial Cell Factories 8*.
- 135. Rosen, B. M., Jiang, X., Wilson, C. J., Nguyen, N. H., Monteiro, M. J., and Percec, V. (2009) The Disproportionation of Cu(I)X Mediated by Ligand and Solvent into Cu(0) and Cu(II)X-2 and Its Implications for SET-LRP, *Journal* of Polymer Science Part a-Polymer Chemistry 47, 5606-5628.

- Rufford, T. E., Hulicova-Jurcakova, D., Fiset, E., Zhu, Z. H., and Lu, G. Q. (2009) Double-layer capacitance of waste coffee ground activated carbons in an organic electrolyte, *Electrochem. Commun.* 11, 974-977.
- Rufford, T. E., Hulicova-Jurcakova, D., Zhu, Z. H., and Lu, G. Q. (2009) Empirical Analysis of the Contributions of Mesopores and Micropores to the Double-Layer Capacitance of Carbons, J. Phys. Chem. C 113, 19335-19343.
- Russo, M. A. L., O'Sullivan, C., Rounsefell, B., Halley, P. J., Truss, R., and Clarke, W. P. (2009) The anaerobic degradability of thermoplastic starch: Polyvinyl alcohol blends: Potential biodegradable food packaging materials, *Bioresource Technology 100*, 1705-1710.
- Russo, M. A. L., Truss, R., and Halley, P. J. (2009) The enzymatic hydrolysis of starch-based PVOH and polyol plasticised blends, *Carbohydrate Polymers* 77, 442-448.
- Saeed, A. O., Dey, S., Howdle, S. M., Thurecht, K. J., and Alexander, C. (2009) One-pot controlled synthesis of biodegradable and biocompatible copolymer micelles, *J. Mater. Chem.* 19, 4529-4535.
- 141. Seo, S. M., Kim, G. H., Kim, Y. H., Wang, L. Z., Lu, G. Q., and Lim, W. T. (2009) Single-crystal Structure of Fully Dehydrated and Largely NH4+exchanged Zeolite Y (FAU, Si/AI=1.70), vertical bar(NH4)(60)Na-11 vertical bar[Si121AI710384]-FAU, Bull. Korean Chem. Soc. 30, 543-550.
- 142. Shen, Q., Li, L. D., He, C., Tian, H., Hao, Z. P., and Xu, Z. P. (2009) A comprehensive investigation of influences of NO and O-2 on N2O-SCR by CH4 over Fe-USY zeolite, *Appl. Catal. B-Environ. 91*, 262-268.
- Surawski, P. P. T., Battersby, B. J., Vogel, R., Lawrie, G., and Trau, M. (2009) Modification and optimisation of organosilica microspheres for peptide synthesis and microsphere-based immunoassays, *Molecular Biosystems 5*, 826-831.
- 144. Tan, K. T., Guiu-Rozas, E., Bon, R. S., Guo, Z., Delon, C., Wetzel, S., Arndt, S., Alexandrov, K., Waldmann, H., Goody, R. S., Wu, Y. W., and Blankenfeldt, W. (2009) Design, synthesis, and characterisation of peptide-based rab geranylgeranyl transferase inhibitors, *J Med Chem 52*, 8025-8037.
- 145. Tang, D. M., Liu, G., Li, F., Tan, J., Liu, C., Lu, G. Q., and Cheng, H. M. (2009) Synthesis and Photoelectrochemical Property of Urchin-like Zn/ZnO Core-Shell Structures, J. Phys. Chem. C 113, 11035-11040.
- 146. Tanksale, A., Zhou, C. H., Beltramini, J. N., and Lu, G. Q. (2009) Hydrogen production by aqueous phase reforming of sorbitol using bimetallic Ni-Pt catalysts: metal support interaction, J. *Incl. Phenom. Macrocycl. Chem.* 65, 83-88.

- Thurecht, K. J., and Howdle, S. M. (2009) Controlled Dispersion Polymerisation in Supercritical Carbon Dioxide, Aust. J. Chem. 62, 786-789.
- Timmins, N. E., and Nielsen, L. K. (2009) Blood cell manufacture: current methods and future challenges, *Trends in Biotechnology 27*, 415-422.
- 149. Timmins, N. E., Palfreyman, E., Marturana, F., Dietmair, S., Luikenga, S., Lopez, G., Fung, Y. L., Minchinton, R., and Nielsen, L. K. (2009) Clinical Scale Ex Vivo Manufacture of Neutrophils From Hematopoietic Progenitor Cells, *Biotechnology and Bioengineering 104*, 832-840.
- Titmarsh, D., and Cooper-White, J. (2009) Microbioreactor Array for Full-Factorial Analysis of Provision of Multiple Soluble Factors in Cellular Microenvironments, *Biotechnology and Bioengineering 104*, 1240-1244.
- 151. Tran, N. H., Wilson, M. A., Milev, A. S., Bartlett, J. R., Lamb, R. N., Martin, D., and Kannangara, G. S. K. (2009) Photoemission and absorption spectroscopy of carbon nanotube interfacial interaction, *Advances in Colloid and Interface Science* 145, 23-41.
- Uhlmann, D., Liu, S. M., Ladewig, B. P., and da Costa, J. C. D. (2009) Cobalt-doped silica membranes for gas separation, *Journal of Membrane Science 326*, 316-321.
- Urbani, C. N., and Monteiro, M. J. (2009) Nanoreactors for Aqueous RAFT-Mediated Polymerisations, *Macromolecules* 42, 3884-3886.
- Urbani, C. N., and Monteiro, M. J. (2009) RAFT-Mediated Emulsion Polymerisation of Styrene in Water using a Reactive Polymer Nanoreactor, *Aust. J. Chem. 62*, 1528-1532.
- 155. Vellayudhan, S., Martin, D., and Cooper-White, J. (2009) Evaluation of Dynamic Creep Properties of Surgical Mesh Prostheses-Uniaxial Fatigue, *Journal* of Biomedical Materials Research Part B-Applied Biomaterials 91B, 287-296.
- 156. Vickers, C. E., Gershenzon, J., Lerdau, M. T., and Loreto, F. (2009) A unified mechanism of action for volatile isoprenoids in plant abiotic stress, *Nat Chem Biol 5*, 283-291.
- 157. Wang, D. W., Li, F., Zhao, J. P., Ren, W. C., Chen, Z. G., Tan, J., Wu, Z. S., Gentle, I., Lu, G. Q., and Cheng, H. M. (2009) Fabrication of Graphene/ Polyaniline Composite Paper via In Situ Anodic Electropolymerisation for High-Performance Flexible Electrode, ACS Nano 3, 1745-1752.
- 158. Wang, H. N., Yuan, P., Zhou, L., Guo, Y. N., Zou, J., Yu, A. M., Lu, G. Q., and Yu, C. Z. (2009) Synthesis and characterisation of TiO2-incorporated silica foams, *Journal of Materials Science* 44, 6484-6489.
- 159. Wang, L. Z., Tang, F. Q., Ozawa, K., Chen, Z. G., Mukherj, A., Zhu, Y. C., Zou, J., Cheng, H. M., and Lu, G. Q. (2009) A General Single-Source Route for the Preparation of Hollow Nanoporous Metal Oxide Structures, *Angew. Chem.-Int. Edit.* 48, 7048-7051.

- 160. Wang, L. Z., Tang, F. Q., Ozawa, K., and Lu, G. Q. (2009) Layer-by-layer assembly of inorganic nano-objects and photo/ electrochemical properties (Review), *International Journal of Surface Science and Engineering* 3, 44-63.
- Wang, X. W., Liu, G., Chen, Z. G., Li, F., Lu, G. Q., and Cheng, H. M. (2009) Efficient and stable photocatalytic H-2 evolution from water splitting by (Cd0.8Zn0.2)S nanorods, *Electrochem. Commun.* 11, 1174-1178.
- Wang, X. W., Liu, G., Chen, Z. G., Li, F., Lu, G. Q., and Cheng, H. M. (2009) Synthesis and Photoelectrochemical Behavior of Nitrogen-doped NaTaO3, *Chem. Lett.* 38, 214-215.
- 163. Wang, X. W., Liu, G., Chen, Z. G., Li, F., Wang, L. Z., Lu, G. Q., and Cheng, H. M. (2009) Enhanced photocatalytic hydrogen evolution by prolonging the lifetime of carriers in ZnO/CdS heterostructures, *Chem. Commun.*, 3452-3454.
- Wang, Z. G., Liu, H., Tan, X. Y., Jin, Y. G., and Liu, S. M. (2009) Improvement of the oxygen permeation through perovskite hollow fibre membranes by surface acid-modification, *Journal of Membrane Science 345*, 65-73.
- 165. Wong, E. H. M., Rondeau, E., Schuetz, P., and Cooper-White, J. (2009) A microfluidic-based method for the transfer of biopolymer particles from an oil phase to an aqueous phase, *Lab on a Chip* 9, 2582-2590.
- 166. Wu, Q., Hu, X., Yu, P. L., Feng, J., Chen, X., Zhang, H., and Qiao, S. Z. (2009) Modeling of a Pilot-scale Trickle Bed Reactor for the Catalytic Oxidation of Phenol, *Separation and Purification Technology* 67, 158-165.
- 167. Wu, Y. W., Goody, R. S., Abagyan, R., and Alexandrov, K. (2009) Structure of the disordered C terminus of Rab7 GTPase induced by binding to the Rab geranylgeranyl transferase catalytic complex reveals the mechanism of Rab prenylation, *J Biol Chem 284*, 13185-13192.
- Xing, W., Huang, C. C., Zhuo, S. P., Yuan, X., Wang, G. Q., Hulicova-Jurcakova, D., Yan, Z. F., and Lu, G. Q. (2009) Hierarchical porous carbons with high performance for supercapacitor electrodes, *Carbon* 47, 1715-1722.
- Yan, M., Mori, T., Zou, J., and Drennan, J. (2009) Effect of Grain Growth on Densification and Conductivity of Ca-Doped CeO2 Electrolyte, J. Am. Ceram. Soc. 92, 2745-2750.
- 170. Yan, M., Mori, T., Zou, J., Ye, F., Ou, D. R., and Drennan, J. (2009) TEM and XPS analysis of CaxCe1-xO2-y (x=0.05-0.5) as electrolyte materials for solid oxide fuel cells, *Acta Mater.* 57, 722-731.
- 171. Yang, H., Han, K. L., Nanbu, S., Balint-Kurti, G. G., Zhang, H., Smith, S. C., and Hankel, M. (2009) Initial rotational quantum state excitiation and isotopic effects for the O(D-1) + HCl -> OH + Cl (OCl + H) reaction, *Journal of Theoretical & Computational Chemistry 8*, 1003-1024.

- 172. Yang, H., Han, K. L., Schatz, G. C., Lee, S. H., Liu, K., Smith, S. C., and Hankel, M. (2009) Integral and differential cross sections for the S(D-1) plus HD reaction employing the ground adiabatic electronic state, *Phys. Chem. Chem. Phys. 11*, 11587-11595.
- Yang, H. G., Liu, G., Qiao, S. Z., Sun, C. H., Jin, Y. G., Smith, S. C., Zou, J., Cheng, H. M., and Lu, G. O. (2009) Solvothermal Synthesis and Photoreactivity of Anatase TiO2 Nanosheets with Dominant {001} Facets, *Journal of the American Chemical Society* 131, 4078-4083.
- 174. Yu, A. M., Gentle, I. R., and Lu, G. Q. (2009) Biocompatible polypeptide microcapsules via templating mesoporous silica spheres, *Journal of Colloid and Interface Science 333*, 341-345.
- 175. Yu, J. J., Cheng, J., Ma, C. Y., Wang, H. L., Li, L. D., Hao, Z. P., and Xu, Z. P. (2009) NOx decomposition, storage and reduction over novel mixed oxide catalysts derived from hydrotalcite-like compounds, *Journal of Colloid and Interface Science 333*, 423-430.
- 176. Yuan, P., Zhou, X. F., Wang, H. N., Liu, N. A., Hu, Y. F., Auchterlonie, G. J., Drennan, J., Yao, X. D., Lu, G. Q., Zou, J., and Yu, C. Z. (2009) Electron-Tomography Determination of the Packing Structure of Macroporous Ordered Siliceous Foams Assembled From Vesicles, *Small 5*, 377-382.
- 177. Zeng, P. Y., Shao, Z. P., Liu, S. M., and Xu, Z. P. (2009) Influence of M cations on structural, thermal and electrical properties of new oxygen selective membranes based on SrCo0.95M0.05O3-delta perovskite, *Separation and Purification Technology* 67, 304-311.
- 178. Zhang, H., Wang, S. F., Sun, Q., and Smith, S. C. (2009) Kinetic isotope effect for ground state proton transfer in the green fluorescent protein: a quantumkinetic model, *Phys. Chem. Chem. Phys. 11*, 8422-8424.
- Zhang, H., Xu, Z. P., Lu, G. Q., and Smith, S. C. (2009) Intercalation of Sulfonate into Layered Double Hydroxide: Comparison of Simulation with Experiment, *J. Phys. Chem. C* 113, 559-566.
- Zhang, L., Qiao, S. Z., Yan, Z. F., Zheng, H. J., Li, L., Ding, R. G., and Lu, G. Q. (2009) CNTs/mesostructured silica coreshell nanowires via interfacial surfactant templating, *Chin. Sci. Bull.* 54, 516-520.
- Zhang, Y. Q., Ga, X. Q., Wang, Y. L., Zhang, Y. H., and Lu, G. Q. (2009) Study on the build of channels in accurate separation membrane and its selective mechanism, *Journal of Membrane Science 339*, 100-108.
- Zhao, C. X., and Middelberg, A. P. (2009) Microfluidic mass-transfer control for the simple formation of complex multiple emulsions, *Angew Chem Int Ed Engl 48*, 7208-7211.

- 183. Zheng, H. J., Tang, F. Q., Jia, Y., Wang, L. Z., Chen, Y. C., Lim, M., Zhang, L., and Lu, G. Q. (2009) Layer-by-layer assembly and electrochemical properties of sandwiched film of manganese oxide nanosheet and carbon nanotube, *Carbon* 47, 1534-1542.
- Zheng, H. J., Tang, F. Q., Lim, M., Rufford, T., Mukherji, A., Wang, L. Z., and Lu, G. Q. (2009) Electrochemical behavior of carbon-nanotube/cobalt oxyhydroxide nanoflake multilayer films, *J. Power Sources* 193, 930-934.

## **AIBN SEMINARS 2009**

Friday 30 January Associate Professor Peter Kingshott Interdisciplinary Nanoscience Centre (iNANO), The University of Aarhus, Denmark. Title: New material surfaces based on polymer nanofibres and colloids

## Friday 13 February

Professor Marcus Textor, ETH Zurich, BioInterfaceGroup, Department of Materials, Zurich, Switzerland Title: Bioinspired surface modification and characterisation for applications in the biosciences

## Wednesday 4 March 2009

Professor Minoru Terano, School of Materials Science, Japan Advanced Institute of Science and Technology (JAIST) Title: Historical developments and recent achievements in heterogeneous olefin polymerisation catalysts

## Thursday 5 March

**Dr John Forsythe**, Department of Materials Engineering, Division of Biological Engineering, Monash University, Australia Title: Nerve repair in the CNS using scaffolds

Thursday 12 March **Professor Paul Meredith**, School of Mathematics & Physics, The University of Queensland, Australia Title: Advanced materials for a sustainable future – from solar cells to chemi-sensors

### Thursday 19 March

Professor Nick Fisk, Director, UQ Centre for Clinical Research, The University of Queensland, Australia

## Title: Fetal stem-cells: betwixt and between

Thursday 19 March

Professor Lu Chang Qin, W.M. Keck Laboratory for Atomic Imaging and Manipulation, Department of Physics and Astronomy, University of North Carolina at Chapel Hill, North Carolina, USA Title: Structure, property and applications of single nanotubes and nanowires

### Thursday 26 March

Professor Mark Dodgson, Director of the Technology and Innovation Management Centre, The University of Queensland, Australia Title: Managing innovation

## Thursday 7 April

Professor Erich Windhab, Swiss Federal Institute of Technology Zürich (ETH), Switzerland: Institute of Food Science and Nutrition; Laboratory of Food Process Engineering Title: Process engineering of complex multiphase

Thursday 9 April Professor Matt Cooper, Institute for Molecular Bioscience, The University of Queensland, Australia Title: Biosensors and interfaces – an industry perspective

Thursday 16 April Drs David Haylock and Susan Nilssen, Australian Stem Cell Centre, Melbourne, Australia Title: Constructing an artificial haemopoietic stem cell niche; understanding the critical components

### Thursday 23 April

Duncan McGillivray, AINSE Research Fellow, University of Auckland Title: Clues to cellular membrane interactions using X-rays and Neutrons

### Wednesday 29 April

Michelle Peake, Chief Operating Officer, Alpha Biologics Pty Ltd Title: Building and equipment design in

### compliance with cGMP for a biopharmaceutical facility in Malaysia

### Thursday 30 April

Assistant Professor Matthew Hynd, College of Nanoscale Science and Engineering, Title: Emerging applications of nanobiotechnology

Friday 1 May Professor Maria Forsyth, Monash University, Melbourne, Australia

Title: Taming the reactive metal: passive surface formation in ionic liquids

### Wednesday 6 May

Professor Jim Swartz, Departments of Chemical Engineering and Bioengineering, Stanford University, USA

Title: Cell-free synthesis of complex enzymes and protein assemblies for biofuels and vaccines

## Thursday 7 May

Mr Elvis Shoko (PhD candidate), Department of Physics and Condensed Matter Physics Group, The University of Queensland, Australia **Title:** Charge distribution near oxygen vacancies in cerium oxides

### Thursday 14 May

Marshall, Investment Manager, Uniseed, Australia Title: Uniseed - commercialising UQ technology through start-ups

### Thursday 21 May

Professor Ko Higashitani, Graduate School of Engineering, Kyoto University, Japan Title: Applications of nano-particles to chemical mechanical polishing, micro-wire networks and living cells

## Thursday 11 June

Professor Annika Scheynius, Karolinska Institutet, Clinical Allergy Research Unit, Karolinska University Hospital Solna, Stockholm, Sweden Title: Interaction of nanomaterials with antigen presenting dendritic cells

Thursday 18 June **Euan Murdoch**, CEO of Goanna Corp Pty Ltd and Founder of Herron Pharmaceuticals Title: Commercialisation: The process can be your best dream or your worst nightmare ... it's your choice

Thursday 25 June Professor Rose Amal, School of Chemical Sciences and Engineering, University of New South Wales, Australia Title: Harnessing solar energy for water and air purifications

Thursday 23 July **Professor Greg G Goss**, Department of Biological Sciences, University of Alberta, Canada Title: Nano-Bio interactions of functionalised silicon and carbon-based nanomaterials

Monday 10 August **Professor Gerry Fuller**, Stanford University **Title**: Oriented collagen materials for contact guidance of cells

### Thursday 13 August

Professor David Reutens, Director, Centre for Advanced Imaging, The University of Queensland, Australia

Title: Imaging and experiments of nature

Thursday 13 August Dr Stephen C. Pak, Magee-Womens Research Institute, Pediatrics, University of Pittsburgh School of Medicine Title: C elegans as tools for drug discovery

## Friday 14 August

Professor Ning Wang, Physics Department and the Institute of Nano Science and Technology, the Hong Kong University of Science and Technology Title: 1D nanomaterials: growth, structure and property

Monday 17 August Dr Patrick Ganster, Centre Interdisciplinaire en Nanoscience de Marseille, France **Title:** Molecular dynamics simulation of silicon oxidisation: strain and diffusion

## Thursday 20 August

Professor Richard Sadus, Director of the Centre for Molecular Simulation, Swinburne University Title: Application of molecular simulation to molecular motors

## Thursday 27 August

Bill Walker, Department of Employment Economic Development and Innovation Title: Nanotechnology in Queensland - An industry development perspective

### Thursday 10 September

Professor Paul Burn, School of Chemistry and Molecular Biosciences, The University of Oueensland, Australia Title: Probing Interactions of light-emitting materials with neutrons

## Thursday 17 September

Bob Christiansen and Gareth Dando, Southern Cross Venture Partners, Australia Title: How NOT to get your start-up VC funded -common mistakes on the fundraising trail

## Thursday 24 September

Professor Xungai Wang, Centre for Material and Fibre Innovation, Deakin University Title: Recent research on nanofibres and biological fibres

## Thursday 8 October

Professor Jurg Keller, Advanced Water Management Centre, The University of Queensland, Australia Title: Novel biotechnology opportunities with bioelectrochemical systems

## Thursday 15 October

Professor Peter Hodgson, Deakin University Title: Nanostructural engineering of metals

## Thursday 22 October

Professor Lidia Morawska and Peter McGarry Title: Detection and characterisation of airborne engineered nanoparticles as part of exposure assessment and management

Thursday 29 October Professor Graeme George, Queensland University of Technology and School of Engineering, The University of Queensland Title: From engineering polymers to biomaterials: silicones in scar remediation

### Thursday 5 November

Professor Kazuyoshi Takayama, Institute of Fluid Science, Tohoku University, Japan Title: Applications of shock wave research to medicine in tohoku university

## Thursday 12 November

Professor Brad Sherman, TC Beirne School of Law, the University of Queensland, Australia Title: Patent law for frontier technologies: issues for the future

Tuesday 17 November Dr Leslie Yeo, Micro/Nanophysics Research Laboratory, Department of Mechanical & Aerospace Engineering, Monash University, Melbourne Title: Micro/nanophysics

Thursday 19 November Professor George Simon, Department of Materials Engineering, Monash University Title: Functional Polymer Nanocomposites

## Thursday 26 November

Professor Herbert Waldmann, Director of Max-Planck Institute, Germany

Title: Surface immobilisation and ligation of biomolecules

### Friday 27 November

Professor Søren Hvilsted, Danish Polymer Centre, Department of Chemical and Biochemical Engineering, Technical University of Denmark Title: The Potential of "click" chemistry on conducting polymers with special emphasis on selective functionalisation by "electroclick" chemistry

Monday 14 December Yusuf Yagci, Department of Chemistry, Istanbul

Title: Photochemical methods for the preparation of nano and complex macromolecular structures

## Monday 14 December

Professor Balasubramanian Viswanathan, Head, National Centre for Catalysis Research, Indian Institute of Technology – Madras, India Title: Catalytic applications for energy conversion processes

AIBN acknowledges the support of the Queensland Government and Atlantic Philanthropies.

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