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Front cover: AIBN Building at The University of Queensland

Overview

The Institute was established to combine two transformative technologies in bioengineering and nanotechnology, fields that are having a fundamental impact in the 21st century.

AIBN, an integrated multi-disciplinary research institute, brings together the skills of world-class researchers at the interface of the biological, chemical and physical sciences to alleviate problems in human health and environmental issues.

1

AIBN timeline

"The Australian Institute for Bioengineering and Nanotechnology was conceived at the dawn of the century to secure Queensland's place in one of the most thrilling new fields of research and innovation. It has achieved its early objectives – and then some. Today, AIBN is a fertile ecosystem of researchers and innovators who are determined to deliver life-enhancing benefits to people in Queensland, Australia and worldwide."
Peter Beattie, AC
Premier of Queensland, 1998-2007

Aug 2003 Professor Peter Gray appointed inaugural Director.

Dec 2003 Donna Hannan appointed Deputy Director (Operations).

April 2006 Qld Deputy Premier Anna Bligh announces BIO 2006 projects, including:

- Australian Stem Cell Centre at AIBN $2 million
- NIRAP: $3 million to support projects led by Professors Trau and Whittaker (another seven NIRAP projects were funded by the Qld Government and AIBN Industry Partners up to 2015)
- $6.5 million from the Smart State Innovation Building Fund to establish the Bionano-products Development Facility

June 2005 Foundation AIBN Group Leaders appointed: Professors Max Lu*, Anton Middelberg*, Matt Trau*, Julie Campbell*, Lars Nielsen, Michael Monteiro, Andrew Whittaker, Darren Martin, Justin Cooper-White, Peter Halley, John Drennan (*AIBN Executive Members).

Oct 2006 AIBN building opened by Qld Premier Peter Beattie; UQ Chancellor Sir Llew Edwards AC; Chuck Feeney, founder The Atlantic Philanthropies; UQ Vice-Chancellor Professor John Hay AO; and Professor Gray.

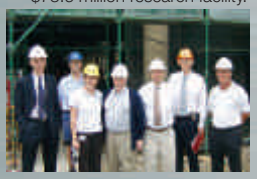
Nov 2006 $6.8 million funding of new ARC and NHMRC grants announced. Total research funding from national and international sources $111 million – as at 2015.

2002 2003 2004 2005 2006 2007 2008

Dec 2002 AIBN established by the UQ Senate.

November 2003 Professor Paul Greenfield AO accepts $5 million cheque towards AIBN building from Qld Deputy Premier Paul Lucas.

March 2006 AIBN building site visit: Chuck Feeney, founder The Atlantic Philanthropies, and UQ colleagues inspect the $73.6 million research facility.



June 2006 AIBN Student Association established.

April 2006 Professor Max Lu the only Australian to make the *Phoenix Weekly* magazine list of top 50 most influential Chinese in the world.

Dec 2008 Dr Akshat Tanksale, AIBN's first PhD graduate, with UQ Chancellor Sir Llew Edwards AC (left) and Professor Peter Gray.

2007 National Collaborative Research Infrastructure Strategy facilities established at AIBN:

- Biologics
- Fabrication
- Microscopy
- Metabolomics
- Stem Cells Limited (StemCore) (2011)

Total funding of $61 million attracted by 2015 to the facilities from government, industry and end user sources.

Nov 2007 Dow and AIBN launch a research alliance. Dow CEO and Chair Andrew Liveris AO signs the first of six major Dow-AIBN research collaborations that eventually lead to the formation at UQ of the $12 million Dow Centre for Sustainable Engineering Innovation, the first Dow Centre outside North America. UQ was represented by Professors John Hay, Paul Greenfield and Peter Gray.

Feb 2010 Professor Lars Nielsen forms the Qld Sustainable Aviation Fuel Initiative with partners Amyris, Boeing, Virgin Airlines, IOR, Mackay Sugar, JCU and the Qld Government.

Aug 2010 AIBN Seven Year Review conducted by UQ Academic Board. Review committee:

- Professor Mike Hoare, University College London (Chair)
- Professor Tom Davis, University of NSW
- Dr Carrie Hillyard, CM Capital
- Professor Regis Kelly, California Institute for Quantitative Biosciences
- Professor Pamela Silver, Weiss Institute and Harvard Medical School

Sept 2011 Professor Mark Kendall founds Vaxxas Pty Ltd to develop his Nanopatch needle-free vaccination technology. The company raised $42 million in venture capital and has major collaborations with Merck and WHO.

June 2012 Professor Darren Martin founds TenasiTech Pty Ltd, which raises $3.5 million in venture capital funds.

June 2012 Professor Mark Kendall awarded $100,000 Rolex Laureate Award for Enterprise.

June 2013 Professor Justin Cooper-White joint appointment as CSIRO Office of the Chief Executive Science Leader.

April 2014 Official launch of the $26 million ARC Centre of Excellence in Convergent Bio-Nano Science and Technology, which has four Chief Investigators from AIBN.

Feb 2015 Professor Lars Nielsen awarded an $8 million prestigious Novo Nordisk Foundation Laureate Research Grant (only two are awarded globally each year).

April 2010 Qld Premier Anna Bligh and Treasurer Andrew Fraser award the Premier's Fellowship to AIBN Group Leader Professor Anton Middelberg.

July 2009 AIBN Industrial Affiliates Program established.

2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015

April 2009 Ros Kelly AO, Chair of the National Breast Cancer Foundation (NBCF), and AIBN Deputy Director and Group Leader Professor Matt Trau discuss research that led to two $5 million grants from NBCF.

May 2011 Qld Government contracts AIBN's National Biologics Facility to make an anti-Hendra monoclonal antibody, available on compassionate grounds to people judged high risk of contracting the deadly virus. World-first Phase 1 trials, funded by the Qld, NSW and Federal governments, started in April 2015.

Nov 2011 Official launch of Stem Cells Australia, a $21 million ARC Special Research Initiative which has five of its 18 Chief Investigators from AIBN.

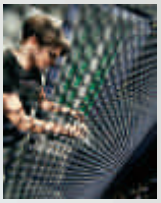
Dec 2011 Qld Premier Anna Bligh announces a major collaboration between AIBN, the Qld Government and DSM Biologics, operator of a $65 million scale-up facility. The DSMB/ Patheon facility opens on time and on budget in October 2013.

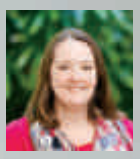
Sept 2012 Amanda Pearce wins the final of UQ's 3 Minute Thesis. Previous AIBN winners include Tim Brennan (2013 People's Choice Award) and Sean Muir (2011 runner-up).

June 2013 After several years as an AIBN summer then honours student, James Briggs is offered a full fellowship to Harvard for his PhD.

Sept 2014 Dr Liang Zhou becomes the 10th AIBN researcher to be awarded a UQ Foundation Research Excellence Award.

Sept 2014 AIBN's Centre for Theoretical and Computational Molecular Science, directed by Professor Debra Bernhardt, buys a new high performance computer.





May 2015 Associate Professor Christine Wells is recognised for outstanding work as part of the FANTOM consortium and Project Grandiose and awarded the prestigious Metcalf Prize by the National Stem Cell Foundation of Australia.

Message from the Vice-Chancellor

It is my great pleasure to contribute to this report on the foundational years of UQ's AIBN, particularly as it celebrates the period overseen by the inaugural director, Professor Peter Gray.

Peter and AIBN staff, students, industrial affiliates, partners and philanthropists have championed a culture of outcome-driven research excellence, where new solutions to individual and mass problems are pursued and harnessed.

Their approach has helped place transformative technologies in the hands of local and global society and industry. They have pioneered ways to prevent and fight human and animal diseases, explored paths towards lower-carbon economies, and worked with businesses in a number of sectors on improving their triple bottom line.

Crucially, the AIBN has been pivotal in attracting national and international investment, and outstanding talent, to Queensland. It has stimulated jobs growth, business opportunities, and Queensland's reputation as a place where great innovations are born and emerging innovators are fostered.

Moreover, the AIBN has helped cement UQ's position as a global top 50 university, and exemplified our University's vision of *knowledge leadership for a better world*.

Peter leaves the AIBN in great shape for his successor, Professor Alan Rowan, to continue the outstanding work. AIBN is now an institute of international standing, poised to deliver benefits to an even wider audience.

For all this, and much more, I thank and congratulate Peter and his colleagues and partners, past and present. They have established unshakable foundations for emerging innovators who are driven to create a healthier, more sustainable and more prosperous world.

Without trailblazers like Peter and his colleagues at AIBN, UQ's ambition to create change would remain just that - an ambition. These fine colleagues make it a reality.

Professor Peter Høj
Vice-Chancellor and President
The University of Queensland

It is with immense pride that I look back on all that has been achieved at the AIBN since inception in 2002, just some of which is profiled in this retrospective review.

AIBN was the second major research institute established by UQ after the successful formation of the Institute for Molecular Biosciences.

Since inception, AIBN researchers have raised $111 million to fund research in the institute from national and international competitive grant schemes, philanthropy, industry and other end-users of our research. During this period AIBN researchers have published 2092 papers that have been cited more than 34,000 times.

In keeping with AIBN's push to develop two transformative technologies, nanotechnology and bioengineering, it was necessary to develop substantial research infrastructure. In 2007, after the announcement by the Federal Government of a National Collaborative Research Infrastructure Strategy (NCRIS), AIBN successfully attracted five facilities (nodes) to the institute: the National Biologics Facility; the Australian National Fabrication Facility; the Australian Microscopy and Microanalysis Research Facility; Metabolomics Australia; and subsequently the Stem Cells Core facility.

Collectively these facilities have attracted, in addition to the research funding above, federal and state government and industry and end-user funding totalling $61 million. The NCRIS facilities have provided, in many cases, unique infrastructure necessary for

AIBN Director
Executive Summary

the high-end research of AIBN and other researchers and our industrial collaborators.

For any research institute, the quality of the research output is of paramount importance. The high quality of AIBN's research has been confirmed in all national Excellence in Research for Australia (ERA) exercises. AIBN research ranked at five, the highest ranking possible, for all six of the fields of research that cover research conducted in the institute.

The decision in 2002 to form an institute bringing together the two transformative bionano technologies was visionary. It was championed at UQ by the then Senior Deputy Vice-Chancellor Professor Paul Greenfield with strong support from discipline leaders Professors Matt Trau, Max Lu and Lars Nielsen. The group's advocacy convinced three key stakeholders to move ahead with forming the institute: the then Queensland Premier Peter Beattie; the founding chair of The Atlantic Philanthropies, Chuck Feeney; and UQ's then Vice-Chancellor Professor John Hay. The support of those three allowed a specialised $76 million building to be designed and constructed for the institute. The official opening was in October 2006. The fact that the building was finished on time and within budget is a testament to the skills and professionalism of the then Deputy Vice-Chancellor (Research) Professor David Siddle, who chaired the project control group, and Project Manager Peter Sampson.

The institute's success has been due in no small measure to the high quality of its people, working in a dynamic, well-equipped environment. Since its inception in 2003, AIBN has grown to nearly 500 people.

The timeline (pages 4 & 5) reviews some key events since inception. This timeline is a very brief summary of the institute's many successes and achievements and I apologise for the many omissions.

This review also outlines internal groupings within AIBN that are core to the institute's smooth operation. The AIBN Student Association is run and strongly supported by the 144 research higher degree students enrolled in the institute. More recently, an Early and Mid-Career Researchers' Committee has been established to cater to the needs of that group, who are the leaders of the future. As a technology based institute, AIBN was always keen to ensure we actively promoted our industrial engagement, and our Industrial Affiliates Program continues to act as a focal point for many of those activities.

In early 2016 I will hand over to my successor, Professor Alan Rowan. I would like to acknowledge and thank all the AIBN staff and students who have contributed in no small measure to AIBN's successes over the years. It has been an enormous pleasure and honour to have been the inaugural Director over such an exciting and productive period, and I step down with full confidence that the institute will continue on its upward trajectory. Our high-quality operations team, ably led by AIBN's Deputy Director (Operations), Dr Zoe Cahill, continues to ensure the smooth running of the institute.

The AIBN Executive, comprising Professors Matt Trau, Michael Monteiro, Debra Bernhardt, Lars Nielsen, Darren Martin, Justin Cooper-White, Andrew Whittaker and Mark Kendall meets weekly to advise on operational and strategic matters affecting the institute, while all Group Leaders and Associate Group Leaders meet monthly and take part in annual retreats and other planning days.

Particular thanks go to AIBN's Advisory Board, ably chaired by Euan Murdoch, who have provided high-level advice and support and been unstinting in challenging the institute's goals and strategic directions. AIBN board member and chair of the Scientific Advisory Committee, Professor Chris Lowe, from Cambridge University, deserves special thanks and mention for his 100 percent attendance over the years at board and other meetings.

Finally I would like to acknowledge UQ's senior management for their interest in and support for AIBN and me personally over the years. Professors Peter Høj (Vice-Chancellor and President), Max Lu (Provost and Senior Vice-President), Robyn Ward (Deputy Vice-Chancellor (Research) and Vice-President (Research)) and Anton Middelberg (Pro Vice-Chancellor (Research and International)) have all given their time generously, and their ongoing commitment to the institute has played a key role in our continuing successes. We are particularly proud of the many AIBN alumni who now have senior roles in industry and academia in Australia and internationally. The fact that two former AIBN Group Leaders, Professors Max Lu and Anton Middelberg, now occupy senior management roles at UQ is a fitting testament to the drive and skills of those who helped shape the institute in its formative years.

Professor Peter Gray
AIBN Director

Board Members

The AIBN Board is an advisory body, established to assist AIBN's Director in matters relating to the institute's governance, defined strategic goals, progress against goals, and levels of funding required to support ongoing operations and strategic initiatives.

The board has a broad ambit, including providing advice on funding opportunities, commercialisation paths, extension activities and growth strategies for AIBN on a strategic and operational basis. It reviews the institute's progress in research, internationalisation, commercialisation, governance and management.

It is also charged with advising on matters such as raising AIBN's international profile to maximise benefits to Queensland and Australia generally, and with assisting to maintain AIBN's high visibility and reputation in research, industry, government and public domains.

Euan Murdoch (Chair)

Euan Murdoch was founder of Australian-owned Herron Pharmaceuticals. His career has included positions on the Australian Food and Grocery Council, the Complementary Healthcare Council of Australia, the Queensland Biotechnology Advisory Council, the Reserve Bank of Australia Small Business Advisory Board, Harvest Fresh Cuts Pty Ltd, and Sigma Pharmaceuticals. In 2000, he received the Bicentenary Medal for services to the pharmaceutical and complementary healthcare industry. In 2005, Mr Murdoch became Chair of the Queensland Biotechnology Advisory Council and a member of the Smart State Council, an advisory body established to provide strategic high-level advice to the Queensland Government.

Professor Peter Gray

BSc Chem Eng (Hons) Syd, PhD NSW, FTSE, FIEAust, FAICD

Professor Peter Gray was appointed inaugural Director of AIBN in August 2003. He has held positions at the University of New South Wales as Director of the Bioengineering Centre and Professor of Biotechnology, and at the Garvan Institute of Medical Research as a Senior Principal Research Fellow. Professor Gray has had commercial experience in the US, working for Eli Lilly and Co and Cetus Corporation. He has held academic positions at the University College of London and the University of California, Berkeley. While at UNSW, he built the research and development capabilities in mammalian cell culture to be the leading group in Australia with an extensive collaborative network of international research groups and corporations.

Kathy Hirschfield

Kathy Hirschfeld is a non-executive director of InterOil Corp, Transfield Services Ltd, and Toxfree Solutions; and a Senator of The University of Queensland. She is on the board of UN Women in Australia. A chemical engineer, Ms Hirschfeld's 20-year career with BP included oil refining, logistics and exploration, located in Australia, the UK and Turkey. Her last executive role was Managing Director of the BP Bulwer Island Refinery in Brisbane, with responsibility for all aspects of the business.

Ms Hirschfeld was recognised by Engineers Australia in 2014 as an Honorary Fellow – the 9th woman to be so honoured. She is a Fellow of the Australian Academy of Technological Sciences and Engineering and the Institution of Chemical Engineers (UK) and a member of Chief Executive Women.

Professor Emeritus Christopher R Lowe

OBE, FREng, FInstP, FRSC

Professor Lowe is in the Institute of Biotechnology at the Department of Chemical Engineering and Biotechnology at the University of Cambridge and researches in diagnostics and therapeutics in the healthcare biotechnology sector. He is a Fellow of the Royal Academy of Engineering, the Institute of Physics and the Royal Society of Chemistry. He has several national and international prizes: Queen's Award for Technological Achievement; Queen's Anniversary Prize for Higher and Further Education; Most Entrepreneurial Scientist of the UK; OBE in the Queen's New Year Honours; BBSRC Commercial Innovator of the Year in 2011.

Bob McCarthy AM

Bob McCarthy has spent the past 30 years in senior positions in the public and private sectors. He has been Director-General of several Queensland Government departments, including the Department of Natural Resources and Mines and the Department of State Development and Innovation. He has been at the forefront of efforts to diversify the Queensland economy and develop new industries, based on science and innovation. In July 2009, Mr McCarthy joined UQ as Adjunct Professor in AIBN. He is a key person in progressing UQ's research efforts in biofuels technology and has an important role in expanding UQ efforts to include major international companies, such as Boeing and GE.

Dr Susan Pond AM

MBBS (Hons 1) USyd, MD UNSW, DSc UQ, FRACP, FTSE, FAHMS

Dr Susan Pond is Adjunct Professor in Sustainability and Leader of the Alternative Transport Fuels Initiative at the United States Studies Centre at the University of Sydney. Her interests include accelerating the transition to alternative fuels for transport, particularly by sectors with critical needs, such as aviation and shipping.

Dr Pond is Vice President of the Academy of Technology, Science and Engineering and a Board Member of Engineering Sydney and Biotron Ltd. She has been a board member of the Australian Nuclear Science and Technology Organisation and Innovation Australia. Previously, she held senior leadership and executive roles in business and academia, including Chairman and Managing Director of Johnson & Johnson Research Pty Ltd and Professor of Medicine at the University of Queensland.

Professor Robyn Ward AM

Deputy Vice-Chancellor (Research) and Vice-President (Research)

MBBS (Hons 1) UNSW, PhD UNSW, FRACP, FAHMS

Professor Robyn Ward joined UQ as Deputy Vice-Chancellor (Research) after many years of work within hospital and academic settings in New South Wales, including roles as Director of the Prince of Wales Cancer Centre and Clinical Associate Dean at UNSW. She remains Director of the Translational Cancer Research Network, a NSW-based multi-institutional group, supported by the Cancer Institute NSW. For the Commonwealth, she chairs the Medical Services Advisory Committee and is a long-standing member of the Pharmaceutical Benefits Advisory Committee. Professor Ward also chairs the NHMRC's Human Genetics Advisory Council and is a member of the NHMRC Council.

Scientific Advisory Committee

The Scientific Advisory Committee advises AIBN's Board and Director on science direction and research strategies.

Responsibilities include:

- Identifying future strategic opportunities for fields of research, collaboration and cross-disciplinary foci
- Identifying unique funding opportunities for AIBN's activities
- Assisting in providing global visibility for AIBN's activities
- Proposing strategies for training and developing researchers and research students to build scientific capacity and capability in a multi-disciplinary, global environment
- Recommending research strategies and goals to the Board.

Professor Emeritus Chris Lowe (Chair)

Professor of Biotechnology, University of Cambridge

Professor Barry Buckland

Visiting Professor Department of Biochemical Engineering, Faculty of Engineering Science, University College London; CEO of BioLogicB LLC

Professor Martin Pera

Chair of Stem Cell Sciences, University of Melbourne, Florey Neuroscience and Mental Health Institute and Walter and Eliza Hall Institute of Medical Research

Professor Virgil Percec

P Roy Vagelos Chair and Professor of Chemistry, University of Pennsylvania

Professor Chunli Bai

President, Chinese Academy of Sciences

Professor Thomas W Healy AO

Particulate Fluids Processing Centre, University of Melbourne

Professor Andrew Holmes

University Laureate Professor of Chemistry, CSIRO Fellow and Distinguished Research Fellow (Imperial), University of Melbourne

Professor Laura Poole-Warren

Pro Vice-Chancellor Research Training and Dean Graduate Research School, University of New South Wales

Professor Martin Lavin

Centre for Clinical Research, The University of Queensland

Professor Harvey W Blanch

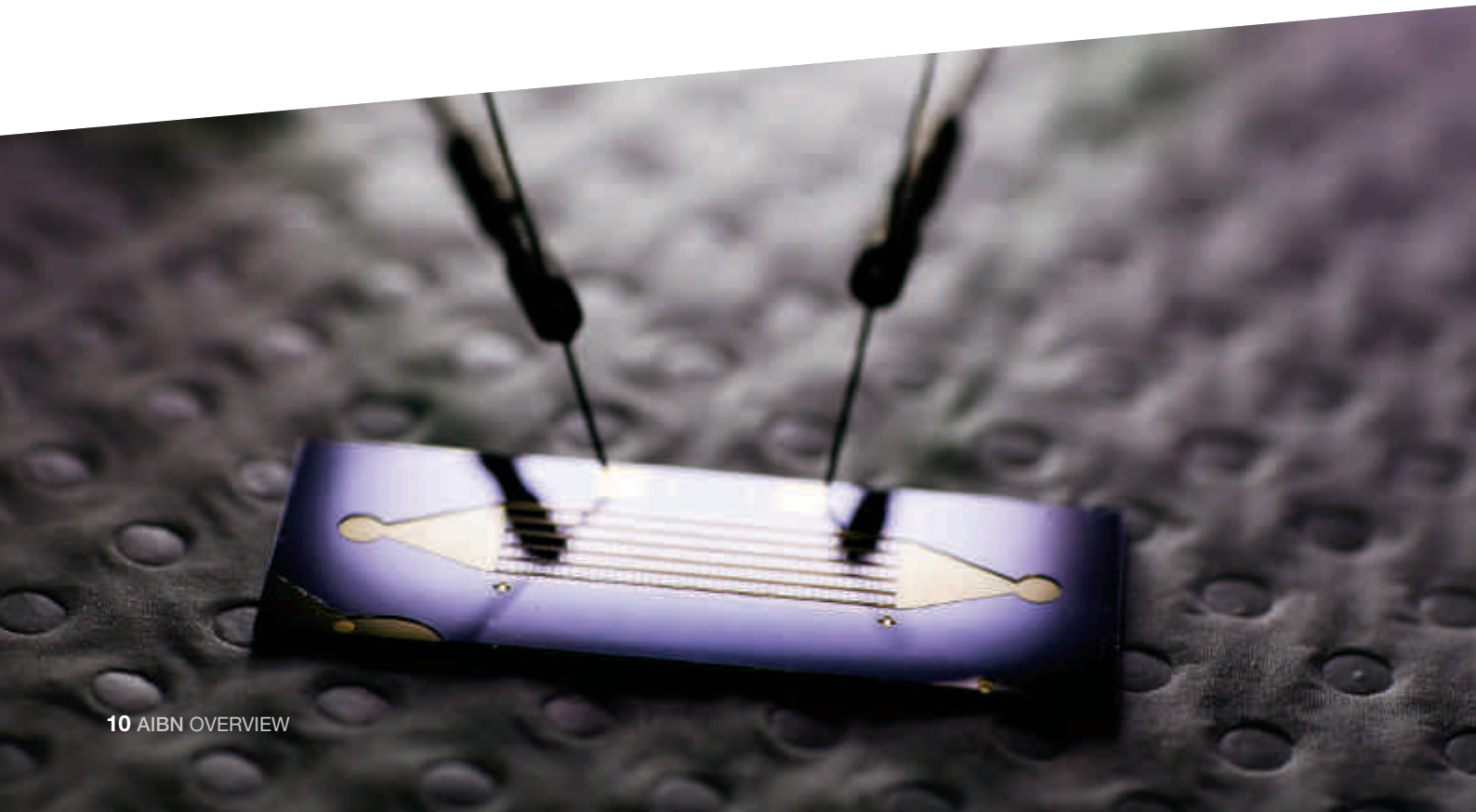
The Merck Professor of Biochemical Engineering, University of California (Berkeley)

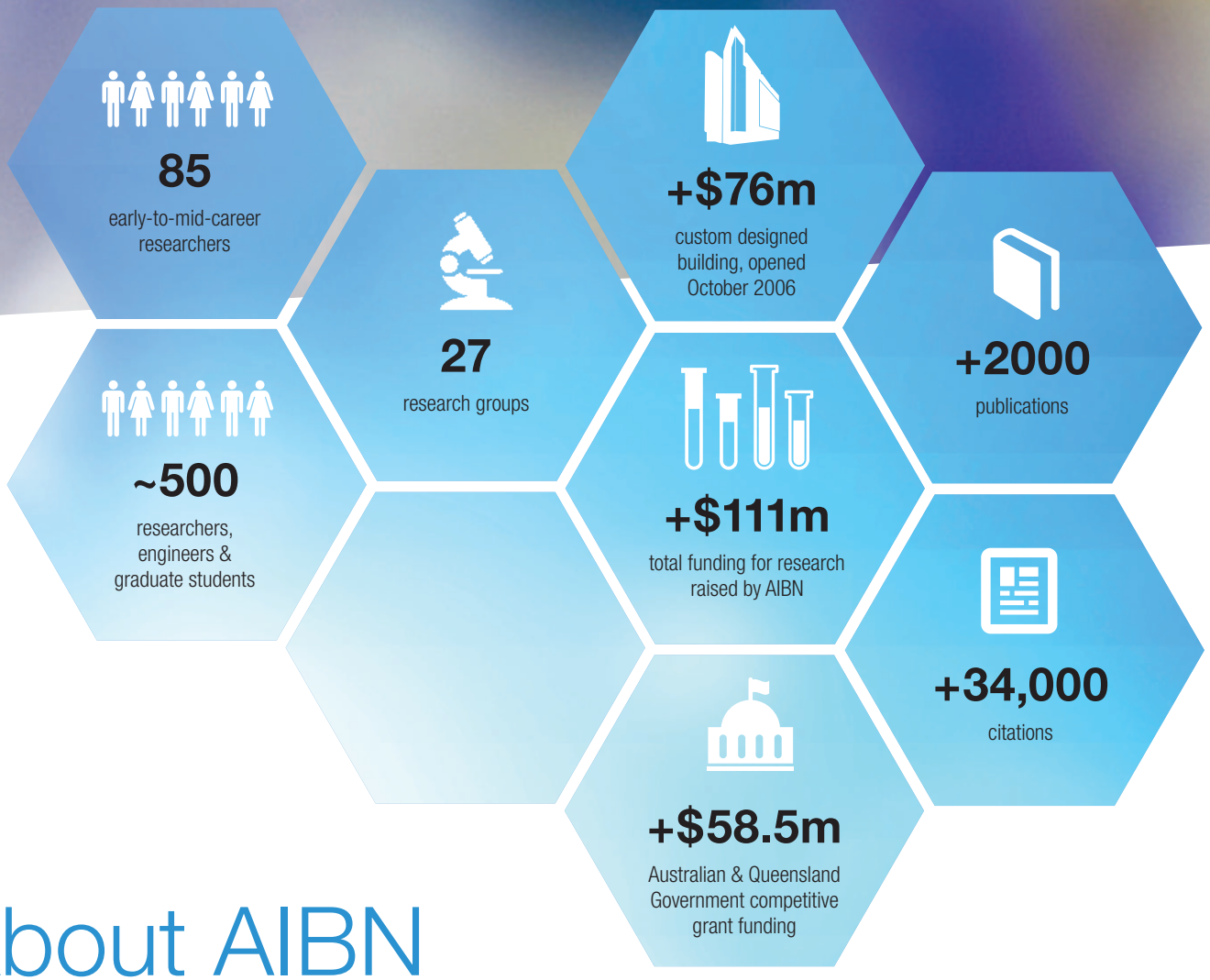
Professor Colin Raston

South Australian Premier's Professorial Research Fellow in Clean Technology, Flinders University

Dr Anita Hill

Chief of Process Science and Engineering, CSIRO





About AIBN

The Australian Institute for Bioengineering and Nanotechnology (AIBN) is a multi-disciplinary research institute with a strong focus on commercialisation and industry partnerships.

AIBN was established in December 2002 and Professor Peter Gray appointed inaugural director in 2003. Its $76 million research facility was opened in 2006.

AIBN has continued on a fast-paced trajectory since its inception, achieving key milestones as its research teams develop new products, processes, and devices that tackle critical global challenges, such as climate change, through clean energy and improved environmental practices, to health care issues, such as the rising incidence of chronic disease and the ageing population.

AIBN provides an intellectually stimulating, supportive environment for collaborative research on bio-nanotechnologies.

Its strategic research focus reflects the intersections between bioengineering and nanotechnology. Four key strengths are:

- nanomaterials
- cell and tissue engineering
- systems biotechnology, and
- nanobiotechnology.

AIBN's excellence goes beyond basic research, with a focus on inventing, translating and commercialising technologies that generate positive outcomes for health and the environment. AIBN promotes and develops the growth of innovative industries that benefit the Queensland, Australian and global economies.

AIBN's research is deployed on industry problems through consulting, partnering and contract and collaborative research. The institute facilitates that through state-of-the-art research infrastructure, equipment and capabilities in its purpose-built facility.

AIBN houses:

- National Biologics Facility - Queensland node
- Australian National Nanofabrication Facility - Queensland node
- Metabolomics Australia - Queensland node
- UQ's Protein Expression Facility
- the Pluripotent Stem Cell Core Facility (StemCore)
- Centre for Microscopy and Microanalysis
- AIBN's Centre for Theoretical and Computational Molecular Science

The infrastructure is matched by a critical mass of internationally recognised researchers, including chemists, biologists, engineers and computational scientists.

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

AIBN's broad range of research programs includes:

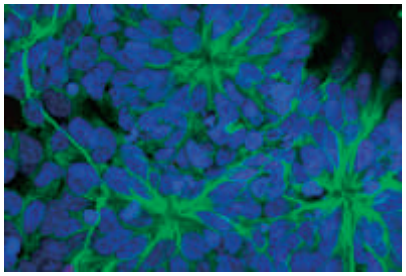
- Delivering therapeutic agents using polymer chemistry, virus-like particles, and needle-free transdermal technologies.
- Using metabolic engineering to produce new bioproducts from cells.
- Combining stem cell biology with novel scaffolds for regenerative medicine.
- Developing nanomaterials for orthopaedic applications, enzyme encapsulation and biosensors.
- Low-cost, high-performance absorbents to remove arsenic for water treatment.
- Photocatalysts for environment remediation and novel membranes for water desalination and recycling.
- Nanotechnology for energy and environmental applications.


Discovery

AIBN has a dynamic research environment. The Institute conducts world-class research in nanoscale science, technology and engineering and is committed to translating this research into commercial outcomes. Integral to AIBN's ongoing research success is a unique combination of facilities and capabilities.

2

AIBN research – snapshots

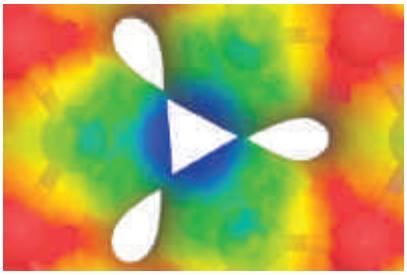


Genome edited iPSCs for regenerative medicine and disease modelling

Stem cell researchers, led by Professor Ernst Wolvetang, are using induced pluripotent stem cells (iPSCs) to study neurological disease. Correcting or introducing specific DNA mutations with precise genome editing technology and subsequent differentiation of iPSCs into neural cell types allows unprecedented insight into degenerative diseases of the brain.

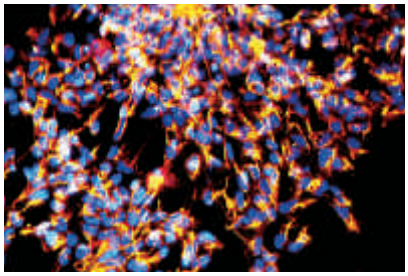
FANTOM5 promoter atlas published in *Nature* and other journals

Professor Ernst Wolvetang and Associate Professor Christine Wells are examining the complex networks that regulate gene expression responsible for the diversity of cell types that make up humans. The FANTOM5 atlas of human gene expression, involving scientists from more than 20 countries, will help identify genes involved in disease and develop personalised and regenerative medicine.



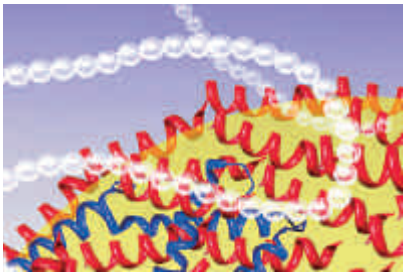
Materials for rechargeable batteries from computational modelling

Professor Debra Bernhardt and her team are using computational molecular science to assist in development of new materials for use in rechargeable batteries. Porous two dimensional materials have recently shown promise as alternatives to graphene for the anodes of lithium ion batteries.



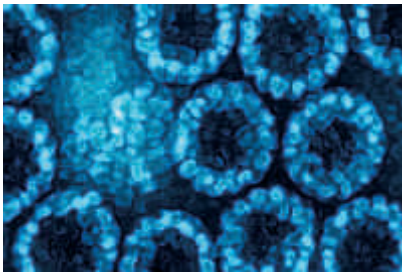
Nanobridges, a thermo-responsive polymer for human stem cell expansion and release

A new method for producing human stem cells for expansion and release involves using long, flexible, thermo-responsive polymer "worms", a nanomaterial that does not use cell membrane disrupting enzymes or other inhibitors during stem cell subculturing, and is ideal for large-scale production. The research is led by Professor Peter Gray and Professor Michael Monteiro.



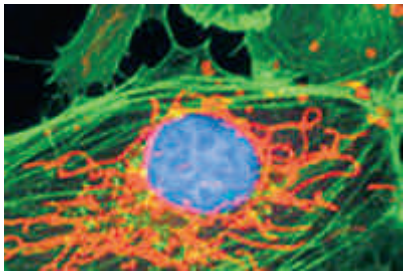
Nanoemulsions for drug delivery

Overcoming chemical challenges that limit the targeted delivery of therapeutics, such as cancer drugs, with a world-first, self-assembled targeting nanoemulsion is the focus of a project led by Dr Frank Sainsbury and Professor Anton Middelberg. These nanoemulsions can sequester poorly soluble drugs and selectively deliver them to cancers, minimising off-target effects and significantly increasing payloads reaching target cells.



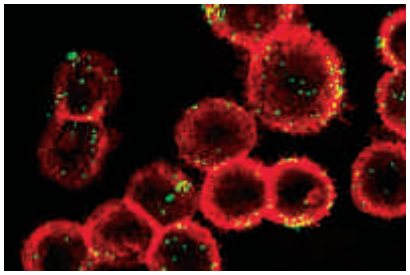
Novel modular virus-like particle and capsomere vaccine development

Novel modular virus-like particle (VLP) and capsomere technologies can potentially enable low-cost, rapid and scalable manufacture of new vaccines. Researchers led by Professor Anton Middelberg and Associate Professor Linda Lua have developed new vaccine technologies that can broaden vaccine delivery for infectious diseases in humans and animals. In 2014 the research was published widely in an article titled *The economics of virus-like particle and capsomere vaccines.*



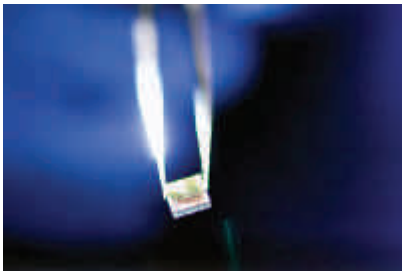
Phase 1 clinical trial for Hendra antibody

Professor Peter Gray and the National Biologics Facility are working on proving the safety of the only known effective treatment for humans exposed to Hendra virus. Researchers have started Phase 1 clinical trials of a human monoclonal antibody capable of neutralising Hendra virus.



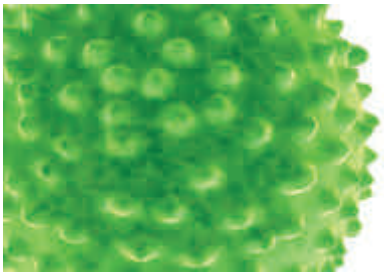
Antibody-targeted nanomedicines

Associate Professor Stephen Mahler and his team are designing antibodies that are able to target nanoparticles carrying payloads of cytotoxins to various tumours, increasing the efficiency of drug delivery and decreasing the side effects of drugs. The antibody-targeted nanoparticles (green dots) attach to receptors on cancer cells (outlined in red). Tumour cells internalise the nanoparticles, resulting in tumour cell death.



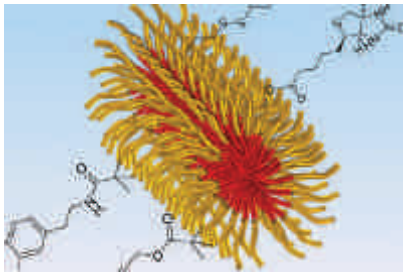
Collaboration with WHO on polio vaccine delivery

The Nanopatch, invented by AIBN's Professor Mark Kendall, aims to replace traditional needle and syringe vaccine delivery methods with a small patch. A new research collaboration between Vaxxas, a start-up company spun out from UQ, and the World Health Organisation (WHO) will evaluate the Nanopatch's use as a platform for polio vaccine delivery.



Delivery technology

AIBN's Professor Chengzhong (Michael) Yu and Dr Neena Mitter at the Queensland Alliance for Agriculture and Food Innovation are developing silica based delivery technologies to enhance the delivery efficacy of vaccines and pesticides for advanced and sustainable agriculture.



Multifunctional nanoworms and nanorods

Professor Michael Monteiro and his group have produced multifunctional polymer worms made through a unique emulsion polymerization method developed in the group. These worms were attached with a variety of fluorescent probes and many other biomolecules of interest. These structures have potential in drug and vaccine delivery, photonics, diagnostics, and self-healing coatings.

Arsenic removal

Professor Chengzhong (Michael) Yu and his team are engineering functional nanomaterials to remove toxins from contaminated water to combat the global threat of water contamination and eutrophication. The group has developed low-cost, high-performance absorbents for removing arsenic and phosphates.

$8.6m award to unlock cancer cell code

AIBN bioengineer Professor Lars Nielsen has won a prestigious Novo Nordisk Foundation Laureate Research Grant, worth up to $8.6 million.

Professor Nielsen, who leads research into systems and synthetic biology, is one of only five researchers worldwide to be awarded the seven-year grant.

"My goal at the Novo Nordisk Foundation in Denmark will be to engineer a fast-growing human cell to help answer why cancer cells, and other fast-growing mammalian cells, produce lactic acid," Professor Nielsen said.

In 1924 German Nobel Laureate Otto Warburg noticed cancer cells produced lactic acid despite having sufficient oxygen. Muscles also produce lactic acid during strenuous exercise but only when lacking oxygen.

Warburg's theory was lactic acid produced by cells caused cancer.

"The Warburg effect was a hot topic in cancer research until it was discovered that every fast-growing cell in the human body produces lactic acid," Professor Nielsen said. "However, the reason why remains a mystery, so my project aims to explain the Warburg effect within a detailed kinetic and regulatory model of central carbon metabolism in cultured mammalian cells."

Professor Nielsen's work in developing computational tools to analyse and design complex biological systems has been applied to systems as diverse as bacteria, baker's yeast, sugarcane and insects, and attracted industrial partnerships with companies including Dow, Metabolix, Amyris, LanzaTech, Boeing, Virgin Australia and GE.

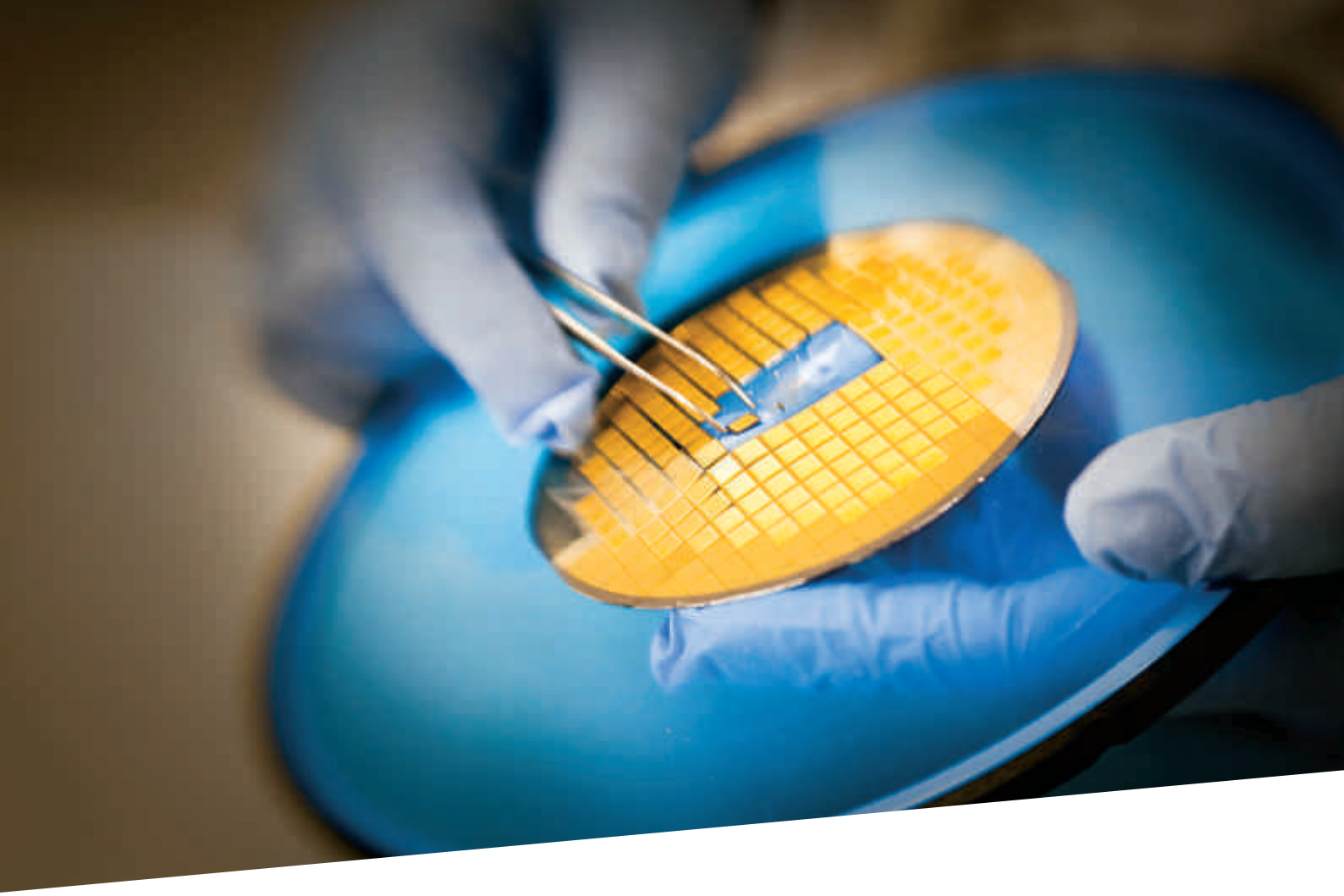
The Novo Nordisk Foundation grant will enable Professor Nielsen to establish a team to examine how to model cell metabolism. Given the rapid development of microbial engineering tools, he is confident his team may get close to their goal, although he does not discount the difficulty of the task.

"We may be able to model metabolism if we know the architecture of a cell and how much enzyme and protein there is, and what the metabolites are. But we won't know how to determine quantities of the protein expressed, as this is a massively complicated calculation made in the cell.

"Each cell in the human body contains about 25,000 to 35,000 genes and, in front of every gene, there may be 50 binding sites that are integrated into the process of what quantity of a particular protein is made. All these sites bind to each other and everything in the cell is bound together and networked in a very complicated way," Professor Nielsen said.

"The system is so sensitive to any change in parameters that even a difference in base pairs in the DNA of two people could change the result. It may never be possible for us to compute all the possible interactions. The human cell has had millions of years to get these calculations right."

Professor Nielsen will continue in his role at AIBN on 50 percent basis for the first two years of his appointment at the Novo Nordisk Foundation Centre for Biosustainability in Copenhagen. He took up his new role in June 2015.



Vaccine technology company attracts $25m

Vaccine technology company Vaxxas has moved a step closer to achieving its goal of improving world health, thanks to a $25 million capital raising.

The company, a startup of The University of Queensland's UniQuest commercialisation company, has attracted the funding led by Australian venture capital firm OneVentures in its series B fundraising to further the Nanopatch.

The Nanopatch, invented at UQ's AIBN by Professor Mark Kendall, seeks to replace traditional needle and syringe methods with a small patch that delivers vaccines painlessly.

In 2011, UniQuest, working with Professor Kendall, founded Vaxxas to advance the Nanopatch towards being a clinically proven product.

"This investment is a key next step in advancing a series of clinical programs and developing a pipeline of new vaccine products for major diseases using Vaxxas's patented Nanopatch technology," Professor Kendall said.

"The Nanopatch has the potential to improve global health. The technology is the size of a postage stamp, and has thousands of small projections designed to deliver the vaccine to abundant immune cells in the skin.

"It is designed for thermostability, making it cheaper to produce, more convenient to transport, and easier to access in developing countries."

Deputy Vice-Chancellor (Research) Professor Robyn Ward said the significant investment demonstrated the high quality of research coming out of UQ.

"The Nanopatch is an excellent example of the practical research UQ experts are tackling," she said.

"From a concept developed on campus to international testing, the Nanopatch is an inspiring success story of what researchers at UQ are achieving."

UniQuest CEO Dr Dean Moss welcomed the funding.

"UniQuest is delighted that Vaxxas has been able to raise funds in a series B venture financing round from existing and new investors, taking the total capital raised by the start-up company to $40 million," he said.

"There is huge potential with this technology, if successful, to improve health worldwide.

"It is already one of UniQuest's 30-plus commercialisation stories and I look forward to seeing the next exciting step in development of the needle-free vaccination technology."

Genomics pioneer wins prestigious award

Associate Professor Christine Wells has received one of two $50,000 Metcalf Prizes from the National Stem Cell Foundation of Australia for leadership in stem cell research.

Associate Professor Wells is revolutionising the way stem cell researchers and bioinformaticians share information and interact in this rapidly growing field.

The Metcalf Prize is named for Australia's pioneering stem cell researcher, the late Professor Donald Metcalf, AC, an internationally renowned expert on blood cell formation, who died in December 2014.

Associate Professor Wells is a recognised pioneer of genomics — the study of the structure and function of an organism's genome — and its role in immunity and stem cell biology. She discovered the function of several genes involved in fighting infection and that regulate inflammation.

Associate Professor Wells leads the Stemformatics initiative — an online encyclopaedia that puts vital data at the fingertips of stem cell researchers and their cross-disciplinary collaborators.

Stemformatics has enabled the discovery of a new type of pluripotent stem cell — cells that can give rise to any type of cell — and only the second type that can be grown in the laboratory from adult tissues.

"I work on what we call 'atlas' projects that effectively map and make available detailed information about how different genes are expressed, as stem cells divide and specialise," Associate Professor Wells said.

She will use her Metcalf Prize to further grow Stemformatics as a vital piece of research infrastructure for the worldwide stem cell research community. That will allow researchers to interrogate their own data more deeply, compare it with other researchers' data, gain new insights, and perhaps even discover other classes of stem cells with therapeutic potential.

Associate Professor Wells is a member of the Project Grandiose consortium, a group of about 50 researchers operating across five nations, which has developed new ways to reprogram normal adult cells, such as skin cells, into cells similar to those found in early embryos.

The development is expected to help researchers explore ways to arrive at new cell types in the laboratory, with important implications for regenerative medicine and stem cell science.

Associate Professor Wells also has an ongoing, senior role in the international genome consortium, Functional Annotation of the Mammalian Genome (FANTOM), with the Riken Institute in Japan.

"Human life begins from a single fertilised egg which divides repeatedly to form all the different types of cells a body requires to function," she said.

"The FANTOM5 team appears to have uncovered a key part of the puzzle about how cells differentiate to perform different functions and develop into more specialised cell types, such as brain cells, blood cells or muscle cells."

When cells turn on new genes, the process starts from enhancer regions, a type of DNA "switch", and key regulatory elements throughout the genome.

"We knew enhancers played a role in development, but the FANTOM research shows they are much more dynamic than initially thought and responsible for activating a cell to react to its environment," Associate Professor Wells said.

The study would inform future medical research. "We are just beginning to understand the implications of this finding. It is one part of a very complex puzzle of life," she said.

Stem cell powerhouse achieves global recognition

AIBN researchers are turning tiny stem cells into health, wealth and international reputations.

When Professor Peter Gray came to Queensland in 2003 as AIBN's inaugural Director, he began building a strong cadre of 'bio' and 'nano' experts. They have had particular success in stem cell research, a field predicted to revolutionise medical research and treatment.

Five of 18 chief investigators with Stem Cells Australia (SCA) – a seven-year Australian Research Council Special Research Initiative – are AIBN group leaders. They are Professors Ernst Wolvetang, Justin Cooper-White, Lars Nielsen and Peter Gray and Associate Professor Christine Wells.

AIBN scientists collaborate with SCA colleagues and have teamed up with industry and researchers globally. Genome biologist Associate Professor Wells, for instance, has a joint appointment at Glasgow University and close associates in Germany, Japan, Denmark, and Boston, Massachusetts.

As part of an international team, Project Grandiose, she helped identify new ways to track the production of 'artificial' stem cells, called induced pluripotent stem cells (iPSCs). Created by turning back the developmental clock of adult cells, such as skin cells, to their earliest days as embryonic stem cells, iPSCs can develop into any cell type in the body.

Associate Professor Wells also leads the project's Stemformatics initiative. "The stemformatics.org group's role is to help researchers access the vast information and data generated from the project," she said.

Associate Professor Wells and Professor Wolvetang also contribute to another international consortium, the Functional Annotation of the Mammalian Genome (FANTOM). Using iPSC technology, Professor Wolvetang's team identified the first moments of altered brain development in Down syndrome, a condition causing varying degrees of intellectual and physical disability.

Professor Gray said bioengineer Professor Cooper-White "builds exquisite mini-devices" and one, a patented credit card-sized 'microbioreactor', permits stem cells to be cultured under thousands of different conditions to determine the best environment for individual projects.

In 2014, Professor Cooper-White and Professor Melissa Little, from UQ's Institute for Molecular Bioscience, signed an agreement with US biotech company Organovo to use his device to print 3D human kidney tissue. The mini-kidneys could lead to better disease modelling and drug development, and help tackle chronic kidney disease, which costs Australia $1.8 billion a year.

Systems biologist Professor Nielsen's stem cell work promises huge health and commercial benefits. Professor Nielsen developed a process for manufacturing mass quantities of neutrophils outside the body. Neutrophils are a type of white blood cell that form the body's first line of defence against invading bacteria and fungi. They are damaged or killed by anti-cancer drugs. The result is a life-threatening condition called neutropenia.

Because it is impractical to obtain neutrophils from donors, Professor Nielsen uses the technology to produce transfusible neutrophils from blood stem cells to treat cancer patients. Unable to raise money in Australia for a Phase 1 clinical trial, he is working with University of Toronto stem cell scientist Peter Zandstra at Canada's Centre for Commercialisation of Regenerative Medicine.

The neutrophil work is a classic example of the "challenge projects" Professor Gray knew could be advanced by combining the world's best 'bio' and 'nano' brains and state-of-the-art facilities under one roof.

Professor Gray and AIBN Group Leader Professor Michael Monteiro are wielding bio and nano tools to create complex structures built from polymers, or large molecules. The scaffolds will be ideal for working with adult or iPSC stem cells by producing the volume of cells needed for clinical testing.

Professor Gray said together AIBN's scientists attracted "some of the brightest young minds in Australia to undertake research higher degree studies that will equip them with the skills and confidence necessary to take their place on the world stage".

Industry Alliances

AIBN is home to world-leading researchers, state-of-the-art facilities and equipment, and cutting-edge nano and biotechnologies. AIBN researchers are well placed and strongly motivated to work with industry. Industry partners can access AIBN's wealth of capabilities and technologies through a range of partnering mechanisms.

3

Work with us

Commercialisation and industry engagement

AIBN has extensive research capabilities, combined with a unique and comprehensive suite of facilities, available to industrial research communities in Australia.

AIBN can undertake research and development with flexible arrangements to meet partners' needs, including:

- Consulting
- Contract research
- Joint research projects (for example, ARC Linkage Grants)
- Access to facilities and infrastructure
- Technology for licensing or co-development.

Innovation and commercial development strategy

AIBN's mission is to combine academic excellence with positive commercial and societal impacts. The institute aims to exploit cutting-edge nano and biotechnologies to develop new products and processes; and to play a major role in supporting development of Australian nano and biotechnology industries. Those objectives are achieved through a multi-faceted commercialisation strategy, including:

- Working with AIBN researchers to identify potential commercial opportunities for AIBN technology and ensuring suitable intellectual property protection
- Creating spin-off companies and executing licensing agreements, in collaboration with UQ's commercialisation company, UniQuest Pty Ltd
- Proactive engagement with industry on either a project-by-project basis or a project-independent basis
- Identifying and developing funding opportunities to support and facilitate commercialisation of AIBN technologies.

AIBN spin-off companies

AIBN has a track record of creating spin-off companies to develop and commercialise products arising from AIBN technology.

Spin-off companies are nurtured within the institute through their early operations, providing a base for them to mature into independent small and medium-sized enterprises.

Two successful AIBN spin-off companies are Vaxxas Pty Ltd and TenasiTech Pty Ltd.

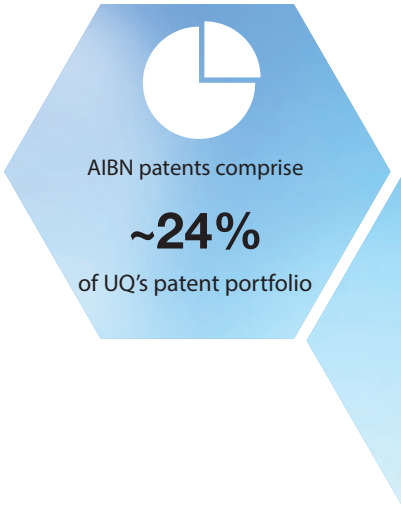
Vaxxas was founded in 2011 to develop and commercialise the Nanopatch technology created in AIBN Group Leader Professor Mark Kendall's laboratory. Nanopatch is a novel, needle-free way to deliver vaccines via the skin. Animal studies have demonstrated that Nanopatch delivery can reduce the amount of vaccine required for an efficacious immune response about 100 fold, compared to conventional vaccine delivery. Vaxxas has received strong backing from a syndicate of venture capital and other private investors and has raised about A$40 million. It has entered into a research partnership with Merck and Co, a major international player in the vaccine industry.

TenasiTech is an advanced materials technology company, arising from research in AIBN Group Leader Professor Darren Martin's laboratory. The company was founded in 2007 and financed by investments from Uniseed and angel investors, and grants from the Queensland and Australian governments. Through several co-development projects with multinationals, TenasiTech's additive platform is proven in multiple plastics and in multiple industries. The technology delivers valuable improvements to moulded or extruded products and coatings, such as strength and toughness, scratch and chemical resistance, and higher operating temperature performance.

Success stories

AIBN technologies have underpinned multiple projects that have yielded commercial benefits and/or positive societal impacts. Several are profiled in the following pages:

- Human trials of a Hendra virus antibody
- Preserving van Gogh's *Sunflowers* painting
- Re-engineering living systems using systems and synthetic biology
- Licensing AIBN's nanoparticle drug delivery technology to UK company Oxford Pharmaceuticals to "taste mask" oral drugs
- A portable DNA disease scanner that's delivering field results
- A ceramic nano-additive for plastics and rubbers to make them scratch resistant.



AIBN Industrial Affiliates Program

The Industrial Affiliates Program (IAP) is a project-independent vehicle for engagement between AIBN and industry.

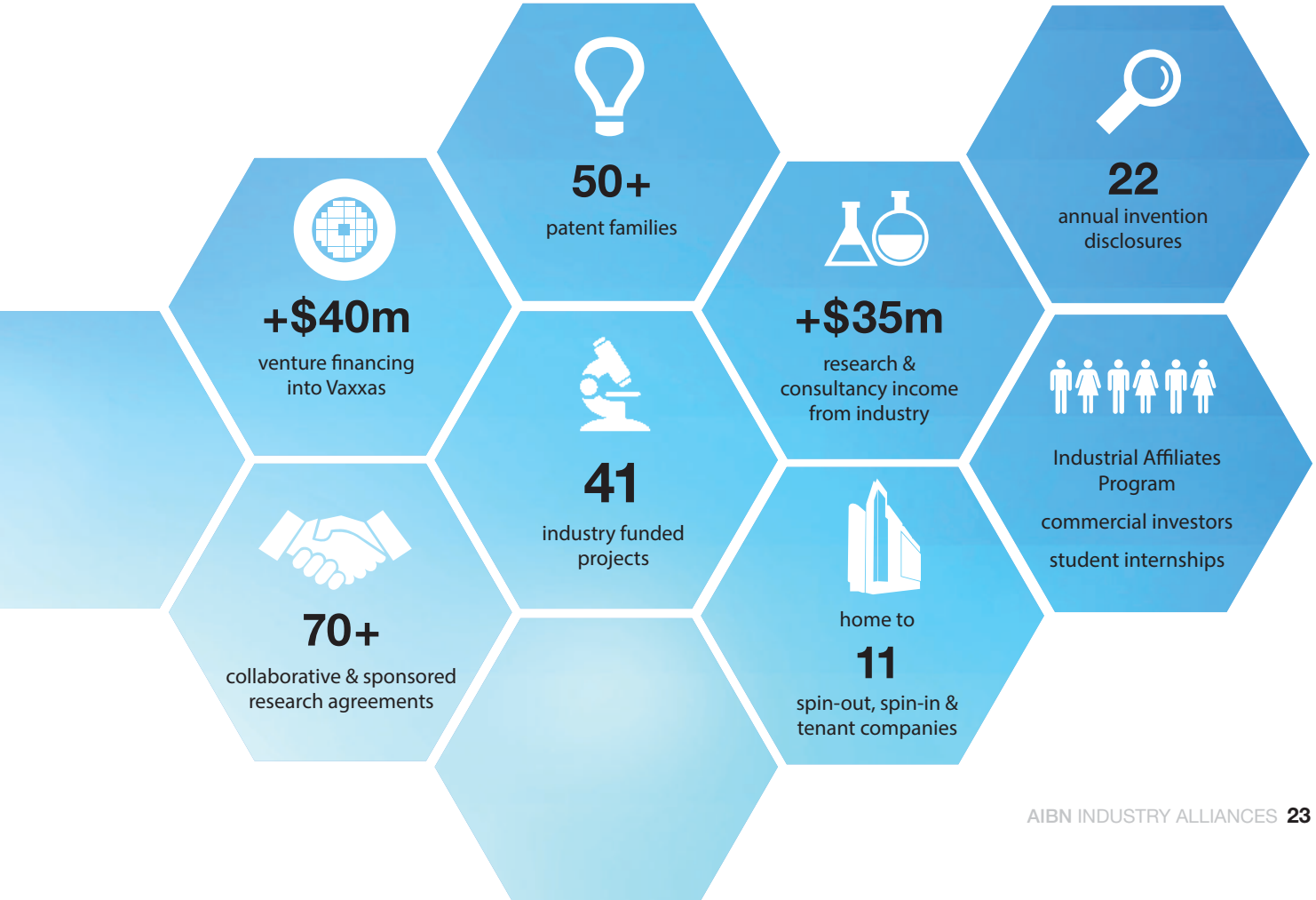
The program is membership based, with the membership level determined by the degree to which a member company wants to engage with AIBN and tap into AIBN's facilities, equipment and expertise.

IAP membership facilitates interaction between member companies and one or more AIBN research groups, with interactions leading to future formal relationships, for example, joint research projects.

Benefits vary according to the IAP membership level. All members can access exclusive networking events; are invited to seminars, symposiums and conferences organised by AIBN; can nominate suitably qualified people as UQ Academic Adjuncts; and can access AIBN public disclosures.

Under the IAP banner, AIBN runs regular networking and information events, including an annual showcase and networking event and a biannual Thought Leaders' dinner.

The events are well attended and promote informal interaction between AIBN researchers, IAP members, and other academic and industry leaders. IAP is just one program through which AIBN seeks to develop long and fruitful relationships with Australian and international industry, and underpin a vibrant innovation economy in Queensland and Australia.



Hendra virus: research leads to clinical trial

Queensland's Department of Health has been granted approval to start testing a monoclonal antibody against the Hendra virus on human volunteers.

The approval follows a $1.2 million state and federal government grant to fund human clinical safety trials.

The trials will be run at Q-Pharm clinics at the QIMR Berghofer Medical Research Institute and supervised by Hendra virus specialist Dr Geoffrey Playford from the Princess Alexandra Hospital.

AIBN Director Professor Peter Gray said the trials' journey began in 2010 when Queensland's Chief Health Officer obtained a licence from US researchers led by Professor Chris Broder to produce the experimental antibody called m102.4.

"The m102.4 monoclonal antibody cell line was originally obtained for producing and stockpiling the m102.4 human monoclonal antibody for human compassionate use in cases of Hendra virus exposure," Professor Gray said.

"Our experts at AIBN have worked hard to develop a bioprocess to produce the m102.4 monoclonal antibody at the very high purities required for use in humans. It's now exciting to think that, with human trials being approved in compliance with international guidelines, we are that much closer to saving infected people's lives."

The antibody has been used on compassionate grounds in 11 people, of whom 10 survived.

Dr Playford said there was insufficient information to determine whether using the monoclonal antibody influenced that outcome, so further research was required.

A monoclonal antibody is a laboratory-produced molecule that is carefully engineered to block the ability of Hendra virus to attach to and infect cells.

Dr Playford said monoclonal antibodies mimicked antibodies the human body naturally produced as part of the immune system's response to germs, vaccines and other invaders.

"Almost like an intelligent missile, the monoclonal antibody is designed to seek out Hendra virus" he said.

"The antibody is designed to attach to part of the Hendra virus, thereby alerting the body's immune system to the presence of the virus, marking it for destruction.

"The study's main objective is to evaluate the safety and tolerability of m102.4. We want to find out how the antibody makes people feel and whether there are any side effects. The trial will also determine the amount of antibody in a person's blood at various times during the study and the effect it has on the immune system."

Queensland's Chief Health Officer Dr Jeannette Young said testing the monoclonal antibody on humans would see the state move one step closer to protecting those at high risk of developing Hendra virus following contact with infected horses.

The trial involves AIBN, Queensland Health, the Queensland and New South Wales Intergovernmental Hendra Virus Taskforce, Q-Pharm, QIMR Berghofer Medical Research Institute, American Hendra virus expert Dr Chris Broder, the Uniformed Services University of the Health Sciences, the Henry M Jackson Foundation for the Advancement of Military Medicine, and the Alister Rodgers Memorial Fund.

Van Gogh painting under the microscope

A minute paint sample from Vincent van Gogh's *Sunflowers* painting in Amsterdam's Van Gogh Museum is under the microscope at AIBN.

The tiny sample is being examined at UQ's Centre for Microscopy and Microanalysis (CMM), through high-resolution 3D imaging.

AIBN Affiliate Group Leader Professor John Drennan said the analysis was designed to improve understanding of the ageing characteristics of significant artworks in a bid to improve conservation techniques.

"CMM's recently installed Gatan 3View/ Zeiss microscope system will examine cross sections of the paint samples," Professor Drennan said.

"The instrument consists of a diamond blade operating inside a high-resolution scanning electron microscope. The blade cuts precisely controlled sections that are imaged sequentially so a 3D image can be constructed," he said.

The instrument is usually used to section biological samples. This is the first time it has been used on materials such as paint sections.

Professor Drennan has been working with Queensland Art Gallery-Gallery of Modern Art (QAGOMA) Conservator of Paintings Gillian Osmond and CMM's Robyn Webb and Ron Rasch, using the Gatan 3View/ Zeiss to examine paint conservation issues for significant Australian artworks.

Professor Drennan showed 3D images and video from that work to members of the University of Amsterdam's *Paint Alterations in Time* (PAinT) team while on sabbatical in The Netherlands.

"Dr Katrien Keune and Dr Annelies van Loon were so impressed with the quality of the images that they suggested, in collaboration with Van Gogh Museum Head Conservator Dr Ella Hendriks, that it would be worth attempting to build a 3D image of the paint layers in van Gogh's *Sunflowers*," Professor Drennan said.

Pin-head-sized samples previously extracted for other studies were now in Brisbane and QAGOMA's Ms Osmond would oversee the sectioning process.

"The aim is to build a clear 3D map of the various paint layers van Gogh used in this painting," Professor Drennan said.

"We hope this analysis will add valuable information to the body of knowledge the Dutch conservators use in their continual monitoring and preservation of these important art works."

Professor Drennan said the miniscule samples had been taken from the edge of the canvas or along cracks in the painting to ensure the artwork was not damaged.

Re-engineering retrofits living systems

The human genome project inspired the development of high throughput, low-cost “omics” technologies.

Scientists can now sequence a microbe in a morning and prepare a comprehensive molecular inventory in a week.

Thousands of healthy or aberrant human tissue samples are being sequenced to determine the diversity of human genomes and their expression. Scientists are rapidly moving towards producing complete molecular inventories for each individual cell in an organism.

AIBN’s applied systems biologists and systems biotechnologists do more than develop tools for better understanding (analysis); they use those tools to design products and processes for human benefit (synthesis).

They are moving from crude retrofitting of living systems with a few genes using genetic engineering to purposeful re-engineering of living systems using systems and synthetic biology.

The group is built around core expertise in metabolic modelling, high quality omics and data mining. AIBN Group Leader Professor Lars Nielsen is an internationally renowned expert on genome scale modelling and fluxomics. Dr Mark Hodson, who runs the Queensland Node of Metabolomics Australia, was Principal Scientist at GlaxoSmithKline in the UK and Director of Contract Research at Biocrates in Austria, before joining AIBN. Head of bioinformatics, Dr Robin Palfreyman, worked with Gemini and Sequenom in the UK and the US, before joining the group. The core expertise is applied broadly across many biological systems.

Professor Nielsen heads the mammalian systems biology team, which works closely with the National Biologics Facility at AIBN to develop superior CHO and HEK cell lines for biopharmaceuticals production.

As part of Stem Cells Australia, the group has developed efficient processes for producing red and white blood cells from cord blood stem cells, which are undergoing preclinical evaluation by the Centre for Commercialisation of Regenerative Medicine, in Toronto, Canada.

Dr Steve Reid’s baculovirus team uses systems biology to develop better production processes for viral biopesticides used to control the helicoverpa moth. Advances have brought the technology close to commercial competitiveness and may provide an important tool against increased chemical resistance.

A10-year collaboration with Metabolix Inc on bioplastic production in sugarcane has just ended. Headed by Professor Steve Brumbley and Dr Richard McQualter, the collaboration demonstrated commercial levels of production in the greenhouse, which now must be matched in the field. Under Dr Cristiana Dal’Molin’s guidance, work continues on plant genome scale modelling with multiple collaborators.

Plant molecular biologist Dr Claudia Vickers heads the isoprenoid pathway engineering and synthetic biology team. It uses model microbes to produce natural plant isoprenoids for use in applications varying from sustainable aviation fuels to plant hormones regulating branching.

Industrial biotechnology is dominated by production in non-model organisms and Dr Esteban Marcellin’s team is developing systems and synthetic biology solutions for non-model organisms. That is achieved in close collaborations with researchers at major chemical (Dow Chemical Co), pharmaceutical (Zoetis), and biotechnology (LanzaTech) companies and has yielded significant improvements.

Working across a diverse range of organisms is challenging and only viable through close collaboration with field experts. The advantage is that knowledge gleaned from one system can lead to unanticipated findings in unrelated organisms.

Nanotechnology that is not hard to swallow

AIBN nanotechnology may soon be included in the mix of some of the world's most popular drug tablets that are swallowed daily by millions of people around the world.

AIBN's Associate Professor Gordon Xu and his research team invented a process to manufacture clay nano-particles to deliver benefits including masking the taste of drugs, reducing side-effects, such as gut inflammation, and increasing the drugs' bioactivity and functionality.

"Our technology can carry many drugs, including most non-steroidal anti-inflammatory drugs (NSAIDs)," Associate Professor Xu said.

NSAIDs are one of the most widely used classes of drugs, with combined annual sales of more than $12 billion. More than 30 million users worldwide consume NSAIDs each day. However, chronic use of NSAIDs can cause gastro-intestinal side effects, such as ulcers and bleeding, and lead to significant increases of disease and mortality in a substantial number of patients, resulting in increased healthcare costs.

Ibuprofen, naproxen and aspirin are now being formulated by UK-based Oxford Pharmascience Group Plc (OXP) with its OXPzero platform and being progressed to clinical proof of concept (POC) trials.

OXP is a publicly listed company with a strong investor base and a business model of improving medicines and developing supergenerics.

Associate Professor Xu's patent family has now been licensed to OXP in exchange for upfront fees and royalties on product sales.

"When OXP entered into a commercial relationship with us, we worked closely with them to apply our technology to their product development needs for OXPzero, such as optimal compositions, temperature and pressure with the aim to improve drug delivery in tablet format," Associate Professor Xu said.

Marcelo Bravo, OXP's Chief Executive Officer, said the company's NSAID program had the potential to deliver significant value with potential sales of more than $100 million a year by 2020.

"In a POC trial with OXPZero ibuprofen, our product showed significantly milder results in the gastro-intestinal tract than current standard ibuprofen," he said. "The OXPzero platform developed by OXP with AIBN technology may significantly reduce gastro-intestinal side effects associated with these drugs.

"We are selectively applying it to the most commonly used NSAID molecules, ibuprofen, naproxen, diclofenac and aspirin."

Mr Bravo said demonstrating the bioequivalence of immediate release OXPzero naproxen was a great result and a significant milestone for OXP.

"We can now proceed with confidence on our clinical programs for both OXPzero naproxen and OXPzero ibuprofen," he said.

Point-of-care DNA analysis within a single drop

A single-drop instant DNA test invented by AIBN scientists could revolutionise disease detection in crops and livestock, and have wider applications in human health.

Professor Matt Trau's team collaborated with Professor Jimmy Botella, from UQ's School of Agriculture and Food Sciences, to patent a cocktail of micro and nano particles in water that can be programmed to test for particular pathogens at single molecule level.

Professor Trau, from AIBN's Centre for Personalised Medicine, said the test was unique because it delivered an almost instant result and required no specialist equipment or training.

"Thanks to nanotechnology, we have replaced a laboratory with a single drop of fluid, which can accurately test for the presence of particular pathogens in the field, at the point of care," he said.

The test uses a single drop of fluid, similar to a swimming pool test kit for pH levels, to accurately detect the presence of pathogens, such as viruses, bacteria, fungus and parasites, that contain DNA or RNA. If the pathogen is present, the result is displayed and can be detected by the naked eye.

"We've removed the need for specialist equipment and trained personnel – everything is miniaturised in a single drop of fluid," Professor Trau said.

The DNA detection kit is being trialled in Cambodia to test for crop pathogens, with support from the Australian Centre for International Agricultural Research, in a project run by Professor Botella.

The test has proved accurate in detecting human diseases, such as HIV, malaria, tuberculosis and the H1N1 influenza virus.

"DNA testing is very much in demand at the moment for applications in agriculture, veterinary science and human health," Professor Trau said. "We believe this test will detect the presence of cancer as well, and we are currently undertaking work in this area."

Professor Trau said the test could also detect pathogens, such as hepatitis, in food.

The DNA test featured as the cover story in the 19 March 2015 edition of the Royal Society of Chemistry's *ChemComm* journal.

Durable glass bound for electronics

Acrylic products' poor scratch-resistance is a key barrier to more widespread replacement of traditional glass.

AIBN Group Leader Professor Darren Martin said the current standard for making a plastic product scratch resistant involved using solvents and chemicals to apply a hard coat.

"This is expensive and the coating goes on after the moulded article has been made."

The solution is a ceramic nano-additive for plastics and rubbers that Professor Martin's team has developed. It is easy to incorporate into the manufacturing process.

"What we offer is a mechanical pigment, similar to a paint colour pigment, but instead of colour we add scratch-resistance and better mechanical properties and durability," he said.

"Plus you can add it to the acrylic raw material, so you don't need to apply the hard coat. It's better for the environment in terms of reduced chemical and solvent use. You get a more durable and scratch-resistant product for shiny black electronics equipment, mobile phone screens, interior parts for cars, such as consoles and doors, or kitchen cupboards, signage and shop fronts – and for a fraction of the cost of the coated articles."

Professor Martin said TenasiTech's nano-additive was developed within his AIBN research group, as the team worked on polyurethane rubbers.

TenasiTech is an Australian company founded in 2007. It has a strong presence in the USA, where CEO Richard Marshall is based.

Its SOLID additive range provides a significant boost to acrylics technology, which doubles the surface hardness and scratch-resistance of acrylic without loss of gloss or impact strength. The company's Adaptive Polyol technology takes thermoplastic polyurethanes to extreme performance levels without loss of flexibility.

Professor Martin and his team worked with several major plastics industry companies to validate the TenasiTech product in terms of an industry test called pencil hardness. "Getting the green light from these large players in the validation of our product was very important for us and our board.

"The next step is to do more work with several global companies at various tiers in the supply chain."

In 2004 Professor Martin approached UniQuest after getting "some pretty special results" in the lab to protect the group's inventions and ideas.

TenasiTech secured investment from members of angel investment groups Brisbane Angels and Melbourne Angels and from UQ-based venture fund and founding investor Uniseed. UQ's School of Chemical Engineering has also supported the research.

UQ Provost and Senior Vice-President Professor Max Lu said TenasiTech epitomised the importance of diversified support for research and commercialisation at UQ.

"This investment is important for TenasiTech's future in realising the commercial potential of its range of high-performance additives," he said.

Dr Ian Nisbet BSc, PhD, MAICD

Deputy Director (Commercialisation)

Dr Nisbet, Deputy Director (Commercialisation) at AIBN, has more than 30 years' experience in the biotechnology sector in Australia and the United States. He is founder and partner in biotechnology consulting company Afandin Pty Ltd. In his consulting capacity, Dr Nisbet has worked closely with several biotechnology companies, including ChemGenex Pharmaceuticals Ltd (as VP Oncology). He is chair of vivoPharm Pty Ltd; a non-executive director of Solagran Ltd, ACYTE Biotech Pty Ltd, Cerulean Pharma Australia Pty Ltd, Tunitas Therapeutics Australia Pty Ltd and MyoKardia Australia Pty Ltd; and an executive director and co-founder of Senz Oncology Pty Ltd. Dr Nisbet is a former chair of Verva Pharmaceuticals Ltd and a former director of Xenome Ltd, Ambri Ltd, Meditech Research Ltd, Velacor Pty Ltd and Adipogen Pty Ltd.

Dr Nisbet led two companies as CEO and managing director, most recently Xenome Ltd, a public, unlisted company developing novel pain therapies; and previously Meditech Research Ltd, then a publicly traded Australian biotechnology company and now a subsidiary of Alchemia Ltd. Dr Nisbet led the merger with Alchemia and was the key driver behind Meditech's development and commercialisation strategies for hyaluronic acid drug delivery technology.

Before joining Meditech, Dr Nisbet worked at Millennium Pharmaceuticals Inc, in Cambridge, MA, USA, (now a subsidiary of Takeda Pharmaceutical Co Ltd) for almost seven years in senior positions. His responsibilities included managing a global VELCADE® strategic alliance between Millennium and the J&J family of companies; in-licensing two oncology product candidates; leading a team responsible for FDA approval and the US commercial launch of VELCADE® in 2003; leading a diligence team and merger integration team for Millennium's acquisition of COR Therapeutics Inc; and serving as interim manager for Millennium San Francisco (the ex-COR site).

Before joining Millennium, Dr Nisbet worked for CSL Ltd for more than 17 years. He held different scientific and management positions, the last was Director, Planning and Coordination. He was responsible for developing, implementing and managing project management at CSL and had direct management of several of CSL's external relationships.

Dr Nisbet received a B Sc in microbiology and biochemistry from the University of Melbourne and a PhD in molecular biology from Monash University. He is a graduate of the Advanced Management Program from the Melbourne Business School at the University of Melbourne and a member of the Australian Institute of Company Directors.

Dr Aoife Cullen BSc, HDip, PhD, MAICD

Business Development and Industry Engagement Manager

Dr Cullen is the Business Development and Industry Engagement Manager for the AIBN. She has a research background in biochemistry, with a PhD in neuroscience, focusing on drug development countering glutamate excitotoxicity and postdoctoral research in developing therapies for Parkinson's disease.

Dr Cullen's role with AIBN is to lead innovation-driven transactions, conduct due diligence and opportunity analysis and stakeholder management. She is responsible for providing commercialisation, innovation transfer and research development for the AIBN. Dr Cullen has managed large-scale collaborative research bids, from proposal development to securing funding, negotiating transactions and project management. The AIBN portfolio spans >45 patent families and Dr Cullen has arranged significant deals and large-scale projects, including licensing therapeutic antibodies, cancer therapies, cell therapies and cell lines.

Overseeing the commercial development of the AIBN's drug delivery, biotechnology and nanotechnology programs, she liaises with partners to negotiate licensing, contract and sponsored-research agreements and capital raising for forming new companies. Before joining AIBN Dr Cullen worked for UniQuest as a commercialisation manager, as a project manager with the Bank of Ireland, an analyst with Scottish Equitable and as a science editor for publications from Elsevier.

Dr Cullen is a graduate of University College Cork, and has postgraduate qualifications from Dublin Institute of Technology and a PhD from Trinity College Dublin. Dr Cullen has attended Stanford University's Institute for Entrepreneurship as a United States Study Centre scholarship recipient and is a member of the Australian Institute of Company Directors, AusBiotech and Knowledge Commercialisation Australia.

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Thought Leaders' Dinner Series

AIBN's biannual Thought Leaders' dinners are a major event in the institute's engagement and outreach program.

Attendees include CEOs or other senior executives from IAP member companies; representatives from companies with which AIBN interacts (or would like to interact); government representatives; AIBN Group Leaders; and other senior academics.

Each dinner includes a luminary guest speaker, a leader in one or more fields of industry, finance, innovation or entrepreneurship. The Thought Leaders' dinner series began in 2011 and, since then, has become a much-anticipated feature of AIBN's calendar.

Guest speakers

Mr Bill Ferris AC: Executive Chair of private equity group CHAMP since its formation in 2000 and the father of venture capital in Australia, having founded Australia's first venture capital firm in 1970.

Mr Mike Fitzpatrick: Chair of the Australian Football League, Treasury Group Ltd, Infrastructure Capital Group, and Non-Executive Director of Rio Tinto plc and Rio Tinto Ltd; founder and former Managing Director of Hastings Funds Management Ltd, and biotech investor.

Ms Lucy Turnbull AO: Sydney's first female Lord Mayor (2003-2004) and Deputy Lord Mayor (1999-2003); Chair of ASX-listed biotechnology company Prima Biomed Ltd and other private investment and not-for-profit companies.

Dr Peter Farrell: Founder, Chair and ex-CEO of Resmed Ltd; Visiting Professor and Chair of the UNSW Centre for Innovation and Entrepreneurship; Australian Entrepreneur of the Year, 2001; and US National Entrepreneur of the Year, 2005.

Dr Jim Aylward: Founder of Peplin Ltd and inventor of Picato (ingenol mebutate) marketed by Leo Pharma (acquirer of Peplin) for treating actinic keratosis; joint winner of the 2012 LSQ Excellence Award in recognition of his contribution to the life sciences industry.

Mr Jim Kalokerinos: co-founder of Techlab Enterprises, Pacific Diagnostics (sold to Baxter International), and Panbio Ltd (ASX: PBO, sold to NYSE-listed Investors Inverness Medical, now Alere); Director of Brisbane Angels Group Ltd; member of the investment committee for Terra Rossa Capital.

Professor John Shine AO: Chair of CSL Ltd, President, Museum of Applied Arts and Science; Executive Director, Garvan Institute of Medical Research 1990-2011; 2010 recipient of the Prime Minister's Prize for Science, the nation's highest scientific award.

Professor Jim Patrick AO: Chief Scientist and Senior Vice President, Cochlear Ltd; honorary appointments as Adjunct Professor at the University of Melbourne, La Trobe University and Macquarie University.

Dr Alan Finkel AO: Chancellor, Monash University; President, Australian Academy of Technological Sciences and Engineering; co-founder and Chair, Cosmos Magazine; Chair, Australian Centre of Excellence for All-Sky Astrophysics; Executive Chair, Stile Education; founder, Axon Instruments, a California-based, ASX-listed company that was acquired in 2006 and is now part of Danaher Medical Technologies.

Research collaborations*

AUSTRALIA

Industry
ACYTE Biotech Pty Ltd
Adelaide Health Service Inc.
Anteo Diagnostics Ltd
Aortech Biomaterials Pty Ltd
Avipep Pty Ltd
Becton Dickinson Pty Ltd
Bioproton Pty Ltd
Biosceptre International Limited
Boeing Defence Australia Ltd
BSES Ltd.
CBIO Limited
Cochlear Limited
Creata (Aust) Pty Ltd
CSL Limited
Dow AgriSciences
DSM Biologics Company Australia Pty Ltd
EnGenelc Ltd
Genea Ltd
Huon Aquaculture Group Pty Ltd
Implicit Bioscience Ltd
Inter-K Pty Ltd T/as Inter-K Peptide Therapeutics
Lipotek Pty Ltd
Mackay Sugar Limited
Medigen Pty Ltd
Medvet Science Pty Ltd
Mesoblast Pty Ltd
Minomic International Ltd
NewSpec Pty Ltd
Novozymes Biopharma AU Ltd
Patheon Biologics Australia Ltd
Patrys Ltd
Pfizer Australia Pty Ltd
Plantic
Polyactiva Pty Ltd
ProteoBioactives Pty Ltd
PureDepth Inc.
Q-Pharm Pty Ltd
Q-Sera Pty Ltd
Qubist Molecular Design Pty Ltd
Santos
SkillPro Services Pty Ltd
Sugar Research Australia Ltd
TenasiTech Pty Ltd
Tomato Exchange Pty Ltd
TransBio Limited
Vaxine Pty Ltd
Vaxxas Pty Ltd
Very Small Particle Company
William A Cook Australia Pty Ltd
Zoetis Australia Research and Manufacturing

Academic & Research Institutes
ARC Special Research Centre for Green Chemistry
Australian National University
Australian Proteome Analysis Facility Ltd
MacQuarie University
Australian Stem Cell Centre Limited
Baker IDI Heart & Diabetes Institute
Baker IDI Heart Diabetes Institute Holding Ltd
Garvan Institute of Medical Research
Griffith University
James Cook University
La Trobe University
Ludwig Institute for Cancer Research Ltd
Macfarlane Burnet Institute for Medical and Public Heath Ltd
Mater Medical Research Institute
Monash University
Murdoch Children's Research Institute
Murdoch University
New Zealand Forest Research Institute Limited
QIMR Berghofer Medical Research Institute
Queensland University of Technology
The Sydney Children's Hospitals Network
Telethon Kids institute
UniQuest Pty Ltd
University of Adelaide
University of Melbourne
University of New South Wales
University of South Australia
University of Southern Queensland
University of Technology Sydney
University of Western Australia
University of Wollongong
Victor Chang Cardiac Research Institute
Walter and Eliza Hall Institute of Medical Research
Foundations – Not for Profit
Hear and Say Centre
Cure Brain Cancer Foundation
National Breast Cancer Foundation
Cancer Council Queensland

Government
AusBiotech
Australian Coal Research Limited
Australian National Fabrication Facility
Australian Nuclear Science and Technology Organisation
Australian Red Cross Blood Service
BioPharmaceuticals Australia (BPA)
Commonwealth Govt of Australia
Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Co-operative Research Centre for Autism
Co-operative Research Centre for Biomarker Translation (CRC-BT)
Co-operative Research Centre for Polymers
CSIRO
CSIRO, Molecular and Health Technologies
Dept of Employment, Economic Development and Innovation
National Health and Medical Research Council
Office of the Gene Technology Regulator
Qld State Govt, Dept of Primary Industries and Fisheries
Qld State Govt, Dept of Science, IT, Innovation and Arts
Queensland Health
Queensland Clinical Trials Network (QCTN)
Rural Industries Research and Development Corporation
Therapeutic Innovation Australia (TIA) Limited

NEW ZEALAND

Industry
IZON Science Ltd
Lanzatech NZ Ltd

EUROPE

Industry
DSM Biologics Company BV
MicroVet
Novartis Pharma AG
Novozymes
Oxford Pharmascience Group PLC
Patheon Biologics BV
Plant Bioscience Ltd
Xell AG

Academic & Research Institutes
Cambridge Technology Centre
Centre for Research in Agricultural Genomics Consortium
Comparative Genomics Group, University of Oxford
Grenoble University
Politecnico di Milano
Queen Mary University of London
Universitatsklinikum Hamburg-Eppendorf
University College London
University of Bielefield
University of Duisburg-Essen
University of Newcastle
University of Nottingham
University of Warwick
Westdeutsche Studiengruppe

Foundations – Not for Profit
Foundation Jerome Lejeune

ASIA

Industry
Creata (HK) Pty Ltd
Sentinext Therapeutics
Shanghai Pharmaceuticals Holding Co. Ltd.
SiChuan HuaChuan Pharmaceutical Industry Ltd.

Academic & Research Institutes:
Bioprocessing Technology Institute, A-Star
Chinese Academy of Sciences
Development Center for Biotechnology
Hubei University
Institute of Medical Biology, A-Star
National Taiwan University of Science and Technology
Pasteur Institute of Ho Chi Minh City
Riken Yokohama Institute
Wuhan Institute of Technology
Wuhan University

MIDDLE EAST

Academic & Research Institutes
King Saud University
Qatar University
University of Dammam

USA AND CANADA

Industry
Amyris Biotechnologies Inc.
Dow Chemical Company
Medicago Inc.
Merck
Metabolix Inc.
Novartis Vaccines and Diagnostics Inc.
Organovo Holdings, Inc.
Patheon Inc.
Pfizer Inc.
Protein Sciences Corporation

Academic & Research Institutes
Centre for Commercialisation of Regenerative Medicine
Clemson University
Harvard University
Mercer University
Rice University
Seattle Biomedical Research Institute
Uniformed Services University
University de Sao Paulo
University of California
University of Maine
University of Massachusetts
University of Michigan
University of Texas
University of Washington
Washington Technology Center, University of Washington

Foundations – Not for Profit
Global Health Discovery, Bill and Melinda Gates Foundation
Medicine in Need Corporation
PATH

Government
Air Force Office of Scientific Research
Asian Office of Aerospace R&D
The Defence Science and Technology Organisation of the Department of Defence

Regulatory Bodies
The Center for Biologics Evaluation and Research, CBR, FDA

** For reasons of confidentiality a number of companies have not been listed*

Facilities

AIBN has attracted a significant concentration of national research infrastructure, including National Collaborative Research Infrastructure Strategy-funded initiatives. The facilities within the institute are the largest concentration at any site in Australia and contribute to AIBN being a 'bio-nano' powerhouse.

4

NCRIS-funded facilities

AIBN hosts five National Collaborative Research Infrastructure Strategy facilities at the Institute: Biologics, Fabrication, Microscopy, Metabolomics, and Stem Cells Limited (StemCore).

The Australian National Fabrication Facility-Queensland (ANFF-Q)

ANFF-Q offers training on state-of-the-art characterisation and micro and nanofabrication equipment.

Its capabilities are:

- Material and polymer characterisation: Analytical support for research in nanostructures, polymeric materials and electrostatics
- Imaging and surface characterisation: High resolution and precise examination of complex materials and novel biological systems, including multilayered and thin-film characterisation
- Lithography suites: Design, manufacture, profiling and surface characterisation of microfluidic and other devices
- Etching suites: Patterning of surfaces and devices with micrometre precision using dry and wet etching
- Deposition equipment to deposit layers of metals, metal oxides, and dielectrics onto substrates with precision and accuracy
- Organic device fabrication and testing to synthesise functional organics (photonics and electronics), fabricate and test the devices, and fully characterise the resulting materials
- Silicon carbide epitaxial fabrication suite: Catering from research to pilot production, the silicon carbide on silicon processing capability supports the next generation of high-performance devices
- Raman spectroscopy suite: This high-quality instrumentation facilitates in-depth analysis of materials.

The Centre for Microscopy and Microanalysis (CMM)

CMM – the Queensland node of the Australian Microscopy and Microanalysis Facility (AMMRF) – facilitates research outcomes through the provision of training expertise and state-of-the-art infrastructure in microscopy and microanalysis.

The capabilities afforded by the CMM include:

- Seven transmission electron microscopes, nine scanning electron microscopes, three optical microscopes and four X-ray analysis instruments including instruments dedicated to electron probe micro-analysis, focused-ion beam SEM, serial block-face imaging and cryo-tomography
- A wide range of microanalysis and localised spectroscopic techniques: e.g. energy dispersive X-ray analysis; electron energy-loss spectroscopy; electron back-scatter diffraction; electron diffraction; X-ray diffraction, reflectivity and photoelectron spectroscopy; and Raman spectroscopy
- Extensive expertise and infrastructure to aid in the preparation of samples for microscopy and microanalysis: including ultra-microtomy, cryo-methods, polishing and ion-milling.

In addition, the CMM develops and delivers training in advanced microscopy and microanalysis, including the development of online training tools, and is actively engaged in research to develop methodologies in the discipline.

See the *Van Gogh painting under the microscope* feature on page 25 for an example of just one of CMM's projects.

StemCore

StemCore is a state-of-the-art Pluripotent Stem Cell Core Facility at AIBN that enables and accelerates stem cell research for academics and industries working in the area of regenerative medicine.

With its extensive expertise in the area of pluripotent stem cell biology, StemCore offers a range of products, services and training, including:

- Proprietary human embryonic and induced pluripotent stem cells
- Cell line characterisation services such as mycoplasma, teratoma, DNA karyotyping and DNA profiling assays
- Custom generation of induced pluripotent stem cell lines
- Differentiation of stem cells into ectodermal, mesodermal and endodermal cells
- Screening and maintenance of genome-edited cells
- Hands-on training in generation, culture and characterisation of human pluripotent stem cells.

Since establishment in July 2011, StemCore has served > 80 academic and industry clients and secured $3 million in NCRIS funding so far. StemCore is one of the few labs to have successfully employed non-viral, genome-integration free technology to generate >200 iPSC lines from several diverse and challenging diseases such as Schizophrenia, X-linked cerebral palsy, X-linked chromosomal disorders, Parkinson's, Down-syndrome and a world-first foray into autism.

Eminent academic partners include Harvard University, the Translational Research Institute, the Victor Chang Cardiac Research Institute and the University of Sydney.

Industry partners include Evotec International AG and Genea Biocells.


SMALL

NCRIS-funded facilities

National Biologics Facility

About the Facility

Biologics are an exciting new class of therapeutics, developed using the power of biotechnology and genetic engineering. The National Biologics Facility was established to assist Australian academic and industrial researchers wishing to bridge the gap between research discoveries and the bioprocesses required to produce material for pre-clinical and clinical trials, and is supported by funding from the National Collaborative Research Infrastructure Strategy (NCRIS). The facility operates two nodes; one at AIBN, and a second at the CSIRO Molecular Health Technologies in Melbourne under the leadership of Professor Peter Gray and Associate Professor Stephen Mahler, and Dr Tim Adams and Dr George Lovercz, respectively.

The Queensland node consists of a specially designed $15 million suite of laboratories, clean rooms and state-of-the-art equipment, and is staffed by a team of expert scientists and bioprocess engineers with world-class experience in protein engineering, mammalian cell line development and biopharmaceutical development. The facility includes a certified Physical Containment 2 (PC2) large scale clean room operating under a cGMP-like Quality Management System.

The facility is currently working with academic, research institute and industry collaborators on developing biologics with the potential to evolve into the next generation of therapeutics. The facility can advise and assist clients on antibody discovery and engineering, mammalian cell line generation, upstream and downstream process development and protein analytics. In addition to all the expertise required for antibody discovery and protein manufacturing, the facility is also equipped with strong skills in project planning and understanding regulatory requirements for ISO9001, cGLP/cGMP operations and TGA/FDA/EMEA regulatory requirements. Many staff have experience working for commercial biologics companies in Australia and overseas. All staff have worked together on internal, academic and industry projects, and their activities are supported by other personnel with additional expertise in crystallography, surface plasmon resonance, protein formulation, metabolomics and proteomics. Over the last six to seven years the NBF laboratories have conducted thousands of experiments for more than 100 collaborative partners.

Equipment

To excel on the world stage, NBF needs world class infrastructure. NBF has built state-of-the-art nodes at both UQ and CSIRO in an effort to create a biologics plant of the future. Such a unique facility has and will continue to connect cutting edge research to the advanced manufacturing sector. The facility has a range of high-throughput equipment for cell line development and clonal isolation, including a fluorescence activated cell Sorter and a robotic mammalian cell picker (ClonePixTM).While a clone select imager is paired with either bioLayer interferometry or surface plasmon resonance for clonal characterisation and selection. The facility is equipped with a variety of stainless steel or single use bioreactors ranging from 1L to 50L capacity, and downstream process equipment capable of processing high volumes of biologics material. Traditionally, manufacturing plants seek size and volume to meet demands, but NBF's biologics plant of the future seeks new processes such as using perfusion mode culture to reduce the environmental footprint without compromising on productivity. Additionally, the facility has a suite of analytical equipment to study protein quality, stability and activity, including high performance liquid chromatography, microfluidics based fractionation, surface plasmon resonance and isothermal titration calorimetry.

While the advanced manufacturing suite has been the cornerstone of the facility since 2007, the Queensland node has also evolved in developing state-of-the-art phage display techniques under the leadership of Dr David Chin and Dr Martina Jones. The possibilities with phage display technology are endless, and with the use of the facility's in-house libraries (both immune and naive) new and exciting biologics are being generated for a range of epitopes, from allergens to cancer biomarkers. These may become new treatments for the diseases of tomorrow, for the next generation.

Services

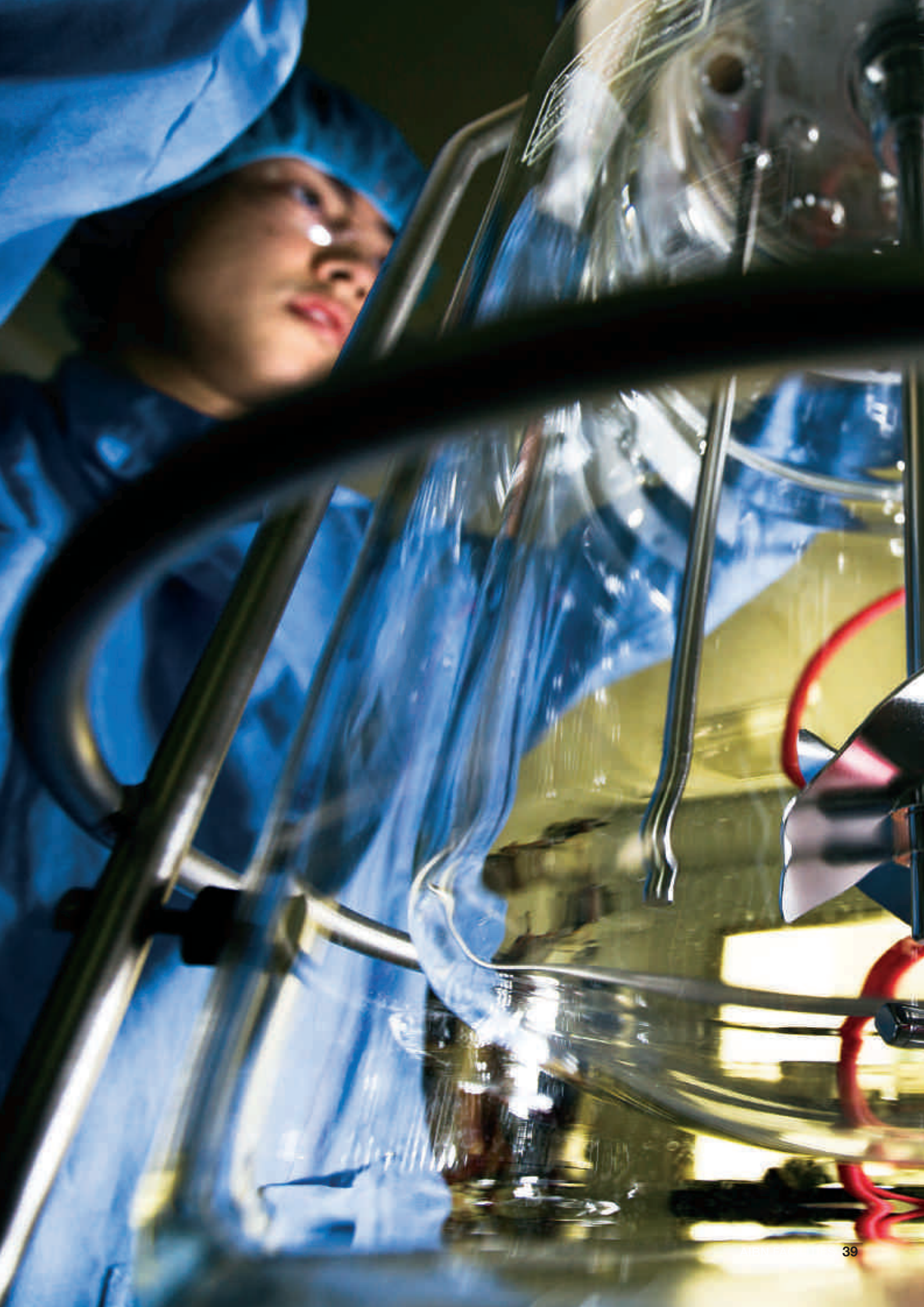
NBF's capabilities form a suite of services that are available to all Australian researchers, from leading academics to Australian companies. Capabilities include:

- antibody discovery and engineering
- cell line development
- upstream production
- downstream process development
- protein analytics
- access to analytical instrumentation.

Supporting Translational Research

In a collaboration supported by UQ, the Queensland Government, Therapeutic Innovation Australia and TransBio, the National Biologics Facility is assisting to develop a monoclonal antibody to treat graft versus host disease. Starting as a collaboration with the Mater Medical Research Institute, Dr Jones and her NBF team isolated a monoclonal antibody targeting the human protein CD83 using the facility's dedicated phage display laboratory. Through the support of the Queensland Government and Patheon Biologics, Dr Trent Munro and his NBF team were able to firstly create a production level cell line for the expression of the product followed by bioprocess development required for large scale manufacture of the antibody. The antibody was subsequently acquired by the CRC for Biomarker Translation, managed by TransBio Ltd. It is currently entering the early phases of clinical trials.

The article *Hendra virus: research leads to clinical trial* on page 24 provides an example of critical research conducted with the support of NBF facilities.



Metabolomics Australia – Queensland Node

AIBN hosts one of four nodes within the NCRIS-funded Metabolomics Australia network, part of Bioplatforms Australia.

Integrated within AIBN's Systems and Synthetic Biology Group, the Queensland Node provides long-standing expertise in targeted and untargeted metabolomics as well as specialised expertise in metabolic engineering, directed to understanding and manipulating cellular behaviour at a system level.

The Queensland Node's facilities are set up for the qualitative and quantitative measurement of multiple metabolic intermediates, in addition to metabolic flux analysis, flux balancing and isotopomer modelling. It serves the Australian biotechnology community by developing fluxomics models, used to analyse and engineer mammalian, plant or microbial fermentation systems and employed to optimise product development.

The Queensland Node of Metabolomics Australia's services include:

- GC-MS and UHPLC-QTOF-MS-based untargeted/profiling analysis
- Quantification of central carbon metabolism, including glycolysis, TCA cycle, co-factors, nucletotides, pentose phosphate pathway and others, using LC-QTRAP-MS
- HPLC-based amino acid, sugar and organic acid analysis
- Access to genome scale modelling (experimental and theoretical)
- Metabolic flux analysis from the exometabolome
- 13C metabolic flux analysis
- Spatiotemporal metabolic flux analysis in multi-cellular organisms
- Method development/optimisation for quantifying individual metabolites/ compounds using HPLC-, GC-MS-, UHPLC-QTOF-MS- and/or LC-QTRAP-MS-based analysis.

The Node is led by Professor Lars Nielsen and managed by Dr Mark Hodson. In the past five years the node has successfully serviced more than 80 customers, enabling more than 1000 separate projects comprising more than 30,000 sample analyses. These projects arise from diverse biological questions relating to plants (sugarcane engineering; maize spoilage; wheat resilience), microbes (bacterial disease; yeast bioengineering; viral biopesticide production) as well as veterinary (equine laminitis) and clinical medicine (type 1 diabetes; epilepsy; chronic kidney disease).

More information on synthetic biology research at AIBN is in the article *Re-engineering retrofits living systems* on page 26.

UQ Protein Expression Facility

The UQ Protein Expression Facility (PEF), an internationally recognised research facility, specialises in recombinant protein production for academic and industry researchers.

Founded by Associate Professor Linda Lua in 2004, PEF serves a diverse client base across UQ and more broadly.

PEF incorporates sophisticated facilities to support high-throughput scale-down screen and scale-up bioreactor production, operated by highly skilled specialists with extensive knowledge and expertise in protein production.

As the only facility in Australia to offer protein production in bacteria, yeast, insect cell, mammalian cell and a eukaryotic cell-free translation system, PEF has an impressive track record and a portfolio of national and international users from university, industry and government sectors. By using a rapid, flexible protein production pipeline, PEF streamlines molecular cloning, protein expression and protein purification while delivering industry-competitive turnaround times.

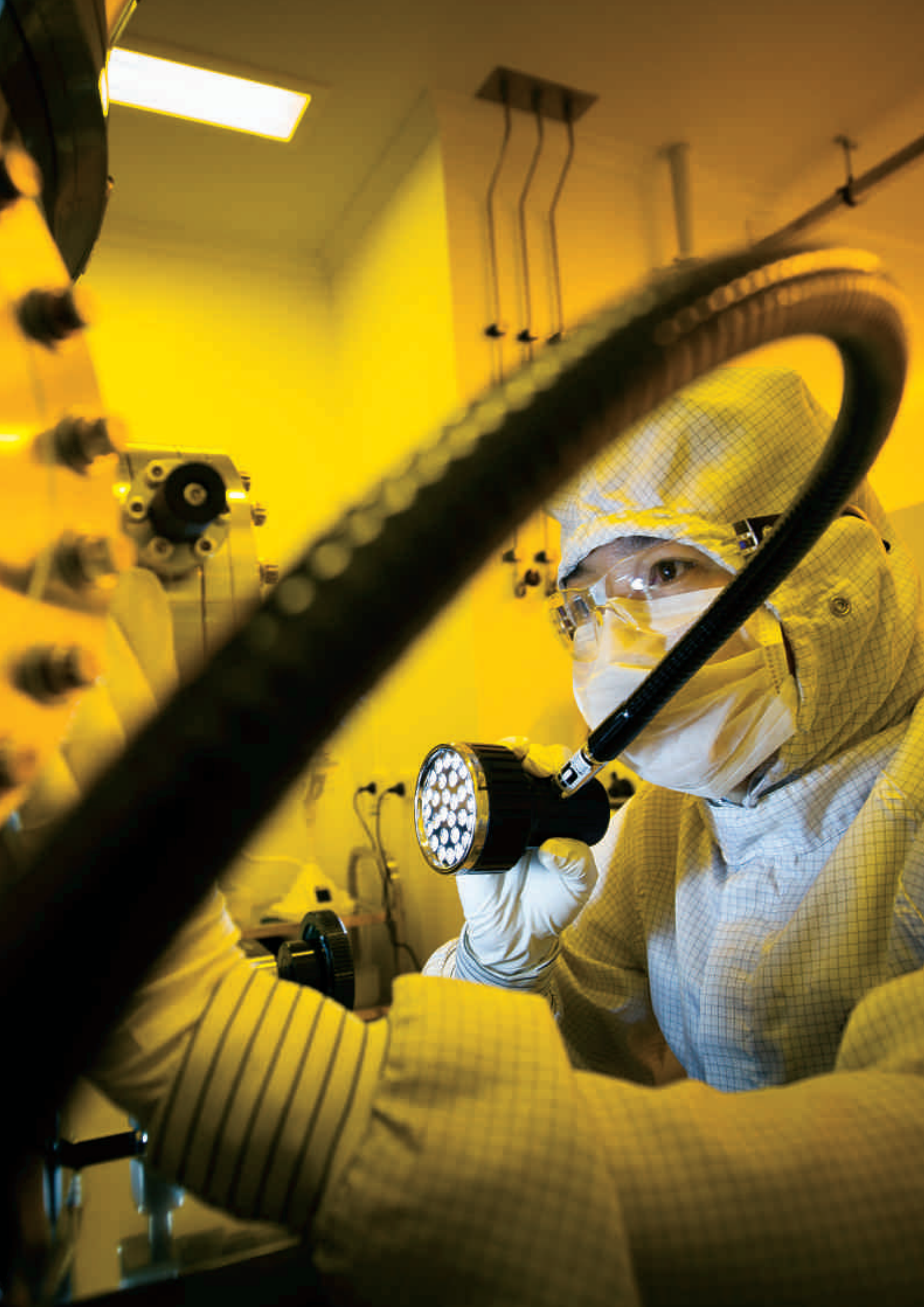
PEF expertise underpinned engagement with about 200 academic research groups and companies, completing hundreds of projects. PEF seeks to establish productive research links globally and nationally on behalf of researchers across UQ, with partners from industry and institutions, increasing UQ's visibility in the protein technology arena.

The engagement includes researchers globally, such as Malaysian Biotechnology company Sentinext Therapeutics, on developing a safe bivalent vaccine against hand, foot and mouth disease; and non-profit global health organisation PATH on diagnostics for malaria elimination. Working closely with researchers, PEF collaborations include Protein Sciences Corporation, USA; the International Vaccine Institute, South Korea; the Oxford Protein Production Facility in the UK; and the Dortmund Protein Facility at the Max Planck Institute, Germany.

In Australia, PEF services clinical-phase biotechnology company Lipotek, start-up company Q-Sera Pty Ltd on improved blood collection tube, biopharmaceutical company CSL, animal health company Zoetis, Telethon Kids Institute on drug discovery, 16 Australian universities, QIMR Berghofer Medical Research Institute, CSIRO, Queensland Health, and DAFF.

PEF convened and hosted the last four biannual Australian Protein Production Symposia on the UQ campus. The facility has brought together 71 presentations into coherent programs and hosted more than 20 world-leading international speakers.

PEF's technical development, staff and capabilities have grown annually to provide cutting-edge expertise and technology to meet research demands.



Research Leaders

AIBN has attracted a dynamic group of talented research group leaders, all recognised experts in their fields, who are committed to the institute's vision and underlying research philosophy.

Individually and collectively, they attract major research funding from national and international sources, including strong support from industry, and attract emerging leaders from mid and early-career postdoctoral researchers.

5

Fellowships & Awards

Qld Smart Futures Premier's Fellowship

2010 Professor Anton Middelberg

Australian Research Council – Professorial Fellowship

2011 Professor Andrew Whittaker

Australian Research Council – Federation Fellowships

2008 Professor Max Lu

2004 Professor Matt Trau

2003 Professor Anton Middelberg
Professor Max Lu

Australian Research Council – Future Fellowships

2015 Dr Chunxia Zhao

2014 Dr Zhongfan Jia

2013 A/Professor Zhi Ping (Gordon) Xu

2012 Dr Kristofer Thurecht

2012 Professor Lianzhou Wang

2011 Professor Ajayan Vinu
Associate Professor Idriss Blakey

2010 Professor Michael Yu
Professor Mark Kendall
Dr Annette Dexter

2009 Professor Michael Monteiro

Australian Research Council – Discovery Early Career Research Awards

2014 Dr Frank Sainsbury
Dr Yuling Wang

2013 Dr Simon Corrie
Dr Jess Frith

2012 Dr Muhammad Shiddiky

Qld Government Fellowships

2014 Dr Claudia Vickers – Mid-Career

Dr Esteban Marcellin – Early-Career

2012 Associate Professor Christine Wells
Dr Trent Munro

2010 Dr Chamindie Punyadeera
Dr Claudia Vickers

2009 Dr Simon Corrie
Dr Zhen Li
Dr Chenghua Sun

2007 Professor Mark Kendall

National and International Research Alliances Program

2010 Professor Lars Nielsen – Queensland Sustainable Aviation Fuels Initiative

Professor Anton Middelberg – Vaccine Now – Beating Infectious Disease with Rapid Response Technology

Professor Andrew Whittaker – Spinal Cord Repair

2009 Professor Mark Kendall – International Needle-free Vaccination Alliance (INVax)

Dr Krassen Dimitrov – Molecular Diagnostics for Tropical Disease

Professor Lars Nielsen – Korea-Australia Bio-Product Alliance

2008 Professor Max Lu – Queensland-China Alliance in Nanomaterials for Clean Energy Technologies

2007 Professor Andrew Whittaker – International Biomaterials Alliance

Professor Matt Trau – Novel Nanotechnology Platforms for Disease Biomarker Diagnostics

Australia's Top 100 Most Influential Engineers

Professor Max Lu

Professor Peter Gray

Professor Anton Middelberg

Professor Mark Kendall

Qld Tall Poppy

2014 Dr Claudia Vickers

2013 Dr Simon Corrie

2012 Dr Kristofer Thurecht

UQ Foundation Research Excellence Awards

2014 Dr Liang Zhou

2013 Dr Claudia Vickers

2012 Dr Da-Wei Wang

2011 Dr Jian Liu

2010 Dr Chenghua Sun
Dr Kristofer Thurecht

2009 A/Professor Zhi Ping (Gordon) Xu

2008 Dr Shizhang Qiao

2008 Professor Lianzhou Wang

2004 Professor Michael Monteiro

Queen's Birthday Honours

2013 Board member
Mr Robert McCarthy AM awarded Member of the Order of Australia

2006 Emeritus Professor and former Group Leader Julie Campbell AO awarded Order of Australia Officer


AIBN

Research Group Leaders

AIBN is at the forefront of the intersection between bioengineering and nanotechnology. Its researchers' work is world renowned and cutting edge.

ALEXANDROV GROUP

Professor Kirill Alexandrov

*Joint appointment with UQ's Institute for Molecular Biosciences

Synthetic biology and molecular engineering

Professor Alexandrov's group uses methods of protein engineering to create biological systems not found in nature. In particular the group is developing protein biosensors that could seamlessly connect living organisms and electronic devices. The group is also developing a range of approaches for protein engineering, including creating proteins with new functionalities, such as unnatural amino acids.

International links

Professor Alexandrov is a co-founder of successful German biotechnology company Jena Bioscience and a UK mHealth company, Molecular Warehouse. He has maintained close collaborative links with the Dortmund Protein Production Facility at the Max-Planck Institute. He has close collaborations with Brisbane biotechnology company Bioproton LLC and Perth biotechnology company Phylogica.

Memberships, patents and funding

Professor Alexandrov has raised about $22 million in funding since 2008; secured six Australian Research Council (ARC) and four National Health and Medical Research Council (NHMRC) grants since 2008; and been awarded an ARC Future Fellowship. He filed six patents, all of which were licensed to start-up companies. He introduced high–throughput molecular cloning technology to the UQ Protein Expression Facility.

Key publications

Cui Z, Stein V, Tnimov Z, Mureev S, Alexandrov K. Semi-synthetic tRNA complement mediates in vitro protein synthesis. *J Am Chem Soc* 2015, 137(13):4404-13

Stein V, Alexandrov K. (2014) Synthetic protein switches: design principles and applications. *Trends Biotechnol* pii: S0167-7799(14)00239-X

Stein V, Alexandrov K. (2014) Protease-based synthetic sensing and signal amplification. *Proc Natl Acad Sci USA*.111 (45):15934-9

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

Nguyen UT, Guo Z, Delon C, Wu Y, Deraeve C, Fränzel B, Bon RS, Blankenfeldt W, Goody RS, Waldmann H, Wolters D, Alexandrov K. (2009) Analysis of the eukaryotic prenylome by isoprenoid affinity tagging. *Nature Chemical Biology* 4: 227-235

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BERNHARDT GROUP

Professor Debra Bernhardt

Theoretical and computational molecular science: nonequilibrium systems, fluids and materials

Professor Debra Bernhardt is internationally recognised for her contributions to the development of nonequilibrium statistical physics and thermodynamics, including far-from equilibrium fluids and confined fluids. She is Fellow of the Royal Australian Chemical Institute and Director of the AIBN Centre for Theoretical and Computational Molecular Science.

Her research career includes appointments at the University of Basel, Switzerland; the Australian National University, Canberra; and Griffith University, Brisbane, where she was founding Director of the Queensland Micro and Nanotechnology Centre. She completed first class honours and a PhD in Newcastle, Australia.

Professor Bernhardt's research involves use of various theoretical and computational approaches to develop a fundamental understanding of the behaviour of matter. The group uses quantum chemistry, classical and quantum molecular dynamics, statistical mechanics and dynamical systems theory to characterise structure, kinetic, transport, material and catalytic properties of complex systems in application areas, including design of materials, separation science, energy storage and conversion.

Debra Bernhardt publishes under her maiden name, Debra J Searles.

2014 project outcomes

- Prediction that boron materials, such as B_{80} fullerene, will adsorb carbon dioxide. This is relevant in research areas such as carbon capture, gas separation and catalytic conversion of carbon dioxide to useful chemicals.
- Simulation studies of the optimal protocols for determination of free energy differences via the Jarzynski equality highlighted that predictions from the theory of stochastic systems do not always apply in deterministic dynamics.
- Proposal that far-from equilibrium is more appropriate to consider dissipation to describe the system than temperature and entropy, which are ill-defined.
- Density functional theory calculations demonstrated the mechanism and performance of some catalysts used in hydrogen production.

2014 highlights

- Launch of the AIBN Centre for Theoretical and Computational Molecular Science Symposium
- UQ Major Equipment and Infrastructure/ National Health and Medical Research Council equipment grant to buy a high-performance parallel computer cluster that supports research ranging from developing advanced materials for clean fuel to engineering new vaccines to develop anti-cancer drugs.
- Co-chair of Molecular Modelling 2014: From biomolecules to materials, in Queensland, July/August
- Plenary at the 6th Pacific Rim Conference on Rheology in Melbourne, July
- Award lecturer, Window on Science, Asian Office of Aerospace Research and Development (AOARD), June

2014 external grants

- Two ARC Discovery grants
- ARC Linkage Infrastructure, Equipment and Facilities Grant
- AOARD Grant

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COOPER-WHITE GROUP

Professor Justin Cooper-White

Engineering to solve problems in biology

Professor Justin Cooper-White is Director of the Australian National Fabrication Facility-Queensland Node and Associate Dean (Research) at UQ's Faculty of Engineering, Architecture and Information Technology. He is a past president of the Australasian Society for Biomaterials and Tissue Engineering and the Australian Society of Rheology. Professor Cooper-White has been appointed a CSIRO Office of the Chief Executive Science Leader.

International collaborations

Professor Cooper-White has past and currently active international collaborations with world-leading research groups at MIT, USA; Stanford, USA; ETH and EPFL, Switzerland; SNU, Korea; the University of Grenoble, France; Politecnico di Milano, Italy; UCL, UK; and the Max Planck Institute, Germany.

He has performed contract research and consultancy work for Unilever, UK; Nestle International, Switzerland; Rhodia, USA; and Inion, Finland since 2001. He has previously held a Visiting Professor Fellowship (2007) at ETH Zurich and a Politecnico di Milano Visiting Professor Fellowship for 2012-2013.

Publications

He is associate editor of the *Korean-Australian Rheology Journal*; serves or has served on the editorial boards of *Rheological Acta*, *Soft Materials*, *Biomicrofluidics* and the *Open Biomedical Engineering Journal*; and is a reviewer of major international journals, including *Nature Methods*, *Advanced Materials*, *Lab on a Chip*, *Stem Cells*, *Stem Cells and Development, Biomacromolecules, Tissue Engineering, Langmuir, Biomaterials* and *Journal of Non-Newtonian Fluid Mechanics*.

International conferences

Professor Cooper-White has been chair or co-chair of three international conferences, focusing on rheology or biomaterials and tissue engineering: the Australian representative on the International Advisory Committee, 15th International Congress on Rheology, Monterey, US; a member of the International Scientific Advisory Committee for the World Congress on Biomaterials, Amsterdam, Netherlands; and an Australian representative on the International Union of Societies for Biomaterials Science and Engineering.

Recognition of Professor Cooper-White's standing in the research field is reflected in the nine plenary and more than 25 keynote presentations he has been invited to give at national and international conferences since 2001. He received the 2005 Annual Award of the British Society of Rheology for contributions to the fields of rheology and non-Newtonian fluid mechanics. His work on engineered surfaces, specifically for directing mesenchymal stem cell fate, was highlighted as one the most influential works on stem cell-biomaterial interactions at the 2008 World Biomaterials Congress in Amsterdam, the Netherlands.

Patents

He is the inventor on six international patents. He has performed contract and sponsored research work for multinationals, such as Mesoblast, Rhodia, Unilever and Nestle International, and has received more than $45 million in competitive grant funding.

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DRENNAN GROUP

Professor John Drennan

Director, Centre for Microscopy and Microanalysis

Ceramic fuel cell technology, microstructural evaluation of ceramics, crystallography, electron microscopy, microstructural evaluation of materials, fuel cell technology

Professor John Drennan is an internationally-recognised expert in advanced materials characterisation and has worked with the US Department of Energy; the National Institute of Materials Science (NIMS), Japan; and IBM. He has held four Australian Research Council (ARC) Discovery grants.

International links

Professor Drennan has been a post-doctoral researcher at Imperial College, London; worked for CSIRO; and was seconded to Ceramic Fuel Cells, Melbourne. He has collaborated with Professor Richard Catlow, from University College London; Professor Peter Battle, from the University of Oxford; and NIMS in Japan. NIMS appointed Professor Drennan an International Fellow – the only Australian to be granted the honour. He has been selected to review the US Department of Energy's program Structural ceramics and mechanical behaviour of ceramics: Emphasis on microstructure and microchemistry.

Memberships and funding

Professor Drennan has been a member of the International Advisory Committee of the NanoCluster at Nanyang Technological University, Singapore; an external reviewer of the materials division of the Australian Nuclear Science and Technology Organisation (ANSTO); and a reviewer for international journals, such as the *Journal of Materials Science*, *Solid State Ionics*, the *Journal of the European Ceramics Society* and the *Journal of the Japanese Ceramic Society*.

Professor Drennan has been a visiting scientist at IBM's TJ Watson Research Centre in New York, US. He has been an associate editor of the *Journal of the American Ceramic Society*. Professor Drennan has been a key driver in obtaining more than $12 million in infrastructure funding from competitive sources, including ARC and the National Collaborative Research Infrastructure Strategy.

Awards and plenaries

Professor Drennan is the recipient of the 2010 John Sanders Medal from the Australian Microscopy and Microanalysis Society; two travelling fellowships from the Science and Techology Agency, Japan; and a Commonwealth Post Graduate Scholarship. He was an invited plenary lecturer at the International Symposium on EcTopia Science, at Nagoya University, Japan, in December 2011.

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GRAY GROUP

Professor Peter Gray

Director, Australian Institute for Bioengineering and Nanotechnology

Bioengineering of mammalian cell expression of r-DNA proteins and stem cell cultivation

Professor Peter Gray has built Australia's leading research group for the expression of biologics in mammalian cell culture. The group has developed novel approaches for selecting highly expressing clones using high-throughput FACS and Clonepix methodologies.

The group has developed a high yielding CHO transient cell expression technology that allows for plasmid replication and segregation on cell division, resulting in the production of more than four times the amount of monoclonal antibody per unit of DNA transfected and a six-fold increase in final culture volume when compared to other transient systems.

Collaborations are with fellow AIBN Group Leader Lars Nielsen on the quantitative metabolomics of CHO cells, and with Group Leader Steve Mahler on aspects of monoclonal antibody expression in CHO cells.

Professor Gray's group has been researching conditions that will allow the fully defined expansion of pluripotent stem cells. In an on-going collaboration with AIBN Group Leader Michael Monteiro and Associate Group Leader Zhongfan Zia, a novel, patented, thermo-responsive nanobridge system has been developed that uses a simple temperature drop to enable scalable sub-culturing of pluripotent stem cells without requiring added enzymes or chemicals.

International links

Professor Gray has research collaborations with several leading international groups. Protein expression work has involved a major collaboration with Patheon (previously DSM Biologics) and other corporate and academic groups through licence arrangements with the UQ-UNSW spin-off company Acyte Biotechnology Pty Ltd. Stem cell work has involved the Canadian Centre for Regenerative Medicine, in Toronto, Canada.

The sustainable aviation fuel project is conducted in association with Amyris, San Francisco, and Boeing, in Seattle, and the US Department of Energy through the Joint Bioenergy Research Institute, in San Francisco. Collaborations in in-vitro protein synthesis have been conducted with Professor James Swartz, Stanford University, San Francisco, CA. The anti-Hendra virus monoclonal antibody has been conducted with Drs Chris Broder and Mitko Dimitrov at NIH, Washington DC, USA.

Memberships, patents and funding

Professor Gray's research is covered by three issued US, European and Australian patents in the field of biologics, and a provisional patent for the nanobridge system for enzyme-free sub-culturing of pluripotent stem cells. Since the start of 2014, invited papers on aspects of the research have been given at PepTalk, 2014, Palm Springs, USA; Cell Culture Engineering XIV, Quebec City, Canada; the International Conference on BioNano Innovation, Brisbane, Australia; Fudan University, Shanghai, China; and Cell-based Therapies IV, San Diego, USA.

Professor Gray is Director of the Queensland node of the National Biologics Facility, a national research capability that has attracted $16 million of federal and state government funds.

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HALLEY GROUP

Professor Peter Halley

Head of School, School of Chemical Engineering, Faculty of Engineering, Architecture and Information Technology

Biofluids characterisation and biopolymer processing

Professor Peter Halley is a leading international expert in bio-based polymers and translational polymer research. His initial work on Australia's first biodegradable thermoplastic starch polymers led to the establishment of spin-off company Plantic Technologies, more than $75 million in venture financing, sales of commercially viable products, and a continued research provider relationship with Plantic.

Professor Halley has led translational research projects in biopolymers and biofluid platforms for agrifood, biomedical and high-value manufacturing sectors that have attracted more than $14 million in government and industry funding; and produced patents, licences and new industrial know how. He is on the editorial board of three journals. He is Head of School of Chemical Engineering at UQ.

International links

Professor Halley has been visiting or invited professor at Queen's University Belfast, the University of Strasbourg and Institut National des Sciences Appliquées de Lyon (INSA) in France. He has strong international collaborations with Los Alamos National Labs, US; the Cadbury Research Centre, UK; the US Department of Agriculture; the Colorado School of Mines, US; AnoxKaldnes, Sweden; the University of Bradford, UK; the University of Warwick, UK; and TNO, the Netherlands.

Memberships, patents and funding

Professor Halley has led research projects in biopolymers and biofluid platforms that have attracted more than $14 million in continuous government and industry funding since 1995. His patent portfolio includes patents in starch polymers, lignin polymers and oxodegradable polymers. He was made a Fellow of the Royal Australia Chemical Institute in 2008 and a Fellow of the Institution of Chemical Engineers in 2006. He is on the board of the UQ Dow Sustainable Engineering Innovation Centre, the UQ RTA Bauxite Alumina Centre, the UQ Remondis Bioprocessing Centre, the UQ Academic Board and the EAIT Faculty Leadership Advisory Group.

Awards and plenaries

Professor Halley has a Queen's University Belfast Visiting Professor Fellowship. He received an Invited Professorship at INSA de Lyon and was awarded the Cooperative Research Centre (CRC) for Polymers Chairman's Award for Excellence in Commercialisation.

Innovation and technology transfer awards have been awarded by the CRC Association, CRC Sugar and CRC Food Packaging. Among more than 40 invited keynotes and plenaries were presentations at the International Biopolymer Symposium, Strasbourg, France; PPS international meeting, Banff, Canada; World Congress on Chemical Engineering, Montreal, Canada; and the BioEnvironmental Polymer Society international meeting, Monterrey, Mexico.

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KENDALL GROUP

Professor Mark Kendall

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

Professor Mark Kendall is the inventor of the Nanopatch, a needle-free vaccine delivery device that is under rapid research and development to product through spin-off company Vaxxas. He co-founded Vaxxas with $40 million in capital investment, one of the largest investments in an Australian start-up biotechnology company.

The first trials with blank Nanopatches (without vaccine) in human volunteers are planned in Brisbane. The trials aim to assess the patch and applicator's usability under developing-country field conditions, as a pre-cursor to potential clinical trials. Funding associated with Prof Kendall's 2012 Rolex Award for Enterprise will enable a field trial in Papua New Guinea, where medical and climatic conditions mirror much of the developing world.

The Nanopatch technology has been licensed to US-based pharmaceutical company Merck & Co. Under the agreement, Merck is funding an extensive development program to explore using the Nanopatch for delivery of an important vaccine.

Professor Kendall is an inaugural Australian Research Council Future Fellow.

International links

Professor Kendall has key international links spanning academia and industry, including the University of Oxford, where he was a lecturer; Harvard; PATH; WHO; and the University of Washington. Professor Kendall is a member of a WHO-sponsored Scientific Advisory Group that aims to fast–track the development of needle–free vaccine delivery technology for use in under-developed low-resource regions.

While Professor Kendall was a lecturer at the University of Oxford, he was instrumental in building up vaccine development companies PowderJect and PowderMed, which were sold to Pfizer for $US400 million.

Patents and funding

Professor Kendall is the recipient of more than $40 million in competitive research funding and another $58 million from industry. He edits papers in the *Journal of Nanotechnology* and *Shock Waves Journal*. Professor Kendall is the inventor of 96 patents.

Awards and plenaries

Professor Kendall is a Rolex Laureate, recognising pioneering efforts to expand knowledge and improve human life. He is the recipient of many prestigious accolades, including the Australian Innovation Challenge in 2011. He was selected as one of Australia's top 100 engineers in 2012, 2014, and 2015. His AIBN group received the 2011 Eureka Prize for Interdisciplinary Research; and the Queensland Clinical Trial Network and Merck's 2010 Translational Research Excellence Commercialisation Award.

Professor Kendall won the Australian Society for Medical Research and Amgen's Australia Medical Researcher Award in 2008; and was named Young Engineer of Britain 2004. He has presented at more than 90 international seminars and conferences.

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MAHLER GROUP

Associate Professor Stephen Mahler

Biologic medicines and targeted nanomedicines

Associate Professor Stephen Mahler has a focus on technologies associated with monoclonal antibodies, including developing nanomedicines targeted to tumour cells using antibody fragments. Other applications include antibodies with therapeutic and/or diagnostic utility, some of which are in early stage commercial development.

In the area of nanomedicines, Associate Professor Mahler has strategic collaborations with Sydney-based companies EnGeneIC and Minomic, which have been funded through the Australian Research Council Linkage scheme. Through the EnGeneIC collaboration, Associate Professor Mahler and his team have developed novel bispecific antibodies using antibody engineering techniques capable of targeting the EnGeneIC Drug Delivery Vehicle (EDV) to potentially many different types of cancer cells. The team's work enables antibody-targeted EDVs to be produced in a simpler manufacturing process.

Simultaneously, EDVs' targeting efficiency to tumour cells is enhanced. EDVs are taken up by cancer cells and release cytotoxins that can kill the cancer cells. They can carry several different cytotoxic drugs and gene silencing molecules. Problems related to developing multi-drug resistance are potentially addressed. These nanomedicines are now being translated to the clinic in Australia and the USA.

Associate Professor Mahler has consulted for a wide range of biotechnology companies nationally and internationally. He has academic collaborations with international organisations, including the University of Cambridge, UK, for antibody engineering; and Nanyang Technological University, Singapore, for targeted drug delivery.

Educational activities and initiatives

Associate Professor Mahler is Plan Leader for Chemical and Biological Engineering in UQ's School of Chemical Engineering and facilitates student interactions with AIBN. He has developed a Continuing Professional Development (CPD) program in biologic medicines and delivered the CPD program nationally and internationally to big pharma, biotechnology companies, regulatory agencies, universities and conference workshops. They include Pfizer Australia, AbbVie, Patheon, the National Pharmaceutical Control Bureau, Malaysia, and the National Forum for Biosimilars, in Brazil.

Memberships, patents and funding

Associate Professor Mahler has been a member of the editorial board of the *Journal of Chemical Technology and Biotechnology* since 2004. He has secured more than $5 million in competitive funding over the past five years for projects principally associated with biologics discovery, recombinant protein production and developing targeted drug delivery systems.

Before joining AIBN, Associate Professor Mahler was co-director of the Bioengineering Centre at the University of NSW and secured $2 million in National Collaborative Research Infrastructure Strategy funding. He has six patents and two provisional patents in antibody engineering and targeted nanomedicines.

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MARTIN GROUP

Professor Darren Martin

Deputy Director (Graduate Studies)

Polymer nanocomposites and nanotoxicology

Professor Darren Martin is Chief Scientific Officer for start-up company TenasiTech Pty Ltd, which is commercialising a polymer nanocomposites platform for large polyurethane and acrylic polymer markets and applications. TenasiTech won the prestigious iLab Prize in the national Enterprize Competition; and received the 2010 UQ EAIT Faculty Commercialisation award.

His team is now commercialising a new nanotechnology platform based on a unique nanocellulose derived from Australian spinifex grass.

Professor Martin's research operates at the nexus of three key themes:

- Strong fundamental materials science with global benchmarking
- Safe biomaterials and nanomaterials
- Scalable advanced manufacturing.

His efforts in these areas during the past two decades have contributed to two successful start-ups, numerous products, and a strong platform for globally competitive nanocomposites innovation.

International links

Professor Martin's international collaborators include Pennsylvania State University; Purdue University, US; Warwick University, UK; the Institut National des Sciences Appliquées de Lyon, France; and the University of Padova, Italy. He has several materials co-development projects and collaborations with companies such as Cochlear Ltd, Aortech Biomaterials, and others in North America, Europe and Asia.

Memberships, patents and funding

Professor Martin is AIBN Deputy Director – Postgraduate Studies. He is recognised as a global leader in translational materials science and engineering and has published more than 100 book chapters and peer-reviewed papers; has seven patents; and has attracted more than $10 million in research funding since 1999.

From 1993 to 1999, his research contributed to the spin-off Aortech Biomaterials, commercialising new polyurethane pacemaker insulation from the Cooperative Research Centre for Cardiac Technology.

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MIDDELBERG GROUP

Professor Anton Middelberg

Pro Vice-Chancellor (Research and International)

Vaccine engineering and functional new nanomaterials based on engineering molecular assembly in a process context

Professor Anton Middelberg is UQ's Pro Vice-Chancellor (Research and International), leading key aspects of a university-wide research and internationalisation portfolio.

His team's research projects encompass new technologies for cost-effective rapid vaccine development, sustainable biosurfactant technologies and nanomedicine approaches based on fundamental understanding of bio-nano interactions.

Professor Middelberg and his research group are taking significant steps in learning how to engineer new systems for vaccine engineering and sustainable "green" materials, including biosurfactants.

He was awarded the annual 2010 Queensland Premier's Fellowship for his vaccine research. His 2011 seminal paper on new vaccine processing in the leading journal *Vaccine* saw him invited to be an Associate Editor of that journal.

Professor Middelberg has been named by Engineers Australia as one of the 100 most influential engineers in Australia. His many awards include the Brodie and Shedden-Uhde medals of the Institution of Engineers Australia, and he has published more than 170 refereed papers at the interface between biology and engineering.

International links

Professor Middelberg is Editor-in-Chief of leading international journal *Chemical Engineering Science* and an editorial advisory board member for *Trends in Biotechnology*. He has editorial roles on the *Biochemical Engineering Journal*, *ChemPhysChem*, the *Journal of Microbiology and Biotechnology* and *Biotechnology and Bioengineering*. He has joint publications with researchers from Tianjin University, China; Oxford and Cambridge universities, UK; the University of California Berkeley, US; KAIST, Korea; and companies including Eli Lilly, Novartis and Dow.

Professor Middelberg has served in scientific roles for international conferences including the International Biotechnology Symposium, in Daegu, South Korea (2012); the International Small-Angle Scattering Conference, Sydney (2012); the Asian Congress of Biotechnology, Shanghai, China (2011); and Recovery XIV, Lake Tahoe, USA (2010).

Memberships, patents and funding

Professor Middelberg is an elected Fellow of the Australian Academy of Technological Sciences and Engineering and a Fellow of the Institution of Chemical Engineers, UK. He has attracted more than $13 million in research funding since 2003 and been named as an inventor on almost 58 patents and applications.

Awards and plenaries

Professor Middelberg's invention of peptide surfactants was awarded three major prizes including the 2006 TechConnect Prize in Boston. His has given plenary lectures at the World Congress of Particle Technology in Beijing (2014); the World Congress of Chemical Engineering 9 GLS-11 in Seoul (2013); the 7th Vaccines and ISV Conference in Barcelona (2013); and the 14th Asia Pacific Confederation of Chemical Engineering Congress in Singapore (2012).

Research impacts

Professor Middelberg's research on biosurfactants led to the founding of Pepfactants Pty Ltd by Uniquest. His vaccine technology patents have been orientated toward influenza and rotavirus and are being further developed, by AIBN, in collaboration with CSIRO and the International Vaccine Institute in Seoul.

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MONTEIRO GROUP

Professor Michael Monteiro

Deputy Director (Research)

Polymer chemistry: 'living' radical polymerisation, emulsion polymerisation, polymer nanostrutures, 'click' reactions, dendrimers and kinetic modelling

Professor Michael Monteiro has established an international reputation in 'living' radical polymerisation both in solution and emulsion (or dispersion). He aided the development, with Professor Virgil Percec, of the new SET-LRP method that has now been taken up by industry. He has built a reputation for creating complex polymer architectures, including dendrimers and cyclic topologies.

Professor Monteiro is now building designer polymers for various biomedical applications, including vaccines, drug delivery and stem cells. His group designed a polymer using SET-LRP that can release siRNA on-demand, resulting in 100 percent death of cancer cells in vitro.

His group has established a new method to produce polymer nanostructures using emulsion polymerisation, including worms, rods, vesicles, loops, and disks. These nanostructures can be made on industrial scales.

Professor Monteiro is dedicated to translating research into commercial outcomes, with seven PCT and provisional patents since 2005 and two start-up companies, DendriMed Pty Ltd and MetaloTek Pty Ltd.

He has attracted Australian Research Council (ARC) and National Health and Medical Research Council grants and Queensland Government funding of more than $7 million.

He was awarded an ARC QEII Fellowship in 2004, an ARC Future Fellowship in 2009, and a UQ VCRTF starting in 2016.

Memberships, funding and patents

- Editor: *European Polymer J* (Elsevier)
- Editorial advisory boards: *Biomacromolecules* (ACS Journal) (2013-); *Macromolecules* (ACS Journal) (2008-2010); *Journal of Polymer Science Part A Polymer Chemistry* (2009-)
- Current ARC funding: Precision-engineered polymer nanomaterials, $420,000; with Dr TP Munro, On-demand scaffolds for directed stem cell differentiation
- Selected patents: Release Media Prov AU2012902396; Polymeric dendrimers for siRNA delivery Prov AU2012903138

Awards and plenaries

- 2015: Product Engineering; Advances in Polymer Science, Cancun – plenary
- 2015: Cyclic Macromolecules, Crete – plenary
- 2015: Pacifichem, USA - plenary and invited to three symposiums
- 2014: John Blandford Lecture, Cornea Society Meeting – plenary
- 2014: Functional Polymeric Materials Conference, Mexico – invited lecture
- 2014: ACS, San Francisco, USA – invited lecture
- 2012: IUAPC POC14, Qatar – keynote
- 2011: Australian Leadership Award

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NIELSEN GROUP

Professor Lars Nielsen

Systems and synthetic biology

Professor Lars Nielsen leads the development of experimental and computational tools to analyse and design complex biological systems. His group is internationally recognised for developing the first genome-scale metabolic reconstructions (GSMRs) for animals and plants, and he participates in several ongoing reconstruction efforts.

GSMRs are well-curated compendia used to explore principles and evolution of metabolism. The Nielsen Group has worked with companies to explore agricultural traits (Dow AgriSciences), enhance bioplastic production (Metabolix), and increase biopharmaceutical production (Sigma).

Genome-scale modelling underpins novel strategies for engineering industrial microbes and processes for producing primary and secondary metabolites. Working with multinationals (Toyota, Dow, Pfizer), international biotechnology companies (Novozymes, LanzaTech) and Australian companies (Agrichem), the Nielsen Group has developed better processes for producing materials and bioactives (antibiotics, biopesticides).

Professor Nielsen has played an important role in building Queensland industrial biotechnology as an expert advisor to government, research bodies and domestic and international companies. He has partnered with the world's pre-eminent metabolic engineers and key companies to build capacity in yeast and *E coli* metabolic engineering.

Professor Nielsen applies systems analysis and design approaches to tissue engineering, including novel strategies for generating microtissues for drug screening and using stem cells to produce red and white blood cells for transfusion.

Memberships, funding and patents

Professor Nielsen has been granted four patents in stem cell cultivation and metabolic engineering. Two stem cell patents have been licensed for commercialisation. He is on the Scientific Advisory Board of InSphero (2009–), a Swiss company commercialising microtissue technology originating from the Nielsen laboratory.

He is an editorial board member of *ACS Synthetic Biology*, *Metabolic Engineering*, *Biotechnology Journal*, *Biotechnology and Bioengineering* and *Bioprocess and Biosystems Engineering*. In the past decade, he has been part of successful research grant applications totalling $75 million, including $33.7 million for his own systems and synthetic biology group at AIBN.

Awards and plenaries

- 2015: NNF Laureate Research Grant
- 2014 International Conference in Bioinformatics, Sydney – plenary
- 2014 Green Chemistry GRC 2014, Hong Kong – invited talk
- 2014 Metabolic Engineering X, Vancouver – invited talk
- 2013 Singapore Synthetic Biology Symposium – keynote
- 2013 USP Conference on Synthetic Biology, Sao Paulo – plenary
- 2013 Cold Spring Harbor Synthetic Biology, Suzhou – keynote
- 2012 COBRA, Helsingor – keynote
- 2012 American Society of Plant Biology, Austin – invited talk (major symposium)
- 2011 Congress of the German Society for Transfusion Medicine, Hannover – plenary
- 2009 Australasian Symposium on Metabolomics, Auckland – plenary
- 2008 Cell Culture Engineering XI, Sunshine Coast – keynote

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TRAU GROUP

Professor Matt Trau

Deputy Director

Nanoscience, nanotechnology, molecular diagnostics

Professor Matt Trau is AIBN's Deputy Director. Since graduating from the University of Sydney (BSc Hons I, University Medal) and the University of Melbourne (PhD in Physical Chemistry, 1993), he has held positions in industry and academia across the globe.

They include a Fulbright Research Fellowship at Princeton University, USA; and research scientist at Dow Chemical and ICI Pty Ltd. Professor Trau has been a Visiting Professor at the Dana Farber Cancer Research Institute, Harvard Medical School, Boston (2000); and the Fred Hutchinson Cancer Research Centre, Seattle (2008).

Professor Trau is internationally recognised for his innovative, cross-disciplinary research at the interface between chemistry, nanotechnology, biology and medicine. He has co-authored more than 130 refereed publications, which include 8 Science and Nature family journal publications.

His major awards and honours include an ARC Federation Fellowship; a Queensland Young Tall Poppy Award; a UQ Foundation/Vice Chancellor's Research Excellence Award; a Paul Harris Fellowship; and a Pink Circle Award for breast cancer research excellence.

Multi-disciplinary international programs

Professor Trau has raised more than $25 million in competitive national and international grant funding in the past 10 years. In the last five years, he has initiated and led several large international programs that involve close collaboration between leading nanotechnologists, molecular biologists, geneticists and commercial researchers, with the goal of creating cutting-edge diagnostics.

They included a $4 million National and International Research Alliances Program (NIRAP) grant from the Queensland Government And, a M$5 NIH program grant from the US, and two consecutive $5 million multidisciplinary collaborative grants from the National Breast Cancer Foundation (NBCF). The grants involve research collaborations with high-calibre scientists: Dr Lee Hartwell (2001 Nobel Laureate) from Seattle was a co-chief investigator on the NIRAP grant, and each of the NBCF grants include leading geneticists, pathologists and oncologists from Australia and around the world.

Professor Trau has been a consultant for national and international companies, such as Merck, Digene, Beckman Coulter, Panbio and Al Scientific. He is the founder and Director of Nanomics BioSystems Pty Ltd, a spin-off company from his laboratory.

Plenary lectures, international conferences

Since 2003, Professor Trau has presented more than 60 invited plenary/keynote lectures at major national and international conferences. He has also been convenor, chair, co-chair and symposium chair for 10 major international conferences including the 5th International NanoBio Conference, Brisbane, 2014

2015 public lectures include:
Consilium 2015, Sanctuary Cove QLD, August 2015, plenary session; Ludwig Cancer Prevention Conference, Memorial Sloan-Kettering Cancer Center, New York, July 2015, Keynote; US-Australia Biomedical Cooperation, University of Canberra (co-organised by the US Embassy, the NIH & the NHMRC), invited talk & session chair, July 2015; Olivia Newton-John Cancer Research Institute Inaugural Symposium, keynote, April 2015; Diamantina Health Partners Symposium on Circulation Tumour Cells, Translational Research Institute, Brisbane, March 2015; Global Edge Leadership Conference, Young Presidents Organisation, Melbourne Convention Centre, March 2015; 4th Asia Pacific Breast Cancer Summit, Brisbane, March, 2015, keynote and session chair; 7th Advanced Materials & Nanotechnology Conference - AMN7, Nelson, New Zealand, February, 2015, keynote.

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WANG GROUP

Professor Lianzhou Wang

Design and development of functional nanomaterials for clean energy applications

Professor Lianzhou Wang has an international reputation for preparing and applying functional nanomaterials for use in renewable energy conversion/storage systems, including photocatalysts, rechargeable lithium batteries, and new generation solar cells.

Research highlights include:

- Key insights into the exfoliation, re-assembly and application of 2D layered materials that play important roles in various applications, including photocatalysis, biomedicine, UV-blocking coatings and re-chargeable batteries (published in *J Am Chem Soc, Adv Mater*, invited reviews in *Chem Rev* and *Chem Soc Rev*, and applied patents).
- Innovative band-gap engineering of a series of perovskite semiconducting materials as visible light photocatalysts for efficient solar fuel generation, solar cell electrodes, and environmental remediation (published in *Adv Mater*, *Energy Environ Sci*, and *Angew Chem,* invited review articles in *J Photochem Photobio C*, *Review*, *J Mater Chem)*.

Research linkages

Professor Wang has built strong international links and nurtured long-term collaborations with world leaders in material science, catalysis and energy conversion sectors, including Professors Takayoshi Sasaki and Jinhua Ye and Dr Kiyoshi Ozawa, from the National Institute for Materials Sciences, Japan; Professor Guozhong Cao, from the University of Washington; Professor Michael Wark, from Ruhr-University Bochum, Germany; and Professors Huiming Cheng and Can Li, from the Chinese Academy of Sciences.

Professor Wang's industry partners include Dow Chemicals, Bao-steel, Bluoscope, Leling New Energy and Nanopac.

Research funding, publications and patents

Professor Wang is an ARC Future Fellow and Research Director of the Nanomaterials Centre. He has attracted 15 ARC grants; two CSIRO Flagship Cluster projects; one major Queensland Government funding; a CRC program; and industry grants, totalling more than $15 million. Professor Wang has contributed eight book chapters, had more than 210 original journal publications, has 11 patents and has delivered more than 50 plenary, keynote and invited presentations.

Awards and international standing

STA Fellowship of Japan; ARC QEII Fellow; UQ VC's Senior Research Fellow; UQ Research Excellence Award; Scopus Young Researcher Award in the Engineering and Technology category.

He has organised more than 20 international conferences and symposiums as organising chair or a board member. Professor Wang is Associate Editor-in-Chief of the *Journal of Nanoparticle Research* and *Science Bulletin* and on the editorial board of three other journals.

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WELLS GROUP

Associate Professor Christine Wells

Cellular differentiation and activation

Associate Professor Christine Wells is an internationally recognised pioneer of genomics in its application to innate immunity and stem cell biology. She has driven programs to identify the genetic elements that define the innate immune system, contribute to the regulation of immune genes and describe the functions of new gene products.

During the past decade, Associate Professor Wells has made key contributions to several seminal papers that mapped out mammalian genome architecture and transcriptional complexity. Through gene-discovery programs in macrophage biology she characterised a role for the C-type lectin Mincle in host-fungal interactions and has identified novel proteins that modify inflammatory signalling.

In 2011, she established Stemformatics.org – a collaborative hub for Australian and international stem cell researchers.

International links

Associate Professor Wells has accepted a joint appointment as reader at the University of Glasgow's Institute of Infection, Immunity and Inflammation, enabling her to establish translational linkages for her AIBN research into cellular differentiation and activation.

She has an ongoing and senior role in the international consortium Functional Annotation of the Mammalian Genome (FANTOM), with the RIKEN Omics Sciences Centre, in Yokohama, Japan. She is a member of the Canadian-led Project Grandiose, in collaboration with Dr Andras Nagy.

Memberships and funding

Associate Professor Wells is a member of the executive committee for the Australian Genomics and Associated Technology Association and chaired the society's 2013 conference in Queensland. She is a committee member for the Lorne Genome Conference. Associate Professor Wells is on the editorial board of *Genomics, Proteomics & Bioinformatics.* She has been guest editor for *PLOS Genetics.*

Associate Professor Wells has been awarded $4.5 million in funding in the past five years, including $3 million in National Health and Medical Research Council, Australian Research Council and Queensland Government grants as chief investigator.

Awards and plenaries

Associate Professor Wells has been invited to speak at national and international conferences, including the Chinese Academy of Sciences 2013 Genomics Conference, in Beijing.

Her awards include a Queensland Government Fellowship (2013); and the Women in Technology Biotech Research Award (2010).

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WHITTAKER GROUP

Professor Andrew Whittaker

Polymer chemistry: living radical polymerisation, polymer architecture, physical chemistry, biomaterials, imaging agents, thin films, lithography, magnetic resonance

Professor Andrew Whittaker has achieved international recognition in three fields:

- magnetic resonance of materials
- polymeric biomaterials
- photolithography.

Underpinning this is his expertise in polymer physical chemistry. In the field of NMR and MRI of materials he has performed important research on the structure of nanomaterials. He has made advances to understand transport in biomaterials and the development of novel imaging agents. In the field of lithography his work continues to inform the design of next-generation photoresists and related materials.

Professor Whittaker leads one of Australia's largest polymer research groups, with almost 45 researchers investigating important technological questions. His work is heavily funded by national funding agencies and industry. In particular he has received substantial support from industry, including Dow, Intel, Sematech and Eli Lilly.

Professor Whittaker has attracted about $17 million in project funding and $10 million in infrastructure support from the Australian Research Council (ARC), the National Health and Medical Research Council, the Queensland Government and the Australian Cancer Research Foundation. He is a chief investigator of the ARC Centre of Excellence in Convergent Bio-Nano Science and Technology, with funding of $26 million over seven years.

Professor Whittaker is active in supporting his profession, having served as president of the major societies representing his profession. He is a member of the ARC College of Experts.

Memberships, funding and patents

- Member: National representative to Pacific Polymer Federation
- Editorial boards: *Radiation Physics and Chemistry* (2010-), *Journal of Applied Polymer Science* (2011-), *Macromolecules* (2009-2011)
- Current external funding: ARC COE, DP, LP and LE; NHMRC project grants; ACRF; Cure Brain Cancer Foundation, AOARD
- Selected patents: Lithographically produced features, WO 2014 127340 A1

Awards and plenaries (since 2014)

- Plenary talks: 2014 Polychar 2014, Stellenbosch; Nanomedicine 2014, Sydney
- 2014 Paul J Flory Polymer Research Prize, Polychar World Forum
- 2014 National High-end foreign experts recruitment project, China
- 2014-2018 Visiting Professor, Hubei University
- 2015 Chinese Academy of Sciences President's International Fellowship (visiting scientist)

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WOLVETANG GROUP

Professor Ernst Wolvetang

Combine functional genomics approaches in human-induced pluripotent stem cells to provide fundamental insights into neurological diseases and deliver better health outcomes for patients

Human-induced pluripotent stem cells (hiPSCs) capture the genetic make-up of an individual and can make every cell type of the human body. Hence they are an ideal model system for human functional genomics or drug screening and an attractive vehicle for personalised regenerative medicine.

Professor Wolvetang's laboratory is a leader in the generation and neural differentiation of hiPSC, and has established the CRISPR technology, cell-based reporters and 2D and 3D culture platforms required to conduct novel functional genomics approaches for a range of neurological diseases, such as Alzheimers, Down syndrome, autism, schizophrenia and Ataxia-taliengectasia.

In future, the lab will increasingly exploit iPSC as a tool to interrogate the ageing process and explore the possibilities of cell-based and direct reprogramming approaches for treating disease.

Prizes

- 2014: Recipient of the Aon regenerative medicine prize, LSQ

Talks

- Reprogramming and disease modelling, ASSCR conference, Lorne, 2014 – invited speaker
- Cell reprogramming approaches to cure disease: the way of the future, AusBiotech conference, Gold Coast, 2014 – invited speaker
- Human-induced pluripotent cells as tools to study neurological diseases, 11th annual world conference of the Society for Brain Mapping & Therapeutics, 2014 – keynote speaker
- Generating and correcting stem-cell-based models of disease with CRISPR genome editing tools, Genome Engineering of Cells and Organisms: CRISPR and TALENs Workshop, Melbourne, 2014 – keynote speaker

Grants

- 2014-2017: CIA – Professor Ryan Lister, CIB – Associate Professor Wolvetang, CIC - Dr Oz Bogdanovic: Deciphering the role of atypical DNA methylation in neural genome regulation and neurological disorders
- 2014-2017: CIA – Associate Professor Wolvetang: Targeting cerebellar degeneration in Ataxia-telangiectasia using induced pluripotent stem cells, BrAshat grant
- 2014-2016: CIA – Associate Professor Wolvetang, CIB – Associate Professor Christine Wells: Understanding Alzheimer's disease using Down syndrome as a model, NHMRC

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XU GROUP

Associate Professor Zhi Ping (Gordon) Xu

Functional nanomaterials for drug and gene delivery, and as nanoadjuvants for vaccines

Associate Professor Zhi Ping (Gordon) Xu is an Australian Research Council (ARC) Future Fellow (2013-2016). Since 2004, he has received several fellowships and awards, including an ARC Australian Postdoctoral Fellowship (2005-2007), an ARC Australian Research Fellowship (2008-2012), and a UQ Foundation Research Excellence Award (2009). Associate Professor Xu and his colleagues have received funding from ARC, the National Health and Medical Research Council (NHMRC) and the Queensland Government of more than $7 million. Associate Professor Xu is an ARC and NHMRC referee.

Associate Professor Xu has led a research team in control preparation, functionalisation and bioapplication of various nanomaterials, including layered double hydroxide (LDH) nanoparticles, lipid-coated calcium phosphate nanoparticles, liposomes and nanoemulsions, focusing on cancer treatment and bioimaging. His research theme is biomolecule-nanoparticle hybrids as efficient platforms to improve human health and enhance food security. Research keywords include target drug/gene delivery, cancer chemotherapy and immunotherapy, bioimaging, anti-bacteria and anti-virus for plants and animals through slow release and vaccination promotion.

International and industry collaborations

Associate Professor Xu has established an international reputation, publishing more than 175 papers in high-impact journals with more than 4000 citations (as at March 2015). He has been ranked #8 top researcher in the field of LDH materials for publications among hundreds of peers in the last 20 years. He has an international patent, which has been sub-licensed to Oxford PharmaScience Group Plc in the UK, to reuse non-steroidal anti-inflammatory drugs (NSAIDs) by hybridising with LDH nanomaterials to form new formulations for efficient use. NSAIDs have global annual sales of up to $12 billion.

Associate Professor Xu has initiated collaborations with industry companies, including AgriChem, Incitec Pivot, Nufarm, Essential Oils of Tasmania, SirTex Medical, Cobbett and Israel ICL Innovation.

He is an editorial board member of *Current Pharmaceutical Design*, *Biointerface Research in Applied Chemistry* and the *American Journal of Nuclear Medicine and Molecular Imaging*.

Current grants

- siRNA-based anti-tumour immunity (2014–2016)
- Nano-encapsulation of plant extracts for targeted delivery in animal healthcare (2014–2015) Rural Industries Research & Development Corporation
- New surface characterisation facility for nanotechnology, bioengineering and manufacturing research (2014–2015) UQ Major Equipment and Infrastructure
- Engineering LDH nanoparticles toward an efficient targeted clinical delivery system (2013-2016) ARC Future Fellowship
- BioClay: Novel spray-on crop protection (2015-2017) Queensland Accelerate Science and Innovation Program

Keynotes and invited talks

- 2015: 6th International NanoMedicine Conference, Sydney - invited
- 2014: International Conference on Small Science, Hong Kong – invited
- 2011: Particulate Processes in the Pharmaceutical Industry III, Gold Coast – keynote
- 2009: 14th International Symposium on Recent Advances in Drug Delivery Systems, Salt Lake City – keynote

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YU GROUP

Professor Chengzhong (Michael) Yu

Applied functional nanomaterials

Professor Michael Yu is an internationally recognised expert in materials science. He has research interests in developing new functional composites for delivery, clean energy and environmental applications. He has more than 200 publications with a total citation of more than 9000.

International links

Professor Yu has collaborations with scientists in chemistry, material science and chemical engineering from the US, Japan, Sweden, France and China. Through these collaborations, more than 50 international journal papers have been published.

Memberships, patents and funding

Since he joined AIBN in 2010, Professor Yu has attracted five Australian Research Council (ARC) grants and funding from Cancer Council Queensland and the Queensland Government's Research Partnership Project, totalling more than $6.2 million. Before joining AIBN, Professor Yu attracted 12 grants from the National Science Foundation of China; the Chinese Ministry of Science and Technology; the Chinese Education Ministry; and the Shanghai Government. He has applied four patents at UQ with one licensed to industry.

Professor Yu is a referee for more than 50 international journals and a reviewer for ARC and the National Health and Medical Research Council.

Awards and plenaries

Professor Yu is an ARC Future Fellow (2009). He is the recipient of the Le Févre Memorial Prize for Chemistry (Australian Academy of Science, 2015); the IUPAC Distinguished Award for Novel Materials and their Synthesis (2014); the 2009 Innovation Award of the Chemistry Academy of China; the 2009 Young Scientist Award of the Ceramic Society of China; the 2005 New Century Scientist Award from the Chinese Ministry of Education; and the 2004 Young Scientist Award from the Chemistry Academy of China. Professor Yu received the National Excellent Doctoral Dissertation Award in China (2004); the second prize of the National Science Award of China (2004); and the Shanghai Science & Technology Progress Award (2002). He has been invited to give more than 50 plenary, keynote and invited talks.

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Associate Group Leaders

Associate Professor Idriss Blakey

Principal Research Fellow

Rational design, synthesis and self-assembly of functional materials for nanofabrication, sensors and biomedical imaging agents

Awards

Associate Professor Idriss Blakey is lead chief investigator on an Australian Research Council (ARC) Discovery Project, chief investigator on an ARC Linkage Project, in partnership with the Dow Chemical Company, and holds a UQ Vice Chancellor's Research and Teaching Fellowship.

He has been awarded more than $10 million in research project and infrastructure funding from ARC, industry, the Queensland Government and UQ, including four ARC Discovery Projects as lead chief investigator and an ARC Future Fellowship that focused on blue sky research with practical aims.

He has been awarded four ARC Linkage Projects and a Queensland Government Smart State Fellowship that focused on developing advanced polymers for use in computer chip manufacture. He worked closely with industry partners, such as Dow Chemical Company, Intel Corporation and Sematech.

Publications

Associate Professor Blakey's contributions to polymer science and nanotechnology have been published by leading publishers, including Wiley, the American Chemical Society and the Royal Society of Chemistry.

He is a regular reviewer and adjudicative reviewer for more than 20 journals and for granting bodies, including ARC, the Wellcome Trust, the US Department of Energy and the Australian Synchrotron.

He has one fully granted patent, two patents at the PCT stage and three provisional patents.

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Dr Simon Corrie

Australian Research Council Discovery Early Career Researcher Award (ARC DECRA)

Design, fabrication, and evaluation of microprojection array technology for rapid, multiplexed biomarker detection via skin application

Awards

Dr Simon Corrie is a chief investigator in the Australian Research Council (ARC) Centre of Excellence in Convergent Bio-Nano Science and Technology and a recipient of the prestigious ARC Discovery Early Career Researcher Award (2013-2015). His research efforts also attracted a Queensland Young Tall Poppy Award in 2013.

Projects and publications

Dr Corrie has developed several molecular technologies with applications in diagnostics, publishing the work in the Royal Society of Chemistry and the American Chemical Society journals and presenting it at international conferences. He regularly reviews journal articles for a range of publications and reviews grant and fellowship applications for ARC and the National Health and Medical Research Council.

After completing his PhD in physical chemistry, Dr Corrie received an American Australian Postdoctoral Fellowship in 2007 to work in Professor Nancy Kiviat's HPV Research Laboratory at the University of Washington, in Seattle, gaining experience in developing clinically-relevant diagnostic technologies. Dr Corrie returned to Queensland as a lead chief investigator on an ARC Discovery Project and Smart Futures Fellowship.

He joined Professor Mark Kendall's research group at AIBN, focused on developing and evaluating diagnostic Micropatches. A related patent application is at a national stage in several countries.

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Dr Zhongfan Jia

Australian Research Council Future Fellow

Engineered polymer scaffolds for controlled proliferation and differentiation of stem cells

Dr Zhongfan Jia is an Australian Research Council (ARC) Future Fellow (2014-2017). He obtained a PhD in polymer chemistry and physics from Fudan University, China, and joined AIBN as a UQ Postdoctoral Research Fellow in 2009.

Since then, he has been working in Professor Michael Monteiro's group on complex polymer design and synthesis and polymer functionalisation for biomedical applications.

Before joining AIBN, Dr Jia worked as a postdoctoral research fellow in the Centre for Advanced Macromolecular Design at the University of New South Wales.

Publications/awards

Dr Jia has continuously publishing in leading chemistry and polymer journals, including *Nat Commun*, *Angewandte Chemie Int Ed*, *J Am Chem Soc*, *Macromolecules and Biomacromolecules*.

He regularly reviews journal articles in polymer and biomaterial publications and for granting bodies, including ARC DP and Fellowship. He has written reviews, highlights and book chapters.

Dr Jia received the Excellent PhD Thesis Award of Shanghai, China in 2008 (top three percent in Shanghai). He was also awarded a UQ Postdoc Fellowship (2009-2012), UQ ECR Award (2010) and a UQ Trans-Pacific Fellowship (2012). He obtained the Scientific and Technical Award from the Shanghai Municipal Government in 2011 and the Science and Technology Progress Award from the Ministry of Education, China in 2011. In 2013, he was awarded an Australian Research Council (ARC) Future Fellow (2014-2017).

Current projects

Precise design and synthesis of functional polymer nanomaterials are of great interest for applications ranging from biomedicine to imaging and energy transfer and storage. Dr Jia has been working in living polymerisation techniques (radical and ionic polymerisations) and 'click' chemistry to create abundant polymers with difference chemical compositions and architectures.

His current research topics are:

- Synthesis of thermo-responsive nanostructures in water through RAFT-mediated emulsion polymerisation. The resulting nanostructures with combined functional groups provide coupling points for bioconjugation with biomolecules as extracellular matrix.
- Synthesis of new types of radical polymer as fully organic electrode materials in organic battery applications.

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Dr Esteban Marcellin

Queensland Government Accelerate Fellow

Industrial biotechnology and systems metabolic engineering

Dr Esteban Marcellin is trying to shift production of chemicals from petrochemical-derived products to more sustainable alternatives. Using bio-catalysts as cell factories, his research is transforming inexpensive feedstocks into chemicals and fuels. From conventional sugars to gasified waste, Dr Marcellin's research is trying to change the way chemicals are made. For example, gas fermentation does not compete with arable land or the food chain and is readily available at a low cost.

Systems metabolic engineering is a powerful, novel approach that guides the improvement of biological processes by identifying gene targets for engineering. Coupled with mathematical models, it can understand, predict, and optimise cell properties and behaviour, for example, identifying gene targets for knockout and up-regulation. These experimental and computational tools can be used to drive cell productivities close to capacity.

In collaboration with industry leaders, including Dow, Dow AgroSciences, LanzaTech and Zoetis, Dr Marcellin is applying systems metabolic engineering to produce propionic acid, enhance clostridial vaccine yields, and increase the production scope of gas fermenting bacteria.

Industry and international collaborations

Dr Marcellin's research has contributed to attracting more than $4.9 million in competitive grants, including three ARC Linkage grants, a Queensland Accelerate Fellowship and several research contracts with multinational companies.

Publications and awards

Dean's Commendation for Outstanding Research Higher Degree Thesis from UQ (2010); UniQuest TrailBlazer Award (2009); UQ Partners in Research Excellence Awards in the Science market channel (2015)

Dr Marcellin's research has been published in high-quality scientific papers, including *Metabolic Engineering, Molecular and Cellular Proteomics* and the *Journal of Biological Chemistry*.

Dr Marcellin has established a recognised international reputation in the fields of industrial biotechnology and systems metabolic engineering. He has contributed to several book chapters, reviews and research papers in leading journals. His work has been presented at national and international conferences and he is an invited reviewer for more than 20 journals.

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Dr Muhammad Shiddiky

National Health and Medical Research Council
RD Wright Biomedical Research Fellow

Microfluidic devices and electrochemical nanobiosensors for detecting and diagnosing cancer and other diseases

Before joining the Trau Group at AIBN, Dr Shiddiky was a postdoctoral research fellow in the School of Chemistry at Monash University.

Publications

He has co-authored more than 50 journal publications, many of which appear in high-ranking journals in the field, for example, two in *J Am Chem Soc*, nine in *Analytical Chemistry*, six in *Chemical Communications*, and two in *Scientific Reports*.

He has maintained an average citation count for his referred publications of more than 20 per publication.

Awards/publications

In 2014, Dr Shiddiky received an Australian Research Council (ARC) Discovery grant as joint chief investigator with AIBN Group Leader Professor Matt Trau. Major awards and honours include an ARC Discovery Early Career Researcher Fellowship, a National Health and Medical Research Council Career Development Fellowship, a UQ Postdoctoral Research Fellowship, a UQ ECR Award, and a Graduate Student Award for PhD research excellence, from Pusan National University, South Korea.

He is co-editor of two books published by Nova Science Publishers, in the US; and lead author of three book chapters and four major review articles.

His contributions in the research field have been acknowledged with invitations to present at many national and international conferences and be joint guest editor for a special issue of the international journal *Sensors*.

Dr Shiddiky is a regular reviewer for more than 15 top-ranking journals in the fields of chemistry, miniaturised systems and electrochemical biosensors and for granting bodies, including ARC. He has two patents at the PCT stage.

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Dr Kristofer Thurecht

Australian Research Council Future Fellow

Design and synthesis of architectural polymers applied to molecular imaging and drug delivery in nanomedicine

Dr Thurecht's research focuses on developing polymer and nanoparticle-based devices for nanomedicine. His team works across the boundaries of chemistry and materials, biology and imaging science to probe how nanomaterial properties affect their function in living animals.

Awards

In 2015, Dr Thurecht was awarded the David Sangster Polymer Science and Technology Award from the Royal Australian Chemical Institute Polymer Division for outstanding contribution to polymer science by a researcher under the age of 40. He has been recognised for scientific excellence with a 2012 Queensland Young Tall Poppy Science Award and a 2010 UQ Foundation Research Excellence Award for his work in developing polymer theranostics.

International links/collaborations

Dr Thurecht has strong international links with researchers, particularly in Europe. His work with the University of Nottingham's Professor Cameron Alexander is focused on understanding how biological media influences material properties of nanomedicines. This is exemplified by an Australian Research Council (ARC) Discovery Project, in which Dr Thurecht is lead chief investigator and Professor Alexander is international PI, that studies physiological conditions that can act to enhance delivery of siRNA to cells. Dr Thurecht also collaborates with Dr Kerstin Münnemann, at the Max Planck Institute for Polymer Research in Mainz, Germany, on developing new polymeric contrast agents based on hyperpolarisation techniques. Dr Thurecht was UQ's representative on the Australia-China Young Scientist Exchange Program in 2014.

Current projects and industrial links

Since 2010, Dr Thurecht has been chief investigator on grants totalling more than $5.2 million and for the Centre of Excellence in Convergent BioNano Science and Technology ($26 million in total). He is an ARC Future Fellow and holds ARC DP and Linkage grants, a National Health and Medical Research Council Project grant and funding from the National Breast Cancer Foundation. He conducts research collaborations with biotechnology companies, including Minomic, Clarity Pharmaceuticals and InterK, and won an ARC Linkage grant to develop new diagnostics based on Minomic's patented MIL-38 antibody.

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Dr Claudia Vickers

Queensland Government Accelerate Mid-Career Fellow

Systems and synthetic biology in the fields of isoprenoid biology/regulation, metabolic engineering, carbohydrate metabolism/engineering, and beer systems biology

Dr Claudia Vickers is an internationally-recognised expert in isoprenoid biology, carbohydrate metabolism, synthetic biology and metabolic engineering. Her diverse research areas are linked though understanding fundamental biology and applying that understanding to industrial bioprocesses to develop sustainable, environmentally friendly practices.

She has made seminal contributions to understanding isoprenoid biochemistry/physiology; understanding and engineering sucrose use in industrial microbes; and understanding and engineering isoprenoid pathways in microbes. She has developed many enabling tools for molecular and synthetic biology in plants and microbes. The tools are used in labs across the world.

Awards and fellowships

Dr Vickers has attracted more than $4.5 million in competitive grants and fellowship funding since 2010 as lead investigator or co-chief investigator.

They include a Queensland Government Accelerate Mid-Career Fellowship (2014-2017); Australian Institute of Policy & Science Young Tall Poppy Science Award (2014); UQ Foundation Research Excellence Award (2013); Queensland Government Smart Futures Fellowship (2010-2014); Australian Academy of Science Travel Fellowship (scientific visit to Korea 2010); and Nature Chemical Biology Grand Challenge Commentary competition winner (2010).

Publications

Dr Vickers has authored three book chapters and 40 journal articles and been invited to present at 12 national or international conferences.

Professional positions

Chair, Synthetic Biology Australasia; Editor, *Biotechnology Letters* and *Microbial Biotechnology*; Affiliated Academic, UQ School of Chemistry and Molecular Biosciences and School of Chemical Engineering; Executive Committee of the International Meeting on Biosynthesis, Functions and Synthetic Biology of Isoprenoids; ad hoc reviewer for more than 30 journals, the Australian Research Council, and seven international granting agencies; invited to present workshops for the Australian Academy of Science and the Australian Council of Learned Academies/Australian Academy of Technological Sciences and Engineering.

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Dr Chun-Xia Zhao

ARC Future Fellow

Microfluidics and bio-inspired nanotechnology for drug delivery and controlled release

Dr Chun-Xia Zhao has been active in patent application and transferring her research into practical applications as evidenced by her four patents.

Awards

Dr Zhao is an Australian Research Council (ARC) Future Fellow (2014-2018). She joined AIBN in early 2008 as a Postdoctoral Fellow after obtaining her PhD at Zhejiang University, China.

In 2011, she was awarded an ARC Discovery project as sole investigator. In 2014, she was awarded an ARC Future Fellow and appointed an Associate Group Leader.

Her research in bio-inspired nanotechnology and microfluidics has attracted more than $2 million in research funding since 2011, including four ARC projects as lead investigator, two national prestigious fellowships, and two UQ projects.

International links/collaborations

Dr Zhao was invited to visit Harvard University as a Fellow of the School of Engineering and Applied Science (October - December 2014), working with a leading pioneer in microcapillary and microfluidics, Professor David Weitz.

She has contributed high-quality scientific papers published in international top-refereed journals, including *Angewandte Chemie Int Edition*, *Chemical Communications*, *Advanced Drug Delivery Reviews*, *Journal of Materials Chemistry*, *AIChE Journal*, *Biotechnology and Bioengineering*, and *Vaccine*.

Dr Zhao has established a recognised international presence in the fields of nanomaterials, microfluidics and drug delivery. She has been invited to submit book chapters, reviews and research papers in leading journals.

She has been invited to present her work at international conferences and is an invited reviewer for more than 20 journals, including *Advanced Materials*, *Chemical Communication* and *Lab on a Chip*.

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Early-Mid Career Research

AIBN contributes to the education and training of future generations of smart scientists and research leaders.

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Early-Mid Career Research Committee

AIBN contributes to educating and training a future generation of smart scientists and research leaders.

Early-to-mid-career researchers (EMCRs) are recognised as the driving force of innovation within academic research but face significant challenges as they develop their careers, typically in the five to 10 years after completing their PhDs.

Challenges include the requirement to develop high-quality research outputs and participate in personal development activities to ensure the substantial time spent on funding applications is successful. Competition for funding nationally and internationally has become even more competitive, with only 15 percent to 20 percent of grant applications receiving funding.

To help EMCRs meet the challenges and build their careers, AIBN and UQ provide a wealth of resources and career-related planning advice. The AIBN EMCR Committee facilitates a range of networking opportunities, mentoring, leadership training and personal and professional support. It hosts inter-institute seminars, symposiums and conferences, provides professional development assistance, including help with grant writing and information on careers outside academia, and provides an EMCR website of resources.

The committee is dedicated to building AIBN's EMCR community to ensure the institute's highly skilled researchers can work together to grow to their career potential and increase their visibility.

At a glance

- EMCRs are a critical component of AIBN's innovation and research focus. Of its 450 research and support staff, 85 are EMCRs, 39 percent of whom are female.
- AIBN attracts top researchers from across the globe and offers international networking opportunities. More than a quarter of AIBN EMCRs are from China, with emerging research leaders from Argentina, Bangladesh, Brazil, Canada, Cuba, Estonia, France, Germany, Greece, India, Indonesia, Iran, Italy, Kazakhstan, Mexico, New Zealand, Pakistan, Peru, Scotland, Singapore, Spain, Sri Lanka, Switzerland and the United Kingdom.

Awards and achievements

AIBN has five ARC Future Fellows, four Discovery Early Career Research Award recipients, three Queensland Government Accelerate Fellows, one NHMRC Career Development Fellow and two NHMRC Early Career Fellows.

Recent achievements by AIBN EMCRs include:

- Dr Claudia Vickers:
  2014 Queensland Tall Poppy award

Exchange Program

- Associate Professor Idriss Blakey participated in the Australia Japan Emerging Research Leaders Exchange Program
- Dr Kristofer Thurecht participated in the 2014 Australia-China Young Scientists

> “AIBN has been a unique environment for me. It has given me first-class research training while allowing me to be exposed to commercial activities first hand.”

Tissue biomechanics drive micro-manufacturing

Dr Michael Crichton joined AIBN in 2007 as a PhD student after completing an undergraduate Masters of Aeronautical Engineering, with Honours, at the University of Glasgow, Scotland.

After working for an aircraft manufacturer for a short time, he started looking for a new direction and decided biomedical research was where he wanted to head.

Recognising a similar path AIBN Group Leader Professor Mark Kendall had taken in his research (aerospace engineering then transitioning to biomedical research), Dr Crichton joined Professor Kendall’s lab to undertake a PhD in development of the Nanopatch vaccine delivery device.

During his PhD, Dr Crichton was exposed to many facets of multidisciplinary research that allowed him to build a wide range of skill sets, including understanding immunology, nanotechnology and engineering. Commercial aspects of his work were being developed and in 2011 he received a UniQuest Trailblazer award.

He was part of a team that spun off Vaxxas Pty Ltd, a company Professor Kendall co-founded in 2011 with a $15 million investment from Australian and US investors to advance the Nanopatch towards clinical testing and product development.

After completing his PhD in 2012, Dr Crichton joined Vaxxas. He led device design, worked on international collaborations, and helped generate new intellectual property for the company.

After two years of industrial experience, Dr Crichton returned to Professor Kendall’s group to initiate his own direction of research. His work focuses on tissue biomechanics with a range of applications, including micro-devices for health and medical uses.

He chairs AIBN’s Early/Mid-Career Researcher (EMCR) Support Committee and is a member of the executive of the Australian Academy of Science EMCR Forum.

“AIBN has been a unique environment for me. It has given me first-class research training while allowing me to be exposed to commercial activities first hand,” Dr Crichton said.

“My experience in the aircraft industry made me realise I didn’t want to be a small part of a huge project. With Professor Kendall I got to be a large part of developing a new and interesting technology. The Nanopatch was a great learning experience and the time at Vaxxas gave me some great insights on product development.

“Now, with three PhD students, I aim to develop new methods for understanding tissue biomechanics by using innovative micro-manufacturing approaches, including 3D printing,” he said.

“I would like to use understanding of biomaterial tissues to drive innovative development of devices and materials, and to understand how nature transmits disease. This field is only just opening up and there are so many things we have the potential to do. Hopefully I can help realise some of these.”

Study with us

AIBN provides supervisory expertise and support for future research leaders undertaking research higher degrees across a wide range of fields.

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Research Higher Degrees at AIBN

AIBN is a world-class science research facility that is home to excellent researchers and students developing technologies to improve human health, prosperity and the environment.

AIBN has a talented and globally diverse cohort of research students enrolled in UQ's Doctor of Philosophy (PhD) and Master of Philosophy (MPhil) programs – collectively known as Research Higher Degrees (RHD). AIBN's RHD program enables students to engage with world-class researchers, facilities and support. AIBN cultivates research talent and trains professional independent researchers for the future.

AIBN provides supervisory expertise for future research leaders undertaking RHD in a range of fields, including engineering, chemistry and biology, and across four research themes of cell and tissue engineering; systems biotechnology; nanomaterials; and nanobiotechnology.

AIBN houses 400 scientists, engineers and graduate students in 26 research groups.

AIBN research support model

AIBN supports research students through a suite of policies and services specifically designed to enhance their experience and accelerate progress towards a successful thesis. AIBN selects high-calibre students who are a good fit to the research focus and culture.

All students are materially supported to the level of the Australian Postgraduate Award and provided with new IT equipment and access to domestic and international travel. Progress is monitored and performance rewarded through AIBN's incentivised milestone processes.

Good academic writing is essential to a career in research and encouraged through the Successful Science Writing program specifically developed for AIBN and now adopted more broadly in UQ's Faculty of Science. There is a vigorous focus on publication throughout candidature to promote AIBN's work and enhance students' post-doctoral employment outcomes.

AIBN students are party to patents arising from their research work. The institute vigorously pursues opportunities for commercial translation of intellectual property developed within AIBN. The Industrial Affiliates Program and industry internship opportunities contribute to post-doctoral employment prospects for AIBN's alumni.

AIBN Student Association

The AIBN Student Association (ASA) provides a valuable support network, advocacy role and social activities for students. ASA was established to promote cooperation between students and research groups and **has three main aims:**

- To promote cooperation between students and other groups within AIBN and generate an awareness of the skills and expertise that exist within AIBN.
- To provide a support network for AIBN students and young researchers.
- To hold social events for club members, such as movie nights, trivia nights, and intra-AIBN sports competitions.

ASA is very active in providing peer-to-peer mentoring, technical and professional development opportunities and inter-cultural exchanges.

RHD student profile

AIBN encourages and cultivates research by students at undergraduate, honours and postgraduate levels.

Summer and winter research internship programs provide real-world research experience and lab skills to students with an interest in research as a potential career. Those opportunities provide scope for co-authorship in research publications and continuity into Honours, Masters and PhD research projects.

- More than 50 percent of AIBN RHD students have received competitively awarded scholarships
- Emphasis on productive and timely PhD completions promoted by financial incentives, travel allowances and other material support
- AIBN has a strong commercial focus
- AIBN holds a weekly research seminar series and an annual research institute symposium
- ASA is active in providing academic and social support.

144

Research Higher Degree students 2015 cohort

62
UQ competitive scholarships

116 PhDs awarded

7 MPhils awarded

Donald Tugby Nanotechnology Prize 2014
Elizabeth Mason

91
International students from 24 countries

15
UQ Future leaders

39%
Female students

8
Dean's Award Outstanding Thesis

UQ Runner-up & People's Choice 2013
Tim Brennan

UQ Winner 2012
Amanda Pearce

UQ Finalist 2011
Sean Muir

AIBN Research Higher Degree conferrals

MPhil Awards

2008
Budi Hartono, Sandy

2010
Hu, Kaiyin
Stickler, Peter

2011
Orpe, Ajay

2013
Sebakhy, Khaled

2015
Mehlman, Michael
Yang, Yannan

PhD Awards

2008
Tanksale, Akshat

2009
Chuan, Yap
Ladewig, Katharina
Rowlands, Andrew
Varcoe, Kylie

2010
Chau, Lien
Chen, Annie
Chen, Wendy
Cheung, Kwok Wai Steny
Marcellin Saldana, Esteban
Musumeci, Anthony
Noohom, Wadcharawadee
Wong, Yunyi

2011
Arifin, Yalun
Codamo, Giuseppe
Gu, Zi (Sophia)
Hudson, James
Klaysom, Chalida
Lawrie, Kirsten
Lonsdale, Daria
Mills, Richard
Tan, Guak Kim
Titmarsh, Drew
Truong, Xuan
Wang, David
Yan, Xiao Xia

2012
Cameron, Andrew
Connors, Natalie
Crichton, Michael
Dietmair, Stefanie
Dimitrijev, Mirjana
Ding, Tao
Hou, Jia
Lee, Hui Hui
Mooney, Jane
Nabi, Geety
Popat, Amirali
Raphael, Anthony
Squires, Oliver
Wibowo, Nani
Zakaria, Hidayatul

2013
Andriani, Yosephine
Archer, Colin
Budi Hartono, Sandy
Cameron, Jessica
Chen, Xiaojing
Chuang, Ya-Mi
Fiset, Erika
Hitchens, Kelly
Jaramillo Ferrada, Pamela
Kadri, Atikah
Kulis, Jakov
Li, Peng
Liew, Mervyn
Luckman, Paul
Matindoost, Leila
Muir, Sean
Nguyen, Hoang Quan
Ooi, Huey Wen
Osman, Azlin Fazlina
Rivera Hernandez, Tania
Sabri, Suriana
Sandstrom, Anne
Truong Phuoc, Nghia
Vijayan, Dipti
Yang, Jie
Zhu, Yian

2014
Amiralian, Nasim
Anggraeni, Melisa
Brennan, Timothy
Bruschi, Michele
Buchsteiner, Maria
Cuauhtemoc, Licona
Depelsenaire, Alexandra
Dong, Hai-Yan
Fearnley, Liam
Gillard, Marianne
Hossain, Md. Daloar
Huynh, Hoai
Jambhrunkar, Siddharth
Liu, Chunli
Maisonneuve, Benoit
Martinez Salazar, Veronica
Meliga, Stefano
Osmond, Gillian
Palanisamy, Ramkumar
Qian, Kun
Santander Borrego, Miriem
Shrotri, Abhijit
Thakar, Nilay
Tran, Thi-Bich-Trinh
Wang, Kewei
Yu, Meihua
Zheng, Yao

2015
Alharbi, Samah
AlSultan, AbdulKarim
Boase, Nathan
Brunck, Marion
Chrysanthopoulos, Panagiotis
Fletcher, Nicholas
Hidalgo-Gonzalez, Alejandro
Kao, Li Pin
Lebani, Kebaneilwe
Lim, Soo
Lin, Sharon Chien-Yu
Ma, Yiming
Mateyawa, Sainimili Vaubula
Pradal, Clementine
Taylor, Karin
Tran, Nguyen
Wibowo, David
Williams, Thomas
Yang, Tianyu
Zeng, Bijun
Zhang, Jun

Graduation ceremony 10 December 2008: Dr Akshat Tanksale, AIBN's first PhD graduate, receives his testamur from UQ Chancellor Sir Llew Edwards

Decoding spinifex grass

Dr Nasim Amiralian has played a key role in an AIBN discovery team decoding spinifex grass's unique mechanical properties.

Dr Amiralian participated in a research project conducted with the Myuma Dugalunji Aboriginal Corporation, which is paving the way to create an Aboriginal-owned spinifex bio-refining industry in Australia's remote outback.

She began the spinifex conversion process as part of her PhD studies with AIBN. Her PhD project was the first exploratory materials science study of spinifex components.

The main goal was to explore spinifex's unique compounds, structures and properties that may have applications in materials science and engineering.

"My PhD project was firstly planned based on Aboriginal people's experiences of using spinifex resin as an adhesive for hafting tools and mending cracks. I needed to extract spinifex resin and improve its thermal and mechanical properties to develop its application as an adhesive or for making composite materials," Dr Amiralian said.

The work combined Aboriginal traditional knowledge with modern themes of biomimetics, nanotechnology and polymer science to explore future sustainable applications of spinifex grasses, which are an abundant and renewable bio-resource.

"Around Australia, there is the familiar desert scenery of ring-shaped spinifex hummocks covering the landmass. The grass is endemic, covering more than 27 percent of Australia, and has been used for more than 1000 years by indigenous Australians," she said.

Dr Amiralian studied optimising spinifex resin extraction and determining its efficacy as a timber coating and termite deterrent. Another part of her work focused on deconstructing the cellulosic components of the grass, and preparing high-quality cellulose nanofibre.

She discovered a unique, very high aspect ratio cellulose nanocrystal and nanofibrils, using simpler, cost effective, more environmentally friendly chemical and mechanical methods.

Dr Amiralian's work has been conducted in collaboration with a multidisciplinary team of researchers from anthropology, architecture, botany and materials science at AIBN and UQ, and with the Myuma Dugalunji Aboriginal Corporation, which operates an award-winning enterprise and training practice for indigenous communities in north-west Queensland.

Dr Amiralian said she was very proud of her PhD work at AIBN and appreciated the opportunity to work with "fascinating and supportive people" in a "culture of integrity and respect".

"AIBN and specifically my supervisor, Professor Darren Martin, played a vital role in me achieving this breakthrough. I had the opportunity to pursue an individual research project and develop my own ideas and methods for investigation, and I greatly appreciate Professor Martin's constant support and motivation."

The Iranian-born student said her research and the mentoring she received at AIBN had helped her better understand her capabilities and talents.

Dr Amiralian is now a postdoctoral appointment in the Martin Group.

In April, UQ and the Myuma Dugalunji Aboriginal Corporation, based in Camooweal, north-west Queensland, signed a landmark agreement to develop the spinifex fibres to make plastics and rubbers more durable and create a completely natural carbon fibre product.

Graduate moves to contract manufacturing

Since his PhD was awarded in July 2011, Dr Joe Codamo has worked in bioprocess engineering and project management for contract biopharmaceutical manufacturer Patheon Biologics, first in the Netherlands and now at the new facility in Brisbane.

Dr Codamo's skills and experience saw him promoted to Senior Project Manager at Patheon Biologics (formerly DSM Biologics) and he became a member of the site management team at the $65 million biologics manufacturing facility, which opened in 2013.

Dr Codamo has a long-standing working relationship with AIBN Director Professor Peter Gray. After completing a Bachelor of Science in Biotechnology with Honours at the University of NSW with Professor Gray in 2004, he moved to Brisbane in 2007 to start a PhD at AIBN, with Professor Gray and Dr Trent Munro as his supervisors.

As well as gaining access to AIBN's research capabilities, Dr Codamo credits the institute with developing his skills in manufacturing through its industrial partnerships and focus on commercial relevance.

"There were several reasons I chose AIBN. It was the first institute of its kind in Australia to have a strong focus in biotechnology and commercialisation. It suited my aspirations of eventually moving into a biotechnology-related industry position," he said.

"The greatest advantage of studying at AIBN was the access students have to an extensive range of specialised equipment and resources, and specialised training in operating state-of-the-art equipment, which is of vital importance when moving into the workforce.

"The opportunity to work and collaborate with experienced researchers from diverse backgrounds contributed significantly towards successful completion of my PhD and in my training as a research scientist.

"Experiences gained at AIBN prepared me for the roles I have had at Patheon, especially for interactions with industry and the importance of understanding the research and process development."

At Patheon's Brisbane facility, Dr Codamo's first role was designing large-scale biopharmaceutical production processes and co-ordinating process transfers from the Netherlands to Brisbane, while ensuring compliance with Good Manufacturing Practices.

As Senior Project Manager, he manages all customer programs executed at the Brisbane site.

"Patheon is the first contract manufacturing organisation of its type in Australia. The success of the Brisbane facility is critical to fostering further biotech development in Queensland and Australia. Several members of Patheon's Brisbane team previously worked or studied at AIBN, so the facility's success so far is, in part, testament to the quality of AIBN staff and graduates," he said.

Renewable energy conundrum unravelled

AIBN's world-renowned facilities and interdisciplinary expertise has helped Dr Tim Brennan unravel a renewable energy conundrum.

Dr Brennan's journey to a PhD was non-traditional. Having obtained undergraduate qualifications in chemical engineering at the University of California, Berkeley, Dr Brennan was working at the US Department of Energy's Joint BioEnergy Institute. There he successfully developed a technology to break down plant biomass into sugars for biofuel production. The technology was licensed and marketed.

Engaging with leading scientists in the industry raised Dr Brennan's awareness of challenges confronting the biofuel industry. Overcoming the toxicity of bioenergy fuel components was an important key to converting organic compounds into jet fuels.

In a chance meeting with AIBN Director Professor Peter Gray, Dr Brennan realised AIBN's industry focus would contribute to an ideal research environment. "AIBN had established an exciting, new jet fuel initiative, the Queensland Sustainable Aviation Fuel Initiative, with strong industry connections with a Californian company, Amyris Inc.

"When I was offered the opportunity to pursue my PhD in a research institute with cutting-edge facilities and expertise I couldn't wait to find out more. Against the idyllic backdrop of the Australian coastline, for an avid surfer like me, the decision was easy."

Under the guidance of Professor Lars Nielsen and Dr Jens Krömer, Dr Brennan's research project was conducted within the systems and synthetic biology group. His challenge was to engineer baker's yeast to replace ethanol as a jet fuel.

"My research achieved two objectives: firstly, offering tools to the community to engineer microbes capable of coping with high amounts of toxic hydrocarbons. Secondly, I've contributed to a fundamental understanding of solvent toxicity in yeast. Reprogramming microbes to produce therapeutics or green products will continue to develop rapidly. AIBN offers world-renowned facilities and expertise to undertake this research," he said.

Dr Brennan's work has been widely recognised. He was runner up in the Fame Lab competition and the People's Choice Award in the UQ 3-Minute Thesis competition.

Ultimately, Dr Brennan's research has helped make sustainable forms of jet fuel a more tangible solution.

Dr Brennan's legacy at AIBN extends beyond his PhD project. Faced with the challenge of meeting like-minded students across other disciplines and connecting with industry, he created a solution. "With the support of Professor Chris Greig, at the UQ Energy Initiative, we founded the UQ Student Energy Network (UQ SEN), which aims to help students develop their professional networks and skills in the energy space."

UQ SEN now has more than 300 members.

The next chapter in Dr Brennan's journey will draw on skills that have been keys to his success at AIBN, research and innovation.

Dr Brennan hopes to further develop his business acumen and work with industry to develop technologies that help the world use energy more efficiently and sustainably.

AIBN springboard for prestigious scholarship

UQ science graduate James Briggs was one of only seven Herchel Smith Fellowships awarded in 2012 to students across the entire graduate sciences intake at Harvard University, Cambridge, Massachusetts, USA.

The Herchel Smith Fellowship pays full tuition, a generous living stipend, and includes a travel allowance to support regular international conference attendances.

"Without the early exposure to research, I certainly wouldn't have developed the attributes of an independent scientific investigator necessary to gain admittance into a school such as Harvard University," Mr Briggs said.

"For this opportunity I am indebted to AIBN and, in particular, Ernst Wolvetang."

Mr Briggs secured a place in AIBN's Summer Internship Program at the end of his first undergraduate year. He spent 12 weeks working on a focused research project alongside leading stem cell researcher Professor Wolvetang.

Professor Wolvetang said: "From the beginning it was clear James had the brains and the motivation to do good research. That is the type of student I try to encourage in my lab."

That led to a casual research appointment in Professor Wolvetang's lab and a second placement in the internship program with opportunities for Mr Briggs to conduct his own research projects.

AIBN gave Mr Briggs a chance to build a network of collaborators important for his research career.

During his fellowship, James rotated through several labs at Harvard, rubbing shoulders with luminaries such as global genomics leader Assistant Professor John Rinn, Professor Sharad Ramanathan, and Professor Marc Kirschner. He is jointly supervised by Professor Kirschner and Assistant Professor Allon Klein in the Department of Systems Biology at Harvard Medical School.

James entered his third year of graduate study in mid-2015. He is now using single-cell RNA sequencing technologies and statistical models to study questions such as: what is a cell-type? How many cell-types are there? What makes them behave differently from one another? How does our genetic program generate these cell-types in a developing embryo?

"Individual cells are one of the fundamental units of biology. Although we know a lot about cell-types, there are many areas in which our understanding remains incomplete. Arriving at a better understanding of cell-types is an important prerequisite to harnessing the power of stem cells and understanding why diseases of cell-types, such as cancer, are so hard to treat," Mr Briggs said.

Mr Briggs's collaboration with Assistant Professor Rinn began when Mr Briggs was completing Honours, supervised by Professor Wolvetang and the Institute for Molecular Bioscience's Professor John Mattick and Dr Guy Barry.

Mr Briggs and Professors Wolvetang and Mattick have authored a review article for the journal *Neuron,* demonstrating the longevity of the early relationships in Mr Briggs's research.

"The standard of work expected at Harvard is very high, but that is why you sign up for such a program," Mr Briggs said.

"The resources, reputation, and cumulative intellectual mass available at Harvard have enabled me to approach some of the most fundamental and challenging problems of contemporary biology. Many of these problems have become apparent to me only because of the collaborative atmosphere at Harvard. My interests are evolving continuously.

"Researchers today have a unique chance to make lasting contributions that will better almost all aspects of life – from health to food production and clean energy. It is deeply satisfying to be a part of that."

International reputation attracts overseas students

Research fellow Dr Sophia Gu chose to study at AIBN because of its international reputation for quality research.

She graduated from Anhui Agricultural University, in China, in 2006 with a Bachelor of Science and came to AIBN in 2007 to start her doctorate.

During her PhD studies, Dr Gu created a smart, nanoparticle-based, antibody-motivated drug delivery device for preventing restenosis, a cardiovascular disease.

The work has been published in several high-impact journals, including *Chemistry of Materials, Biomaterials,* and *Advanced Healthcare Materials.*

She was awarded a Chinese National Award for Excellence in Students Abroad, a global, competitive award that commends Chinese students studying abroad who achieve excellent academic performances. Dr Gu was one of seven winners in Australia in 2008.

She was also awarded a UQ Graduate School International Travel Award, an Endeavour International Postgraduate Research Scholarship, a UQ International Living Allowance Scholarship, and an AIBN scholarship. She won best student poster at the 4th ARC Centre of Excellence for Functional Nanomaterials Annual Conference.

Since receiving her PhD in August 2011, Dr Gu has continued to work at AIBN. Her first-year postdoctoral work demonstrated that pre-coating layered double-hydroxide nanoparticles with protein was a safe, efficient, low-cost approach to stabilising nanoparticles. The work helps pave the way for the application of layered double-hydroxide nanoparticles in gene therapy.

Dr Gu is now working on a project to further advance the technology, supported by a National Health and Medical Research Council Early Career Fellowship.

"My research field fits well with AIBN's focus on producing advanced technology and science by combining biotechnology and nanomaterial science and engineering," she said.

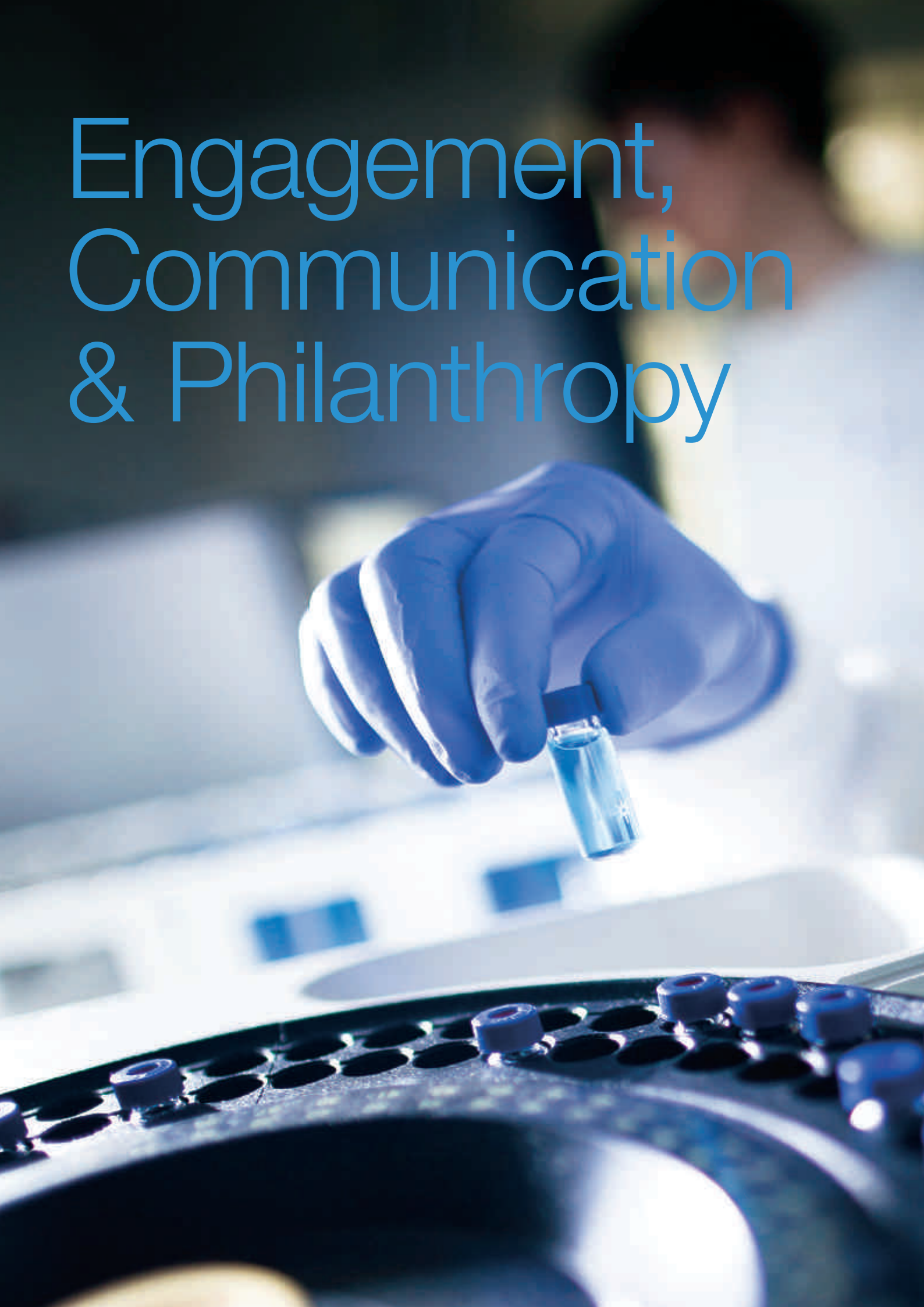
"AIBN provides an excellent environment that enables me to develop as a scientist."

Dr Gu appreciates AIBN's access to world-class equipment and opportunities for training on grant writing and presentation skills. "Senior researchers at AIBN share their success experiences to help us with career development," she said.

"AIBN emphasises researchers' career development and provides opportunities to every researcher to develop to become a leading scientist in his or her field."

Dr Gu said AIBN was a multicultural institute. "People with different nationalities, cultures, and religions get along well together and respect each other."

Engagement, Communication & Philanthropy



AIBN is committed to industry engagement and sharing its research achievements with a broad array of stakeholders. The institute initiates and coordinates a range of profile-raising events, including conferences, seminars, public lectures and activities to strengthen relationships with external agencies, research collaborators and alumni.

AIBN takes science out of the lab and shares it broadly, keeping its community informed through varied media, including print and electronic communications. AIBN encourages researchers to engage in ambassadorial, support, advisory, public advocacy and fundraising roles to help the institute achieve its goals.

The institute acknowledges the generosity of donors and benefactors. Philanthropic support is crucial in sustaining AIBN's programs and achieving research success.

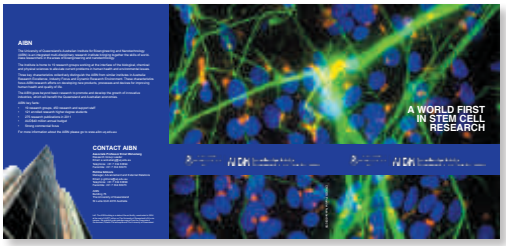
8

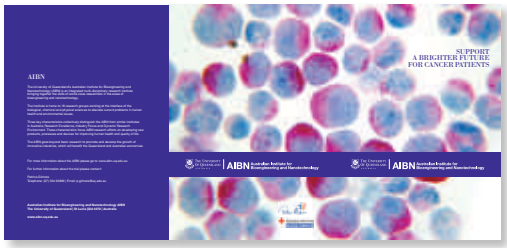
Engagement

AIBN is recognised for the calibre of a wide range of activities which build community and industry engagement.

Continuing Professional Development

Courses offered with high calibre national and international partners both in Brisbane and overseas.



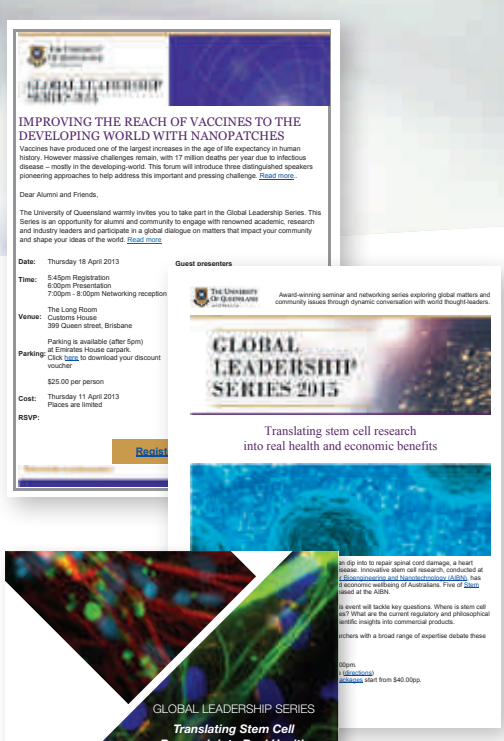


Case for Support

AIBN's vision for the future – opportunities which could be significantly progressed with philanthropic support. These projects often lie within the 'valley of death', that stage where traditional funding is difficult to come by irrespective of the promise the research holds.

AIBN Industrial Affiliates Program

Researchers seek opportunities to increase AIBN's profile and interact with industry, through the Industrial Affiliates Program. The biannual Thought Leaders' dinner series supports AIBN's commitment to industrial engagement (previous speakers are listed on page 31). The *Annual Showcase & Networking* event provides an opportunity to feature some of the institute's emerging technologies.



Global Leadership Series

Dynamic and thought-provoking programme of lectures:

18 April 2013: *Improving the reach of vaccines to the developing world with Nanopatches*

Panel: Professors Ian Frazer; Mark Kendall; Robert Booy; Dr Geoff Garrett AO

15 May 2015: *Translating Stem Cell Research to Real Health and Economic Benefits*

Panel: Dr Norman Swan, Professors Trounson, Pera, Wolvetang, Wells & Gray

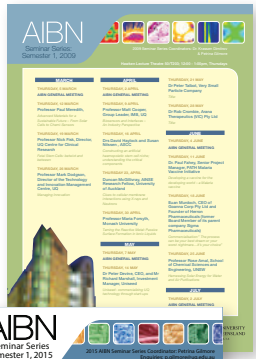
AIBN Symposia & Conferences

A range of promotional material, which includes a dedicated website and branded collateral, is produced to support and augment Institute hosted conferences. A comprehensive review of AIBN Symposia & Conferences follows on page 88.

Media Announcements

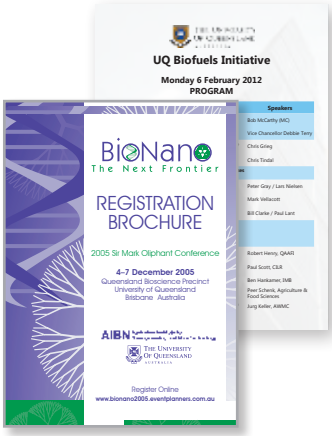
One example of a media launch at AIBN.

$1.2 million Hendra grant – announced by the then Queensland Health Minister, Lawrence Springborg, Queensland Minister for Agriculture, Fisheries and Forestry Dr John McVeigh and New South Wales Minister for Primary Industries, Katrina Hodgkinson.



AIBN Seminar Series

Outstanding researchers present their work to AIBN staff and students. The seminar series supports the building of extended networks and facilitates potential collaborations.



Industry presentations

Showcase events facilitate interaction with colleagues from the tertiary, government and industry sectors.

AIBN Symposia & Conferences

AIBN Symposia 2008 – 2011

AIBN hosted a successful series of annual symposia between 2008 and 2011. Speakers were selected through a competitive process and a poster session featured students and early career researchers' work. The institute-wide events were attended by staff and students.

AIBN Symposium 2008

Plenary speakers: Professor Barry Buckland, Vice-President, Bioprocess R&D Merck and Co, USA; Dr Susan Pond, Managing Director, Johnson & Johnson Research, Australia; Dr Mihail Roco, Senior Advisor for Nanotechnology, National Science Foundation, USA; Professor Chris Lowe, Director, Institute of Biotechnology, University of Cambridge, UK.

AIBN Symposium 2009

Plenary speakers: Professor Harold Craighead, Director, NanoBio Technology Centre, Cornell University; Dr Ian Nisbet, Managing Director & CEO, Xenome.

AIBN Symposium 2010

Plenary speakers: Professor Martin Pera, Director, Eli and Edythe Broad Center for Regenerative Medicine and Stem Cell Research, University of Southern California, USA; Professor Graham Durant, Director, Questacon.

AIBN Symposium 2011

Plenary speakers: Professor Ian Chubb AC, Chief Scientist for Australia; Professor Michael E Mackay, Materials Science & Engineering, University of Delaware, Newark.

International Conference on BioNano Innovation (ICBNI) 2012 – 2014

As the size, scale and range of AIBN research activities grew, a decision was made to expand into an international conference format. Hence, the introduction in 2012 of the 1st International Conference on BioNano Innovation (ICBNI). The intention was initially to hold the ICBNI conference every second year in Brisbane. That changed when a delegation from Chinese Academy of Sciences (CAS) offered to co-host the 2013 conference in Beijing.

Left to right: Professor Kirill Alexandrov, Professor Chris Lowe (AIBN Board member and Chair Scientific Advisory Committee), and Petrina Gilmore

2012 International Conference on BioNano Innovation (ICBNI)

As the size, scale and range of AIBN research activities grew, the symposium was expanded into an international conference. The first, ICBNI 2012, was a great success.

Plenary speakers: Professor Chunli Bai, President of the Chinese Academy of Sciences (CAS); Professor Peter Zandstra, Stem Cell Engineering, University of Toronto; Professor Kenneth Chien, Regenerative Medicine, Harvard University; Dr Ezio Rizzardo, CSIRO; Travis Earle, Nanotechnology, Lockheed Martin Corporation, USA.

Chair: Professor Matt Trau

Organising committee: Professors Kirill Alexandrov, Justin Cooper-White, Peter Gray, Mark Kendall, Anton Middelberg, Michael Monteiro, Lars Nielsen, Matt Trau, Ajayan Vinu, Andrew Whittaker, Michael Yu; Ms Alexandra Depelsenaire, Mr Chris Munro, Associate Professor Ernst Wolvetang, Ms Petrina Gilmore

Conference report: The conference attracted almost 500 participants and 70 top international and Australian invited speakers and entrepreneurs presenting the latest developments at the intersection of nanotechnology and biotechnology. The conference ran five parallel symposia – polymer nanostructures, nanomaterials, vaccines, regenerative materials, and design and synthesis of biological systems.

AIBN received strong sponsorship support from a large number of companies, including platinum sponsor DSM Biologics. The conference was a major success in showcasing AIBN's research excellence to top researchers from around the world.

Early Career Researcher Symposium: To encourage the next generation of young researchers, the conference featured a one-day BioNano ECR Symposium.

2013 International Conference on BioNano Innovation China (ICBNI China)

ICBNI China, hosted by Professor Chunli Bai, CAS President, was formally opened by Ms Frances Adamson, Australian Ambassador to the People's Republic of China. Subsequent events involved the National Center for Nanoscience and Technology; the CAS Institute; Fudan University; the Science and Technology Commission of Shanghai Municipality; the Shanghai Association for Science and Technology; and CSIRO.

Activities supported Chinese RHD student recruitment; access to Chinese funding schemes; collaborative research and industry engagement; and enabled the institute to showcase research in China, a country where AIBN's reputation is growing.

Plenary speakers: Dr Calum Drummond, Group Executive, CSIRO; Professor Lei Jiang, Institute of Chemistry, CAS.

Chair: Professor Michael Yu.

Deputy chairs: Professors Matt Trau, Lars Nielsen and Andrew Whittaker; Ms Petrina Gilmore.

2014 NanoBio Australia

NanoBio 2014 incorporated the 5th International NanoBio Conference and the 3rd International Conference on BioNano Innovation. It had more than 550 participants (including 50 international attendees) and featured a dedicated Early Career Symposium, poster sessions and an Industries of the Future Symposium. Six international plenary speakers and 80 keynote speakers headlined the NanoBio 2014 conference.

Plenary speakers: Dr Leroy Hood, Institute of Systems Biology, Seattle, USA; Professor Pamela Silver, Wyss Institute, Harvard Medical School, Harvard, USA; Professor Molly Stevens, Institute of Biomedical Engineering, Imperial College, UK; Professor Tom Healy AO, University of Melbourne; Professor Virgil Percec, University of Pennsylvania, USA; Dr Steve Turner, Pacific Biosciences, USA).

Co-chairs: Professor Matt Trau and Dr Keith McLean, CSIRO.

Organising committee: Professors Justin Cooper-White, David Haylock, Michael Monteiro, Andrew Whittaker, Michael Yu, Debra Bernhardt, Anton Middelberg, Mark Kendall, Peter Halley, Lars Nielsen and Matt Trau; Dr Jerome Werkmeister, Associate Professor Ernst Wolvetang, Dr San Thang, Dr Anita Hill, Dr Amanda Barnard, Dr Ian Nisbet, Dr Thilak Gunatillake, Dr Claudia Vickers, Dr Colin Scott, Dr Keith McLean, Ms Petrina Gilmore.

Early Career Researcher Symposium: The ECR session featured 43 ECR speakers, including 10 international speakers and 15 AIBN speakers.

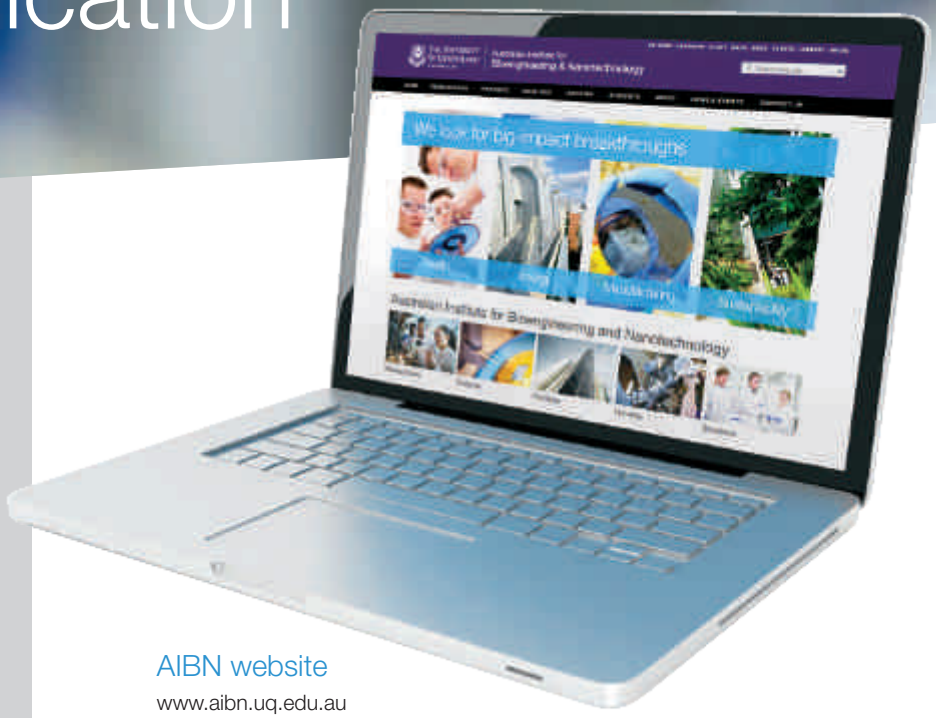
ECR committee: Simon Corrie (Chair), Paul Luckman, Michael Crichton; Axayacatl Gonzalez Garcia, Alexandra Depelsenaire, Timothy McCubbin, Ruth Neale and Paolo Falcaro (CSIRO).

Left to right: Professor Peter Gray, AIBN Director; Her Excellency Ms Frances Adamson, Australian Ambassador to the People's Republic of China; Professor Chunli Bai, President of the Chinese Academy of Sciences; Cathryn Hlavka, Minister Counsellor (Education and Research), Australian Embassy; and Mr Jinghua Cao, Deputy Director, Bureau of International Cooperation, Chinese Academy of Sciences.

Left to right: NanoBio Australia Co-chairs Professor Matt Trau and Dr Keith McLean, CSIRO

Communication

Keeping stakeholders informed and promoting researchers' achievements is vital to AIBN's ongoing successes.



AIBN website

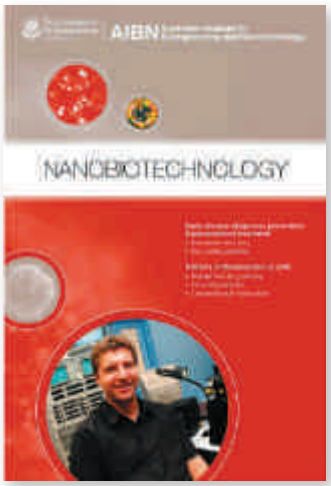
www.aibn.uq.edu.au

A redesigned website showcases AIBN research to industry partners, research collaborators, peers, the broader community and potential students.

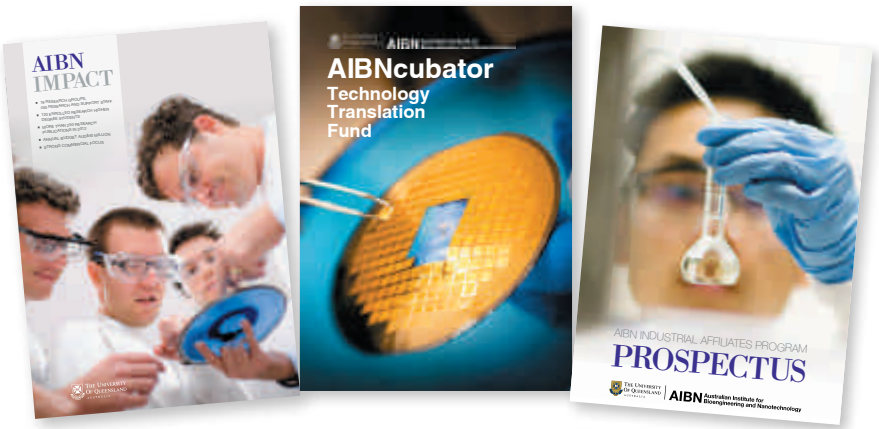
AIBN Quarterly Newsletters

www.aibn.uq.edu.au/quarterly-news

AIBN opening



AIBN Annual Reports 2005 – 2013



Promotional Material

AIBN Impact, AIBNcubator and the AIBN Industrial Affiliates Program.

Philanthropy

Big molecules fight brain cancer

AIBN researchers are working with a team of experts to develop the next generation of imaging and treatment tools to fight brain cancer.

AIBN Group Leader Professor Andrew Whittaker builds and manipulates large molecules for applications in nanotechnology and health.

The polymer chemist is collaborating with a range of scientists and clinicians on the Glioma Project, which was initiated by Stephen Rose, a clinical imaging expert with CSIRO and UQ.

Their collaboration began about five years ago when the pair was discussing the limits of existing diagnostic imaging technology. Associate Professor Rose found the technology frustratingly inadequate for diagnosing a lethal form of brain cancer, glioblastoma.

Glioblastoma is an aggressive, treatment-resistant tumour that forms in glial cells, the connective tissue of the central nervous system, which includes the spinal cord and the brain.

The survival rate is low, with glioblastoma patients living on average only one or two years. Dr Simon Puttick, a Research Fellow in molecular imaging and a new member of Professor Whittaker's AIBN group, said: "Despite the lower incidence of the disease it kills as many people in Australia as melanoma."

Worse, brain cancer kills more children and people aged under 40 in Australia than any other cancer, according to the not-for-profit Cure Brain Cancer Foundation (CBCF).

Randal Bishop knows this terrible statistic well. The deadly disease took the life of his 17-year-old daughter Shaynae in July 2009. The tragedy inspired him to launch the inaugural Bridge2Bridge (B2B) charity cycle ride, under the auspices of the Foundation. Contributions from the 2015 B2B charity cycle ride in NSW will support the Glioma Project's work.

Project partners seek to improve both diagnosis and treatment for glioblastoma. "It's a step-by-step process of identifying enabling technology and seeing if we can get the experts in those fields and engage stakeholders," Professor Whittaker said.

The team includes experts in a range of disciplines - medical research, oncology, physics and biology - from across UQ, CSIRO, Queensland Health, the Clive Berghofer Queensland Institute for Medical Research (QIMR), and Genesis Cancer Care.

With funding from the National Health and Medical Research Council and CBCF, the Glioma Project has taken several big steps, starting with the limitations of imaging technology.

Associate Professor Rose said the critical problem was magnetic resonance imaging (MRI) and positron emission tomography (PET) could not provide detailed information about the activity of the tumour, especially its boundaries, or margins, and glioblastomas may invade healthy tissue, far from the original tumour.

Without precise information, the effectiveness of surgery is reduced. It also makes it difficult to plan and monitor follow-up treatment with radiotherapy or chemotherapy. The Glioma Project team wants to change that and large biomolecules they have developed could be the key.

The idea is to create designer molecules to carry novel biomaterials, or agents, capable of increasing the sensitivity of diagnostic imaging. The molecules could also deliver therapeutic agents, able to kill tumour cells without harming healthy tissue.

To help increase the sensitivity of imaging technology, Glioma Project members at Berghofer QIMR, Professor Andrew Boyd and Doctors Bryan Day and Brett Stringer, have identified a target on the tumour's cells. It serves as a receptor for novel imaging agents created by the group. Known as EphA2, the receptor, a large molecule called a protein, sits on the surface of normal and cancer cells.

It's like a "cellular GPS", Dr Puttick said. "It helps cells know what to do and where to go." When a cell becomes cancerous it will have more EphA2 receptors than the surrounding tissue. Such "over-expression" makes EphA2 a good target for molecules bearing the new imaging agents.

Dr Puttick is creating transporters for the agents. A range of approaches has been identified and tested. The most promising is based on proteins created by Professor Boyd's team and refined by AIBN bioengineering scientist Associate Professor Stephen Mahler. The group is now working with several protein ferries.

The next step is to load the ferries with an "imaging agent sensitive enough and bright enough to mark the tumour", Professor Whittaker said.

Results are "extremely promising", especially for PET scans, which are more sensitive than MRI scans with glioblastoma. Professor Whittaker said: "Now we need something in [the ferry] to destroy the tumour cells."

That "something" is a radioactive substance designed to emit high-energy killer particles. Imaging agents can be used alongside treatment agents, enabling oncologists to ensure the radioactive substances target only diseased tissue.

The group has succeeded in creating advanced biological tools to image and treat brains affected by glioblastoma and has tested them with animals. "We're ready to go to early human trials but need funding," said Professor Whittaker, who attributes the rapid progress to the "open-minded collaboration" between the group's partners.

Studies into better diagnostic imaging for one of the most aggressive forms of brain cancer have attracted funding for AIBN researcher, Dr Simon Puttick, from the Cure Brain Cancer Foundation to lead new, innovative research for diagnosing and treating glioma.

Philanthropy

Research funding like finding a JEM

THERE'S an old saying, "The apple doesn't fall far from the tree". When it comes to John Ebsary the idiom absolutely holds true.

Invention, medical research, philanthropy, and the importance of education – when he looks back on his long and productive life, Mr Ebsary, 73, recognises that he inherited a passion for these concepts along with the family tree.

His father had an extraordinary knack for invention, intuition and practicality. His mother was a tireless advocate for learning and knowledge. These elements are clear in Mr Ebsary's work through the JEM Research Foundation, a private philanthropic organisation which provides funding to AIBN.

"I'm quite interested in stem cell research. When I found that this work was being conducted at UQ which was where my mother did a Bachelor of Arts, it seemed a natural fit," Mr Ebsary says of his decision to support AIBN work.

Initial funding went to the study of mesenchymal stem cells (MSCs), cells found in the amnion, the membrane which covers and protects the developing embryo.

Research conducted in the lab of AIBN Associate Professor Christine Wells, has discovered that the versatile MSCs can develop into bone and cartilage tissue and can travel to sites of injury. They hold great potential for 'off-the-shelf' therapy.

As well, the foundation is supporting AIBN work to develop systems for the mass production of MSCs. "I'm thinking seriously about how the world will supply enough cells to repair bodies in the clinic," Mr Ebsary says, characteristically pulling together interests developed as a youngster growing up in Roseville, New South Wales.

"My father had an interest in medicine that stemmed from his mother who had been a nursing sister and a matron," Mr Ebsary recalls. "He also established the family's philanthropic culture, volunteering time and equipment to medicos, and my mother taught English and history at a girls' school."

In fact, Queensland girl Jessie Eleanor King was one of only 168 women who graduated from UQ in 1938. "She was very interested in education and made sure her children and her children's children were just as keen on education," Mr Ebsary said.

Meanwhile, young John was following in his father Vivian's footsteps, playing around in his dad's factory from an early age. A self-taught fitter and tuner, Vivian Ebsary left school at 14, eventually moving to Sydney. There, he used his curiosity and problem-solving skills to build a successful business manufacturing pumps and assorted on-demand products.

The first medical product was a portable anaesthetic unit, built for an anaesthetist friend who'd put his shoulder out, working around the large, badly designed hospital units. Vivian was hooked.

He went on to develop numerous devices, including equipment used in early open-heart surgery in the 1950s and 1960s. He was involved in development of the first heart-lung machines in Australia, building and donating the first machine to the Royal Alexandra Hospital for Children.

Jessie Eleanor King

"Dad was awarded a Medal of the Order of Australia in 1989 for services to biomedical engineering," Mr Ebsary says. "He was uneducated but had a very astute mind."

Like father like son…almost. Mr Ebsary used his own astute mind to study mechanical and production engineering at Sydney Technical College, now part of the TAFE system. He went to work in the family business, retiring in the early 2000s.

Not happy to twiddle his thumbs, along with his wife Betty, Mr Ebsary founded the JEM Research Foundation. What did she think of the idea? "She was scared to death," he laughs. "But 'can't' wasn't a word my father used, and neither do I."

JEM RESEARCH FOUNDATION

Determined fighter spearheads A-T cure

When people talk about Krissy Roebig they use words like 'determined', 'impressive', 'relentless' and 'gung ho'.

They are not words Ms Roebig uses herself. Firstly, talking about herself is not her style. Secondly, as a widowed mother of three children, she's far too busy to ponder such things.

Most of all, there are more important matters to discuss. Two of her children—Brady, 11, and Ashleigh, 10,—have a rare childhood disease, Ataxia-Telangiectasia (A-T), which has left them in wheelchairs and threatens to shorten their lives.

But there is more. Ms Roebig is the driving force behind BrAshA-T, a charity she and her late husband Sean established. Their idea was to fund research into finding a cure for the debilitating neurological disorder, which has brought fears, tears and financial stress to the family.

Professor Ernst Wolvetang

"Our goal is to change this [experience] for other families and let them know they are not alone, and that someone is fighting for their children's future," Ms Roebig said. "All [A-T] children, including Brady and Ashleigh, need our help."

Mike Clahsen, BrAshA-T's volunteer vice-president said: "What's impressive is that all the funds go into research. Virtually nothing is spent on administration."

Ms Roebig has worked hard, raising awareness of BrAshA-T and lobbying the Queensland Government to establish the National A-T Clinic in Brisbane.

Two clinics—staffed by specialist Dr Kate Sinclair and her colleagues—are held yearly, one for Queensland families, the other for interstate families. BrAshA-T provides financial assistance to enable families to attend.

Thanks to her hard work and the support of BrAshA-T volunteers, Ms Roebig has raised and donated funds to scientists at AIBN and UQ's Centre for Clinical Research (UQCCR).

AIBN stem cell scientist Professor Ernst Wolvetang has met patients like Brady and Ashleigh and their families. "Witnessing the determination of the children to live life to the full, and the heartache borne by their parents, it is self-evident that every effort must be expended to treat this devastating disorder," he said.

A-T is a rare, inherited disease causing severe disability, including difficulty with movement and coordination, a weakened immune system, predisposition to infection, and an increased risk of cancer. It affects between one in 100,000 to 300,000 people, and is generally fatal by age 20.

Collaborating with UQCCR's Professor Martin Lavin, Professor Wolvetang has already made significant progress towards understanding and combating A-T.

They have reprogrammed—for the first time anywhere—skin cells collected from patients like Brady and Ashleigh, turning them into brain cells. Using these induced pluripotent stem cells, the UQ researchers can study the underlying mechanisms of A-T and devise and test potential treatments.

Professor Wolvetang said effective treatments were "still some years away". But he predicts researchers could be screening novel drugs within two years, with animal trials to follow.

Ms Roebig is excited. "I believe where AIBN is heading with [its] research is where we need to be. They've made good progress and the path to a cure, although I know will take time, is I believe the right one." She said her "strong, resilient" children "are what make this all worthwhile".

Tailored therapy targets leukodystrophies

Stephen Damiani has seen something most parents could not even imagine – his son's brain cells growing in a dish.

"It's the most incredible thing I've ever seen," he said when he and his wife, Sally, looked down the microscope at stem cell scientist Ernst Wolvetang's AIBN laboratory.

What they saw was tangible evidence that years of personal and scientific efforts might deliver a tailored therapy to help their seven-year-old son, Massimo, and other children with similar degenerative neurological disorders called leukodystrophies.

Leukodystrophies wreak havoc with the brain's ability to control the body. The brain incorrectly makes myelin, a fatty substance that insulates the nerve fibres that transmit signals to parts of the body.

Symptoms include decreasing ability to control motor functions, like walking and talking. Eventually, sufferers lose sight and hearing and are condemned to a short and difficult life. There is no treatment and no cure.

But that may change, courtesy of the cells growing in Professor Wolvetang's laboratory, and an extraordinary effort to tap the financial and collaborative generosity of people worldwide.

Unwilling to accept there was no hope for Massimo, and inspired by former US President John F Kennedy's pledge to go to the moon, the Damianis established the Mission Massimo Foundation. The non-profit organisation is dedicated to unravelling the genetic basis of, and finding treatments for, genetically unclassified leukodystrophies.

They ran marathons, wrote a book about the family's journey and raffled a ticket to the edge of space, all while pulling together an international team of experts.

Their perseverance paid off. Images of Massimo's brain and spine revealed leukodystrophy. Genetic sequencing focused the search. In 2013, the breakthrough was published.

Professor Wolvetang's former UQ colleague Ryan Taft, now with San Diego-based genetic technology firm Illumina, discovered the gene driving Massimo's disease, the so-called DARS gene, and its critical mutations. He had identified a previously unclassified disorder now known as hypomyelination with brain stem and spinal cord involvement and leg spasticity (HBSL).

Dr Taft and Professor Wolvetang made induced pluripotent stem cells, collected from Massimo's skin cells, to 'differentiate' into brain cells. The stem cell 'line' serves as a basis to study the disease in-vitro along with the in-vivo 'Massimouse' and 'Massifish', animal models of HBSL, now being used to test treatments. In time, stem cell therapy promises a cure.

Mr Damiani said: "I'm excited by how far we've come and how quickly we got there," thanks to the pioneering spirit of scientists and donors "willing to support a high-risk/high-reward research project".

For more information see:

www.missionmassimo.com/

Mission Massimo Foundation