AIBN 07

annual report

The University Of Queensland
AUSTRALIA

AUSTRALIAN INSTITUTE FOR BIOENGINEERING
AND NANOTECHNOLOGY (AIBN)

ANNUAL REPORT 07

contents

VICE-CHANCELLOR'S MESSAGE

The University of Queensland's Australian Institute for Bioengineering and Nanotechnology (AIBN) is rapidly gaining global traction by blending excellence in discovery with attention to the needs of industry and other end-users of research.

Focussing on outcomes that will benefit human health and the environment, AIBN scientists and engineers integrate the physical, chemical and biological sciences. They utilise some of Australia's newest and best bio infrastructure to apply innovative ideas and techniques, and have the added advantage of access to high-quality equipment and people throughout UQ.

AIBN is part of UQ's suite of research institutes. Staff maximise the impact of their own expertise by collaborating with – in particular – peers in the Institute for Molecular Bioscience, the Diamantina Institute for Cancer, Immunology and Metabolic Medicine, the Queensland Brain Institute, the Sustainable Minerals Institute, the Faculty of Biological and Chemical Sciences, the Faculty of Engineering, Physical Sciences and Architecture, and the Faculty of Health Sciences.

Under the stewardship of Professor Peter Gray, AIBN staff and students took full advantage of 2007 as their first full year in new $72 million headquarters. Success in grant acquisition, international collaboration and commercialisation, in addition to strong growth in research higher degree (RHD) student numbers, signalled expansion in international and national recognition of the AIBN.

The Institute's fledgling graduate program grew by more than 100 percent. The building houses 90 RHD students, one quarter of whom are from overseas. In addition the AIBN has implemented new programs by which undergraduate students can gain important laboratory experience that contributes toward their degrees. This laboratory experience exposes the students to the leading edge of Australian bio/nano research, further enriching their undergraduate studies.

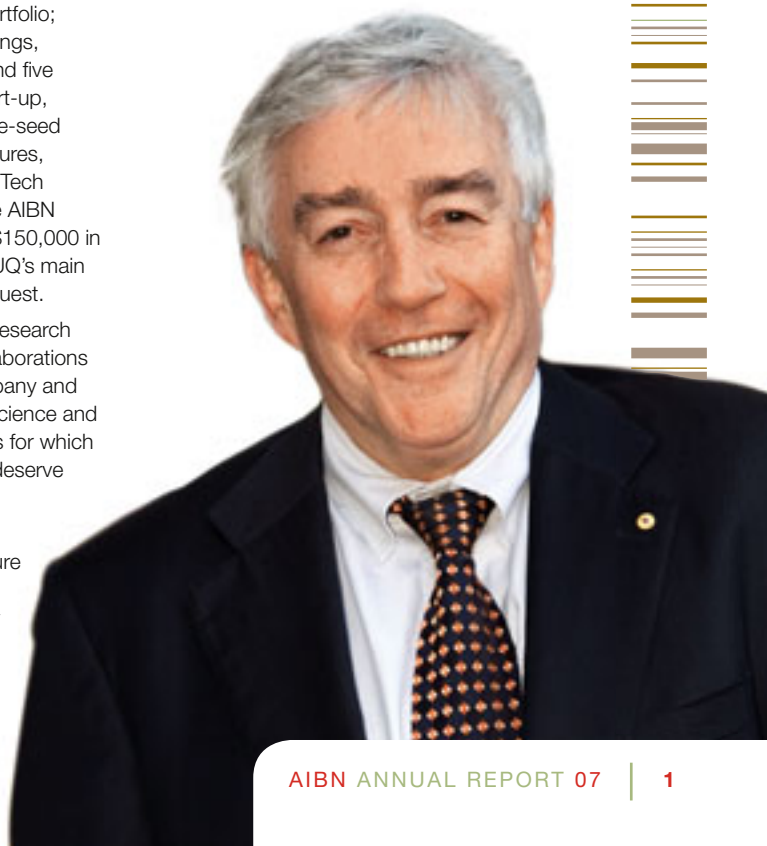
The year also saw the expansion of AIBN's intellectual property portfolio; there were three completed filings, three national phase entries and five provisional patents filed. A start-up, Pepfactants Pty Ltd, raised pre-seed investment, and two new ventures, DendriMed Pty Ltd and TenasiTech Pty Ltd, emerged. As well, five AIBN projects attracted more than $150,000 in proof-of-concept funds from UQ's main commercialisation entity, UniQuest.

Gaining almost $12 million in research grants and forging formal collaborations with The Dow Chemical Company and Korea Advanced Institute of Science and Technology are other initiatives for which Professor Gray and his team deserve great credit.

These and other highlights of 2007 will be a platform for future success by AIBN researchers and their partners in discovery and commercialisation across the national and international communities.

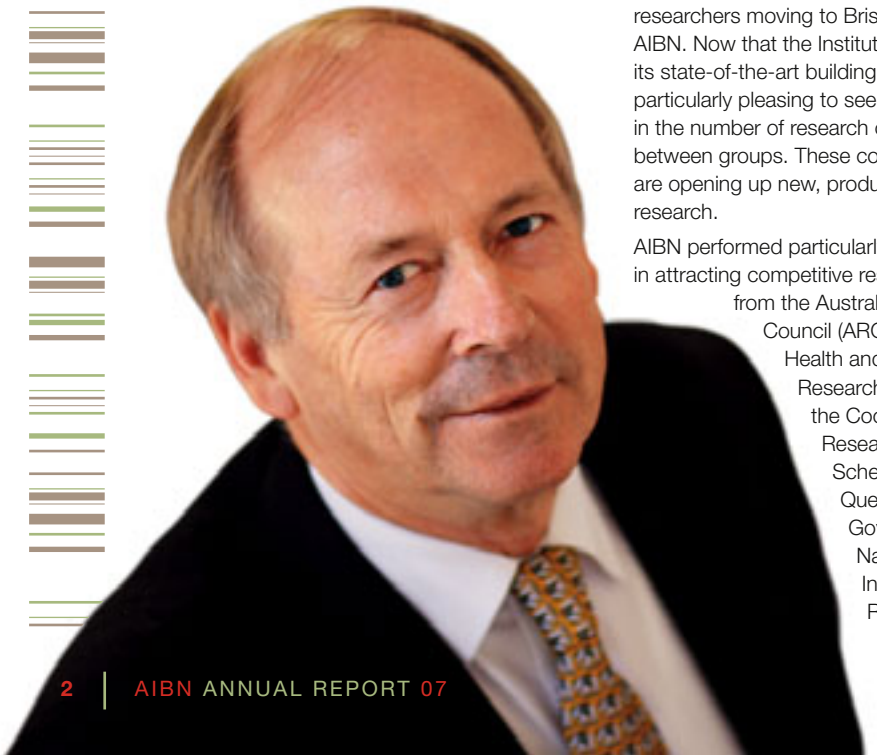
Professor Paul Greenfield AO

VICE-CHANCELLOR
THE UNIVERSITY OF QUEENSLAND



DIRECTOR'S REPORT

It has been gratifying to note that the endeavours of AIBN's staff and students over the last 12 months has enhanced the Institute's national and international reputation in three key areas that collectively distinguish it from other institutes in the country, namely the AIBN's Research Excellence; Industry Focus; and Dynamic Research Environment.



During 2007, AIBN experienced a period of rapid consolidation and growth as the research groups took advantage of the excellent facilities provided in the Institute's new building.

During the year, the number of research groups grew to 17 and by the end of the year the Institute numbered 340 staff and research higher degree students. The reputation of AIBN is rapidly growing, both nationally and internationally, as a place to carry out research of the highest quality at the bio/nano interface. This is demonstrated by the excellent staff and students that our Group Leaders are attracting to the Institute with approximately two thirds of our researchers moving to Brisbane to join AIBN. Now that the Institute is housed in its state-of-the-art building, it has been particularly pleasing to see an increase in the number of research collaborations between groups. These collaborations are opening up new, productive areas of research.

AIBN performed particularly well in 2007 in attracting competitive research funding from the Australian Research Council (ARC), the National Health and Medical Research Council, the Cooperative Research Centre Scheme, from the Queensland State Government's National and International Research Alliances Program and from a number of other Australian and International funding sources as detailed in this report.

In addition, Professor Max Lu's ARC Centre for Functional Nanomaterials was successfully reviewed and as a result awarded the prestigious Centre of Excellence status.

As is befitting for a translational research institute with a strong technology focus, 2007 saw AIBN rapidly expand its commercialisation and technology transfer operations. There are increasing interactions with local small to medium enterprises active in nanotechnology and biotechnology, as well as growing linkages with a number of key multinational partners. The report outlines AIBN start-up companies formed during the year, and the close links developing between the Innovation and Commercial Development team and research groups in the Institute

It is for me to again acknowledge the efforts and contributions of the Institute's 17 Group Leaders, led ably by the AIBN Executive consisting of Professors Julie Campbell, Max Lu, Anton Middelberg and Matt Trau. I also congratulate Ms Donna Hannan for her hard work and dedication in the formation and growth of the Institute. In 2007 the University fittingly recognised the major role she continues to play in the smooth running of AIBN by appointing her Deputy Director (Operations).

The year has also been characterised by a rapid increase in the physical facilities in the building, and I thank Dr Steve Love

and his team for their hard work in rapidly commissioning a wide range of complex equipment, in particular the three NCRIS facilities described in the report.

I must thank the unstinting support of The University of Queensland, in particular the past Vice-Chancellor Professor John Hay who was a tireless advocate for the AIBN. We acknowledge his contribution and look forward to forging a similarly close and enduring relationship with UQ's new Vice-Chancellor Professor Paul Greenfield.

I also thank the Deputy Vice-Chancellor (Research) Professor David Siddle and his staff for their support in the past 12 months. I acknowledge the support of Professors Mick McManus, Stephen Walker and Peter Brooks; the Executive Deans of the Faculty of Biological and Chemical Sciences, the Faculty of Engineering, Physical Sciences and Architecture, and the Faculty of Health Sciences respectively.

In particular I look forward to strengthening relationships with my fellow UQ Research Institute Directors, particularly Professor Brandon Wainwright (Institute for Molecular Bioscience), Professor Perry Bartlett FAA (Queensland Brain Institute), Professor Ian Frazer (The Diamantina Institute for Cancer, Immunology and Metabolic Medicine) and Professor Chris Moran (Sustainable Minerals Institute).

I also thank the Head of the School of Engineering Professor Graham Schaffer and the Head of the School of Molecular and Microbial Sciences Professor Alastair McEwan.

Finally I acknowledge the contribution of Sir Sydney Schubert, the foundation Chair of our State Government Review Committee, who retired from this position in 2007.

Professor Peter Gray

AIBN DIRECTOR

DYNAMIC
RESEARCH ENVIRONMENT

AIBN formalises ties with leading Korean research institute

Demonstrating that AIBN's dynamic research environment is at the front line of the global bioproduct industry, the then Premier of Queensland Honourable Peter Beattie MP witnessed a new partnership with the Korean Advanced Institute of Science and Technology (KAIST) in May 2007.

Regarded as the "MIT of Korea", KAIST has outstanding programs in science and engineering education and research. It is Korea's foremost centre of strategic R&D projects with interests complementary to those of the AIBN.

AIBN and KAIST have teamed up to develop the synthetic biology techniques required to convert sugar cane into "green" plastics and chemicals.

This work involves conducting systems-level analysis and engineering of *E. coli* in order to produce chemicals and materials from sucrose and other related carbon substrates.

Researchers Professor Sang Yup Lee (KAIST) and Professor Lars Nielsen (AIBN) aim to refine the technology so that bacteria will produce the start-up molecules required for plastic and chemical production.

Substituting sucrose for oil in the production of chemicals will reduce the use of non-renewable resources by up to 90 percent. Furthermore, there will be a significant reduction in the amount of energy used in chemical production which currently accounts for seven percent of global energy use.

This will reduce Australia's reliance on the world's diminishing supply of fossil fuels, assist the economic growth of both Korea and Australia, and contribute significantly to a better global environment.

As part of this combined effort it is anticipated that platform technologies in systems biotechnology will be collaboratively developed. In addition, high quality publications and international patents based on the research outcomes are expected.

This relationship formalises existing partnerships between the organisations and will provide opportunities to apply for external grant funding from various research agencies and foster the development of exchange programs for graduate students and researchers between the two organisations.

The Meniscus Project

In any average group of people, one in two has sustained damage to the meniscus in their knee.

The meniscus is the cartilage spacer in the knee found between the thigh and shin bones that absorbs about one third of impact load. Damage to the meniscus manifests as early arthritis and decreased mobility, leading to a decline in quality of life. This obviously has significant implications for Australia's ageing population.

Unlike other body tissues, the meniscus is not supported by an extensive network of blood vessels and consequently is not able to repair itself.

However, some hope does exist for those affected.

AIBN's Meniscus Challenge Project is a multi-disciplinary research effort developing methods to grow an artificial meniscus in a patient's knee. It combines the research of AIBN's Professors Justin Cooper-White and Julie Campbell with that of Professor Peter Brooks from UQ's Faculty of Health Sciences and Dr Peter Myers, a leading Australian orthopaedic surgeon.

Success in this project depends on combining the expertise of these groups to solve complex biological and engineering problems, particularly:

1. Producing scaffolds that encourage the growth of mesenchymal stem cells so that they form the shape and size of a meniscus;
2. Understanding how mesenchymal stem cells differentiate to form the cartilaginous material that is the meniscus, and inducing this process in controlled conditions;
3. Ensuring that there is a method for reliably delivering the required amount of blood to the meniscus.

Researchers are currently undertaking trials in animals to assess their progress to date.

The Meniscus Project came about in 2004 as part of the AIBN's Challenge Project initiative, which aimed to identify ambitious, long-term endeavours focussing on delivering practical outcomes and promoting interdisciplinary research within the Institute.

Critical to the further success of the Meniscus Project has been the attraction of competitive funding from the Australian Research Council.

The research environment at the AIBN, combining the skills of engineers biologists, chemists and computer modelling experts, has played a critical role in establishing and advancing this project. Without the input of both teams it is unlikely the project would have progressed to its current stage in such a short period of time.

INDUSTRY FOCUS

The AIBN and Dow research alliance

In a significant development for Australian research and development, AIBN and world leading chemical company Dow announced a research alliance in late 2007.

This alliance will subject the Institute's science to the intensity of industry demands and global market forces.

The Alliance will initially focus on two key areas, bio-mimicry and developing new manufacturing systems using bio-feedstocks.

The current plastics industry is almost exclusively dependent on petrochemicals and escalating oil costs, concerns about carbon dioxide emissions and global warming, make it imperative to develop new manufacturing processes.

AIBN's research excellence in cell biology and metabolism led by Professor Lars Nielsen, the polymer chemistry structure and function work undertaken by Professor Andrew Whittaker and Associate Professor Michael Monteiro, as well as the chemical self-assembly processing research of Professor Anton Middelberg is being capitalised on by the Dow Chemical Company.

The alliance will ultimately deliver new materials and processes capable of producing desired molecules from renewable resources in a cost effective manner to achieve long term benefits for the consumer.

Together AIBN and Dow will find more resource efficient ways to deliver even better products to markets.

The importance of this alliance is underscored by Dow's position in the global chemical market. With annual sales of $54 billion and 46,000 employees worldwide, Dow delivers a broad range of products and services in around 160 countries. It was ranked 40th in the 2007 Fortune 500 with profits of over USD$3.7 billion.

The research alliance is a significant development in the Institute's industry focus and a relationship that the Institute will nurture with the aim of establishing a long term arrangement.

Clockwise from top left: Present Vice-Chancellor Professor Paul Greenfield AO, AIBN Director Professor Peter Gray, Dow CEO Mr Andrew Liveris and past Vice-Chancellor Professor John Hay AO

TenasiTech Pty Ltd

Ground breaking AIBN work improving the strength and flexibility of thermoplastic elastomers is being commercialised under the name TenasiTech.

The work of Dr Darren Martin increases the strength of thermoplastic polyurethane elastomers whilst maintaining flexibility. The secret to his discovery is synthetic nanoparticles – nanoscale disc-like particles – that when added to conventional thermoplastic polyurethane (TPU) extend its benefits and performance.

Dr Martin's work has resulted in a 120 percent increase in tensile strength with a minimal increase in stiffness and a 10 fold increase in elongation with no loss in dynamic performance.

Although golf balls and condoms were initially targeted, Dr Martin's work also has applications in mining hoses, sports equipment, biomedical elastomers and surgical gloves, to name a few. Basically this technology can be used wherever polyurethane is used.

It will be a new entrant on the global polyurethane market, particularly the soft and flexible polyurethane areas, believed to be worth around USD$12 billion a year.

The invention is the subject of a patent application currently in National Phase Entry.

TenasiTech Pty Ltd is a start-up company formed around the technology to drive the business development and capital-raising to further advance the technology towards products.

RESEARCH EXCELLENCE

International Alliances: part of AIBN's research excellence

Critical to any successful research program are innovative ideas, from a variety of sources, coupled with the ability to act on these ideas.

To facilitate the exchange of innovative ideas, the Queensland Government awarded National and International Research Alliance Program (NIRAP) grants to AIBN researchers Professor Andrew Whittaker and Professor Matt Trau.

These grants are designed to support the delivery of research, development and innovation outcomes made by AIBN researchers and their national and international partners.

AIBN's two successful NIRAP grants commenced in 2007.

The International Biomaterials Research Alliance (IBRA), led by Professor Whittaker, was awarded $1.17 million for the development of biomaterials for medical applications focussing on:

> Dental Bone repair
> Vascular Regeneration
> Vision
> Medical Imaging.

The Alliance consists of international researchers from the AIBN, University of California at Santa Barbara, and Washington University, St Louis both in the United States, along with Warwick University and the University of Nottingham in the UK.

IBRA is unique in bringing together fundamental chemical scientists with clinical researchers working in Queensland hospitals. Its vision is to provide a "bench-top to bedside" path for biomaterials developed in Queensland through collaborations with international partners.

The benefits for Queensland include:

> the establishment of a high-quality network of researchers developing new biomaterials to address specific medical needs
> access to international experts and technologies not currently found in Australia
> the generation of significant intellectual property which will bring a number of technologies to market
> high quality PhD graduates to support Queensland's growing bio- and nano-technology industries.

The Novel Nanotechnology Platforms for Disease Biomarker Diagnostics alliance is a collaborative venture led by AIBN's Professor Matt Trau which partners with the Fred Hutchinson Cancer Research Centre, the University of Washington (Washington State US) and Seattle Biomedical Research Institute in the US and Nanomics Biosystems.

This Alliance aims to address the paucity of tools available for early, molecular-level diagnosis of cancer and infectious diseases. As a consequence of early diagnosis the Alliance believes treatments will become easier to administer and more effective, thereby reducing the impact of disease on the individual, their family and the community as a whole.

The project draws upon facilities and expertise in biological and clinical areas not currently accessible in Queensland.

The successful AIBN applications were deemed to be of national and international significance with potential to benefit the future economic, social and environmental development of Queensland. Furthermore, these grants will build a critical mass of internationally recognised competitive research, development and innovation networks.

Modelling at the Atomic Level

One of Australia's largest dedicated molecular modelling facilities is to be found in the computational bio and nanotechnology laboratory of AIBN's Professor Sean Smith.

This facility has the capability to model interactions between materials, proteins and molecules down to the atomic level.

Characterisation at this atomic level requires a large amount of computing power, with calculations taking anywhere between days and months before a result is available.

In collaboration with Professor Max Lu's group they are exploring how to effectively store hydrogen for use as a clean energy source; a vitally important project in light of growing concerns about green house gas emissions caused by burning the world's finite supply of fossil fuels.

Professor Smith's team characterises the interactions of hydrogen with different materials at the atomic level. This information subsequently guides experiments in Professor Lu's lab to improve the interactions.

In this way the research teams open up two fronts of attack on the problem with the groups attempting to meet each other in the middle.

A recent notable success was achieved with the characterisation and design of catalysts for enhancing functional mobile hydrogen storage materials. Both computational and experimental aspects were pursued in two papers published in the *Journal of the American Chemical Society* during 2007.

This unique approach to research better informs future progress, as well as directing and amplifying outcomes. It couples interesting experimental results with the best available explanation of what is actually occurring. It provides a quantifiable understanding of what might otherwise be interesting phenomena.

Professor Smith's research group also has strong research programs in modelling the photophysics and structural features of fluorescent proteins; modelling complexation of short stranded DNA/RNA with dendrimers and nanoparticles for gene delivery applications; and hydrogen and CO_2 transport within nanoporous materials.

Several AIBN research groups successfully applied for an Australian Research Council Linkage Infrastructure Equipment Facilities grant led by Professor Smith for a new high performance cluster computing facility to drive modelling within the Institute. Clusters of comparable size typically service the Australian research community whereas this facility is exclusively available to AIBN researchers.

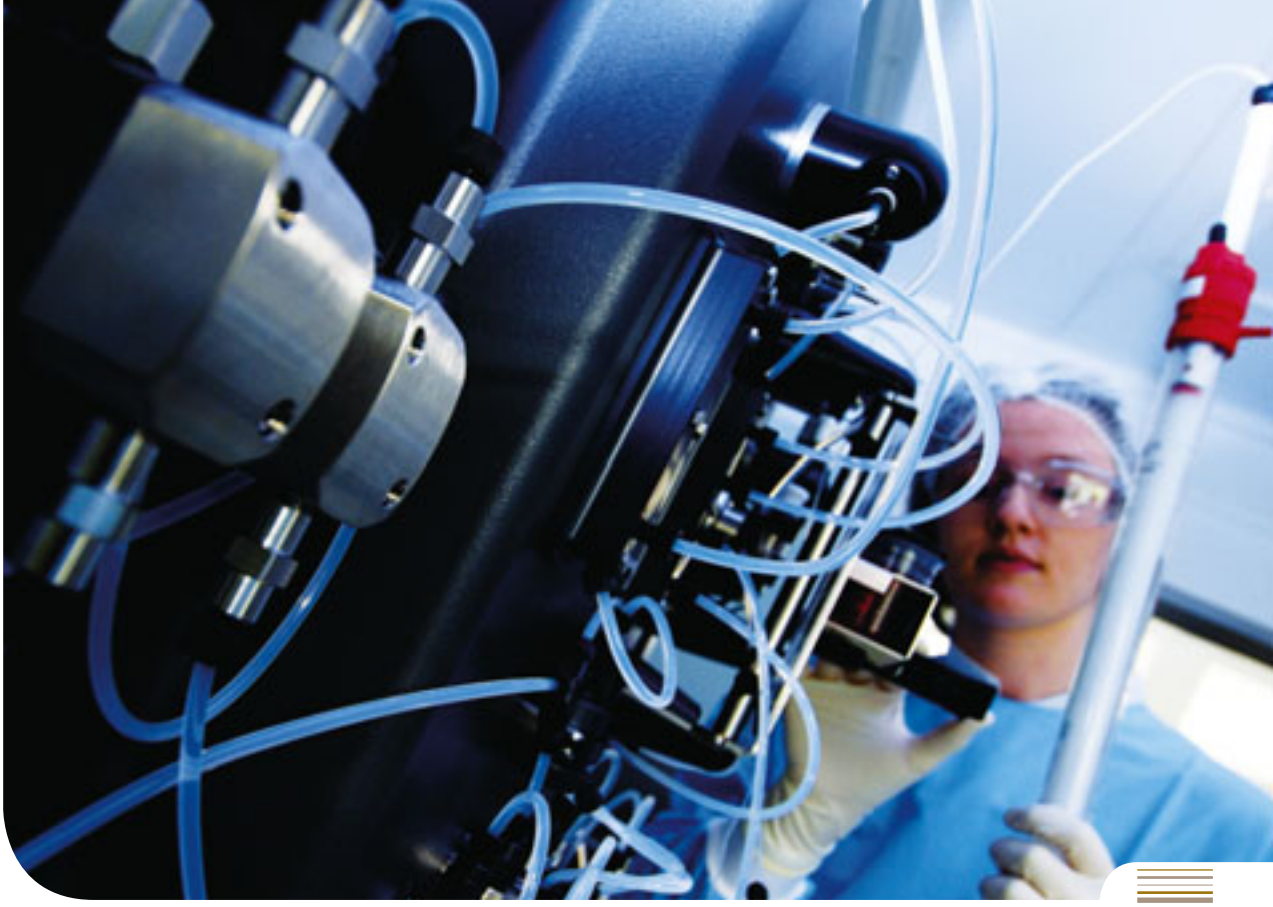
This further demonstrates the multidisciplinary nature of the research environment at the AIBN.

BUILDING AUSTRALIA'S RESEARCH CAPABILITY

As one of Australia's leading research institutes the AIBN has a unique and comprehensive suite of facilities spanning microfabrication, biotechnology products and metabolomics.

These facilities are located in the AIBN as a result of the Institute's successful involvement in Australia's National Collaborative Research Infrastructure Strategy (NCRIS).

Not only do these facilities dovetail with the Institute's research priorities, they service the broader Australian research community by providing accessible infrastructure that meets long term needs and enables the growth of transnational collaborative projects.



NCRIS Biologics Facility

The sale of biopharmaceuticals already accounts for US$60 billion per year and currently represents 25 percent of the new drugs approved by the US Food and Drug Administration. As a result biopharmaceuticals are having an increasing impact on the global pharmaceutical industry.

The path from laboratory bench to clinic is a complex one with a key challenge being the production of potentially valuable compounds in amounts large enough to support pre-commercialisation trials.

The AIBN's Biologics Facility is part of the National Collaborative Research Infrastructure Strategy (NCRIS) and aims to provide Australian researchers with access to state-of-the-art equipment and facilities, as well as superior technical expertise suitable for cell line and bioprocess development along with pilot scale manufacturing.

The Facility specialises in mammalian cell expression technology to develop recombinant proteins with potential therapeutic and commercial value. Key staff in the areas of molecular biology, antibody engineering, mammalian cell culture/biology, and protein function and characterisation have been appointed.

In addition, funding from the Queensland State Government Smart State Innovation Building Fund has enabled the purchase of the Biologics Facility's high through-put capabilities. Equipment such as a Fluorescence Activated Cell Sorter (FACS) and robotic high-expressing clonal selector (ClonePix™) further strengthen the Facility's competence and capabilities in mammalian cell technology.

The Facility is equipped with a variety of bioreactors, including stirred tank and single-use disposable bioreactors, ranging from 1L to 100L capacity and is capable of processing high volume of biologics material with the newly acquired downstream process equipment.

The Facility's staff have experience in international biopharmaceutical industry, and expertise in GMP/GLP in pharmaceutical development.

Working together with many of the academic staff at AIBN, the Biologics Facility can truly provide strong research and manufacturing capabilities to Australian researchers involved in developing recombinant biologics for therapeutic use.

NCRIS Metabolomics Facility

As part of NCRIS's Bioplatforms Australia, AIBN is establishing a metabolomics node which will provide specialised expertise in metabolic engineering.

Metabolomics involves the optimisation of genetic and regulatory processes in cells to increase the production of desired products.

A major focus of the Metabolomics node will be 'fluxomics', which analyses the dynamic change of molecules within a cell over time. With the assistance of AIBN expertise, Australian researchers will have the ability to develop analytical models to improve mammalian, plant and microbial fermentation systems and increase production of desired products.

A particular example of a desired product is polyhydroxyalkenoates (PHAs), the building blocks for plastics, which if produced in a significant quantity and at the required quality, could be used to establish a new "bioplastics" industry.

As a facility available to the wider Australian research community, the Node will also assist other research teams to identify new drug targets and conduct toxicity screens for drug development.

The Metabolomics Facility is funded under the NCRIS scheme to provide infrastructure and expertise in the fields of genomics, proteomics, bio-informatics as well as metabolomics.

The facility will provide services in:

> Genome scale modelling
> Metabolic flux analysis
> Central carbon metabolism analysis
> Training in analytical process development and data analysis.

NCRIS Fabrication Facility

AIBN is home to the Queensland node of the NCRIS Australian National Fabrication Facility (ANFF).

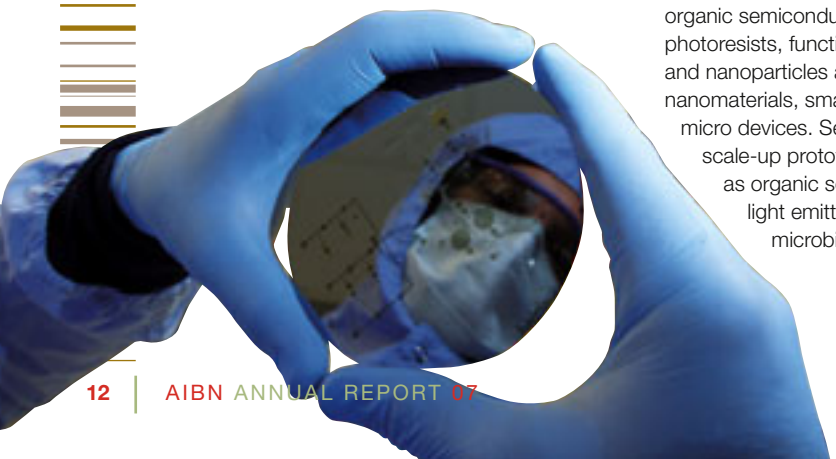
This facility's capabilities support Australian researchers with equipment and expertise in patterning of polymer and glass substrates, the production of novel substrates for immunotherapy and drug delivery, and the fabrication of nanoelectric devices.

The ANFF Queensland node provides a dedicated facility for the synthesis, processing, characterisation and fabrication of functional organics and organic semiconductors, new generation photoresists, functional polymers and nanoparticles and bio-inspired nanomaterials, smart surfaces and micro devices. Services included the scale-up prototyping of devices such as organic solar cells, organic light emitting diodes and microbioreactors.

The facility is more than a collection of leading-edge equipment and specialist clean rooms minimising unwanted particulate contamination; it is managed and staffed by key senior research officers with extensive expertise.

Australian researchers will have access to state-of-the-art equipment such as:

> A prototyping inkjet printer with organic or aqueous solvent based ink capabilities
> High throughput photoresist, monomer, polymer and nanoparticle synthesis units
> Semi automated nanoimprint lithography unit and plasma bonder
> A dip pen lithography unit for micro to nanometre patterning of surfaces and devices
> A deep reactive ion etcher unit for needleless drug delivery patches, nanofluidic devices and surface templating
> A surface and device characterising suite.



2007 FAST FACTS

AIBN's 17 Group Leaders attracted almost $6.8 million in new competitive funding in 2007.

AIBN Group Leaders advised 103 research higher degrees of which 28 are international students in 2007.

AIBN researchers authored 132 journal articles in 2007.

RESEARCH PROJECTS

AIBN has focussed its research in areas that will alleviate current problems in human health, manufacturing, information technology and the environment.

The unique capabilities of the AIBN come from merging the skills of engineers, chemists, biologists and computational scientists to conduct world-class research programs. These multidisciplinary teams work at the interface of the biological, chemical and physical sciences with research programs in the following areas:

> Delivery of therapeutic agents using polymer chemistry, virus like particles and needleless transdermal technologies

> Metabolic engineering of cells to produce new bioproducts

> Regenerative medicine using stem cell biology and novel scaffolds

> Nanomaterials for orthopaedic applications, enzyme encapsulation and biosensors

> Improving energy and the environment though high performance hydrogen storage materials, photocatalysis for environmental remediation and novel membranes for water desalination and recycling.

The Institute's 17 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 the research interests of AIBN's Group Leaders.

Mammalian Cell Lines and Stem Cell Bioprocesses

GROUP LEADER

Professor Peter Gray

Professor Gray's research is focussed on engineering mammalian cells in order to improve their efficiency and utility for the production of complex proteins, which are increasingly being used as biopharmaceuticals.

PROJECTS

The team's research is aimed at reducing some of the 'bottlenecks' present when mammalian cells are used to produce biopharmaceuticals, particularly:

> developing transient protein expression systems which will allow researchers to rapidly produce the larger amounts of protein needed for initial characterisation and testing

> developing high throughput approaches which allow the rapid selection of clones stably expressing high levels of the desired biopharmaceutical

> using modern 'omics' approaches to gain better understanding of cellular metabolism which will allow maximal protein expression by mammalian cell cultures.

The research approaches which have been used to gain a greater understanding of mammalian cell processes are now being applied to even more complex cells, in other words the development of bioprocesses based on embryonic stem cells.

With stem cells the challenge is to accurately define the physical and chemical environment required for the controlled proliferation and subsequent differentiation of the cells. It is then necessary to translate these conditions into processes which can be scaled up to produce the number of cells required for clinical testing.

This research is being conducted in collaboration with AIBN's Professor Justin Cooper-White and Associate Professor Ernst Wolvetang.

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Bioprocess Technology

GROUP LEADER

Dr Steve Reid

Increased resistance to chemical pesticides and concern over their use has renewed interest in the application of biological means to control pests of commercial importance. The Reid Group is involved in advancing the technology necessary to reduce the cost of production of biological control agents. This research is concerned initially with the effective scale-up of insect viruses.

PROJECTS

Many wild type Baculoviruses can specifically infect and kill key agricultural caterpillar pests. These Baculoviruses are the largest viruses known (1 micron in diameter), because they wrap their genomes in large protein coats (Occlusion Bodies). This enables the virus to be stable in the open environment and facilitate delivery to crops using conventional land and air based spraying procedures.

The laboratory has a process patent on a procedure for producing Baculoviruses via fermentation. The lead product is a Baculovirus which targets the Helicoverpa pest species which accounts for the current $US3.2 billion per annum market for traditional chemicals. At current yields the production costs would allow the Helicoverpa species to be targeted in areas where this pest is resistant to most low cost chemical options ($15/Ha), and where only more expensive chemicals are in use ($30-$50/Ha). Further improvements in yield would allow the product to compete on cost alone in all markets, including extensive markets in India and China.

RESEARCH PROJECTS

> Pilot Scale Production of Helicoverpa armigera nucleopolyhedrovirus.

> Expression of the key viral FP25K gene in the Heliothis cell line.

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Systems Biotechnology

GROUP LEADER

Professor Lars Nielsen

This group focuses on the both the advancement of bioengineering science and its application to specific problems. Using thermodynamic principles, novel approaches are developed for handling complex, transient dynamics in developing tissue as well as rational design of complex pathways. These novel approaches are used in the design of bioprocesses ranging from the production of blood cells for transfusion to the production of industrial biopolymers.

PROJECTS

The blood cell factory

Using haematopoietic stem cells, the team is exploring the potential of expanding these *in vitro* for use in the production of blood products.

This has resulted in a clinically meaningful expansion of cord blood stem cells to neutrophils and has been successfully scaled to 10 L in a wave bioreactor. As a result funds are being raised for Phase I clinical trials to investigate the prevention of infection in Acute Myeloid Leukemia patients undergoing chemotherapy.

In addition, work on differentiating cord blood stem cells to red blood cells (RBC) has resulted in 10,000 times improvement on the previous best expansion, equating to 10,000 units of red blood cells from a single unit of cord blood. Following maturation, more than 90% of the cells produced are enucleated RBC and have normal hemoglobin content. The process has been scaled up to 1L in media without the use of animal products or stromal cells.

Metabolic engineering of hyaluronic acid production

Hyaluronic acid (HA) is a high-value medical polymer produced by extraction from animal tissue and fermentation. Using genetic engineering, fermentation strains capable of generating high molecular weight HA, have been developed. This was previously only feasible through extraction from animal tissues.

Renewable materials from sucrose

Sucrose is the preferred substrate for the replacement of petrochemicals with renewable materials. To date metabolic engineering has focussed on glucose-based production and no platforms exist for the group's preferred strain, *E.coli.* In collaboration with Professor Sang Yup Lee at KAIST, the team is developing metabolic engineering platforms for sucrose-based biorefineries.

Metabolic engineering of sugarcane

With colleagues at BSES Ltd, we are investigating the expression of polyhydoxyalkanoates (the building blocks of plastic) in sugarcane and the potential of this as a "green factory" for production of bulk and fine chemicals such as polymers, enzymes and high value metabolites.

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Tissue Engineering and Microfluidics

GROUP LEADER

Professor Justin Cooper-White

Engineering tissue and scaffolds coupled with microfluidics (the study of the behaviour of fluids at the micro and meso scales), when applied to regenerative medicine, have great potential to alleviate many current health problems.

It is important, however, to gain a thorough understanding of these so as to maximise the opportunities presented by these enabling technologies.

PROJECTS

The Group has interests in biomaterials processing, tissue engineering, non-Newtonian fluid mechanics, rheology and microfluidics.

Projects exist in all of these areas with a common focus of providing fundamental insights into complex polymer-based structures and systems, with the aim of ultimately tailoring and controlling their interactions with biological systems.

The project teams are investigating novel methods of surface engineering of these scaffolds for drug delivery and tissue engineering applications, new *in vitro* modules for mapping cell-surface and cell scaffold interactions, manufacturing functional microparticles with micro processing plants and complex fluid behaviour in microdevices

Current research projects include:

> Micro process Plants – Non-Newtonian Flow and Particle Synthesis in confined geometries

> Mastering the microenvironment – integrated, functional, biosynthetic scaffolds for tissue engineering

> Bioactive polymers for wound healing applications

> Bioreactor platform for stem cell expansion.

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Vascular Research

GROUP LEADER

Professor Julie Campbell

The Group's current research interest is in tissue engineering replacement arteries from the patient's own cells using the peritoneal (abdominal) cavity as a bioreactor.

PROJECTS

The team has grown myofibroblast tissue around appropriately shaped polyethylene moulds of tubes or bulbs in the peritoneal cavity of several animal species.

After 2-3 weeks this tissue is grafted into arteries, bladder, vas deferens or uterus to replace resected segments, the myofibroblast tissue differentiates into structures identical to the host organ, remaining functional for at least 16 months.

The group is investigating the origin of the cells that constitute the myofibroblast capsule, as well as the factors influencing differentiation.

In collaboration with Professor Justin Cooper-White the group is developing an artificial meniscus for the knee by populating a novel scaffold with mesenchymal stem cells and differentiating them along different cellular pathways according to function.

In addition, the group is aiming to grow functional kidneys through the incorporation of 'stem' cells into embryonic kidneys transplanted to the peritoneal cavity of adult hosts.

Other research involves basic cellular interactions in the artery wall, and the definition of signal transduction pathways through which factors act to enhance vascular disease regression and prevent disease development / progression.

A long-term interest of the Group is also smooth muscle phenotype and factors affecting the cells' sub-structural compartments.

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Stem Cell Engineering

GROUP LEADER

Associate Professor Ernst Wolvetang

The Stem Cell Engineering Group aims to use novel cutting-edge inter-disciplinary approaches to understand the complex molecular mechanisms that govern human embryonic stem cell (hESC) biology.

This knowledge is not only required for the rational design of bioreactors that can be used to expand and direct hESC into clinically relevant cell types, but also elucidates key aspects of human biology such as early human development, cellular differentiation and carcinogenesis.

CONTACT DETAILS

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PROJECTS

Human embryonic stem cells are immortal and can differentiate into all cell lineages of the body. These properties make hESC not only a potential source of cells for future cell replacement therapies but also allows investigation of early human developmental processes previously inaccessible to experimentation. Furthermore, because of these remarkable characteristics hESC constitute a unique model system for understanding the processes associated with cell transformation and genetic stability as well as a platform for drug screening and disease modeling.

The Stem Cell Engineering Group uses lentiviral delivery of shRNAs and transgenes, microarray analysis, FACS and fluorescent imaging techniques to interrogate hESC behaviour. At present the group focuses on three important aspects of human Embryonic Stem Cell biology:

- The elucidation of the molecular pathways that control undifferentiated growth and lineage specific differentiation of hESC (The role of CD30 in controlling genetic stability of hESC)
- Understanding the cause and consequences of genetic and epigenetic instability of hESC, and the development of strategies how to prevent this (The role of mitochondria and redox signaling in human embryonic stem cells)
- The creation of hESC bioreactors that will deliver safe and efficiently expanded hESC that can be used in regenerative medicine therapies (Characterisation of novel hESC maintenance factors and their use in 3D bioreactors in collaboration with Professors Justin Cooper-White and Peter Gray).

Biopolymer Processing

GROUP LEADER

Associate Professor Peter Halley

The Biopolymer Processing group focuses on taking novel biopolymers (polymers from natural sources), controlled-lifetime polymers (biodegradable, photodegradable, biosorbable) and biomedical polymers, to the next stage of research and development. They focus on the science of the rheology (flow characterisation) and small scale processing of these novel polymers to be able to understand and scale-up the processing of these systems.

PROJECTS

Thermoplastic starch-based plastics

Work in this project has developed commercial biodegradable thermoplastic starch polymers for the packaging industry, and launched Australia's first biodegradable polymer company Plantic Technologies Ltd from the CRC Food Packaging. Current fundamental work is focussing on model starch studies to probe the links between starch genetics, structure, processing and properties to develop new starch systems.

Novel lignin polymers

This project focusses on developing novel products, such as coatings, composites and polymer blends from sugar cane derived lignin. This work is done in the CRC Sugar Industry Innovation through Biotechnology.

CONTACT DETAILS

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Other projects include:

> Photodegradable polyethylene polymers in collaboration with CRC Polymers
> Development of melt processing of TPU nanocomposites with Dr Darren Martin
> Novel starch materials for drug delivery with Professor Andrew Whittaker and Professor Peter Gray
> Novel gels for drug delivery in collaboration with UQ's School of Pharmacy and UniQuest
> Novel processing for biomedical gels with Professor Justin Cooper-White.

Nanotoxicology, Biomaterials and Tissue Engineering

CONTACT DETAILS
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GROUP LEADER

Dr Darren Martin

The primary research themes of this group are the processing and structure-property performance of novel biomaterials and polymer nanocomposites, the biomechanics of tissue engineered medical products (TEMPS), and the toxicology of engineered nanoparticles.

These interests overlap significantly, with a mature initiative investigating the physical and biological performance of biomedical polyurethane nanocomposites, and the mechanics of tissues and tissue engineered constructs for bone, cartilage (articular and meniscus), vascular and abdominal wall TEMPS.

PROJECTS

Structure-property-performance relationships of novel biomaterials and polymer nanocomposites

This research theme encompasses long-term efforts in developing ultra strong, tough and flexible polyurethane nanocomposites for both medical and non-medical applications *(see TenasiTech page 7)*. Other biomaterials research includes new biomaterials for cartilage, bone and vascular therapies.

The Interaction of Engineered Nanoparticles with Biological Systems

Nanoparticle toxicology is an exciting new initiative involving with UQ Pharmacology, the Australian Nuclear Science and Technology Organisation and Argonne National Labs.

This project aims to:

> study the nanotoxicology of carbon nanotubes, layered double hydroxides and synthetic hectorites

> develop unique nanotoxicology assays to determine the biodistribution, bioretention and bioaccumulation of these nanoparticles.

The short term aim is to provide a rigorous demonstration of the benefits of this approach.

The *in vitro* stability of the nanoparticles, their interactions with biomolecules and release from composite matrices (for example, nanocomposite elastomers being developed for biomedical use) will also be investigated.

Polymer Chemistry

GROUP LEADER

Professor Andrew Whittaker

This group is exploring the relationship between a material's structure and its ultimate properties. Strong research programs exist in the fields of:

> polymeric biomaterials
> polymer lithograpy
> advanced NMR methodologies.

The overall aim is to develop a deep understanding of materials' properties to allow design of novel polymer which help solve important problems.

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PROJECTS

Biomaterials

The group has many projects in the field of biomaterials supported by the Australian Research Council, Queensland State Government and Tissue Therapies Ltd. These projects include:

> The study of the fundamentals of diffusion in hydrogels
> Synthesis of polymers for artificial blood vessels
> Novel MRI imaging agents
> New ultrasound contrast agents
> Injectable-curable dental resins
> Artificial vitreous humour
> Delivery of therapeutic proteins for wound healing
> Novel polymer foams formed using supercritical CO_2
> Functional surfaces for bioarrays.

Photolithography

In the field of polymer photolithography there are programs supported by SEMATECH, Intel, IMEC and the Australian Research Council. We are developing polymeric resists for the next generation of lithography. Specific projects include:

> Fundamentals of polymer degradation
> Polymers for immersion lithography
> Resists for EUV lithography
> Non-chemically-amplified resists.

Spectroscopy

The group's expertise in physical chemistry extends to programs in spectroscopy. This work is performed within the Centre for Magnetic Resonance, and is supported by the Australian Research Council.

Current projects include:

> Nanomaterials for surface plasmon resonance
> High pressure NMR
> Hyperpolarised xenon NMR studies of materials structure
> The properties of proteins during dehydration.

Biomolecular Engineering

GROUP LEADER

Professor Anton Middelberg

Professor Middelberg's group focuses on chemical self-assembly processing, with the ultimate aim of understanding new functional products and new process routes for the manufacture of existing products. The group is particularly interested in developing and understanding platform technologies involving the self-assembly or processing of biological molecules such as proteins and DNA. These platform technologies are then directed at multiple applications in academic or commercial spin-out activities.

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PROJECTS

Platform technologies receiving focused research attention include stimuli-responsive Pepfactants®-stabilised emulsions and foams, and self-assembling viral vaccines.

Pepfactants are peptide surfactants – a new class of designer surfactants affording unprecedented control over interfacial properties. Through facile change of bulk conditions, Pepfactants can radically alter interfacial properties and thus foam and emulsion stability. The fundamentals of this technology are being actively researched and applications are being developed in the areas of cancer treatment and personal care.

The technology is the basis of AIBN's first start-up company Pepfactants Pty Ltd (www.pepfactants.com.au).

Research in viral vaccines is directed at understanding and controlling the processing of viral vaccine particles.

The group has developed a platform for the efficient self-assembly of this new vaccine class, using microbial cell factories as a starting point. The technology is being researched for its potential to develop low-cost vaccines for existing third-world diseases and emergent threats such as avian influenza.

Finally the team has research activities in industrial biotechnology, with foci on downstream processing, protein aggregation, and recombinant biosurfactant processing.

Advanced Materials from Complex Polymer Architectures

GROUP LEADER

Associate Professor Michael Monteiro

The main research focus of this group involves developing synthetic methodologies to make complex polymer-based architectures from polymeric units. Uniform chain length and predetermined functionality within the interior or exterior will provide nanomaterials with greater functionality and structural design. Through self-assembly these smart nanostructures can be used in a wide range of biomedical applications, including drug or vaccine delivery devices.

PROJECTS

Next generation nanostructures

This project aims to synthesise the next generation of nanostructures built from linear polymer chains. The project attempts to make a wide range of architectures that are currently unavailable and, in collaboration with cell biologists, use these as vehicles for drug and vaccine delivery devices.

Smart nanopolymers for drug delivery

The aim of this project is to synthesise polymers with complex architectures on the nanoscale in the environmentally friendly medium; water. Once these well-defined nanostructures have been made their structure-property relationships will be evaluated using structural characterisation techniques to determine size and morphology. They will also be functionalised for use as drug and gene delivery devices.

Mechanisms in living radical polymerization

Understanding the mechanisms in living radical polymerization allows for better design of the living agents and the optimal use of living polymerizations. The project will involve the determination of the initiation mechanisms involved in atom radical transfer and reversible addition-fragmentation chain transfer polymerizations.

CONTACT DETAILS
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Gene and Drug Delivery Research

GROUP LEADER

Professor Mark Kendall

Professor Kendall is working to develop a new method of delivering therapeutic agents into the body. Using new nanopatch technology the team hopes to develop new technologies which may be useful in reducing the 14 million deaths per year caused by infectious disease.

PROJECTS

The team is researching how nanotechnology, through the use of nanopatches, might deliver drugs to the Langerhans cells, important immune response cells found just below the surface of the skin. A needle and syringe cannot deliver biomolecules to this precise site as the needle is too large and inserted too far into the skin.

Consequently this is a multi-disciplinary research team with interests in biomedical engineering, diagnostics, dermatology and vaccinology.

The group has projects in the areas of:

Needle-free gene and drug delivery technologies to skin

The aim is to engineer next-generation devices to avoid the key shortcomings of the needle-and syringe.

Micro-nanoprojection array patch (Nanopatch) technology

This is a patch with thousands of tiny projections – invisible to the human eye – dry-coated in biomolecules. When the patch is placed against the skin, these projections push through the outer skin layer and deliver the biomolecules precisely to the target cells.

Measuring key skin properties

To help optimise the delivery device, the group is performing fundamental research into key mechanical and biological properties of the skin before and after the delivery of biomolecules

Clinical applications (systemic responses)

Applying our delivery technologies to key clinical applications, measuring both local and systemic responses in animal models.

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Single Molecule Nanotechnology

GROUP LEADER

Dr Krassen Dimitrov

The next step in personalised medicine is a new technology with the ability to provide cheap and accurate biological information.

PROJECTS

Genes, mRNAs and proteins are increasingly being studied by researchers and health professionals to diagnose the onset of diseases such as cancer, which cause profound changes in gene expression long before clinical symptoms appear.

Dr Dimitrov's interests are in the area of electronic detection of single biomolecules, which pose numerous interesting challenges at the boundary of biochemistry and nanoscience. Recent advances in fabrication and characterization of nanoelectrodes open up the possibility of their use in detection of individual biomolecules, while at the same time overcoming the limitations of optical detection posed by the diffraction properties of light.

Nanobarcodes for electronic detection of biomolecules

Single molecule detection techniques reveal the most intricate quantitative detail, far exceeding the performance of traditional analytical methods that quantify gross statistical samplings. Single-molecule techniques allow each molecule to be individually identified and counted so that the output of the assay is direct digital data, rather than an analog value.

This project's goal is to investigate and develop a highly multiplexed single molecule barcoding system based on electrical detection. The system will have the advantages of low cost, high speed and high sensitivity.

To achieve this goal the following aims are being pursued:

> Fabrication of an electronic nanodetector for electrochemical readout of molecular nanobarcodes

> Development of DNA-based nanobarcodes, consisting of an affinity probe and a barcode segment

> Controlled movement of nanobarcodes in a mirofluidic channel using magnetophoresis.

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GROUP LEADER

Professor Matt Trau

The work of Professor Trau focuses on two main areas:

> nano-scaled molecular biosensors for early detection of cancer and diagnosis of infectious diseases

> artificial tissue matrices for implantation in the human body.

Both of these research areas require creation of novel materials and devices, usually microscopic or colloidal in nature, which have been fashioned to contain designed nanostructures.

Nanotechnology and Biomaterials

PROJECTS

Professor Trau, along with collaborators from the Garvan Institute of Medical Research, Peter MacCallum Cancer Centre, University of Newcastle and Princess Alexandra Hospital, is part of a $5M National Breast Cancer Foundation research project awarded in 2007. This project aims to create and clinically test nanoscaled biosensor technology for early detection of advanced breast cancer. The biosensors have the potential to augment current tumour examination procedures, providing a more accurate determination of metastases risk.

Additional funding from Cancer Australia ($0.6M) will provide an avenue to perform further technical development, assessment and validation of the nanoscaled biosensors for early detection of breast cancer. A single molecule detection technology is also being pursued.

Through a Queensland Smart State grant ($4.2M), Professor Trau's group has established international collaborations with the Fred Hutchinson Cancer Research Center, the Seattle Biomedical Research Institute and the University of Washington. This project aims to connect the latest developments in nanotechnology with clinical applications in cancer and infectious disease.

In addition, the team is researching ways to create artificial tissue, a breakthrough that would enable doctors to trigger regrowth in patients, avoiding the problem of rejection by the body. The research focusses on developing novel biological, degradable and 'living' implants for the human body.

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Energy Interface Architecture for Power Systems

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GROUP LEADER

Professor John Drennan

Power systems based on solid oxide fuel cells operate at high temperatures. An important goal in solid oxide fuel cell research is to lower this temperature without any loss in efficiencies. One approach to solve this challenge is to improve the key interface regions within the cell by designing systems that are optimised for ionic transfer. The interface region between the electrodes and electrolyte are of particular interest and the approach is to use modern templating methods to design structures at the interface that have high exchange efficiencies over a large area.

PROJECTS

Anode electrode/electrolyte interface design

Templating techniques, have been used to prepare a series of electrode microstructures that have a very high gas diffusion without compromising the number of interface sites within the electrolyte. These complex microstructures have been shown to be stable up to high processing temperatures and to have improved electrochemical properties. Realistic test sytems are presently being prepared with a view to applying this approach to new designs in fuel cells where the electrode becomes an important structural unit.

Nano-ionics

If solid electrolyte systems are examined using electron microscopy, diffuse scattering is always seen in recorded structural information. The nature of this effect is not well understood and more importantly, the role it plays in defining the ionic properties of the material is not known.

Detailed microstructural analysis, in combination with ionic measurements, is providing new insights into this phenomenon resulting in the concept of nano-ionics. This project, conducted in collaboration with the National Institute of Materials Science, Japan, is using these detailed studies to redesign systems based on structures at the nanometre scale.

Functional Nanomaterials

GROUP LEADER

Professor Max Lu

The ARC Centre for Functional Nanomaterials' research focuses on the novel synthesis, characterisation and applications of functional nanomaterials such as nanoparticles, nanotubes, thin films, and nanoporous and nanocomposite materials.

Such materials, constructed by self-assembly at the nanometer scale (1-100 nm), possess improved properties and unique functionalities such as high surface area, nanosize and quantum confinement effects, ordered porosity, and high adsorbing and sensing abilities. Thus, they are ideal materials for adsorbents, catalysts, sensors, fuel cells, and battery systems.

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PROJECTS

The clean energy, environmental and health care industries have been identified as areas in which nanostructured materials will have significant impacts and so we are specifically interested in the following technologies:

> Clean energy: gas to liquid conversion, hydrogen production and storage, fuel cells, solar cells and supercapacitors

> Environmental: photocatalytic reduction of pollutants in water and air, economic removal and recovery of organic vapours, greenhouse gas reduction and utilisation and water desalination

> Health: nanomaterials for gene therapy and drug delivery.

A research highlight of 2007 was demonstrating that metallic catalysts enable molecular hydrogen dissociation and that carbon nanotubes (CNTs) enhance atomic hydrogen diffusion at low temperatures. More importantly, metals and CNTs have synergistic effects on improving both practical capacity and reaction kinetics.

Accordingly, the Centre has developed Mg-VTi-CNTs nanocomposites that exhibit superior hydrogen absorption properties with high capacity and ultra fast release speeds at a low temperature. The nanocomposites can absorb 4.2% hydrogen in only 30 seconds and reach 5.1% in only 5 minutes at 150°C. This new development has surpassed the International Energy Agency (IEA) absorption target for on-board hydrogen storage.

These newly developed hydrogen storage materials address all the current limitations of hydrogen storage in a car. They enable fast storage and release of hydrogen at mild temperatures and reduced costs.

Other exciting developments included the filing of two patents for a layered titanate compound showing extraordinary visible-light photocatalytic activity. This compound has applications in solar powered water and air purification; self cleaning surfaces; production of hydrogen from water; and efficient solar cells.

Computational Bio and Nanotechnology

GROUP LEADER

Professor Sean Smith

The group has a multithreaded research program focusing on applying computational molecular science to biotechnology, nanotechnology and environmental science. The group utilizes electronic structure methods, classical and quantum molecular dynamics and stochastic theories to characterize reaction kinetics, photo-physics, catalysis, structure/morphology and electronic properties in complex systems. Major areas of current activity include nanocomposite materials for hydrogen storage; nanoparticle or dendrimer mediated gene delivery; fluorescent proteins for bioimaging; and development of computational quantum dynamics methodologies.

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PROJECTS

Nanocomposite materials for hydrogen storage

Solid state electronic structure calculations and structure/kinetics models are used to elucidate catalytic mechanisms of hydrogen absorption and desorption in designed nanocomposite materials.

Nanoparticle/Dendrimer – DNA interactions for gene delivery

Molecular dynamics simulations are used to explore structure and stability of layer double hydroxide and dendritic nanoparticles in aqueous solution, alone and in interaction with DNA strands.

Nanotubes and Nanoribbons: reactivity, functionalisation and electronics

Electronic structure calculations and *ab initio* molecular dynamics are used to explore structure, reactivity and electronic properties of nanotube and nanoribbon systems, with and without functionalisation.

Fluorescent Proteins: photophysics, mechanism and dynamics

Electronic structure calculations (cluster and QM/MM models), molecular and quantum dynamics are used to explore photophysical properties and proton chain transfer in fluorescent proteins, aimed at both fundamental mechanistic understanding and rational design of improved bio-imaging agents.

Quantum dynamics for hydrogen transport in confined systems

Mixed quantum and classical dynamical algorithms are developed for simulating quantum transport of hydrogen in solids.

Quantum dynamics for gas phase reactions.

Quantum wavepacket methods are used to compute state-to-state reaction probabilities and thermal kinetics in key reactions for combustion and atmospheric science, e.g. HO2 and HOCl.

AIBN GRADUATE PROGRAM

The AIBN's graduate program once again grew significantly in 2007 with 25 research higher degree (RHD) students commencing their studies during the year.

Importantly, all but one of these students is supported by competitive funding; an indication that the quality of students applying to the AIBN is of the highest order.

The 2007 round of the International Postgraduate Research Scholarship was remarkable in that six international students were able to join the AIBN under this program. These students come from China, Scotland, USA, Indonesia and Chile; highlighting the international nature of postgraduate study, as well as the reach of AIBN and UQ into this global market.

In addition, 18 students progressed from provisional to confirmed PhD candidates; a significant milestone in PhD candidature in which students receive important formative advice about their progress toward the submission of an assessable thesis in the appropriate timeframe.

The diligence with which AIBN's current student cohort pursued their studies in 2007 has also been recognised with further merit based scholarships and awards.

Thomas Rufford was awarded an Endeavour Research Fellowship to undertake a four month research visit with Professor Hui-Ming Cheng's Advanced Carbon Group at the Institute of Metals Research of the Chinese Academy of Sciences. Additionally Thomas was a student representative on the management committee of the Australian Research Council's Nanotechnology Network.

Anthony Musumeci was awarded an Australian Institute of Nuclear Science and Engineering (AINSE) post graduate award scholarship, providing extra financial support throughout the duration of Anthony's PhD.

Jennifer Turner won the Open prize in the 2007 UQ Trailblazer competition for her presentation on her "Oxygen Concentration Cell Culture Diagnostic Device".

Drew Titmarsh and James Hudson won student prizes for their presentations on "CellChip – a high through-put screening cell culture lab-on-a-chip" and "Engineered cardiac muscle patch for heart failure reversal/prevention" respectively.

Annie Chen was awarded 50,000 yen in competitive funding from the Young Scientists and Students from Overseas Organisation to attend the Second Japan-Australia Symposium and the 60th Divisional Meeting on Colloid and Interface Chemistry, of the Chemical Society of Japan.

Yunyi Wong, Akshat Tanksale and Carl Urbani were awarded Australian Academy of Technical Sciences and Engineering (ATSE) Young Science Ambassador and Young Nanotechnology Ambassador Awards. These awards are based on the students' academic achievements and personal qualities.

The Institute also implemented two new initiatives with the long term goal of attracting high quality local and interstate students to undertake research higher degrees in the AIBN.

The first of these was the Winter School, in which interstate students were exposed to the breadth and depth of AIBN research through a week long series of seminars and laboratory experiments. The Summer Internship was an eight week opportunity for motivated and high achieving undergraduate students to gain valuable experience in a research laboratory thereby supplementing their undergraduate studies. Eleven students were hosted by seven AIBN groups for this eight week program.

AIBN is now looking to grow these initiatives to ensure a steady flow of high quality and motivated students keen to undertake RHD studies at the Institute.

In conclusion, 2007 should be remembered as a year of substantial growth in the Graduate Program and one in which several foundation stones for continued successes were laid.

Professor Lars Nielsen
AIBN POSTGRADUATE COORDINATOR

STUDENT PROFILE

AIBN's Warren Pilbrough is a rare breed of PhD student, he had secured his first post doctoral position prior to commencing his studies as the recipient of a Merck Doctoral Study Program scholarship.

The Program is an initiative by the global pharmaceutical giant Merck, offering employees the opportunity to undertake a research higher degree on a fraction of their salary and then return to their previous employment at the company. Warren is the first recipient of this scholarship to undertake his PhD in Australia.

Working in the laboratory of AIBN Director Professor Peter Gray, Warren is researching how to improve a strain of mammalian cells called Chinese Hamster Ovary cells (CHO) so that they can produce complex proteins, broadly known as biopharmaceuticals, to be used in the treatment of cancer.

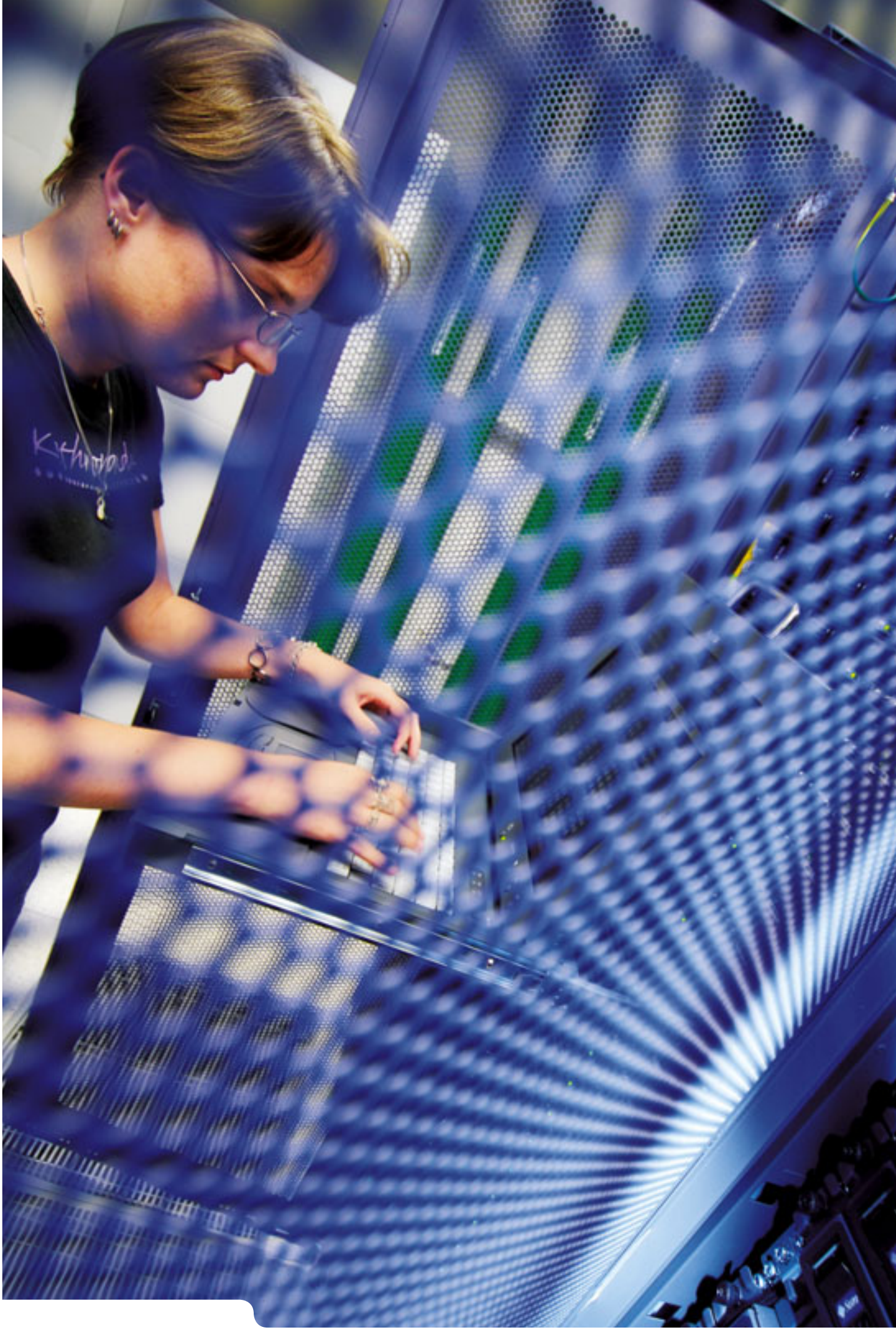
By improving cell growth, cell survival and protein secretion, Warren hopes to increase the amount of protein produced per millilitre of cells. This work underpins the production of commercial quantities of biopharmaceuticals.

A desire to reconnect with Australian science after eight years working with Merck in the US coupled with a small dose of homesickness proved to be the catalyst for his application.

The decision was relatively easy; AIBN had the facilities, expertise and the best people in the country to support him during his project, while Merck recognised the importance of the linkages with AIBN and Warren's research potential.

The benefits are obvious, Warren returns to Merck with a new skill set and fresh ideas as a result of working in a leading edge research facility, while AIBN gains from the presence of an outstanding research student driving the project forward with extensive funding support.

Additionally AIBN recognises there are potential long term relationships with Merck to be built on the back of having Warren undertake a productive PhD at the Institute. This relationship will hopefully contribute to the development of collaborations and agreements between the two parties for years to come.



RESEARCH TRANSLATION AND COMMERCIALISATION

AIBN's core commitment to research excellence is supported by a strong culture of commercialisation and industrial linkages.

A significant emphasis is placed on achieving traditional commercialisation milestones such as patents, partnerships and start-ups, however AIBN's research expertise and infrastructure capabilities also provide an important bridge and resource for local small to medium enterprises, as well as major international companies.

The Institute's National Collaborative Research Infrastructure Strategy (NCRIS) facilities and expertise support the wider Australian research community and are available to commercial organisations. This provides services and capabilities to companies in areas such as:

> Bio-nanodevice fabrication
> Mammalian protein expression and purification
> Metabolomic flux analysis.

In addition AIBN Group Leaders have significant links with industry, engaged in contract research for companies such as Proctor and Gamble, Dow Benelux, Australian Red Cross Blood Services, and Sematech to name a few. A recent example of these linkages is Professor Justin Cooper-White, who spent two months working with UniLever in England on advanced food formulation.

Professor Andrew Whittaker is leading an extensive, multi year, research program for Sematech, an international consortium addressing the technical challenges in semiconductor and emerging technology development. Sematec members represent about half of the world's semiconductor producers, and include IBM, Intel and Hewlett Packard.

AIBN's facilities and commercial focus have also made AIBN a viable career option for those moving from industry to an academic research environment. The AIBN has attracted several researchers who have left positions with leading national and multi-national companies to join AIBN. Additionally, the Institute's commercially focussed research training programs have been successful in attracting students from industry.

AIBN's research translation and commercialisation would not occur but for the Institute's research excellence, industry focus and dynamic research environment.

The sum of these features is a unique research institute with industry relevance.

Dr Craig Belcher
AIBN, MANAGER OF INNOVATION AND COMMERCIAL DEVELOPMENT

2007 FAST FACTS

IP portfolio management

> 11 new patent filings
> 6 complete patent filings
> 3 national phase entry filings
> 3 granted patents

Start-ups

> Pepfactants Pty Ltd raised pre-seed investment from a syndicate investment by UniSeed and Symbiosis Group
> DendriMed Pty Ltd was formed
> TenasiTech Pty Ltd was formed

APPENDICES

Research grants

Type	Scheme	AIBN Group Leader/Investigator	Other Chief Investigators	Project Title	Duration	2007 Award $
Commonwealth Competitive Grant Income	ARC Federation Fellowship	Professor Max Lu		Molecular Engineered Nanomaterials for Advanced Fuel Cells	2003-2007	296,353
Commonwealth Competitive Grant Income	ARC Federation Fellowship	Professor Anton Middelberg		Engineering Nanostructured Bio-Inspired Products	2003-2007	296,353
Commonwealth Competitive Grant Income	ARC Federation Fellowship	Professor Matt Trau		Beyond Microarrays: Nano-Scaled Devices for High Throughput Biological Screening	2004-2008	296,353
Commonwealth Competitive Grant Income	ARC QEII Fellowship	A/Professor Michael Monteiro		Synthesis of Nanocomposite Polymers with Targeted Properties	2004-2008	172,480
Commonwealth Competitive Grant Income	Australian Dental Research Fund Inc	Professor Justin Cooper-White	Dr Joseph Ralph Smid, A/Professor William Young	Enamel mineralization in children with cystic fibrosis	2007	15,400
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	A/Professor Michael Monteiro	Dr Joanne Blanchfield, Professor Virgil Percec	Next Generation Polymer Nanostructures	2006-2008	180,000
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Anton Middelberg	Dr Annette Dexter	Microfluidic Studies of Stimuli-Responsive Emulsions	2007-2009	190,000
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Anton Middelberg	Dr Samuel Peter Mickan, Dr Hwee-Lin Lua	Terahertz Spectroscopy of Mass-Manufactured Viral Vaccines	2007-2009	196,148
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Max Lu	Dr Lianzhou Wang, A/Professor Jin Zou, Professor Serge Kaliaguine	Charge-driven self-assembly of nanocomposites of ionic polymers and oxide nanoparticles		200,000
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Julie Campbell	Mr Tristan Croll, Dr Michael Doran	Tissue Engineering the Meniscus: Combining Novel Biomimetic Hybrid Scaffolds with Adult Stem Cells	2007-2010	150,000
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Julie Campbell	Dr Andrei Zvyagin	Cytorefractometry – a new technique for refractive index tomography of living cells	2004-2007	57,703
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Justin Cooper-White	Dr David Leavesley, Dr Andrea O'Connor, A/Professor Kerry Landman	Mastering the Microenvironment – Integrated functional biosynthetic scaffolds for tissue engineering	2005-2007	150,000
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Mark Kendall	Professor 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	220,000
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Max Lu	Dr Helen Cooper, Mr Zhi Xu	Tailoring of Layered Double Hydroxide Nanoparticles for Effective Delivery of Biologically Active Peptides and cDNAs	2005-2007	100,945
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Sean Smith		Quantum Unimolecular Reaction Dynamics: from Isolated Molecules to Protein-Embedded Chromophores	2007-2009	80,000
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Justin Cooper-White	A/Professor Malcolm R Davidson, Professor Gareth Huw McKinley	Micro Process Plants – Non-Newtonian flow and particle synthesis in confined geometries	2005-2009	190,000

Research grants

Type	Scheme	AIBN Group Leader/Investigator	Other Chief Investigators	Project Title	Duration	2007 Award $
Commonwealth Competitive Grant Income	Australian Research Council – Discovery Projects	Professor Matt Trau	Dr Gwendolyn Lawrie, Professor Pamela A Silver	Multiplexed Molecular Reading of Protein Associations via Nanoscaled Devices	2005-2007	50,000
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Infrastructure	Professor Andrew Whittaker		The Polymer Pharmaceutical/Drug Characterisation and Processing Facility	2007	230,000
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Infrastructure	Professor John Drennan		A High Resolution Analytical Scanning Electron Microscope for South-East Queensland	2007	388,000
Commonwealth Competitive Grant Income	Australian Research Council – Linkage International	A/Professor Peter Halley	Professor Luc Averous, Dr Darren Martin, A/Professor Bhesh Bhandari, Dr Peter Torley, A/Professor Eric Pollet	Functionable Renewable Plastics: Developing Novel Polysaccharide, Protein and Natural Polyester Based Polymer Nanocomposites	2007-2009	12,500
Commonwealth Competitive Grant Income	Australian Research Council – Linkage International	Professor Andrew Whittaker	Dr Idriss Blakey, Professor Steven Melvyn Howdle, Dr Kristofer James Thurecht	Development of Novel Detergents for Green Solvent Systems and Their Self-Assembly into Nanostructures	2007-2009	14,000
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Projects	Professor Andrew Whittaker	A/Professor Bhesh Bhandari, Professor Mike Gidley, Dr Hilton Deeth	The Molecular Mechanism of Protein Instability in Dairy Powder Systems	2007-2010	169,500
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Projects	Professor Andrew Whittaker	Dr Idriss Blakey, Dr David Hill, Professor Graeme Allan George, Dr John Stanley Forsythe, Mr Will Conley	Synthesis and Performance of Novel Polymer Resists for 193 nm Immersion Lithography	2006-2008	357,158
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Projects	Professor Max Lu		Nanostructured Magnesium-base Composites for High-density Hydrogen Storage	2006-2009	162,500
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Projects	Professor Lars Nielsen	Dr Robyn Myra Minchinton, Yoke Fung,	Ex vivo production of neutrophils	2006-2008	107,060
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Projects	Professor Andrew Whittaker	Professor Justin Cooper-White, Dr Edeline Wentrup-Byrne, Dr Jos Malda	Bioactive Polymers for Wound Healing Applications	2005-2008	146,182
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Projects	Professor Max Lu	Dr Zhonghua Zhu	Hydrogen Production by Non-thermal Plasma Assisted Catalytic Pyrolysis of Natural Gas	2005-2009	64,337
Commonwealth Competitive Grant Income	Australian Research Council – Linkage Projects	Professor Max Lu	Dr Yinghe He, Mr Xiangdong Yao	Nanostructured Magnesium-base Composites for High-density Hydrogen Storage	2005-2008	54,166
Commonwealth Competitive Grant Income	Australian Stem Cell Centre	Professor Peter Gray	Professor Lars Nielsen, Professor Justin Cooper-White	Australian Stem Cell Centre Project Agreement Bioreactor Program	2006-2008	550,000
Commonwealth Competitive Grant Income	DEST International Science Linkages / Competitive Grants	Professor Max Lu		Fabrication of Qrganic and Inorganic Hybrid Materials Using Nano Core-shel Structures	2006-2007	11,000
Commonwealth Competitive Grant Income	DEST International Science Linkages / Competitive Grants	Professor Julie Campbell		Vascular smooth muscle cell senescence and the effect of estrogen	2007	
Commonwealth Competitive Grant Income	DEST International Science Linkages / French-Australian Science & Technology (FAST) Program	Professor Anton Middelberg	Dr Hwee-Lin Lua, Dr Waltraud Kaar	Bio-based Functional Materials from Engineered Self-Assembling Peptides (BASE)	2005-2008	141,510
Commonwealth Competitive Grant Income	Monash University	Professor Julie Campbell	Professor Gordon Campbell	Towards renal regeneration: isolation, characterization and functional analysis of renal stem cells	2003-2007	100,000
Commonwealth Competitive Grant Income	NHMRC (Potential Avian Influenza – induced pandemic)	Professor Anton Middelberg	Dr Marcus Niebert, Dr Hwee-Lin Lua	Simplified Process Methods for Mass Vaccine Manufacture	2006-2007	22,000
Commonwealth Competitive Grant Income	NHMRC Equipment Grant	Professor Julie Campbell		Time-lapse and OptiGrid Fluorescence Imaging Suite	2007	7834

Type	Scheme	AIBN Group Leader/Investigator	Other Chief Investigators	Project Title	Duration	2007 Award $
Commonwealth Competitive Grant Income	NHMRC Fellowship Grant	Professor Julie Campbell		Senior Principal Research Fellowship	2006-2010	144,250
Commonwealth Competitive Grant Income	NHMRC Project Grant (All Project Grants)	Professor Julie Campbell	Professor David Craik	Bioengineering of cyclotides with angiogenic properties	2006-2008	175,000
Commonwealth Competitive Grant Income	NHMRC Project Grant (All Project Grants)	Professor Julie Campbell	Dr Barbara Rolfe, Professor Gordon Campbell	Origin of cells in the 'artificial' artery grown in the peritoneal cavity	2005-2007	160,500
Commonwealth Competitive Grant Income	NHMRC Project Grant (All Project Grants)	Professor Mark Kendall	Dr Sarah Waters, Professor Ian Frazer	MPM non-invasive imaging of biological interactions following drug delivery with micro-nanoprojection patches	2007-2009	137,750
Commonwealth Competitive Grant Income	University of Melbourne	A/Professor Peter Halley	Dr K M Abberton, Dr Aurora Messina, Professor Erik Walter Thompson, Dr Wayne A Morrison	Characterization and Optimisation of Myomatrix: A Novel Extracellular Matrix Hydrogel From Muscle	2005-2007	53,000
Other National and International Grant Income	Novozymes Biopolymer A/S	Professor Lars Nielsen		Optimization of hyaluronic acid production by fermentation of the strain streptococcus Equi	2007-2008	8780
Other National and International Grant Income	Australian Institute Nuclear Science & Engineering	A/Professor Peter Halley		Radiolabelling of industrially-relevant nanoparticles for use in nanotoxicology investigations	2007	15,750
Other National and International Grant Income	Australian Institute Nuclear Science & Engineering	Dr Darren Martin	Mr Anthony Musumeci	Tailored nanoparticles for nanotoxicological studies	2007	7150
Other National and International Grant Income	Centre for Low Emission Technology	Professor Max Lu	A/Professor 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
Other National and International Grant Income	CRC for Sugar Industry Innovation through Biotechnology	Professor Lars Nielsen	Dr Stevens Brumbley	The Production of PHB/PHAs in Plants	2006-2007	737,042
Other National and International Grant Income	CRC for Sugar Industry Innovation through Biotechnology	Professor Lars Nielsen		Use of endogenous bacteriocins to manipulate the rumen microbial ecology	2006-2008	259,600
Other National and International Grant Income	CRC for Sugar Industry Innovation through Biotechnology	Professor Lars Nielsen	Mr Peter Abeydeera	Microbial Metabolic Engineering	2006-2010	111,375
Other National and International Grant Income	CSIRO Flagships Collaboration Fund	Professor Max Lu	Dr Lianzhou Wang, A/Professor Joao Diniz da Costa	Flagship Collaboration Research Fund: Advanced Membrane Technologies for Water Treatment	2007-2010	57,457
Other National and International Grant Income	Dow Benelux B.V.	Professor Anton Middelberg		Bio-based Functional Materials from Engineered Self-Assembling Peptides	2005-2007	25,000
Other National and International Grant Income	Queensland Government Smart State National and International Research Alliances Program	Professor Andrew Whittaker	Dr Firas Rasoul, Dr Anne Symons, Dr Craig Jon Hawker, Professor Karen Lynn Wooley, Professor Julie Campbell, Professor Traian Chirila, Professor David M Haddleton, A/Professor Stephen Rose, Professor Steven Melvyn Howdle	International Biomaterials Research Alliance	2007-2011	33,500
Other National and International Grant Income	Queensland Government Smart State National and International Research Alliances Program	Professor Matt Trau	Professor Leland (Lee) Hartwell, Professor Kenneth D Stuart, Professor Nancy B Kiviat	Novel Nanotechnology Platforms for Disease Biomarker Diagnostics	2007-2010	357,500
Other National and International Grant Income	Unilever UK Central Resources Limited	Professor Justin Cooper-White		Continuous manufacturing processes for encapsulation	2005-2007	50,442

AIBN journal publications

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105. Du, Aijun, Smith, Sean, Yao, Xiangdong, Lu, Max (2007) Role of lithium vacancies in accelerating the dehydrogenation kinetics on a LiBH4(010) surface: An ab initio study *Journal of Physical Chemistry C* 111(32) 12124–12128

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Refereed Conference Papers

1. Suzuki, S., Rintoul, L., Monteiro, M. J., Wentrup-Byrne, E. and Grondahl, L. (2007). In vitro mineralization of phosphate-containing polymer ad-layers. In: *Division of Polymer Chemistry*, Chicago, June 2007.
2. Wanno, B., Du, A., Ruangpornvisuti, V. and Smith, S. (2007) Addition of diazomethane to armchair single-walled carbon nanotubes and reaction sequences: A computational study. *Chemical Physics Letters*, *436* : 218–223.
3. Ou, D.R., Mori, T., Ye, F., Zou, J. and Drennan, J. (2007). Aggregation of Dopant Cations and their effect on Electrical Conductivity of Yttrium Doped Ceria. In: Freiman, S. *1st International Congress on Ceramics: A Global Roadmap*, Canada, 25–29 June 2006.
4. Ou, D.R., Mori, T., Ye, F., Zou, J. and Drennan, J. (2007). Influence of Sintering Processes on Microstructures and Electrical Properties of Yttrium-Doped Ceria. In: *The 24th International Japan-Korea Seminar on Ceramics*, Shizuoka, Japan, 20–22 November 2007.

Book Chapters

1. Halley, P., Truss, R., Markotsis, M.G., Chaleat, C., Russo, M., Sargent, A.L., Tan, I. and Sopade, P.A. (2007). A Review of Biodegradable Thermoplastic Starch Polymers. In Celina, M.C. and Assink, R.A. (Ed.), *Polymer Durability and Radiation Effects* (pp. 287–300) United States: American Chemical Society.
2. Timmins, N. E. and Nielsen, L. K. (2007). Generation of Multicellular Tumour Spheroids by the Hanging Drop Method. In *Tissue Engineering Methods in Molecular Medicene 140* 2nd Edition ed. (pp. 141–151) Totowa, N. J.: Humana.
3. Bingley, J., Campbell, J.H., Campbell, G. and Walker, P. (2007). Restenosis: Treatment options current and future. In Fitridge, R. and Thompson, M. (Ed.), *Mechanisms of Vascular Disease* (pp. 191–210) New York, U.S.A.: Cambridge University Press.
4. Vacroe K. M., Blakey I., Chirila, T. V., Hill, A. J. and Whittaker, A. K. (2007). The effect of synthetic conditions on the free volume of poly (2-hydroxyethyl methacrylate) as studied by 1H NMR, 129 Xe NMR, and position annihilation spectroscopy. In Kneipp, K., Aroca, R., Kneipp, H. and Wentrup-Byrne, E. (Ed.), *New Approaches to Biomedical Spectroscopy* 1 ed. (pp. 391–409) Washington DC: American Chemical Society, Washington DC.
5. Zainuddin,. Hill, D., Whittaker, A., Kemp, A. and Chirila, T. (2007). The role of citrate anions in prevention of calcification of poly(2-hydroxyethyl methacrylate) hydrogels. In Celina, M. and Assink, R. (Ed.), *Polymer Durability and Radiation Effects* (pp. 301–316) United States: American Chemical Society.

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114. Wang, Lianzhou, Yan, Z., Qiao, Shizhang, Lu, Max, Huang, Y. (2007) Structural and morphological transformations of mesostructured titanium phosphate through hydrothermal treatment. *Journal of Colloid And Interface Science* 316(2) 954–961
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117. Dexter, Annette F., Middelberg, Anton P. J. (2007) Switchable peptide surfactants with designed metal binding capacity. *Journal of Physical Chemistry C* 111(28) 10484–10492
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120. Qiao, Shizhang, Wang, Lianzhou, Hu, Qiuhong, Zhu, John, Lu, Max (2007) Synthesis of highly ordered large-pore periodic mesoporous organosilica rods. *Solid State Phenomena.* 121–123(1) 381–384
121. Zhou, X.F., Qiao, Shizhang, Hao, N., Wang, X.L., Yu, C.Z., Wang, Lianzhou, Zhao, D.Y., Lu, Max (2007) Synthesis of ordered cubic periodic mesoporous organosilicas with ultra-large pores. *Chemistry of Materials* 19(7) 1870 – 1876
122. Du, Aijun, Smith, Sean, Lu, Max (2007) The catalytic role of an isolated-Ti atom in the hydrogenation of Ti-doped A1(001) surface: An ab initio density functional theory calculation. *Chemical Physics Letters* 450 80–85
123. Du, Aijun, Smith, Sean, Lu, Max (2007) The location of Ti atom in sodium alanate: an ab initio spin-polarised study. *International Journal of Nanotechnology* 4(5) 564–573
124. Rintoul, L., Micallef, Aaron S., Bottle, S. (2007) The vibrational group frequency of the N-Oâ ¢ stretching band of nitroxide stable free radicals. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 1–5
125. Sharpe, Kendall K., Ward, Leigh C., Cichero, Julie A. Y., Sopade, Peter A., Halley, Peter J. (2007) Thickened fluids and water absorption in rats and humans. *Dysphagia* 22(3) 193–203
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127. Yu, Aimin, Lu, Max, Drennan, John, Gentle, Ian R. (2007) Tubular Titania nanostructures via layer-by-layer self-assembly *Advanced Functional Materials* 17(14) 2600–2605
128. Nogita, Kazuhiro, Drennan, John, Knibbe, Ruth, Noguchi, T., Tatenuma, K., Liu, P., Arai, F., Yashima, E., Nishiwaki, M., Kato, S. (2007) Ultrahigh electron emissive carbon nanotubes with nano-sized RuO2 particles deposition. *Journal of Nanoparticle Research* 9(6) 1201–1204
129. Blakey, Idriss, Billingham, N., George, G.A. (2007) Use of 9,10-diphenylanthracene as a contrast agent in chemiluminescence imaging: the observation of spreading of oxidative degradation in thin polypropylene films. *Polymer Degradation and Stability* 92 2101–2109
130. Du, Aijun, Smith, Sean, Lu, Max (2007) Vacancy mediated desorption of hydrogen from a sodium alanate surface: An ab initio spin-polarized study. *Applied Physics Letters* 90(14) 143119–143121
131. Goh, Yong K., Whittaker, Andrew K., Monteiro, Michael J. (2007) Versatile synthetic approach to reversible crosslinked polystyrene networks via RAFT polymerization. *Journal of Polymer Science Part A-polymer Chemistry* 45(17) 4150 – 4153
132. Chen, Zhongxin, Zou, Jin, Lu, Max, Liu, G. (2007) ZnS nanowires and their coaxial lateral nanowire heterostructures with BN. *Applied Physics Letters* 90(10) 1 – 3

AIBN research higher degree students

Student name	Project title	Principal advisor	Commenced
Ian Aird	Cytokine Immobilisation on Microbeads. A NovelApproach to Mimic Signalling in the Haematopoietic Stem Cell Niche	Prof Lars Nielsen	2005
Colin Archer *	Metabolic engineering of E. coli	Prof Lars Nielsen	2007
Yalun Arifin	Metabolic engineering of peptide production in Ecoli	Prof Lars Nielsen	2006
Sandy Budihartono *	Functionalised Mesoporous Silica for Trichodermareesei Cellulase Immobilization Confirmed	Prof Max Lu	2006
Andrew Cameron	Development of a novel polymer scaffold to encourage the differentiation and growth of progenito cells for hernia repair applications	Prof Justin Cooper-White	2007
Jessica Cameron	Bioactive Polymers for Wound Healing Applications	Prof Andrew Whittaker	2006
Lien Chau	Ex Vivo Tissue Vascularisation	Prof Justin Cooper-White	2006
Annie Chen	Nanotechnology based proteomic biosensors	Prof Matt Trau	2006
Wendy Chen	Effect of gene dose on hyaluronic acid metabolism	Prof Lars Nielsen	2005
Kwok Cheung	Fuel cell optimisation through data integration and model harmonisation	Prof John Drennan	2005
Yap Chuan	Self-assembly of virus-like particles (VLPs) in cell-free reactor	Prof Anton Middelberg	2005
Giuseppe Codamo	Process development and characterisation of transient expression technology in CHO cells	Prof Peter Gray	2006
Natalie Connors	Identification of properties that affect *In vitro* virus-like particle assembly	Prof Anton Middelberg	2005
Michael Crichton	Engineering micro-nanprojection array patches for needle free vaccine delivery	Prof Mark Kendall	2007
Stefanie Dietmair	Design of analytical platform to support metabolic engineering of mammalian cells	Prof Lars Nielsen	2007
Mirjana Dimitrijev	Microfluidic emulsions using designed peptide surfactants	Dr Annette Dexter	2007
Tao (Michael) Ding	Computational prediction of biomolecular teraherz spectra	Prof Anton Middelberg	2007
Zi (Sophia) Gu	Control release and effective cellular delivery of anti-restinosis drugs via inorganic LDH nanoparticles	Prof Max Lu	2007
Jia (Jeff) Hou	Limits to expression levels in mammalian cell cultures expressing complex proteins	Prof Peter Gray	2007
Kaiyin Hu	Interfacially active and stimuli-responsive Pepfactants – a new class of emulsifying agents for the manufacture of biocompatible and stable emulsions for drug delivery	Prof Anton Middelberg	2007
James Hudson	The regeneration or restoration of heart muscletissue using novel approaches	Prof Justin Cooper-White	2007
Daisy Irawan	Development of 3-Dimensional Biodegradable Elastomer for Tissue Engineering	Prof Justin Cooper-White	2007
Sani Jahnke	Origin of myofibroblast in cutaneous wound healing and the foreign body response	Dr Barbara Rolfe	2005
Chalida Klaysom	Novel inorganic-organic nanocomposite membranes for electrodialysis application in water recovery	Prof Max Lu	2007
Kirsten Lawrie	Development of non-chemically amplified photoresists for EUV lithography	Prof Andrew Whittaker	2007
Pearl Lee	Development of a novel DNA detection and amplification method to be applied in cancer diagnosis	Prof Matt Trau	2007
Daria Lonsdale	Synthesis of complex polymer architectures for vaccine delivery services	A/Prof Michael Monteiro	2006
Paul Luckman	Non-cell based and cell-based epithelial membrane mimics	Prof Justin Cooper-White	2007
Esteban Marcellin	Understanding molecular weight control of hyaluronic acid production in Streptococcus zooepidemicus: a systems approach	Prof Lars Nielsen	2005
Richard Mills	The investigation of geometric environment on cell migration, recruitment, differentiation and Proliferation	Prof Justin Cooper-White	2007
Jane Mooney	Monocyte/Macrophage Involvement in the Peritoneal Foreign Body Response	Dr Barbara Rolfe	2006
Anthony Musumeci	Tailored nanoparticles for nanotoxicologial studies	Dr Darren Martin	2007
Geety Nabi	Functional testing of bioengineering virus-inspired nanoparticles for gene therapy	Prof Andrew Whittaker	2006
Wadcharawadee Noohom	Nano-Hydroxyapatite composite scaffolds for tissue engineering	Dr Kevin Jack	2005
Warren Pilbrough	Evolutionary engineering of improved mammalian host cells for biopharmaceutical production	Prof Peter Gray	2006
Katharina Porazik	Nanoparticles with application in the delivery of DNA to mammalian cell lines for the production of recombinant proteins	Prof Max Lu	2005
Anthony Raphael	Dry coating vaccines to micro-nanoprojections for needle-free vaccine delivery to skin	Prof Mark Kendall	2008
Tania Rivera	Bioengineering chimeric virus-like particles for mass vaccination	Prof Anton Middelberg	2008
Andrew Rowlands	Conducting porous scaffolds for muscle engineering	Prof Justin Cooper-White	2005
Anne Sandstrom	3D Polymer Scaffolds for muscular tissue engineering	Prof Justin Cooper-White	2008
Oliver Squires	The Production of Novel Fluorinated Contrast Agents for Magnetic Resonance Imaging	Prof Andrew Whittaker	2006
Peter Stickler	Factors affecting the differentiation of biotubes	Prof Julie Campbell	2006
Guak-Kim Tan	Development of tissue engineered 3D-scaffolds for the pancreatic islet's reconstruction	Prof Justin Cooper-White	2007
Akshat Tanksale	Nanostructured catalysts for hydrogen production by aqueous phase reforming of biomass	Prof Max Lu	2004
Drew Titmarsh	Microenvironmental control in coordinating cellular fate processes of stem cells	Prof Justin Cooper-White	2007
Xuan Truong	Preparation and Properties of Controlled Polymer Hydrogel Network	Dr Idriss Blakey	2007
Jennifer Turner	Investigation and development of new tissue culture methods that mimic the *In vivo* microenvironment to aid in research into hernia treatments	Prof Justin Cooper-White	2007
Kylie Varcoe	The development of 129 Xenon NMR methods for the study of polymer structure and dynamics	Prof Andrew Whittaker	2005
David Wang	Design and Synthesis of Injectable Biodegradable Scaffolds for the Repair of Dental Bone	Dr Firas Rasoul	2007
Joshua Watts	Nanostructural semiconducting materials for a new generation of solar cells	Prof Max Lu	2007
Yunyi Wong	Layered Double Hydroxide (LDH) Nanoparticle-based Nuclei Acid Delivery Carrier	Prof Max Lu	2006
Xiao Xia Yan	Mesoporous Bioactive Glass as Composites for Bone Repair and Treatment of Bone Tumour	Prof Max Lu	2007
Hidayatul Zakaria	Terahertz spectroscopy of mass-manufactured viral vaccines	Prof Anton Middelberg	2007

* Students studying Master of Philosophy. All other students are PhD candidates.

AIBN seminars

Speaker Professor Brian Vincent, University of Bristol, UK
Title Monodisperse Silicone Oil Droplets and their Encapsulation with Silica
Date Friday, 9 February, 2007

Speaker Professor David James, Department of Chemical and Process Engineering, University of Sheffield, UK
Title Mammalian Cell Factories: Translating Bioscience into Bioprocessing
Date Tuesday, February 20, 2007

Speaker Professor Can Li, Dalian Institute of Chemical Physics, Chinese Academy of Sciences
Title UV Raman Spectroscopy and Its Applications in the Characterizations of Catalytic Materials
Date Friday, March 2, 2007

Speaker Dr Ernst Wolvetang, Australian Stem Cell Centre, Dept of Anatomy and Cell biology, Monash University
Title Towards a basic understanding of hESC biology
Date Wednesday, March 7, 2007

Speaker Professor Jean-Marie Lehn, Nobel Laureate (Chemistry 1987), ISIS, Université Louis Pasteur, Strasbourg and Collège de France
Title From Supramolecular Chemistry to Constitutional Dynamic Chemistry
Date Friday, March 9, 2007

Speaker Professor Paul Mulvaney, School of Chemistry and Bio21 Institute, University of Melbourne
Title Single Particle Spectroscopy
Date Thursday, March 15, 2007

Speaker Professor Hans J Griesser, Ian Wark Research Institute, University of South Australia
Title Bioactive Materials Surfaces
Date Thursday, May 17, 2007

Speaker Associate Professor Andrew Elefanty and Dr Ed Stanley, Embryonic Stem Cell Differentiation Laboratory, Monash Immunology and Stem Cell Laboratories, Monash University
Title Genetic Modification of Embryonic Stem Cells (Dr Stanley)
Directed Differentiation of Embryonic Stem Cells (Professor Elefanty)
Date Tuesday, March 20, 2007

Speaker Dr Mark Raftery, Bioanalytical Mass Spectrometry Facility, University of New South Wales
Title Multi-dimensional liquid chromatography tandem mass spectrometry for the identification of proteins in complex mixtures
Date Thursday, March 22, 2007

Speaker Dr Silas Villas-Bôas, AgResearch, New Zealand
Title Metabolomics an Emerging Field of Biotechnology
Date Thursday, March 29, 2007

Speaker Professor John Orr, Queen's University Belfast
Title Load Bearing Biomaterials-Polymers at the Hip Joint
Date Monday, April 2, 2007

Speaker Dr Stuart Hazell, CEO PANBIO
Title Development of panDA Homogeneous Assay Technology
Date Thursday, April 12, 2007

Speaker Dr Heike Reents, Research Scientist, Fine Chemicals and Biocatalysis Research, BASF AG, Ludwigshafen, Germany
Title Performance Proteins at BASF
Date Tuesday, April 17, 2007

Speaker Dr Kerry D Fisher, Department of Clinical Pharmacology, University of Oxford
Title Systemic delivery of 'stealth' virus particles for the treatment of cancer
Date Tuesday, April 17, 2007

Speaker Professor John Mattick AO, Institute for Molecular Bioscience
Title The human genome as an RNA machine
Date Thursday, April 19, 2007

Speaker Dr Hans Kocher, Executive Director of the Biologics Centre, Novartis Institutes for Biomedical Research
Title Proteins as Pharmaceuticals
Date Friday, April 20, 2007

Speaker Professor Aibing Yu, Centre for Simulation and Modelling of Particulate Systems, School of Materials Science and Engineering, UNSW
Title Discrete Particle Simulation of Particulate Systems
Date Thursday, April 26, 2007

Speaker Dr Werner Baschong
i) Clinic for Dental Surgery, University Clinics for Dentistry
ii) M E Muller Institute for Structural Biology at the Biozentrum, Switzerland
Title AFM-assessed elasticity of articular cartilage at the glycosamino-glycan level, an early indicator for functional degeneration?
Date Wednesday, May 2, 2007

Speaker Professor Chennupati Jagadish, Department of Electronic Materials Engineering, Research School of Physical Sciences and Engineering, Australian National University
Title Quantum Dots and Nanowires for Optoelectronic Device Applications
Date Thursday, May 10, 2007

Speaker Dr Bernd M Fischer, The Adelaide T-ray Group, School of Electrical and Electronic Engineering, University of Adelaide
Title Bioactive Materials Surfaces
Date Thursday, May 24, 2007

Speaker Dr Stephen Holt, ISIS, Rutherford Appleton Laboratory, UK
Title Membrane Proteins as Sensors: Device Characterisation
Date Monday, May 28, 2007

Speaker Dr Martina Stenzel, Centre for Advanced Macromolecular Design School of Chemical Sciences and Engineering, University of New South Wales
Title The versatility of the RAFT process in the preparation of nanocontainers for biomedical applications
Date Thursday, May 31, 2007

Speaker Professor Hsueh-Chia Chang, Center for Microfluidics and Medical Diagnostics, University of Notre Dame, USA
Title A Dielectrophoretic Platform for Nano-Colloid Manipulation and Analysis on Biochips
Date Friday, June 1, 2007

Speaker Dr Anita Hill, CSIRO Manufacturing and Materials Technology
Title Pore-based Design of Dense Membranes
Date Thursday, June 14, 2007

Speaker Dr Bernd H A Rehm, Institute of Molecular Biosciences, Massey University, New Zealand
Title Polyhydroxyalkanoate granules: Self-assembly and potential applications
Date Thursday, June 21, 2007

Speaker Professor John White, Research School of Chemistry, The Australian National University
Title The Structure of Proteins at Interfaces
Date Thursday, June 21, 2007

Speaker Professor James M Piret, Michael Smith Laboratories & Department of Chemical and Biological Engineering, University of British Columbia
Title Stem Cell Bioengineering
Date Friday, June 22, 2007

Speaker Professor James R McMillan, Dept of Dermatology & Creative Research Institute Sousei (CRIS), Hokkaido University, Japan
Title Babes, blisters and basement membranes: from cell biology and genetics to nanobiotechnology-based therapies
Date Thursday, June 28, 2007

Speaker Professor Luc Averous, University Louis Pasteur, Strasbourg, France
Title Towards the Improvement of Green Plastics
Date Wednesday, July 4, 2007

Speaker Dr Paul A Midgley, Department of Materials and Metallurgy, University of Cambridge
Title 3D Electron Tomography – A New Perspective for Materials Microscopy
Date Friday, July 6, 2007

Speaker Professor Douglas MacFarlane, Monash University
Title Ionic Liquids – Applications in the Chemical- and Bio- Sciences
Date Wednesday, July 11, 2007

Speaker Professor Ramanath, Nanotechnology Center, and Center for Integrated Electronics, Rensselaer Polytechnic Institute, NY, USA
Title Sculpture and novel properties of nanostructures and their assemblies for applications
Date Thursday, July 12, 2007

Speaker Dr Rudy Koopmans, Dow Benelux
Title Overview of Dow's operations Dow Benelux
Date Friday, July 20, 2007

Speaker Dr Mike Johns, Magnetic Resonance Research Centre, Department of Chemical Engineering, University of Cambridge
Title Magnetic Resonance Characterisation of Multiple Emulsions and other Pharmaceutical Systems
Date Friday, July 20, 2007

Speaker Professor Feng-Huei Lin, Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan
Title Tissue Engineering in Blood Vessel
Date Thursday, July 26, 2007

Speaker Professor Sang Yup Lee, Institute for the BioCentury, Korea Advanced Institute of Science and Technology (KAIST)
Title Systems and Synthetic Biotechnology
Date Thursday, August 9, 2007

Speaker Geoffrey Osborne, Director of Flow Cytometry, Queensland Brain Institute / Australian Institute for Bioengineering and Nanotechnology
Title Strategies for ensuring the quality of sample data generated by flow cytometry
Date Thursday, August 16, 2007

Speaker Dr Ben Hankamer, Institute of Molecular Biology, The University of Queensland
Title The Solar Bio-fuels consortium: Developing advanced bio-fuel production systems
Date Thursday, August 23, 2007

Speaker Professor Irene Yarovsky, RMIT University
Title Theoretical Nanoscale Design of Novel Materials
Date Thursday, August 30, 2007

Speaker Dr John Power, Associate Director, Bios Development, Biologicals VMRD, Pfizer Animal Health
Title Overview of Pfizer's animal health R&D interests /activities in Australia
Date Friday, August 31, 2007

Speaker Professor Gerard J Milburn, Centre for Quantum Computer Technology, School of Physical Sciences, The University of Queensland
Title Quantum nanomechanics
Date Thursday, September 2, 2007

Speaker Professor Brij M Moudgil, Department of Materials Science & Engineering, and Particle Engineering Research Center, University of Florida
Title Nanoengineered Particulate Systems for Bio Applications
Date Monday, September 3, 2007

Speaker Professor Derek Hart, Mater Medical Research Institute
Title Moving Towards the Generation of Dendritic Cell Targeted Therapeutics
Date Thursday, September 13, 2007

Speaker Dr José Alarco, Very Small Particle Company Pty Ltd
Title Nanotechnology at VSPC
Date Thursday, September 27, 2007

Speaker Dr Sarah Schmitz, UQ Centre for Nutrition and Food Sciences
Title Microwaves in polymer chemistry: Synthesis of monomers and additives
Date Thursday, September 27, 2007

Speaker Dr Andrei A Gusev, Institute of Polymers, Department of Materials, ETH Zurich, Switzerland
Title Finite Element Approaches to Mesoscopic Materials Modeling
Date Friday, October 5, 2007

Speaker Dr Eric Pollet, Laboratoire d'Ingénierie des Polymères pour les Hautes Technologies (LIPHT), Université Louis Pasteur, Strasbourg, France
Title Biodegradable nanocomposite materials based on polyester / montmorillonite
Date Wednesday, October 10, 2007

Speaker Professor Milton Hearn, ARC Special Research Centre for Green Chemistry, Monash University
Title How to build innovation into biotechnological process developments at the downstream end of the business
Date Thursday, October 11, 2007

Speaker Professor Maree Smith, Director, Centre for Integrated Preclinical Drug Development, School of Pharmacy
Title Neuropathic Pain: Drug Targets and New Therapeutics in Development
Date Thursday, October 18, 2007

Speaker Professor Frederick F Lange, University of California, Santa Barbara
Title Superhydrophobicity and Making Silicon Superhydrophobic
Date Monday, October 22, 2007

Speaker Professor Melissa Little, Chief Scientific Officer, Australian Stem Cell Centre – Queensland Node
Title Approaches to renal regeneration from the top and the bottom
Date Thursday, October 25, 2007

Speaker Professor May-Britt Hagg, Department of Chemical Engineering, The Norwegian University of Science and Technology (NTNU), Norway
Title Material and Membrane Development for Gas Applications at NTNU, Norway
Date Monday, October 29, 2007

Speaker Dr Rudolf Grimm, Worldwide Proteomics and Metabolomics Market Development Manager
Title A Tale of Two 'Omics – Proteomics and Metabolomics
Date Monday October 29, 2007

Speaker Dr Easan Sivaniah, Leeds University
Title Preparation of biocompatible, biodegradable polymer coatings
Date Thursday, November 1, 2007

Speaker Mr Martin Albrecht AC, Chairman of Thiess Pty Ltd
Title Geodynamics
Date Thursday, November 15, 2007

Speaker Professor Michelle Simmons, Atomic Fabrication Facility, University of New South Wales
Title Atomic-Electronics – when will scaling reach its limit?
Date Thursday, November 22, 2007

Speaker Professor Ian Frazer, Diamantina Institute for Cancer Immunology and Metabolic Medicine
Title Progress and pitfalls in vaccine development
Date Thursday, November 29, 2007

AIBN media coverage

Date	Headline	Media
23 Jan 2007	No-pain all-gain with needle-free vaccination	www.abc.net.au
19 Feb 2007	The Medical Journal of Australia: Micro-nanoprojection patch	www.mja.com.au
27 Feb 2007	Two top research institutes open in Queensland	*SD Magazine*; Other – magazines and newsletters
17 Mar 2007	Forum to focus on cane uses	*Herbert River Express*, Pg 3; Other – newspapers
20 Mar 2007	Looking at alternatives	*Mackay Bush Telegraph*, Pg 4; Other – newspapers
21 Mar 2007	Conference focus on uses for sugar	*Tablelands Advertiser*, Pg 7; Other – newspapers
17 Apr 2007	Honey, I shrank the doctor	Bulletin with *Newsweek*, Pg 28; Other – magazines and newsletters
18 Apr 2007	Nanotech testing	IQ, *Courier-Mail*, Pg 28
18 Apr 2007	Pap smear end?	General, *Herald Sun* (Melbourne), Pg 24
25 Apr 2007	Big hopes for nano	*Business Acumen Queensland*, Pg 34; Other – magazines and newsletters
8 May 2007	No more pricks: Vaccine patch set to replace risky syringes	*MX* Brisbane, Pg 1; Other – newspapers
17 May 2007	Sugarcane 'biofactory' of future	Queensland Country Life, Pg 43; Other – newspapers
21 May 2007	Sugarcane will be biofactory of the future	*Australian Canegrower*, Pg 6; Other – newspapers
24 May 2007	Cane conference details advances	*North Queensland Register*, Pg 9; Ten Cairns News Channel 10 TV; Other – newspapers
11 Jun 2007	It's a small world after all	Age Education, *The Age*, Pg 7
25 Jun 2007	Desalination – Opportunities and Challenges	*Water*, Pg 30
2 Jul 2007	Acting small, thinking big	*Queensland Business Review*, Pg 20; Other – magazines and newsletters
31 Jul 2007	New-age science careers	Headstart – Pg 40 *Courier-Mail*
4 Sep 2007	Better chance for arteries	*The Australian*; General News; Hot FM Mackay; River FM (Ipswich); ABC Radio; ABC Western Qld Longreach; ABC North West Qld Mt Isa; 4BC Brisbane ; 4BC Brisbane; Radio 4BC; Other – radio
8 Sep 2007	Drugs reduce heart surgery risks	*Northern Daily Leader*, Pg 24; *Western Advocate*, Pg 16; *National AAP Newswire*; Other – newspapers
10 Sep 2007	Fresh Science and arteries	*ABC* Northern Tasmania *ABC* Radio
27 Sep 2007	Unis win funding: ARC grants awarded for range of projects	IQ, *Courier-Mail*, Pg 72
4 Oct 2007	Nanotech researchers building better golf ball	IQ, *Courier-Mail*, Pg 74
5 Oct 2007	Blood test to diagnose breast cancer	*Launceston Examiner*, Pg 15; *Illawarra Mercury*, Pg 18; *National Barrier Daily Truth*, Pg 6; *Border Mail*, Pg 4; *AAP Newswire*; Other – newspapers
6 Oct 2007	Nanoscience could diagnose cancer earlier	General News, *Canberra Times*, Pg 13
22 Oct 2007	Embarking on bold new research	*Western Advocate*, Pg 8
22 Oct 2007	Quick blood test the great hope for breast cancer	*Illawarra Mercury*, Pg 18
28 Oct 2007	Our Bio Boom	Agenda, *Sunday Mail*, Pg 53
4 Nov 2007	Stem cell breakthrough: Transfusion blood in controversial technique	General News, *Sunday Mail*, Pg 41
25 Nov 2007	Hitting golf balls	*Business Acumen Queensland*, Pg 36; Magazines and Newsletters
6 Dec 2007	Aussies in research deal with Dow Chemical of US	IQ, *Courier-Mail*, Pg 72
10 Dec 2007	Hay turns fascinating ideas into funded projects	Education, *Australian Financial Review*, Pg 31
17 Dec 2007	Former Qld Premier to receive honorary doctorate	ABC 612 Brisbane

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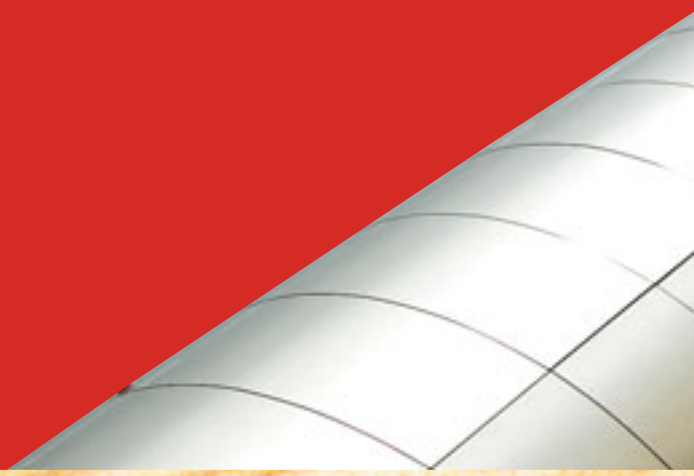

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