



University of
South Australia

The
Wark[™]

Ian Wark Research Institute

ARC Special Research Centre for Particle and Material Interfaces

Annual Report 2011





*Cover: Laureate Professor
John Ralston AO FAA FTSE,
Foundation Director,
Ian Wark Research Institute.*

Vision

An international magnet for research, The Wark advances global knowledge and understanding in interface science and engineering, underpinning Australian industry through breakthrough science and technology transfer.

Mission

As a critical member of an elite international group of colloid and interface science research organisations, The Wark performs outstanding research and attracts sponsors, staff and students from around the globe.

Operating Principles

The activities of The Wark are underpinned by our guiding principles:

- **Strategic Direction.** Invest in areas that build on existing strengths whilst pushing the research boundaries into emerging areas. Demonstrate an unswerving commitment to fundamental research.
- **Partnership.** Undertake intensive collaboration with global industry partners to build research relevance and innovative application.
- **Continuous Improvement.** Practice continuous benchmarking with internationally renowned research organisations.
- **Building Research Capacity.** Attract world-class experienced and early career researchers, as well as PhD students. Support research and analytical skills with high level technical skills.
- **Career Development.** Provide enviable career opportunities, nurture talent, and reward behaviour that supports an open and interactive research culture.

Ian Wark Research Institute (The Wark™)

ARC Special Research Centre for Particle and Material Interfaces

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Advisory Board Report	2
Director's Report	3
The Materials and Minerals Science Learning and Research Hub	5
Governance and Management	6
Staff	8
Postgraduate Students	11
Supporters and Donors	13
Research Funding	14
International Collaboration	15
Industry and Community Engagement	18
Research Highlights	21
Research and Consultancy Projects	32
Honours and Awards	38
Graduates	41
Seminar Program	44
Visitors to the Institute	45
Conference Attendance and Invited Lectures	47
Publications	51
International Collaborators	60

Advisory Board Report



The Advisory Board commends the seventeenth Annual Report of the Ian Wark Research Institute (The Wark™) to the Council of the University of South Australia.

The Institute is working through a period of substantial change. From early 2012, it is relocating some of its research activities into exciting new facilities in the Materials and Minerals Science Building at the Mawson Lakes campus. The foundation Director, Laureate Prof John Ralston is retired and is replaced by Prof Magnus Nydén. Some senior staff positions are yet to be filled. There will be changes to the Advisory Board, not least the appointment of current Board member, Dr Rob La Nauze, to be Chairman; and changes to the Research and Technology Advisory Committee, though retaining continuity with Prof Brian Vincent for another review.

The decrease in industry funding persists, though there remains an expectation that the trend can be reversed, not least by enlarging involvement with a wider range of industries.

It is gratifying to see The Wark Fund and the Norton Jackson Medal Fund gaining support, and we urge all our stakeholders to participate.

Our warmest congratulations go to the recipient of the Ian Wark Research Institute Medal for 2011, Dr Gujie Qian. Presenting these medals was one of the many pleasures of Chairing the Advisory Board over such a long period.

This is my final report, and it is time to express my deepest appreciation to the members of the Advisory Board, the Research and Technology Advisory Committee, the Director, Laureate Prof John Ralston and his staff, for a truly rewarding experience.

Max Richards AM FTSE

Chairman

July 2012

Director's Report



As I pen my final report as Director of The Wark, it is with a great deal of pride and affection that I reflect on the establishment of the Institute in 1994 and the giant strides that it has made since that time.

Specializing in the science and technology of particle and material interfaces, The Wark was the Australian Research Council Special Research Centre in this field from 2000 to 2008. In collaboration with the Universities of Melbourne, Newcastle and Queensland, it developed and led the Australian Mineral Science Research Institute (AMSRI) from 2006 to 2010.

Performing a blend of fundamental and applied research, The Wark attracts support from international and national industry, Australian Government sources and international funding agencies. Staff and graduate students are drawn from the national and international spheres, with 39 different nationalities represented in its 2011 complement of 142 personnel. Our expertise in physical chemistry, with relative citation rates that are consistently double the world average, places The Wark in the top echelon internationally. This expertise in physical chemistry informs outstanding research in minerals processing science and technology, as well as bio and polymer interfaces, with direct technology transfer to industry.

Commencing in 1994 with one new building, we are now distributed across four modern, connected buildings, the latest of which, known as "M²" and described elsewhere in this report, is quite magnificent. Our equipment and facilities are of the best international standard, permitting staff and students to engage in research of the highest quality. Proud of our "research without borders" ethos, The Wark staff and students investigate complex problems of international significance, drawing on the resources of our wide network of international collaborators, as appropriate.

Present research highlights include taking fundamental research on novel automotive mirrors to actual products in the marketplace; assessing the feasibility of different flowsheets for the processing of copper ores using the Mini Flotation Pilot Plant; the development of prenatal diagnosis techniques; the sorting and separation of nanoparticles at the oil-water interface, along with the publication of key papers on, for example, cell factories in *Nanoletters*, anti-ageing creams in *Soft Matter* and smart proteins in *Angewandte Chemie*.

In recognition of its international reputation, The Wark staff are regularly invited to deliver keynote and plenary lectures at major international conferences. Many of our fine PhD students also participate and, not uncommonly, win best student lecture or poster awards. The different fellowships held by staff, through industry funding, the ARC Future Fellow and DECRA schemes as well as the NHMRC and other agencies, attest to the quality of our staff at different levels, as do the various medals and other awards.



The Wark Advisory Board.

It is a sign of a mature Institute that the efforts and rewards are spread widely across the staff and student body. The strong employment record of the over 165 PhD students that The Wark has graduated, coupled to the high quality of their positions within and outside Australia, is immensely gratifying.

Apart from strong leadership at senior levels within The Wark, there are several distinguished bodies that contribute to its continuing success. The first is The Wark Advisory Board, led by its outstanding Chair, Dr Max Richards whilst the second is the Research and Technology Advisory Committee, with Prof Brian Vincent as its Chair. These two groups, coupled to the outstanding support from the most senior levels within UniSA, provide sound advice which is always listened to and, in many instances acted upon, by The Wark Directorate.

At the beginning of April 2012, I hand over the reins of The Wark to an outstanding scientist and educator, Prof Magnus Nydén. I wish him well in steering the good ship Wark in the future and thank The Wark staff and students, along with my splendid UniSA colleagues, for their support over the many years that I have been privileged to work at this wonderful research institute and university. From the bottom of my heart, may I wish you the best of all possible future journeys.

John Ralston AO FAA FTSE

*Former Director and Emeritus Laureate Professor
July 2012*



The Materials and Minerals Science Learning and Research Hub



Photos courtesy of Mr Wayne Grivell, Swanbury Penglase Architects.

The University of South Australia has created the Materials and Minerals Science Learning and Research Hub at the Mawson Lakes campus. Bringing together UniSA's flagship Ian Wark Research Institute (The Wark™) and the Mawson Institute, the hub is intended to be a nexus for innovative learning, teaching and high quality research as well as engaging industry and the broader community in its activities.

At the heart of the hub is the M² Building, an AU\$50 million, purpose-built facility designed to meet the expansion needs of both The Wark and the Mawson Institute, as well as integrated undergraduate teaching and industry interaction.

Spread over three levels, the building houses cutting-edge laboratories encompassing a broad range of disciplines, along with support spaces, offices and common areas. Nestled amongst these are facilities for teaching, undergraduate students and industry representatives.

December 12, 2011 saw the project, which commenced in late 2008, achieve practical completion. Occupation will commence early in 2012.

What started as an ambitious idea, articulated as a two-dimension vision, has resolved into its built form to reveal interesting and eye-catching spaces. All of the elements are present to ensure its success as a home for the hub.

The M² Studio is unparalleled as a flexible, student controlled workspace that is as innovative as it is visually appealing. The theatre is a dramatic and challenging space – and it's already featuring prominently as a marketing tool as well as a place to learn.

The technology transfer node provides an engaging environment for industry representatives, allowing close access to researchers and students, while maintaining a secure environment to ensure privacy and confidentiality can be achieved where necessary.

The laboratory complex has exceeded expectations, providing cutting-edge facilities for researchers and students alike, while maintaining a transparent presence to allow the community a glimpse into the workings of world-leading research teams.

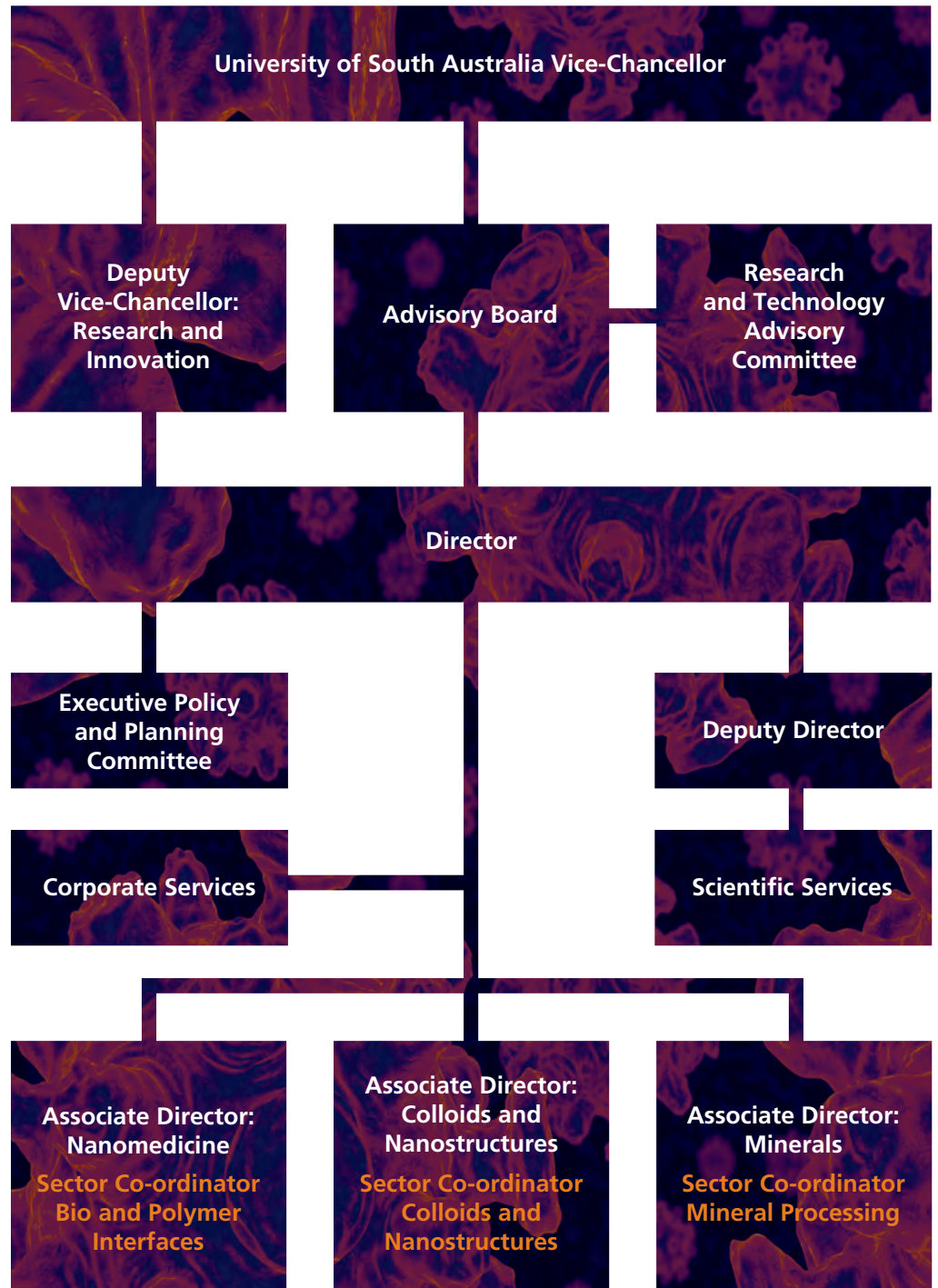
Remarkably, for a project of this complexity and constrained by fast-track delivery requirements, it was also delivered on-time and on-budget. It's even more remarkable when consideration is given to the builders being able to make up for a number of significant delays caused by weather, vandalism and fabrication issues.

The quality of the finished building is also noteworthy, with the builders faithfully delivering the intricate detail and nuance envisaged in the design. The atrium and theatre ceilings, in particular, reflect a level of craftsmanship rarely found in a building of this type.

2012 will see M² come alive as staff and students occupy the spaces, beginning with the offices and workstations. The laboratories will come on line more gradually. The challenge now is for the reality of day-to-day operation to measure up to the ambitions set out in the original brief.

2012 will be an exciting year.

Governance and Management



Advisory Board

The Advisory Board convened on two occasions during 2011. Members were:

Dr Max Richards (Chair)	Chair, School of Botany Foundation, University of Melbourne
Dr Matthew Cuthbertson (Deputy Chair)	Chief Executive Officer, CRC for Advanced Automotive Technology Ltd
Dr Bart Follink	Chief Operating Officer, Global Research Alliance
Dr Paul Heithersay	Executive Director, Department of Primary Industries and Resources of South Australia
Dr Robert La Nauze	Director, Technical Strategy Advisors Ltd
Prof Caroline McMillen	Deputy Vice Chancellor and Vice President: Research and Innovation, University of South Australia
Ms Ann Nelson	Deputy CEO/Director, Bioscience Infrastructure, BioInnovation SA
Prof Andrew Parfitt	Acting Deputy Vice Chancellor and Vice President: Research and Innovation, University of South Australia
Mr Joe Pease	Chief Executive, Xstrata Technology
Dr Neville Plint	Director, Research and Development, Anglo Platinum Ltd
Laureate Prof John Ralston	Director, Ian Wark Research Institute, University of South Australia
Dr Leanna Read	Managing Director and CEO, TGR BioSciences Pty Ltd
Dr Ana-Paula Serond	Director of Innovation, AREVA
Dr Andrew Shook	General Manager, Uranium Customer Sector Group, BHP Billiton
Mr Antony Simpson	Past Chair, Mason & Cox Pty Ltd
Dr Natalia Streltsova	Director Technology - Department of Mineral Projects Development, Vale
Dr David Wyatt	Vice President and Head, Respiratory New Product Introduction Centre of Excellence, GlaxoSmithKline PLC
Ms Madelene Pierce (Executive Officer)	Ian Wark Research Institute, University of South Australia

Research and Technology Advisory Committee

The Research and Technology Advisory Committee, which convenes biennially, visited The Wark from 11-15 April 2011. The visit included several days of intensive discussions with staff and postgraduate students, followed by a presentation and written report to the Advisory Board. Members were:

Prof Brian Vincent (Chair)	Leverhulme Professor of Physical Chemistry, University of Bristol (retired), United Kingdom
Dr Terry Blake	Surface Science Kodak (retired), United Kingdom
Dr Matthew Cuthbertson	Chief Executive Officer, CRC for Advanced Automotive Technology Ltd, Australia
Prof Cyril O'Connor	Director, Centre for Minerals Research, University of Cape Town, South Africa
Prof Marcus Textor	Laboratory for Surface Science and Technology, ETH Zurich, Switzerland
Ms Madelene Pierce (Executive Officer)	Ian Wark Research Institute, University of South Australia

Executive Policy and Planning Committee

The Executive Policy and Planning Committee met on a monthly basis:

Laureate Prof John Ralston (Chair)	Director
Prof Jonas Addai-Mensah	Associate Director: Minerals
Prof Hans Griesser	Deputy Director
Mr Craig Hackney	Facilities and Information Systems Manager
Mr Paul Luppino	Professional Staff Representative
Mr Philip Moore	Manager: Scientific Services
Prof Thomas Nann	Associate Director: Colloids and Nanostructures
Ms Muireann O'Loughlin	Postgraduate Student Representative
Prof Clive Prestidge	Associate Director: Nanomedicine
Dr Craig Priest	Academic Staff Representative
Ms Sandra Ray	Operations Manager
Prof Namita Roy Choudhury	Dean: Research Education
Prof Bill Skinner	Academic Staff Representative
Dr Terry Wilks	Institute Manager
Ms Julie Freytag (Executive Officer)	

Staff

Director

Laureate Prof John Ralston, AO FAA FTSE FRACI
BSc(Hons) MSc DipEd PhD *Melbourne DIC
London, UK* Dr.h.c *Abo Akademi, Finland*

Deputy Director

Prof Hans Griesser, DipChem SciTeachingCert
PhD *ETH Zurich, Switzerland*

Associate Directors

Prof Jonas Addai-Mensah, BEng(Hons) *UST,
Ghana* MSc *TIIT, Israel* PhD *Queensland*
Prof Thomas Nann, MSc PhD *Freiburg, Germany*
Prof Clive Prestidge, BSc(Hons) *Loughborough,
UK* PhD *Bristol, UK*

Institute Manager

Terry Wilks, BSc(Hons) MSc PhD *Newcastle, UK*

Research Professors

Namita Roy Choudhury, BSc(Hons) BTech
MTech(Hons) *Calcutta, India* PhD *IIT,
Kharagpur, India*
William Skinner, BSc *Melbourne* BAppSc PhD
RMIT
Dayang Wang, BEng PhD *Jilin University, PR
China*

Associate Research Professors

David Beattie, BSc(Hons) PhD *Edinburgh, UK*
Naba Dutta, BSc(Hons) BTech *Calcutta, India*
PhD *Kharagpur, India*
Daniel Fornasiero, Maitre es Science *Grenoble,
France* PhD *Adelaide*
Sunil Kumar, BSc(Hons) MSc(Hons) *GNDU, India*
PhD *IIT, Delhi, India*
Dusan Losic, BSc *Novi Sad, Serbia* PhD *Flinders*

Senior Research Fellows

Jason Connor, BAppSc(Hons) *Central
Queensland* PhD *UniSA*
Sarah Harmer, BAppSc(Hons) PhD *UniSA*
Satomi Onishi, BSc *Tokyo University of Science,
Japan* MSc *Ibaraki, Japan* PhD *Saitama, Japan*
Mihail Popescu, MSc *University of Bucharest,
Romania* PhD *Emory University, USA*

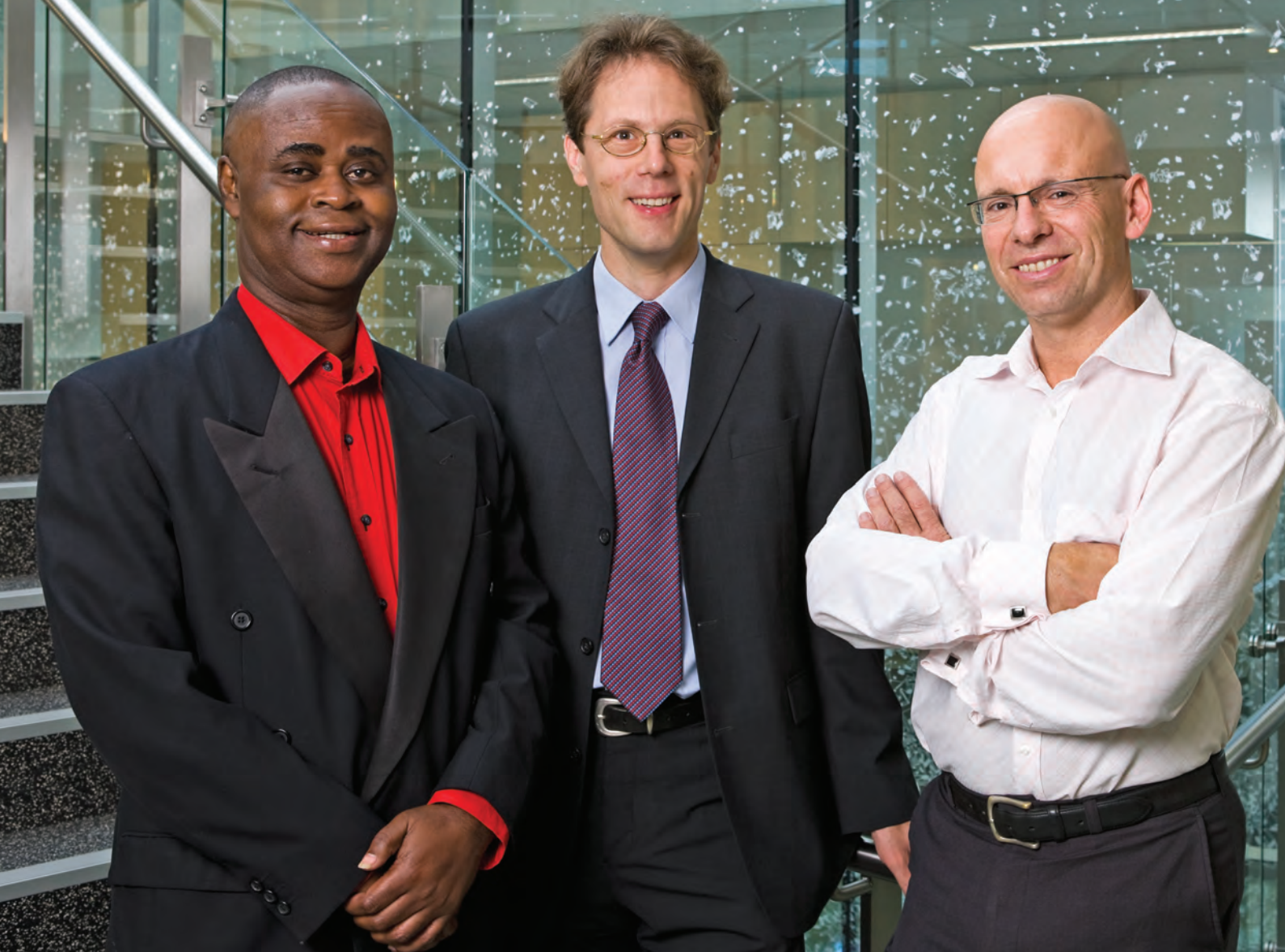
Rossen Sedev, MSc *University of Sofia, Bulgaria*
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BEng *Adelaide*
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Yugoslavia* PhD *UniSA*

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Left to right: Prof Jonas Addai-Mensah, Associate Director: Minerals, Prof Thomas Nann, Associate Director: Physical Chemistry of Colloids and Nanostructures, and Prof Clive Prestidge, Associate Director: Nanomedicine.

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 Daniel Weissmann, ScTechCert SAIT

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 Philippines
 Darren Faulkner, Fitting & Machining App, Adv
 Cert Engineering TAFE
 Simon Field, Cert III Mech Eng TAFE Adv Dip
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 Stefani Griesser, BA(Hons) University of
 Iowa, USA GradDipEd Monash BMedSci &
 AppBiotech CSU
 Craig Hackney, ScTechCert SAIT BBus UniSA
 Marek Jasieniak, BSc(Hons) Cracow, Poland
 Tom Macdonald, BSc(Hons) Flinders

Czeslaw Poprawski, DipMechEng TUW, Poland
ScTechCert SAIT
Phil Souter, Post-trade Certificate TAFE

Administration

Liz Blackmore, DipBusMgmt Business SA
Barbara Chamberlain, AdvDipAcc TAFE
GradCertAcc New England
Teresa Duncan, Cert III Business (Admin) TAFE
Julie Freytag
Tracy Greeneklee, Cert IV Business (Admin) TAFE
Cert IV (Info Tech) TAFE DipBusAdmin TAFE
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Madelene Pierce, BA(Hons) Flinders
Kathryn Prohaska
Sandra Ray, GradDipMgmt MBA UniSA
Baden Smith, AssDipAdvGraphicDes TAFE
Maureen Terry
Paul Wotley, BSc(Hons) Adelaide

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Prof Laurindo de Salles Leal Filho, Mining and
Petroleum Engineering, University of Sao
Paulo, Brazil
Dr Bart Follink, Global Research Alliance,
Victoria, Australia
Prof Roger Horn, Institute of Research Training,
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Prof Takehiko Kitamori, Department of Applied
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Prof Ron Martin, Department of Chemistry,
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Prof Wayne Nesbitt, Department of Earth
Sciences, University of Western Ontario,
Canada

Prof Jordan Petrov, Institute of Biophysics,
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Prof Allan Pring, South Australian Museum,
South Australia

Prof Jarl Rosenholm, Physical Chemistry, Abo
Akademi, Turku, Finland

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A/Prof Bernhard Klein, Norman B Keevil Institute
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Prof Nataliya Mishchuk, Institute of Colloid
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Academia Sinica, Taiwan
Mr George Levay, Levay & Co Environmental
Services, South Australia
Dr Hamid-Reza Manouchehri, Sandvik Mining,
Sweden
Dr Ray Shaw (retired), Rio Tinto Group, Victoria,
Australia
Dr Robert Sumner, BHP Billiton, South Australia

Adjunct Research Fellows

Dr Renate Fetzter, Karlsruhe Institute of
Technology, Germany
Dr Gunhild von Oertzen, Rössing Uranium
Limited, Rio Tinto, Namibia

Postgraduate Students

Degrees Awarded

Daniel Chipfunhu, PhD in Engineering
Lorena Del Castillo, PhD in Applied Science
Jairo Garnica Rodriguez, PhD in Applied Science
Mayur Mistry, PhD in Applied Science
Ataollah Nosrati, PhD in Engineering
Anuttam Patra, PhD in Applied Science
Gujie Qian, PhD in Engineering
Mohanraj Vellore Janarthanan, PhD in Applied Science
Danfeng Xu, PhD in Applied Science
Kai Ying Yeap, PhD in Applied Science
Hardi Ys, PhD in Applied Science

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Joseph Chan, BSc(Hons) *Flinders*
Aidan Cousins, BSc BEd(Hons) *UniSA*
Terry Dermis, BSc(Hons) *UniSA*
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Wendy Harrington-Esposito, BSc(Hons) *UniSA*
Tracey Ho, BSc(Hons) *Flinders*
Lachlan Hyde, BSc(Hons) *Flinders*
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Yogesh Kalegowda, BSc MSc *Kuvempu University, India*
Jessica Kinal, BEng(Hons) *Curtin*
Mohammad Kor, BEng MMinEng *Shahrood University of Technology, Iran*
Jim Lem, BEng MPhil *PNG University of Technology, Papua New Guinea*
Hua Li, BPhil/BA MPhil *Tianjin University, PR China*
Tianqing Liu, BSc *Wuhan University, PR China* MPharmSc *Tasmania*
Jessica Lu (nee Cook), BSc(Hons) *UniSA*
Jennifer Maccarthy, BSc *University of Mines and Technology, Ghana*
Regis Mejjard, MEng *Ecole Centrale de Lille, France* MSc *Universite des Sciences et Technologies de Lille, France*
Thomas Michl, BChem MSc *ETH Zurich, Switzerland*
Muireann O'Loughlin, BSc(Hons) *National University of Ireland, Galway*
Clement Owusu, BSc(Hons) *University of Mines and Technology, Ghana*
Jin Sung Park, BEng *Yeungnam University, Korea* MEng *Anjou University Korea*
Andrea Paul, BGeol Dipl-Geol *University of Cologne, Germany*
Lee San Puah, BEng(Hons) *University of Science, Malaysia*
Ishmael Quaiocoe, BSc(Hons) *University of Mines and Technology, Ghana*
Melanie Ramiasa, Dip Ing (BChemEng MChemEng) *Ecole Nationale Supérieure de Chimie de Rennes, France*
Melissa Santoso, BChemEng *Curtin, Sarawak Campus, Malaysia*



- Yunyu Shi, BChemEng *East China University of Science and Technology, PR China*
 MChemEng *Adelaide*
- Maria Sinche Gonzalez, BEng *San Agustin National University, Peru* MMinRes *Madrid Polytechnic University, Spain*
- Ge Su, BSc MSc *Fudan University, PR China*
- Bogale Tadesse, BEd *Bahir Dar University, Ethiopia* MSc *Addis Ababa University, Ethiopia*
- Sandra Thompson, BAppSc(Hons) *UniSA*
- Duy Tran, BEng(Hons) *Nong Lam University, Vietnam*
- My Yung Truong, BEng *Adelaide*
- Valentin Vancea, DipEng *Transilvania University of Brasov, Romania*
- Zhantao Wang, BEng MEng *Northwest A&F University, PR China*
- Die Yang, BEng *Anhui University, PR China* MSc *University of Science & Technology, PR China*
- Yi Yang, BBioEng MBioEng *Central South University, PR China*
- Yujie Yang, BPharm *Hebei Medical University PR China* BSc(Hons) *UniSA*
- Yang Yu, BSc *Nankai University, PR China* MSc *Tianjin University, PR China*
- Thilagavathi Yuvaraj, BEng *Anna University, India* MBioTech *Flinders*

Dr Luke Parkinson, recipient of the 2010 Ian Wark Research Institute Medal. The Medal was presented to Luke on 15 April 2011 by Dr Max Richards, Chairman, Advisory Board. Photo courtesy of Dr Rossen Sedev.



Dr Norton Jackson AM and Dr Karyn Jarvis, the inaugural winner of The Norton Jackson Material Science and Engineering Medal. The medal was presented at the UniSA Scholarships and Grants Ceremony on 8 June 2011.

Supporters and Donors

The Wark receives generous donations from individuals and organisations through The Wark Fund and the Norton Jackson Medal Fund. We thank all donors for their continuing interest and practical support by investing in our future.

The Wark Fund

Established in 2008, this fund helps to underpin the activities of The Wark. Donated funds may be used to support postgraduate scholarships, postdoctoral fellowships, the acquisition of major equipment, academic research or other special projects.

We acknowledge the following individuals who have made donations to The Wark Fund up to 31 December 2011:

- Dr Matthew Cuthbertson
- Dr Saeed Farrokhpay
- Prof Stephen Grano
- Dr Christopher Greet
- Laureate Prof John Ralston AO
- Dr Leanna Read
- Dr Max Richards AM
- Mr Antony Simpson.

Thank you also to those who wish to remain anonymous. For further information on The Wark Fund, please visit www.unisa.edu.au/giving/fundingpriorities/Wark.asp

The Norton Jackson Medal Fund

Established in 2010, The Norton Jackson Material Science and Engineering Medal is a fitting tribute to a man who has made a distinguished contribution to the knowledge and understanding of the mining industry. This medal recognises the achievements of graduates of The Wark and is awarded annually to the PhD graduate or graduand who has demonstrated the most potential or real application of research in industry.

We acknowledge the following individuals who have made donations to The Norton Jackson Medal Fund up to 31 December 2011:

- Prof Robin Batterham AO
- Mr Derek Carter
- Dr Ian Chessell & Mrs Diana Chessell
- Prof Douglas Coster
- Dr Ian J Duncan
- Dr John Floyd
- Dr Ian Gould AM
- Dr Norton Jackson AM
- Dr David Klingberg AO
- Mr David Lindh OAM
- Ms Yvonne Martin-Clark
- Mr John B Roberts
- Mr Antony Simpson & Mrs Mary Lou Simpson
- Dr John Zillman AO.

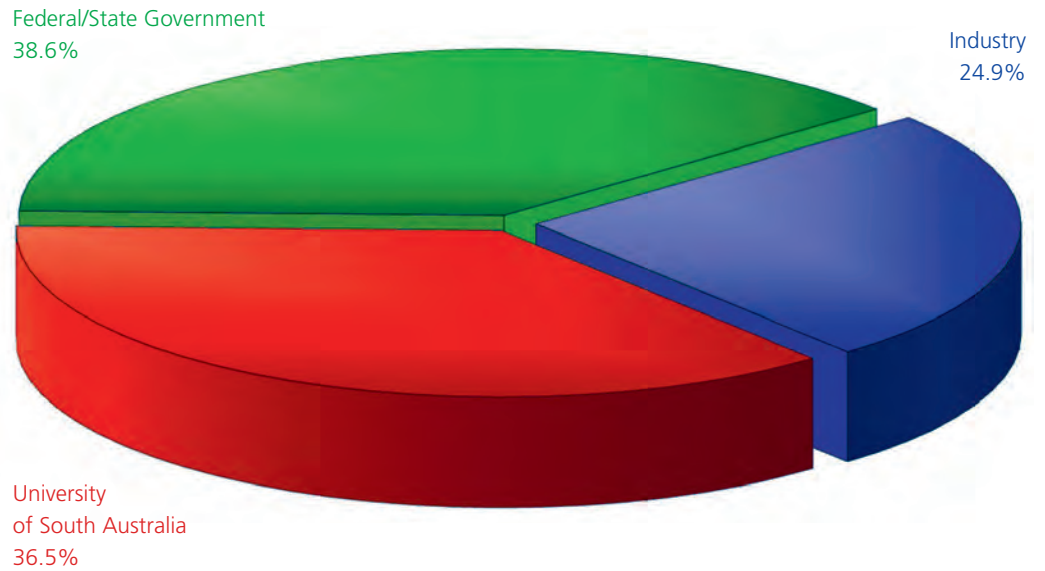
The following organisations have also made generous donations:

- Australia New Zealand Resources Corporation Pty Ltd
- Centrex Metals Limited
- Energy Exploration Limited
- Lincoln Minerals Limited
- R & M Champion de Crespigny Foundation.

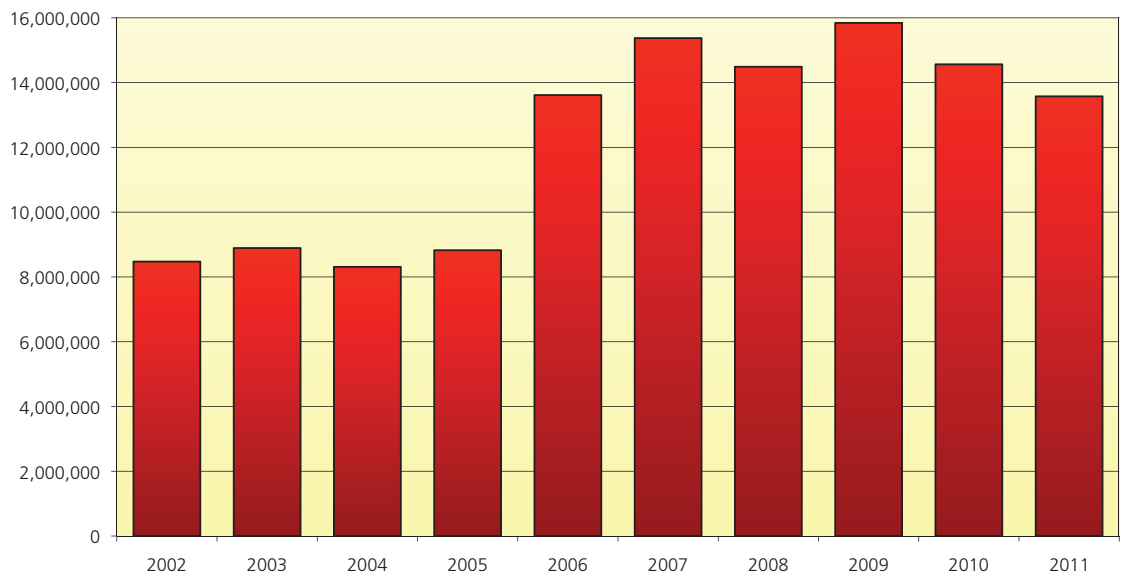
Thank you also to those who wish to remain anonymous. For further information on the Norton Jackson Medal Fund, please visit www.unisa.edu.au/giving/fundingpriorities/nortonjackson.asp

Research Funding

Funding Division - 2011



Operating Revenue for the Period 2002 - 2011



International Collaboration



Staff from the Graduate School of Engineering, University of Tokyo and The Wark, University of South Australia, December 2011.

Photo courtesy of Dr Marta Krasowska.

The Wark has formal partnerships and agreements with institutions in 11 countries to promote international cooperation in research and research education. During 2011, our collaborative activities focused on the following highly prestigious institutions.

Graduate School of Engineering, University of Tokyo, Japan

Collaborative activities in the area of physical chemistry and interfacial physics. Prof Takehiko Kitamori is an Adjunct Research Professor at The Wark, and Laureate Prof John Ralston is a Fellow of the Graduate School of Engineering at the University of Tokyo.

The Wark and the Graduate School of Engineering at the University of Tokyo have a long-standing collaboration on the fundamental physical chemistry and interfacial physics of liquids in micro- and nano-fluidic devices. The successful operation of micro- and nano-fluidic devices relies heavily on interfacial phenomena that can be manipulated by chemical and physical modification of channel walls. This collaboration brings The Wark's expertise in interfacial science together with the University of Tokyo's outstanding track record in micro- and nano-fluidics research to create new knowledge in this multidisciplinary area.

This collaboration was strengthened in 2011 by a number of joint publications and short-term visits:

- A joint refereed journal article 'Microfluidic extraction of copper from particle-laden solutions', *International Journal of Mineral Processing*, 98, 168-173 (2011).
- A joint refereed conference paper 'Process intensification of solvent extraction using microfluidics', *Proceedings of the 19th International Solvent Extraction Conference*, 3-7 October 2011, Santiago, Chile.
- Dr Benjamin Thierry and Ms Daisy Yang were invited to attend the University of Tokyo Summer Camp from 17-19 September. There were a total of 43 attendees at the Summer Camp which focused on 'Micro/nano chemistry and its application to single molecule/cell analysis'.

The 4th Joint Workshop on 'Micro and Nanoscale Wetting and Surface Modification Phenomena' was held at the University of Tokyo from 15-16 December. There were four speakers from the University of Tokyo (Prof Takehiko Kitamori, Dr Kazuma Mawatari, Dr Yutaka Kazoe and Dr Chenxi Wang), as well as Prof Kazue Kurihara from Tohoku University and Prof Shinji Hasebe from Kyoto University. The Wark was represented by Laureate Prof John Ralston, Prof Jonas Addai-Mensah, Dr Marta Krasowska, Dr Mihail Popescu, Dr Craig Priest and Dr Rossen Sedev. The seminars were followed by detailed discussions on scientific developments and future collaboration between the University of Tokyo and The Wark.

The joint research project titled 'Energy dissipation and nanoscale processes at moving contact lines' continued in 2011. The Chief Investigators are Laureate Prof John Ralston, Dr Rossen Sedev and Dr Mihail Popescu, with Prof Siegfried Dietrich (MPI-IS) and Prof Takehiko Kitamori (University of Tokyo) as Partner Investigators. The project is funded as a Discovery Grant through the Australian Research Council (a total of AU\$590,000 over three years).

**Max Planck Institute for Intelligent Systems
(formerly Metals Research), Stuttgart,
Germany**

Collaborative activities in the areas of physical and interfacial chemistry, in particular wetting phenomena, chemically active solid-liquid interfaces, and colloid transport.

The Wark's collaboration with the Max Planck Institute for Intelligent Systems (MPI-IS) continued and expanded during 2011. From The Wark, it involved Laureate Prof John Ralston, Prof Thomas Nann, Dr Marta Krasowska and Dr Mihail Popescu.

As indicated above, Prof Siegfried Dietrich from the MPI-IS is a formal Partner Investigator on the Australian Research Council Discovery Project 'Energy dissipation at a moving contact line', which is led by Laureate Prof John Ralston.

Dr Marta Krasowska visited the group of Prof Siegfried Dietrich at the MPI-IS for one week in August 2011 and presented a seminar.

Significant research activities in the collaboration with the MPI-IS revolve around the area of chemically active colloids, involving Dr Mihail Popescu (The Wark) and Prof Siegfried Dietrich and Dr Mykola Tasinkevych (the MPI-IS), as well as Dr Gleb Oshanin (CNRS, Paris, France), Dr Samuel Sanchez (Leibniz Institute Dresden, Germany), and Dr Larisa Baraban (Technical University Dresden, Germany). Dr Popescu visited the MPI-IS on three occasions during 2011 – an average of one week on each occasion – to facilitate the preparation of research papers and grant proposals. These visits were partially supported by the MPI-IS, as well as by The Wark

The 2011 outcomes included:

- Two joint papers: (i) 'Transport of cargo by catalytic Janus micromotors', *Soft Matter*, 8, 48 (2011) and (ii) 'Pulling and pushing a cargo with a catalytically active carrier', *EPL*, 95, 28004 (2011).

- A conference presentation: 'Catalytically active colloids as particle carriers' at the Microparticles in Stokes Flows Symposium, 21-24 August, Warsaw, Poland.
- Two workshop proposals were submitted:
 - (i) Proposal to the Visitor Program, Max-Planck Institute for Complex Systems, 'Wetting and Capillarity in Complex Systems' [Chairs: S Dietrich (MPI-IS), M Tasinkevych (MPI-IS), MN Popescu (UniSA) and G Oshanin (CNRS Paris, France)], ca 30,000 Euros (cash and in-kind) awarded for international workshop to be held in Dresden, Germany, 13-18 February, 2013.
 - (ii) Proposal to the Visitor Program, Kavli Institute for Theoretical Physics, 'Self-Propelled Micro-Objects', organized by S Dietrich (MPI-IS), M Tasinkevych (MPI-IS), MN Popescu (UniSA) and G Oshanin (CNRS Paris, France), budget under negotiation for a 3-weeks workshop at the Kavli Institute for Theoretical Physics, University of California at Santa Barbara, USA, 10-31 March, 2014.

The following collaborative grant proposals were developed (for submission in 2012):

- Discovery Project 'Forceful or persuasive: Separating fine particles in microchannels' [Prof T Nann (UniSA), Dr M Krasowska (UniSA), Dr MN Popescu (UniSA) and Dr M Rauscher (MPI-IS)] to the Australian Research Council [ca \$500,000 funding request for 2013-2015].
- Grant proposal 'Chemically active micro-objects in spatially confined environments' [M Tasinkevych (MPI-IS), S Sanchez (IFW Dresden) and MN Popescu (UniSA)] for submission to the DFG (Germany) [ca \$350,000 funding request for 2012-2014].

Materials Research Centre, Swiss Federal Institute of Technology, ETH Zurich, Switzerland

Collaborative activities in the area of biomaterials.

Collaborative research on novel antibacterial coatings for biomedical materials and implants continued in 2011, funded via the Swiss CCMX Scheme. Research groups at The Wark, ETH Zurich, University of Basel, EPF Lausanne, and three companies work in an interdisciplinary manner on well-integrated topics. A key aspect is the utilisation of novel antibacterial compounds extracted from Australian plants as coatings to prevent biofilm formation on synthetic biomaterials surfaces. Several coatings have been developed, and researchers at the University of Basel have made progress in understanding the biomolecular pathways of action of these compounds inside bacteria and their effects on bacterial membrane integrity. Prof Hans Griesser is The Wark's contact person; he is closely involved in the project management and participates in progress review meetings.

Prof Marcus Textor from the Laboratory for Surface Science and Technology, ETH is a significant contributor to The Wark through membership of our Research and Technology Advisory Committee who met from 11-15 April 2011. He has visited The Wark on several occasions and spent time with PhD students and early career researchers to provide valuable feedback on their research.

A Sinergia project titled 'Designing interactions across interfaces in ionic liquids' was submitted to the Swiss National Science Foundation in January 2011. This is a collaborative research project led by Prof M Borkovec (University of Geneva), Prof P Dyson (EPFL), Prof N Spencer (ETH) and Laureate Prof John Ralston (The Wark).

Indian Institute of Science, Bangalore, India

Collaborative activities in the area of physical chemistry, surface engineering, nanotribology.

The Wark and the Indian Institute of Science (IISc) in Bangalore together hold an international collaborative grant 'Fluid Flow and Lubrication at the Nanometre Scale' under the Australia-India Strategic Research Fund. This bilateral fund is co-sponsored by the Australian Government through the Department of Innovation, Industry, Science and Research and the Indian Government through its Department of Science and Technology.

One of the activities sponsored under this grant is a series of workshops held jointly between the two institutions, allowing the researchers with an interest in the project to meet and discuss research directions and results.

During 2011, the 4th Indo-Australian Workshop was held in Adelaide from 28-29 July. The Wark delegation consisted of Laureate Prof John Ralston, Prof Thomas Nann, Prof Dayang Wang, A/Prof Naba Dutta, Dr Satomi Onishi, Dr Craig Priest, Dr Rossen Sedev and Dr Catherine Whitby. The Wark presentations involved a wide range of topics including Dynamic Bubble-Mica Interactions in Electrolyte Solutions and Microfluidic Solvent Extraction. From the IISc, speakers included Prof Sanjay Biswas, Prof K Ganapathy Ayappa and A/Prof Raghuraman N Govardhan. They covered topics ranging from Colloidal Forces in Emulsions as Markers for Tribology to Structure and Dynamics of Confined Water, and Flow over Hydrophobic Surfaces in Micro-Channels. The workshop was well-attended and generated significant discussion on future collaboration. The current grant will end on 30 June, 2012.

Industry and Community Engagement



A group of The Wark's Alumni, accompanied by Laureate Prof John Ralston and Mr Antony Simpson.

Industry engagement is driven by the extensive research programs, both active and developing, conducted across a broad range of industries in Australia and globally. This is a particular strength of The Wark, through an ability to apply fundamental research outcomes to real technical challenges in the field. Our major industry partners are listed elsewhere in this Annual Report.

Staff and students at The Wark continue to maintain a broad range of community interactions across a spectrum of activities spanning school visits and presentations, tours of our facilities, industry and community engagement, through to Alumni reunions. This is in addition to the steady flow of national and international visitors who spend varying periods of time at The Wark each year, giving presentations and conducting collaborative research and workshops.

The Wark's Advisory Board has strong representation from industry, academia and government entities. Of special note is the

industry representation, which included Dr Leanna Read, Managing Director and CEO, TGR BioSciences Pty Ltd, in which The Wark / University of South Australia has a shareholder interest. Other industry representatives include Mr Joe Pease, Chief Executive, Xstrata Technology; Dr Neville Plint, Director, Research & Development, Anglo Platinum Ltd; Dr David Wyatt, Vice President & Head, Respiratory New Product Introduction Centre of Excellence, GlaxoSmithKline PLC; Dr Ana-Paula Serond, Director of Innovation, AREVA; and Dr Natalia Streltsova, Director Technology, Department of Mineral Projects Development, Vale. This ensures that the nexus between research, industry and the development of PhD students is as seamless as possible. Similarly, The Wark's links to the State Government of South Australia are strengthened through board members such as Dr Paul Heithersay, Executive Director, Department of Primary Industries and Resources of South Australia and Ms Ann Nelson, Deputy CEO/Director, Bioscience Infrastructure, BioInnovation SA.

Back to The Wark Alumni Reunion Weekend

The Wark's Alumni returned for the inaugural 'Back to The Wark Alumni Reunion Weekend' from 21-23 January 2011. The Alumni were treated to a range of activities that started with a day in The Wark. The day began with a formal welcome and overview of our activities from Laureate Prof John Ralston, followed by a tour of The Wark's facilities that included a closer look at some of the recent additions to our AU\$45million equipment suite and a visit to the microfluidics nanofabrication facility. The afternoon included an engaging technical program where some of The Wark's research leaders – Laureate Prof John Ralston, Prof Hans Griesser, Prof Jonas Addai-Mensah, Prof Dayang Wang, Prof Thomas Nann and Dr Benjamin Thierry - outlined their current work on topics such as process intensification, novel antibacterial coatings, nickel laterite agglomeration, cell membrane capsules, novel ways to capture energy and targeted drug delivery. The day concluded with a cocktail reception at The Samstag Museum of Art.

For the next event, our Alumni were guests at an exclusive Vice Chancellor's lunch at Penny's Hill Winery, where they were able to watch the Tour Down Under competitors as they cycled around beautiful McLaren Vale. The weekend concluded the following day with a relaxing brunch at The Sebel Playford.

The breadth of experiences that our graduates have accumulated is quite staggering. Unsurprisingly, many of them remain active researchers, applying their knowledge in an extension of their doctoral studies or applying their skills to the management of research. A number of graduates still remain at The Wark, becoming valuable members of our research team, while others have gone on to run their own consultancy firms or become application specialists for scientific instrument manufacturers.

Festival of Innovation

The University of South Australia ran the Festival of Innovation on Sunday, 25 September 2011. The event enjoyed a fabulous sunny day, and attracted a good crowd. The Wark tours, run throughout the day, attracted over 40 visitors and the feedback indicated they were very engaged and interested in what they saw. The Wark and the Mawson Institute also had a joint display booth throughout the day.

School Visits

The Wark regularly hosts visits by teachers and high school students from across Adelaide. One example was our participation in a UniSA 'Experience Day' for 23 year 10/11 students who visited on Friday, 4 November. They were from Adelaide High School, Endeavour College, Eynesbury Senior College, Gleeson College, Henley High School, Marden Senior College, Marryatville High School, Norwood Morialta High School, Our Lady of Sacred Heart, Prince Alfred College, St Francis de Sales College, Trinity College and the Xavier College Gawler. The visit was hosted by Prof Clive Prestidge. The students toured the facilities and gained an insight into the broad ranging research activities of the institute and its collaborating partners.

Professional Institutions

Many staff are actively engaged in their respective professional institutions, most prominently the Royal Australian Chemical Institute (RACI), the Australasian Institute of Mining and Metallurgy (AusIMM), Materials Australia (Institute of Materials Engineering Australia), and the Institute of Engineers Australia (IEAust).

Media Coverage

The Wark's staff, students and research projects/ outcomes received considerable media coverage during 2011, including:

- *Flea extract being used to fight the signs of ageing*, The Advertiser, 23 May 2011
- *Climate change: UniSA wins grant for hydrogen research*, ABC News, 26 May 2011
- *AMMRF flagship instrument aids mineral recovery*, AMMRF News Bulletin, May 2011
- *Aboriginal medicinal plant protects implants: Emu-bush prevents germs from the settlement*, 3sat/nano, 30 June 2011
- *Keeping an eye on young scientists*, The Advertiser, 4 August 2011
- *Mineral Analysis in the 21st Century*, SA Mines & Energy Journal, Issue 18, Aug - Sept 2011
- *South Australian Early Career Researcher - SA Tall Poppy of the Year*, Science Excellence Awards SA, 4 November 2011
- *The Wark Leveraging Xradia's Non-Destructive Imaging Solutions*, StockMarketsReview.com, 28 November 2011
- *Recent Research Developments in Minerals Processing at the University of South Australia*, SA & NT Mining and Petroleum Bi-Annual 2011



The Hon Jay Weatherill MP and ANFF-SA Node Director, Laureate Prof John Ralston at the official launch of the ANFF-SA on 16 May 2011.

Research Highlights



Cusped tooth with cavities. Sample provided by Dr Sarbin Ranjitkar, School of Dentistry, University of Adelaide, South Australia.

New Facilities

Multi-Purpose Facility for Enhanced Complex Ore Beneficiation and Waste Material Recycling

Addai-Mensah, J, Skinner, WM, Zanin, M, Ngothai, YM and Grano, SR (University of Adelaide) (ARC LIEF Grant)

The Wark was awarded an ARC Linkage Infrastructure Equipment and Facilities (LIEF) grant for the realisation of an integrated, multi-purpose mineral separation facility which exploits the differences in physical-chemical characteristics (eg density, magnetic, dielectric, triboelectric properties, etc) and behaviour of solid materials to facilitate their separation and upgrade.

This facility is aimed at increasing our ability to judiciously separate, and hence upgrade multi-component, low grade and industrial mineral ores and also treat waste materials which are abundant in Australia. Sustainable development and economic competitiveness of the Australian mining/minerals sector requires frugal use of resources via targeted application of cost-effective technologies for value adding. Novel processes and flowsheets for upgrading multi-phase minerals and waste materials value-adding will be developed within the facility, which will commence in 2012. Advancement of minerals/materials separation science and technology, improved productivity, ecological footprint minimization and frugal use of resources are the major expected benefits.

ANFF-SA Highlights

The Xradia Micro and Nano X-ray Computer Tomography systems are now fully installed and operational. The Xradia Nano/MicroXCT suite is the flagship piece of equipment for the SA Node of the Australian National Fabrication Facility under this funding initiative, the procurement schedule of which was brought forward via the close relationship established with Xradia.

An example of the work being conducted is shown for a cusped tooth from mummified remains. The MicroXCT analysis (20µm resolution) revealed internal cracks in the severe internal cavities which would otherwise require destructive analysis to detect.

ANFF-SA was officially launched on 16 May 2011 by The Hon Jay Weatherill MP, at the time Minister for Education, Early Childhood Development, and Science and Information Economy. During the launch, which was attended by over 100 delegates, the Minister announced that the State Government was fully committed to technology within South Australia, and were demonstrating this by committing \$3.8 million to boost South Australia's science and research capabilities to benefit the State's mineral processing, manufacturing, pharmaceutical, optical and energy industries.

Part of this funding will allow the ANFF-SA to continue to develop its capabilities and to attract and retain key staff. With comments such as "Superior research infrastructure is essential for world-class research, and the ANFF in South Australia will assist in attracting future research funding as well as the recruitment of the best scientists and postgraduates" and "South Australia's commitment to attracting and retaining the world's best researchers to deliver cutting-edge results to benefit the State and nation's economic growth and prosperity", Mr Weatherill's talk was well received.

The launch of the ANFF-SA node featured a tour of the new facilities including the recently purchased Xradia X-ray computer nanotomography systems. Special guests included The Hon Jay Weatherill MP; the Chief Executive Officer of the ANFF, Rosie Hicks; the Chief Scientist of SA, Prof Don Bursill; and UniSA's Deputy Vice Chancellor, Research and Innovation, Prof Caroline McMillen.

New Projects and Funding

Assessing the Feasibility of Developing New Copper Deposits

Moore, P, Newell, R, Quast, K and Zanin, M

In the 21st century, the average grade of copper ores is below 0.6% copper and exists mainly as sulphides or oxide minerals within the ore body. The commercial viability of developing a new ore deposit is based not only on being able to extract copper at the maximum recovery and grade, but also to extract and separate valuable trace minerals from the copper concentrate, such as silver, gold, molybdenum, cobalt and uranium. When establishing the business case prior to significant capital investment in new greenfields projects, it is essential to demonstrate that the target grade can be achieved and these valuable trace minerals can be successfully extracted and purified, as very often it will make the difference between a go or no-go decision.

The Wark was commissioned to work on a supergene-enriched and partially oxidized porphyry copper deposit of Upper Paleocene age. Oxide and supergene sulphide mineralisation (atacamite and chalcocite) was amenable to heap leaching. However, the remainder of the ore body was refractory to treatment with sulphuric acid leaching on all practicable time scales. Froth flotation was therefore employed to physically separate ore from gangue. Samples obtained from exploration drilling campaigns were limited, making conventional pilot scale flotation plant operation on multiple flowsheet configurations impractical.

The Wark operates a sophisticated Mini Pilot Flotation Plant which is unique in Australia due to its extremely small scale that affords the plant a degree of control and flexibility in continuous operation that is impossible to achieve with conventional pilot flotation plants. The chemical

and physical conditions in flotation that affect optimal mineral separations on a continuous basis were monitored and closely controlled. The Wark used this facility to test and evaluate a number of different flowsheet options on a range of ore types and composites expected to be encountered during the operational lifetime of the mine. Using samples of approximately 200 kg per test option at a feed rate of only 5 kg/hour, the plant was operated in continuous mode with roughing, regrinding, cleaning and column flotation. Each flowsheet configuration tested on a conventional pilot scale plant consumes 10 to 20 times the amount of sample required for Mini Pilot Plant operation. Fast analysis of samples was included in the test program through X-ray Fluorescence which provided essential operating data within 2 hours and Atomic Absorption Spectroscopy. QEMSCAN™ analysis was used to determine the nature of valuable mineral losses and impurities.

An optimised flowsheet configuration for producing the copper concentrate and valuable trace minerals was recommended based on test data obtained. Financial modelling of mine economics was possible which provided a sound basis upon which to make strategic business decisions. This assessment was possible at the pre-feasibility stage of the mine site development, minimising the risk of expensive errors and wasted energy.

Shape Sorting of Nanoparticles at Oil/Water Interfaces in Microchannels

Zhou, J (ARC DECRA Grant)

With the advance of nanoscience and nanotechnology, a host of methods have been recently developed to synthesise various nanomaterials. The resulting nanoparticles, however, usually need to be fractionated to further narrow their size and shape distribution, which is essential to understanding their size and shape dependent physicochemical



Mr Keith Quast with The Wark's Mini Pilot Flotation Plant.

properties. Despite the fact that there are numerous methods available for size sorting of nanoparticles, few methods allow direct sorting of nanoparticles by shape. This project aims to investigate the shape dependent interaction and adsorption of nanoparticles at oil/water interfaces and reveal the interfacial adsorption kinetics and mechanism of nanoparticles. By taking the advantage of microfluidics, an efficient and continuous protocol for nanoparticle shape sorting on chip will be developed. This study also helps to understand the assembly of nanoparticles at interfaces, formation of Pickering emulsion and oil recovery.

Engineered Nanoassemblies for Energy Conversion

Dutta, NK, Holdcroft, S (Simon Fraser University, Canada) and Hill, A (CSIRO Materials Science and Engineering) (ARC Discovery Grant)

There is a serious concern that continuation of current trends of burning increasing quantities of fossil fuel to satisfy energy needs will put the world on track for a rise in temperature of up to 6°C and the CO₂ concentration will exceed the range from 570 to 970 parts per million during the 21st century. Despite the fact that solar radiation is ideal to meet the projected future demand, the energy produced from solar remains less than 0.05% of the total extractable

energy due to high costs of classical inorganic solar cells based on single-crystal silicon. This project aims to address the need for improved photon harvesting interfaces for dramatic enhancement of energy conversion in organic photovoltaic cells (OPVs).

OPVs consists of p-type and n-type organic semiconductors forming a planar heterojunction and the main development challenge is to achieve a sufficiently high stability in combination with efficiency. This research will advance the comprehensive understanding, which is crucial for designing unique ordered nanostructure for efficient solar energy conversion in bulk heterojunction photovoltaic cells. The ability to produce such ordered interfaces represents a great impact on the development of light-weight, flexible, large area inexpensive solar cells. This internationally collaborative program will make significant breakthroughs in frontier science and train young researchers in a challenging interdisciplinary research area. This research will contribute towards the development of clean energy technology that can compete with the traditional energy sources without subsidies, and facilitate long-term solution to the energy crisis and global warming. It will also bring significant benefit to Australian industries and assist achievement of renewable energy targets.



PhD student, Mr Regis Mejjard and Ms Lorena Diéguez.

Capturing Foetal Cells from Maternal Blood Using Microfluidics

Diéguez, L and Thierry, B (Channel 7 Children's Research Foundation)

Current strategies to isolate foetal genetic material for prenatal diagnosis, such as amniocentesis and Chorionic Villus Sampling, rely on removal of foetal material from around the developing foetus and are thereby invasive. Once obtained, the material is analysed for cytogenetic, molecular and biochemical abnormalities.

The project aims to design a rapid, robust and inexpensive point of care approach to efficiently isolate foetal cells circulating in maternal blood. Our ultimate aim is to develop a new technology that will enable clinicians to achieve non-invasive prenatal diagnosis and provide fast and reliable information about possible genetic conditions of the foetus.

The number of foetal cells in the maternal blood range is, however, extremely small – typically only a few foetal cells per ml, or as

little as 1 in a billion maternal cells. Current methodologies that isolate specific cells from blood rely on fluorescence activated cell sorting capture, density gradient centrifugation and magnetic activated cell sorting. Although these techniques are well established, the rarity of foetal cells in maternal blood makes their isolation a great challenge. Current techniques lack sensitivity or specificity to be of clinical utility, mainly due to the absence of a ubiquitous marker associated with cells of foetal origin in the maternal blood.

Taking advantage of the state-of-the-art microfabrication facilities available through the newly established South Australian node of the Australian National Fabrication Facility, the proposed platform is designed to enable successive positive/negative enrichment steps towards achieving exquisite specificity in the isolation of the target foetal cells from blood. An innovative combination of physical and immunological criteria will be used to isolate target cells.

Research Outcomes

Reflecting on Automotive Innovation

An AutoCRC research project between UniSA and SMR Automotive has recently completed the translation from innovative science to real world product with the installation and commissioning of a multi-million dollar thin film coating facility in Adelaide. The project brings together researchers from The Wark and the Mawson Institute.

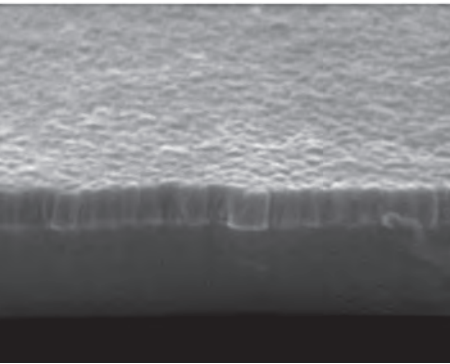
Producing plastic automotive mirrors, this facility was recently opened by Senator Kim Carr. The production facility will begin to produce initial product for export in early 2012. The light-weight plastic mirror offers many consumer and environmental benefits, including:

- reduction in weight of the mirror reflector by 50%,
- reduction in overall mass of the mirror assembly by 15% (this includes the mirror reflector, the mirror housing and actuator),
- a reduction in greenhouse gas emissions due to the reduced mirror mass of up to 400,000 tonnes of CO₂ over 5 years, and
- enhanced safety in a crash situation as plastic (polycarbonate) does not shatter like glass.

The plastic mirror is unique in that its realisation occurred using a combination of collaborative design, innovative processing, novel materials science and surface engineering. Working with the thin film coatings group at UniSA, a multi-layer thin film coating system has been designed and developed to withstand harsh environmental conditions, ranging from -40°C to +80°C and UV exposure, whilst remaining firmly bonded to the polycarbonate substrate and providing abrasion resistance equivalent to that of glass.

The integrated plastic mirror is produced using an expansion-compression moulding procedure. This process produces optical quality substrates with inherently low stress levels – an essential requirement for the stability of the optical design of the mirror. The expansion-compression moulded plastic mirror has clips on the rear surface to allow direct attachment of the mirror actuator, resulting in a reduction in the number of mirror components and significantly simplifying the assembly process relative to traditional float glass mirror product.

The integrated plastic mirror not only replaces glass but also designs out the need for a backing plate and anti-shatter tape (as is currently used worldwide on external automotive mirrors) as well as their subsequent assembly steps. This creates a plastic component that not only reduces the weight of a vehicle, but also enables the functionality of the deleted components at reduced cost. Furthermore, a significant reduction in mirror head mass will improve vibration performance and enable further weight reduction through a decrease in the amount of structural materials within the base and case frames of the exterior mirror. The impact of this product creates substantial environmental benefits as the introduction of this technology will reduce the weight of an exterior mirror by over 15%, and if applied to SMR's current and future market share, will save up to 400,000 tonnes of carbon dioxide emissions over five years (per 100,000 vehicles). Due to this positive environmental impact, SMR was awarded Green Car Innovation Funding in 2010 to co-fund the commercialisation of this technology.

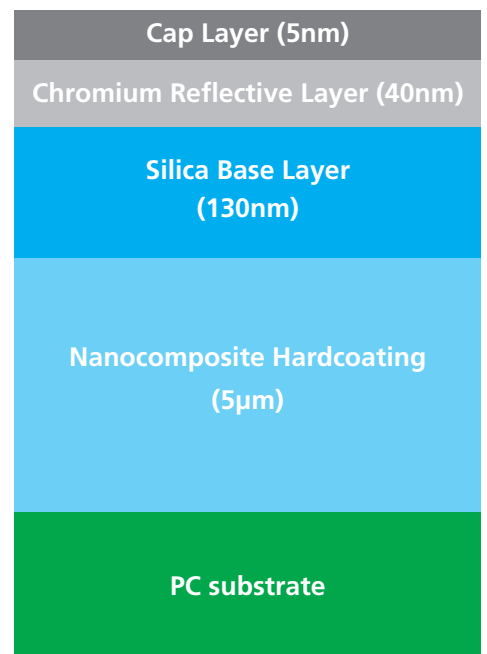


Schematic diagram of coating design
SEM image of top layers of vacuum
coating.

A plastic reflector creates further value direct to the end user in that it is safer than glass in a crash situation as it does not shatter, preventing previously reported eye injuries caused by glass from the broken rear view mirror entering the car through an open window. Furthermore, additional value is created in that the reflector is now plastic and able to be moulded into more complex 3D shapes or more comprehensively incorporated into the mirror casing structure, creating extraordinary opportunity for stylists to change the design paradigm of the exterior mirror. All of this has been made possible by enabling plastic to perform at or above the levels of glass through the application of the nano-engineered thin film coating system to the front surface of the mirror. This multi-layer coating system imparts environmental stability, abrasion resistance and product longevity, and yet it has a total thickness of less than 5 microns, or around 1/10th the thickness of a human hair.

This project has delivered many unique and wide ranging benefits for Australian research and industry. It has forged a highly effective collaboration between UniSA and SMR Automotive (through the AutoCRC), that has seen fundamental science translated into commercial ready product. This has been achieved using an interdisciplinary project team comprised of materials scientists, physicists, process engineers and mechanical engineers. Through the course of the project, staff exchanges have occurred in both directions enabling UniSA researchers to gain insight into the demands of the manufacturing environment, and SMR staff to acquire new skills in materials science and thin film coating so as to be better able to support their new state-of-the-art manufacturing facility. The project team has worked seamlessly to deliver technically complex and challenging milestones

ahead of schedule, recently culminating in the installation, commissioning and launch of the new facility for manufacturing plastic mirrors at SMR's Adelaide plant. The venture by SMR into the new technology domain of thin film coating is a positive from many aspects. This includes the opportunity for an Australian based, tier 1 automotive component supplier to diversify their expertise and further expand their manufacturing capabilities into new industry sectors such as defence, aerospace and biomedical. Over the next 18-24 months, this will create several new jobs within SMR, and lead to further up-skilling of the workforce.



Multi-layered thin film coating system, incorporating a silicon-based hard-coat and a three-layer vacuum sputtered, thin film coating system. The Scanning Electron Microscope (SEM) image left shows the cross sectional structure of the chromium reflective layer and chromium alloy capping layer. The cap layer is essential for high levels of abrasion resistance and environmental stability (moisture barrier). The columnar structure of the cap layer is clearly visible.



The recently opened SMR Automotive production facility in Adelaide, South Australia.

Novel Biomimetic Nanosprings: Protein-Based Elastomer for Engineering Application

Dutta, NK, Roy Choudhury, N, Elvin, C (CSIRO Livestock Industries) and Hill, A (CSIRO Materials Science and Engineering) (ARC Discovery Grant)

This collaborative research project focused on the design and development of novel advanced responsive materials that mimic unique and advantageous characteristics of native resilin. Resilin is a member of the family of elastic proteins that include elastin, gluten, gliadin, abductin and spider silks and occurs as a highly elastic extracellular skeletal component in arthropods (Fig 1a) and is recognized as the most efficient elastic material known (only ~3% of stored energy is lost as heat).

In this collaborative research work a genetic engineering approach was adopted to biomaterials design. It demonstrated the unique multistimuli responsive characteristics of a carefully engineered protein-polymer *rec1-resilin* that originates from a consensus sequence found in native resilin. This highly elastic protein-polymer reveals responsiveness to multiple environmental stimuli, including displaying both a lower and a tuneable upper critical solution temperature (LCST and UCST) (Fig 1b).

This was the first time that both UCST and LCST transitions were demonstrated experimentally for a single polymer. Moreover, this biomimetic protein also shows photo-responsive behaviour (Fig 1d) and exhibits tuneable photophysical properties.

This research was published in the world's leading chemistry journal *Angewandte Chemie. Int. Ed.* and was selected by the editors as a 'hot paper' for its 'importance in a rapidly evolving field of high current interest'. The reviewer of the manuscript comments "*This work will pave the way for the design of novel biologically inspired materials that display this type of advanced responsive behavior ... The work herein reported is highly novel and sheds light into important questions related to the environmental sensitivity of resilin and other repetitive protein-polymers.*"

We have further established that the *rec1-resilin's* molecular conformation, structure and resulting morphology during assembly on solid surface (Fig 1c) can be controlled by tuning the physical conditions at the solid surface, moreover conformational fluctuation and viscoelastic properties of the immobilized protein-polymer are switchable simply by changing the solution environment. It has been confirmed that the change from compact to brush-like conformation of *rec1-resilin* is fast, robust and completely reversible. This understanding of the environment-induced conformational change, responsiveness and packing arrangement of *rec1-resilin* at the liquid-solid interface has many potential applications in biotechnology, medicine, sensors, controlled drug delivery systems and engineering. Using the optimal crosslinking methodology, we have developed *rec1-resilin* hydrogels that exhibit native resilin-like elastic behaviour with an almost perfect resilience value of ~94% - the highest known among synthetic materials.

Recently, we have employed directed self-assembly of *rec1-resilin* to create a pre-organized template to synthesize nano-object and metal nanoparticles of controlled composition, size, morphology and characteristics. We have also developed optically coupled hybrids with unique architectures based on the biomimetic fluorescent protein *rec1-resilin* and nanometer-scale gold nanoparticles (AuNPs) in a one-step method using a non-covalent mode of binding protocol. We have had further success in advancing a methodology to use the *rec1-resilin* molecule as a template for creation of novel platinum group nanoparticle (<5nm) electrocatalysts that exhibit outstanding catalytic activity, efficiency, reactant accessibility, CO tolerance and stability.

This knowledge base was the core of a new research program entitled *Shape Controlled Nanostructured Electrocatalyst for Clean Energy* that has been further supported by the Australian Research Council. The body of work performed under this project has advanced transformational knowledge in molecular design principles for advanced responsive biomimetic materials. It has also seen development of novel resilin-mimetic protein-polymers for a diverse range of potential applications both in the industrial field as well as health and medicine.

This research has demonstrated that careful design can yield novel biologically inspired materials and offer a powerful strategy to design and rapidly develop unique biomaterials.

Selected Publications

'A genetically engineered protein responsive to multiple stimuli', *Angewandte Chemie*, 50, (19), 4428-4431, 2011.

'Self-organization, interfacial interaction and photophysical properties of gold nanoparticle complexes derived from resilin-mimetic fluorescent protein *rec1-resilin*', *Biomaterials*, 32, (11), 2786-2796, 2011.

'The effect of hydration on molecular chain mobility and the viscoelastic behavior of resilin-mimetic protein-based hydrogels', *Biomaterials*, 32, (33), 8462-8473, 2011.

'A pH-responsive interface derived from resilin-mimetic protein *Rec1-Resilin*', *Biomaterials*, 31, (15), 4434-4446, 2010.

'Thermal Analysis of Biological Molecules and Biomedical Polymers', *Thermal Analysis of Rubbers and Rubbery Materials*, iSmithers, UK, 463-521, (PP De, N Roy Choudhury & N Dutta Eds), 2010.

Figure 1

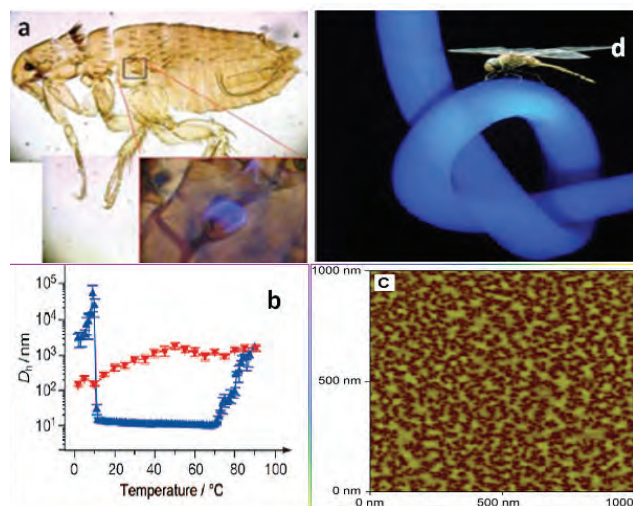


Figure 2

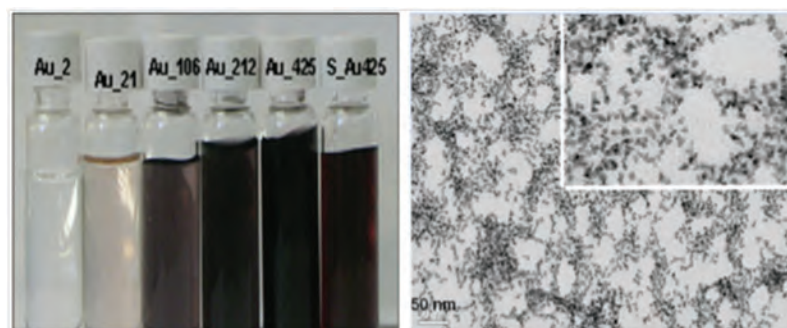
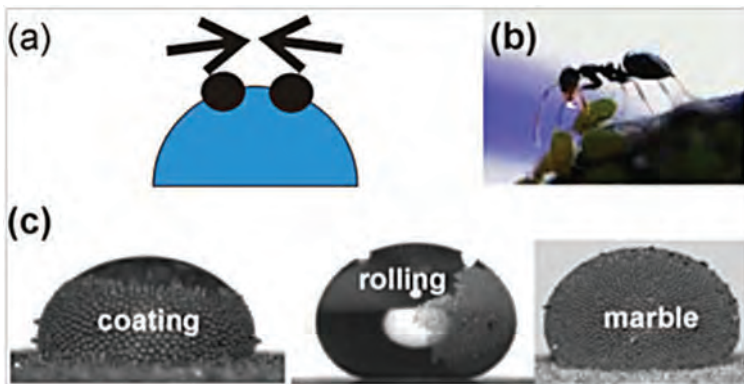


Figure 1: (a) Most resilient and fatigue resistant native resilin in insects. (b) Plot of hydrodynamic diameter D_h (pH 7.4) as a function of temperature: heating blue, cooling red. (c) AFM image of *rec1-resilin* on Si-wafer. (d) Synthetically made crosslinked resilin-mimetic protein-polymer.

Figure 2: Left: *Rec1-resilin* stabilized aqueous colloidal sols containing different size and concentration of AuNPs. Right: Pt nanoparticles formed by template-mediated synthesis using *rec1-resilin* as organized template.



(a) There are attractive interactions between poorly wetted particles trapped on the surfaces of liquid drops. (b) Aphids use these capillary interactions to make protective waxy coatings around drops of honeydew, so the liquid can be harvested later by ants. (c) We showed that the particle coating process is tuned by varying the liquid surface tension and the particle size.

Different Strategies for Winning the Marbles Game

Bian, X, Whitby, CP, Ralston, J and Sedev, R, 'Spontaneous Particle Coating of Droplets on Packed Porous Beds', *5th Asian Particle Technology Symposium*, Singapore, July 2012

Spraying a powdery material with liquid that wets and binds the particles together into clusters helps control the powder porosity and density. Many powders are, however, poorly wet by aqueous solutions. The rate of liquid penetration into the powder is so slow, that the liquid instead evaporates.

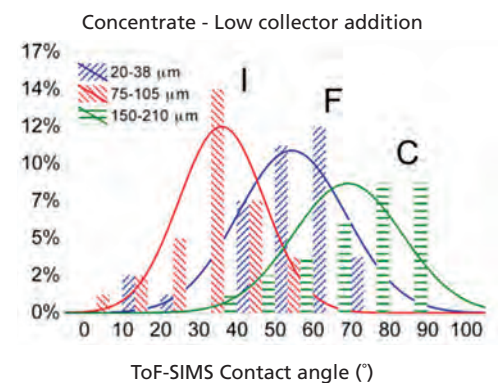
Dr Rossen Sedev and Dr Catherine Whitby worked with their postgraduate student, Xun Bian, to use capillarity to direct assembly of particles from the bed onto the drop surfaces prior to evaporation. A drop placed on a bed of coarse hydrophobic particles is trapped there by particles climbing up its surface to form a close packed coating. This behaviour is linked to the "Cheerios effect" – breakfast cereal particles floating on milk distort the liquid surface, generating attractive interactions.

The particles aggregate into raft-like structures that behave like they are elastic solids. The research exploits this feature to identify new strategies for producing particle encapsulated drops, or liquid marbles. Spontaneous particle coating is a new approach to forming "dry water" powders used in cosmetic products. This research will be presented at the 5th Asian Particle Technology Symposium in Singapore in 2012.

Different Strategies for Winning the ToF-SIMS Surface Analysis to Measure Particles Contact Angle

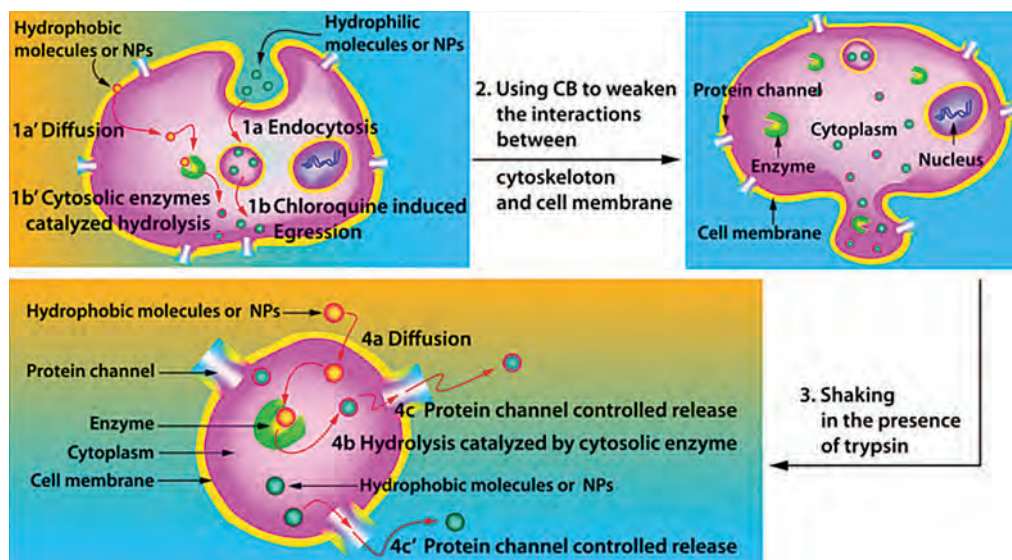
Brito E Abreu, SI & Skinner, W, 'ToF-SIMS-derived hydrophobicity in DTP flotation of chalcopyrite: Contact angle distributions in flotation streams', *International Journal of Mineral Processing*, 98, (1-2), 35-41, 2011

Measuring and controlling particles hydrophobicity in the flotation process is a key research objective. This study revealed the exciting possibility of correlating Time-of-Flight Secondary Ion Mass Spectroscopy (ToF-SIMS) to the contact angle of mineral particles. In this study, the surface spectra of chalcopyrite particles conditioned with collector was correlated to contact angle directly measured by means of traditional methods, and ultimately to the flotation rate and recovery. This is a new and very promising application in minerals flotation, since it opens to the possibility of characterising a flotation feed in terms of contact angle distribution and predicting the flotation response, as well as changes to the flotation response resulting from surface modifications (oxidation, collector adsorption, etc). The study is relevant not only to copper deposits, since it can be extended to any mineral system of interest.



Distribution of ToF-SIMS inferred contact angles in fine (F), intermediate (I) and coarse (C) chalcopyrite particles reporting to the flotation concentrate.

Graphic depiction showing the use of living cells to produce CMCs for humanized encapsulation of drugs and inorganic NPs.



Depression of Pyrite in Porphyry Copper Flotation

Zanin, M & Farrokhpay, S, 'Depression of pyrite in porphyry copper flotation', *Proceedings of the 8th International Mineral Processing Seminar (PROCEMIN 2011)*, 135-143, Chile, (W Kracht, R Kuyvenhoven, S Lynch-Watson & G Montes-Atenas, Ed(s)), 2011

One of the major issues in the flotation of copper from porphyry ores is the high contamination of the copper concentrate with pyrite. High lime additions are used in plant practice to increase the pH and depress pyrite. Nevertheless, several concentrators report high pyrite recovery, especially in rougher/scavenger flotation. Furthermore, plant results rarely match batch flotation tests, due to the complexity of the electrochemical interactions leading to pyrite activation. In this work, combined plant studies and laboratory tests have been used to diagnose pyrite flotation in a large porphyry copper mine. Surface analysis techniques such as ToF-SIMS have also been applied to investigate pyrite activation. The role of copper ions and xanthate collector on the activation of pyrite has been identified, and strategies to prevent and/or reverse activation developed. The recovery of pyrite in rougher/scavenger flotation was reduced by more than 50% with a proper reagent conditioning scheme.

Cells as Factories for Humanized Encapsulation

Mao, Z, Cartier, R, Hohl, A, Farinacci, M, Dorhoi, A, Nguyen, T, Mulvaney, PC, Ralston, J, Kaufmann, SHE, Mohwald, H & Wang, D, 'Cells as factories for humanized encapsulation', *Nano Letters*, 11, (5), 2152-2156, 2011

Biocompatibility is of paramount importance for drug delivery, tumour labelling and in vivo application of nanoscale bioprobes. Until now, biocompatible surface processing has typically relied on PEGylation and other surface coatings, which, however, cannot minimize clearance by macrophages or the renal system but may also increase the risk of chemical side effects. Cell membranes provide a generic and far more natural approach to the challenges of encapsulation and delivery in vivo. Here we harness for the first time living cells as "factories" to manufacture cell membrane capsules for encapsulation and delivery of drugs, nanoparticles, and other biolabels. Furthermore, we demonstrate that the built-in protein channels of the new capsules can be utilized for controlled release of encapsulated reagents.

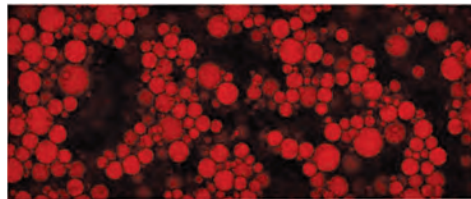
**Laponite-Stabilised Oil-in-water Emulsions:
Viscoelasticity and Thixotropy**

Corbi Garcia, P and Whitby, CP

Paints, yogurts, lubricants and other emulsions are different from simple liquids like water. They consist of drops of one liquid dispersed in another. Typically they are stabilised by complex mixtures of surfactants. Although emulsions are readily stabilised by simple surfactants, they age when stirred, poured or spread. Their appearance and texture changes irreversibly. Emulsions that instead recover the consistency and structure they had at rest (thixotropy) can be used for delivering active ingredients.

Dr Catherine Whitby worked with a visiting student, Paula Corbi Garcia, to test their hypothesis that emulsions stabilised by clay particles alone are thixotropic. They found that drops and clay particles assemble into a three dimensional interconnected network. They manipulated the time-dependent flow behaviour of the emulsions by varying the amount of salt present. Clay particles are an economical and environmentally benign alternative to surfactants. Emulsions stabilized by clay particles have the potential for improved spreadability due to the thixotropy of the drop-particle network. Their research was accepted for publication in the leading journal for soft condensed matter, *Soft Matter*.

(a) Emulsions have a rich morphology due to drop aggregation into complex networks.



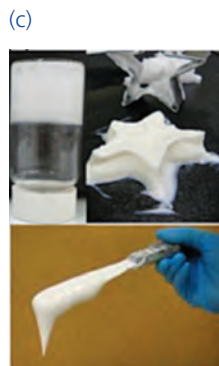
(b) The network structures break apart when emulsions flow. These changes are not easily reversed in conventional emulsions.

(a)

(c) Using clay particles to stabilise emulsions means we can take advantage of their ability to repair network structures.



(b)



(c)

Research and Consultancy Projects

Total project funding over AU\$50,000

BIO AND POLYMER INTERFACES

Advanced nanostructured biointerfaces for cell capture

Research Sponsor: Australian Research Council Discovery Grant

Chief Investigators: H Griesser, B Thierry, C Prestidge and M Brown (Royal Adelaide Hospital)

Partner Investigator: M Tabrizian (McGill University)

Advanced therapeutic strategies for non-invasive administration of anti-cancer drugs

Research Sponsor: Cancer Council SA

Chief Investigator: S Simovic

Chemokine gradients for the guidance of tissue engineering and directed migration of captured cells

Research Sponsor: National Health and Medical Research Council

Chief Investigators: H Griesser, R Short (Mawson Institute, UniSA), K Vasilev (Mawson Institute, UniSA), M Brown (Royal Adelaide Hospital), J Hayball (School of Pharmacy and Medical Sciences, UniSA) and C McFarland (UNSW)

Development and evaluation of novel antibacterial coatings for the prevention of infection of biomedical implants and devices

Research Sponsors: National Health and Medical Research Council and ITEK Pty Ltd

Chief Investigators: H Griesser, M Perkins (Flinders University) and S Semple (Sansom Institute, UniSA)

Development of novel antibacterial coatings

Research Sponsor: RMS Foundation

Chief Investigators: H Griesser, M Perkins (Flinders University) and S Semple (Sansom Institute, UniSA)

Electromaterials Fellowship

Research Sponsor: ITEK Pty Ltd

Chief Investigators: R Fabretto, H Griesser and P Murphy (Mawson Institute, UniSA)

Engineered nanotube membranes for molecular separation and biosensing

Research Sponsor: Australian Research Council Fellowship

Chief Investigator: D Losic

Functional nanoparticles: Towards novel advanced cancer diagnostic, prognostic and therapeutic strategies

Research Sponsor: National Health and Medical Research Council Career Development Award

Chief Investigator: B Thierry

Immunotargeted nanoparticles to improve tumour delivery of chemosensitising cytotoxic drugs and β -radiation

Research Sponsor: National Health and Medical Research Council

Chief Investigators: H Griesser, B Thierry, P Majewski (Advanced Manufacturing and Mechanical Engineering, UniSA), M Brown (Royal Adelaide Hospital) and J Taylor (Royal Adelaide Hospital)

Improved functionality of grain storage products

Research Sponsor: Grains Research and Development Corporation

Chief Investigators: D Losic and C Saunders (Barbara Hardy Institute, UniSA)

Improving the pharmacotoxicology of poorly soluble oncology drugs using a novel nanotechnology based delivery system

Research Sponsor: Cancer Council SA

Chief Investigators: C Prestidge, B Boyd (Monash University), D Keefe (University of Adelaide), M Brown (Royal Adelaide Hospital) and A Davey (Sansom Institute, UniSA)

Microchip impedance biosensor for biomedical diagnostics

Research Sponsors: Australian Research Council Linkage Grant and Inphaze Pty Ltd

Chief Investigators: D Losic and C Priest

Microfabricated devices: A significant advance for the detection and molecular analyses of circulating cancer cells

Research Sponsor: National Health and Medical Research Council

Chief Investigators: B Thierry, C O'Doherty (Sansom Institute, UniSA) and J Ralston

Novel silver nanoparticle coatings for the prevention of infection of biomedical implants and devices

Research Sponsor: National Health and Medical Research Council

Chief Investigators: H Griesser, K Vasilev (Mawson Institute, UniSA), H Morris (IMVS), T Kuchel (IMVS), S Pearce (Surgical Research) and C Ndi

Periodic nano-ratchets: A new paradigm for biomolecule separation

Research Sponsor: Australian Research Council Discovery Grant

Chief Investigators: D Losic and L White (School of Mathematics and Statistics, UniSA)

Principal Investigator: W Guo (Nanjing University)

Preclinical evaluation of novel prostate targeted nanoparticles for imaging primary and metastatic prostate cancer (administered by the University of New South Wales)

Research Sponsors: Cancer Australia and Prostate Cancer Foundation of Australia

Chief Investigators: P Russell (UNSW), B Thierry, B Walsh (Mimomic), J Bucci (UNSW), P deSouza (UNSW) and A Khatri (UNSW)

Sentinel lymph node biopsy in oesophageal adenocarcinoma – improving staging accuracy and optimising treatment (administered by the University of Adelaide)

Research Sponsor: NSW Cancer Council

Chief Investigators: N De Young (University of Adelaide) and B Thierry

Surface for tissue engineering

Research Sponsor: CRC for Polymers

Chief Investigator: H Griesser

COLLOIDS AND NANOSTRUCTURES

Advanced nanoscale materials engineered from diatomaceous earth

Research Sponsors: Australian Research Council Linkage Grant and Mount Sylvia Diatomite Pty Ltd

Chief Investigators: D Losic and J Addai-Mensah

Anomalous interfacial air bubble dynamics: The importance of electrokinetic effects in thin film drainage

Research Sponsor: Australian Research Council Discovery Grant

Chief Investigators: R Horn (Deakin University) and S Miklavcic (School of Mathematics and Statistics, UniSA)

Artificial photosynthesis for solar fuel production

Research Sponsor: Australian Research Council Future Fellowship

Chief Investigator: T Nann

C1-25: Plastic mirror – process development

Research Sponsor: CRC for Advanced Automotive Technology

Chief Investigators: P Murphy (Mawson Institute, UniSA), H Griesser and R Short (Mawson Institute, UniSA)

C1-48: Plastic mirror – coating development

Research Sponsor: CRC for Advanced Automotive Technology

Chief Investigators: P Murphy (Mawson Institute, UniSA), H Griesser and R Short (Mawson Institute, UniSA)

Dispersants for printer inks

Research Sponsor: Tonejet Corporation Pty Ltd

Chief Investigators: M Krasowska and J Ralston

Electrowetting as a tool for measuring the surface energy of solids

Research Sponsor: Australian Research Council Discovery Grant

Chief Investigators: R Sedev, J Connor and J Ralston

Energy dissipation and nanoscale processes at moving contact lines

Research Sponsor: Australian Research Council Discovery Grant

Chief Investigators: J Ralston, R Sedev and M Popescu

Principal Investigators: S Dietrich (Max Planck Institute) and T Kitamori (University of Tokyo)

Enhanced depression and dispersion of minerals in flotation (P498C)

Environmentally benign flotation chemicals (P498C)

Research Sponsors: Australian Research Council Linkage Grant and AMIRA International Ltd

Chief Investigators: D Beattie, D Fornasiero, J Addai-Mensah and J Ralston

Fluid flow and lubrication on the nanometre scale

Research Sponsor: Australia India Strategic Research Fund Grant

Chief Investigators: R Sedev, J Ralston, C Priest and R Horn (Deakin University)

Gradient index optical coatings by plasma polymerisation

Research Sponsor: CRC for Advanced Automotive Technology

Chief Investigators: H Griesser, P Murphy (Mawson Institute, UniSA) and R Short (Mawson Institute, UniSA)

Impact of recycled and low quality water on sustainable mineral processing practices

Research Sponsors: Australian Research Council Linkage Grant and AMIRA International Ltd

Chief Investigators: D Fornasiero, C Moran (University of Queensland) and J Ralston

Nanoparticle adsorption at air-water interfaces for foam stabilization

Research Sponsor: Australian Research Council Discovery Grant

Chief Investigators: D Wang, D Beattie and C Whitby

Principal Investigator: H Moehwald (Max Planck Institute)

Nanostructured anticorrosive coating for wave energy conversion module

Research Sponsors: Australian Research Council Linkage Grant and Wave Rider Energy Pty Ltd

Chief Investigators: N Roy Choudhury and N Dutta

Novel nanostructured polymeric membranes for energy storage applications

Research Sponsors: Australian Research Council Linkage Grant and ZBB Technologies Ltd

Chief Investigators: N Roy Choudhury and W Skinner

Particle-bubble interactions

Research Sponsor: CSIRO Process Science and Engineering

Chief Investigators: J Ralston, D Fornasiero and P Koh (CSIRO Process Science and Engineering)

Particles at interfaces: Controlling detachment
Research Sponsor: Australian Research Council
Future Fellowship
Chief Investigator: C Whitby

Shape controlled nanostructured electrocatalyst
for clean energy generation
Research Sponsor: Australian Research Council
Discovery Grant
Chief Investigators: N Dutta and N Roy
Choudhury

Slippery when wet: Lubrication with responsive
polymers
Research Sponsor: Australian Research Council
Future Fellowship
Chief Investigator: D Beattie

Synthesis and characterisation of cadmium-free
quantum dots
Research Sponsor: Australian Research Council
Discovery Grant
Chief Investigators: T Nann and W Skinner

Testing of nano-nouvelle electrodes for
photocathodic hydrogen production
Research Sponsor: Nano-Nouvelle Pty Ltd
Chief Investigator: T Nann

MINERAL PROCESSING

A step change in fine particle beneficiation –
inverse flotation (administered by the University
of Newcastle)
Research Sponsor: Australian Coal Association
Research Program
Chief Investigators: K Galvin (University of
Newcastle), C Whitby and J Ralston

Characterising and controlling the surface
properties of fine mineral particles generated
during grinding and the effect on flotation
properties
Research Sponsor: Magotteaux Australia Pty Ltd
Chief Investigator: M Zanin

Collection of coarse composite particles by
bubbles in flotation
Research Sponsors: Australian Research Council
Linkage Grant and AMIRA International Ltd
Chief Investigators: D Fornasiero, W Skinner,
M Zanin, H Manouchehri, L White (School of
Mathematics and Statistics, UniSA), S Grano
(University of Adelaide) and A Pring (SA
Museum)
Partner Investigator: L Leal (University of
Sao Paulo)

Differential sulphide flotation - flowsheet
development
Research Sponsor: Industry Partner
Chief Investigator: I Ametov

Enhanced depression and dispersion of minerals
in flotation (P498C)
Research Sponsor: AMIRA International Ltd
Chief Investigators: D Beattie, D Fornasiero,
J Addai-Mensah and J Ralston

Feasibility of producing 30-40% rare earth
concentrate
Research Sponsor: Arafura Resources Ltd
Chief Investigators: R Newell and P Moore

Froth functionality
Research Sponsor: AkzoNobel
Chief Investigators: R Sedev, M Zanin and
J Connor

Gypsum desaturation project
Research Sponsor: Industry Partner
Chief Investigators: J Addai-Mensah and
J Connor

Impact of recycled and low quality water on
sustainable mineral processing practices
Research Sponsor: Australian Research Council
Linkage Grant and AMIRA International Ltd
Chief Investigators: D Fornasiero, C Moran
(University of Queensland) and J Ralston



*Mr Louie Del Castillo and
Dr Massimiliano Zanin.*

Influence of process mineralogy and pulp chemistry on the flotation of fine and coarse minerals (P260F)

Research Sponsor: AMIRA International Ltd
Chief Investigators: D Fornasiero, W Skinner, M Zanin and L Leal (University of Sao Paulo)

Leach residue settling

Research Sponsor: Industry Partner
Chief Investigators: J Addai-Mensah, W Skinner and J Connor

Matching flotation concentrate composition to downstream processing in copper production

Research Sponsors: Australian Research Council Linkage Grant and Industry Partner
Chief Investigators: S Harmer and I Ametov

Mini Pilot Plant studies

Research Sponsor: Industry Partner
Chief Investigators: P Moore, R Newell and M Zanin

Optimising the recovery of fine and coarse particles in mineral flotation

Research Sponsors: Australian Research Council Linkage Grant and AMIRA International Ltd
Chief Investigators: D Fornasiero, W Skinner, M Zanin, L White (School of Mathematics and Statistics, UniSA) and A Pring (SA Museum)
Partner Investigator: L Leal (University of Sao Paulo)

Preconcentration and agglomeration to enhance heap leaching of nickel laterite

Research Sponsor: CSIRO Flagship Collaboration Fund

Chief Investigators: J Ralston, D Fornasiero, J Addai-Mensah and W Skinner

Solving froth stability problems

Research Sponsor: MMG Century

Chief Investigators: S Farrokhpay and M Zanin

The effect of microorganisms on surface properties of chalcopyrite

Research Sponsor: CSIRO Process Science and Engineering

Chief Investigators: S Harmer and M Chen (CSIRO Process Science and Engineering)

Testing of various ore samples using a modified technique for simultaneous data acquisition from multiple measurements

Research Sponsor: Orica International Pty Ltd

Chief Investigators: P Moore and W Skinner

Tin flotation in the <10 micron non-magnetic fraction of Mt Garnet ores

Research Sponsor: Consolidated Tin Mines Limited

Chief Investigators: S Farrokhpay and M Zanin

SCIENTIFIC SERVICES

Stormwater filtration systems product performance testing and analysis

Client: Ecosol Pty Ltd

Chief Investigator: S Abbott

Testing of various ore samples using a modified technique for simultaneous data acquisition from multiple measurements

Client: Orica International Pty Ltd

Chief Investigators: P Moore and W Skinner

CORPORATE

Australian Mineral Science Research Institute

Research Sponsors: AMIRA International Ltd, Australian Research Council Linkage Grant, South Australian Government and UniSA

Chief Investigator: J Ralston

Fabrication of advanced materials

Research Sponsors: National Collaborative Research Infrastructure Strategy / Education Investment Fund, UniSA and South Australian Government

Chief Investigator: J Ralston

SA regional facility for microscopy

Research Sponsors: National Collaborative Research Infrastructure Strategy / Education Investment Fund, UniSA and South Australian Government

Chief Investigator: H Griesser

Spectroscopic imaging for materials, minerals and life sciences

Research Sponsor: Australian Research Council LIEF Grant

Chief Investigators: D Beattie, J Ralston, A Ellis (Flinders University), T Kee (University of Adelaide), K Bremmell (School of Pharmacy and Medical Sciences, UniSA), J Morrison, G Andersson (Flinders University), D Lewis (Flinders University), D Saint (University of Adelaide), K Vasilev (Mawson Institute, UniSA) and F Malherbe (Swinburne University of Technology)

Honours and Awards



Prof Jonas Addai-Mensah and his daughter Janet, with The Hon Julie Bishop MP, Federal Deputy Leader of the Opposition (left), and The Hon Isobel Redmond MP, South Australian Leader of the Opposition (right). Photo courtesy of Prof Addai-Mensah.

Prof Jonas Addai-Mensah Excellence Award in Chemical and Interfacial Engineering, Australian-African Chamber of Commerce

On 16 July, Jonas was presented with a National Award for "Excellence in the field of Chemical and Interfacial Engineering" by the Australian-African Chamber of Commerce. The award ceremony at the Adelaide Festival Theatre was attended by dignitaries, members of the diplomatic corps, academics, the business community and state and federal politicians.

Mr Simon Field, Prof Hans Griesser and Mr Colin Hall (Dr Drew Evans, Mr Bill Frank, A/Prof Peter Murphy, Mr Bob Speedie and Mr Kamil Zuber - Mawson Institute) Project title: Plastic Mirrors – Process and Coating Development

Silver - SAE Australasia Automotive Engineering Excellence Awards. The society of automotive engineers aims to recognise excellence in automotive engineering, manufacturing, design and quality to help raise the standards and public perception of the Australian automotive and related industries. This award was accepted at their annual dinner on 9 July 2011 in Melbourne by Peter Murphy, Colin Hall and Dr Scott Edwards (SMR Automotive Australia).

The AutoCRC - Research Excellence Award. This award, presented to the plastic mirrors team, was accepted by Colin Hall on 7 July 2011 at the AutoCRC technical conference in Melbourne. It recognises innovative research within the AutoCRC, as applied to the automotive sector.

Dr Karyn Jarvis Norton Jackson Material Science and Engineering Medal

Karyn is the inaugural winner of the medal which was presented at the UniSA Scholarships and Grants Ceremony on 8 June 2011. Her PhD project, under the supervision of Prof Clive Prestidge and Dr Tim Barnes, was titled 'Optimising the interfacial properties of porous silicon for effective control of molecular and biomolecular interactions'.

The Norton Jackson Material Science and Engineering Medal recognises the achievements of graduates of The Wark and is awarded annually to the PhD graduate or graduand who has demonstrated the most potential or real application of research in industry.

Dr Xiaokong Liu, Dr Angel Tan and Dr Haolan Xu Australian Nanotechnology Network (ANN) Early Career Symposium Travel Grants

The ANN Early Career Symposium is held annually to provide a forum where early career researchers and postgraduate students working on nanotechnology research can present their work and interact with other research groups in Australia. The travel grants enabled Xiaokong, Angel and Haolan to present their work at the Macquarie Graduate School of Management (MGSM) at Macquarie University, Sydney in November 2011.

Ms Jessica Lu Best Wark Student Seminar

Jessica is in the third year of her PhD program and her principal supervisor is Prof Hans Griesser. Her talk was titled 'Synthesis of antibacterial serrulatanes' and discussed her research using organic chemistry synthesis to access these powerful antibacterial natural compounds.

His Excellency Rear Admiral Kevin Scarce AC CSC RANR, Governor of South Australia and Dr Craig Priest. Photo courtesy of the Australian Institute of Policy and Science.



Ms Jessica Lu
UniSA Three-Minute Thesis Competition

As the winner of The Wark's 3MT Competition in 2010, Jessica took part in the UniSA Grand Final on 23 August 2011. Her presentation was titled 'Synthesis of antibacterial compounds from Australian native *Eremophila* for biomedical device coatings'. She was placed second according to the judges' choice (winning \$1,000) and first according to the people's choice (winning \$500).

Dr Luke Parkinson
Frater Award – Australian National Fabrication Facility Staff Development Award

Named after Dr Robert Frater AO, former ANFF Chair, this award recognises ANFF staff excellence. The \$4,000 staff development award will be used to extend collaborative micro and nanofluidic work with the University of Tokyo, and to participate in the Micro Total Analysis Systems 2012 meeting in Okinawa, Japan.

Dr Luke Parkinson
Ian Davey Research Thesis Prize

Luke's research focused on understanding bubble-particle interactions, a topic of relevance and interest to many industrial processes such as flotation, food processing, foam and froth behaviour. His thesis was titled, 'Induction time and bubble-particle interactions' and his principal supervisor was Laureate Prof John Ralston.

Dr Craig Priest
South Australian Early Career Researcher – Tall Poppy of the Year, SA Science Excellence Awards

Craig was named the South Australian Tall Poppy of the Year at the SA Science Excellence Awards Gala Dinner on 3 November 2011. The South Australian Tall Poppy of the Year acknowledges an outstanding young research scientist, selected from South Australia's Young Tall Poppies. Craig received \$10,000 to assist in his research and a seat on the Premier's Science and Industry Council for 3 years.

Dr Craig Priest
South Australian Tall Poppy Award, Australian Institute of Policy and Science

The prestigious annual Young Tall Poppy Science Awards aim to recognise the achievements of Australia's outstanding young scientific researchers and communicators. Craig was one of eight recipients of a Tall Poppy Award, presented by His Excellency Rear Admiral Kevin Scarce AC CSC RANR, Governor of South Australia, on 25 August at Government House.

Dr Gujie Qian

Ian Wark Research Institute Medal

Gujie's research explored the mechanisms of formation of the most common sulfide mineral, pyrite, under hydrothermal conditions and mainly consisted of two parts: (1) replacement of magnetite (Fe_3O_4) by pyrite (cubic FeS_2); (2) replacement of pyrrhotite (Fe_{1-x}S) by pyrite (and marcasite, orthorhombic FeS_2). His thesis was titled 'Formation of pyrite under hydrothermal conditions' and his supervisors were Prof Bill Skinner and Adjunct Prof Allan Pring.

The Ian Wark Research Institute Medal is awarded annually to the graduate or graduand from the Ian Wark Research Institute with the most outstanding thesis. The Medal is based on the creativity and originality of the research, the student's comprehension of the field, the significance and utility of the research as a contribution to, or as an application of, knowledge and the impact of the thesis through the number and level of international publications.

Mr Keith Quast

President's Award, Royal Australian Chemical Institute (South Australian Branch)

Keith received the award for grateful recognition of years of outstanding and extended contribution and meritorious service to the South Australian Branch of the Royal Australian Chemical Institute promoting chemistry in a variety of roles and contexts.

Dr Haolan Xu and Dr Jingfang Zhou Australian Research Council (ARC) Discovery Early Career Researcher Award (DECRA)

Haolan and Jingfang, from The Wark, were two of the four UniSA researchers awarded a prestigious ARC DECRA, with funding commencing in 2012.

Haolan's Fellowship provides ARC funding of \$375,000 over a period of three years for his project titled 'Study of Oriented Attachment of Nanocrystals at Oil-water Interfaces'.

Haolan will study various interactions between nanocrystals and oil-water interfaces to guide and govern the oriented attachment crystal growth at oil-water interfaces.

Jingfang's Fellowship provides ARC funding of \$375,000 over a period of three years for her project titled 'Shape Sorting of Nanoparticles at Oil/Water Interfaces in Microchannels'. Jingfang will investigate shape effect on the adsorption of NPs at oil/water interfaces and develop a novel technique for shape sorting of NPs using oil/water interfaces in microchannels.

In both cases additional funding and resources are provided by UniSA.

Wark Student Travel Grants

Each year travel grants of up to \$1,000 are made available to HDR students enrolled at The Wark, with a maximum of \$3,000 overall being available each half year. The grants are for the purpose of attending conferences held at locations either in Australia or internationally. In 2011, the following students were recipients of Travel Grants:

- Trent Albrecht
- Moom Sinn Aw
- Yusuf Ferdosi
- Maria Sinche Gonzalez
- Regis Mejjard
- Andrea Paul
- Bogale Tadesse
- Yang Yu
- Thilagavathi Yuvaraj.

Graduates

Daniel Chipfunhu

BSc(Hons) MSc *University of Zimbabwe* PhD *UniSA*

Principal Supervisor: Dr Massimiliano Zanin

Thesis Title: *Effect of surfactants and hydrophobicity on collection of fine particles by bubbles in flotation*

This thesis deals with the relationship between critical contact angle for flotation and particle size, and the effect of surfactant in solution. A critical contact angle was shown below which flotation does not occur, which increases as particle size decreases. Surfactant adsorption at the solid-liquid and liquid-gas interfaces was shown to affect the fundamental processes of bubble-particle collision and attachment and ultimately the flotation recovery.

Graduate Position: Metallurgist, Aditya Birla Minerals, Mt Gordon, Queensland

Lorena Del Castillo

BSc MSc *University of the Philippines* PhD *UniSA*

Principal Supervisor: Dr Satomi Onishi

Thesis Title: *Surface forces and hydrodynamic effects in bubble interactions*

This study contributes to our understanding of how bubbles in liquids interact with other surfaces. Results revealed that the air/water interface is more complex than what current theories assume. It suggests that electrostatic and hydrodynamic boundary conditions at the interfaces are not constant but strongly depend on the kinetics (such as approach velocity) of the interfaces. Furthermore, surface charge on the bubble depends on its proximity to another surface and may also be coupled to fluid flow.

Graduate Position: Research Associate, Ian Wark Research Institute, University of South Australia

Jairo Garnica Rodriguez

BEng *Universidad Nacional de Colombia* MEng MPhil *Queensland* PhD *UniSA*

Principal Supervisor: Dr Rossen Sedev

Thesis Title: *Superhydrophobic metal surfaces*

Surfaces with extremely low water wettability were produced by surface roughening of metals via chemical or electrochemical pathways, followed by surface modification with a self-assembled monolayer. An original adhesive force study showed that liquid droplets display a soft sphere adhesive behaviour when interacting with a superhydrophobic surface. Given their unique wettability, robustness and superior mechanical stability, these surfaces can be used in applications as diverse as fuel cells, surface protection and low friction systems.

Graduate Position: Postdoctoral Fellow, Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris, France

Mayur Mistry

BAppSc BSc(Hons) PhD *UniSA*

Principal Supervisor: Prof Namita Roy Choudhury

Thesis Title: *Understanding structure-property relationship in proton conducting hybrid membrane*

The focus of this thesis is to establish the structure-property-performance relationship in a new type of proton conducting composite membrane for high temperature electrolyte application. The work has clearly demonstrated that proton conductivity is strongly dependent on the interfacial interaction and organization in these complex systems, which evolve with temperature.

Graduate Position: Research Associate, Imperial College, London, United Kingdom

Ataollah Nosrati

BSc Petroleum University of Technology, Iran
MSc Tarbiat Modarres University, Iran PhD
UniSA

Principal Supervisor: Prof Jonas Addai-Mensah

Thesis Title: *Interfacial chemistry, particle interactions and processability of aqueous muscovite clay mineral dispersions*

Clay gangue minerals (eg muscovite) when associated with valuable metal ores (eg copper) may present significant challenges due to pulp gelation during hydrometallurgical processing. This research examines the factors influencing pulp/interfacial chemistry and particle interactions of aqueous muscovite dispersions underpinning pulp gelation.

Graduate Position: Research Associate, Ian Wark Research Institute, University of South Australia

Anuttam Patra

BSc(Hons) Calcutta, India MSc IISc, Bangalore, India PhD UniSA

Principal Supervisor: Laureate Prof John Ralston

Thesis Title: *Design of pyrimidine-based photoresponsive surfaces and light induced wettability control*

Surfaces which change their properties when exposed to light were generated in this research, using organic molecules found in the structure of DNA, to form thin surface films. The wettability of these designed, light sensitive surfaces can be controlled by manipulating the structure of the pyrimidine-based molecules used to construct the thin films. The incorporation of photosensitizers enables the wavelength of the incident light to be varied over a significant range, permitting the development of clever sensing devices.

Graduate Position: Post Doctoral Research Fellow, Luleå University of Technology, Sweden

Gujie Qian

BEng Tongji University, PR China MEng East China University of Science and Technology, PR China PhD UniSA

Principal Supervisor: Prof Bill Skinner

Thesis Title: *Formation of pyrite under hydrothermal conditions*

This project was to experimentally explore the mechanisms of formation of pyrite, the most common sulfide mineral, by replacing magnetite under hydrothermal conditions. The major finding of this project was that the mechanisms of the replacement reactions were all that of dissolution-precipitation reactions. The research outcomes can help us to understand the Fe sulfide ore formations in nature.

Graduate Position: Research Projects Officer, CSIRO Land and Water, South Australia

Mohanraj Vellore Janarthanan

BPharm JSS College of Pharmacy, India MPharm Curtin PhD UniSA

Principal Supervisor: Prof Clive Prestidge

Thesis Title: *Nanoparticles coated liposomes for encapsulation and delivery of proteins*

Liposomes (or lipid vesicles) are excellent pharmaceutical carriers, but their use as oral medicines is limited. Nanoparticle coated liposome hybrids were developed that address the problems of rapid drug leakage, poor storage stability and gastrointestinal degradation. These improvements in the pharmaceutical performance of liposomes enable enhanced oral delivery of proteins and peptides.

Graduate Position: Research Assistant, School of Pharmacy and Medical Sciences, University of South Australia

Dr Ataollah Nosrati at the UniSA Graduation Ceremony.
Photo courtesy of Dr Nosrati.



Danfeng Xu

BSc *Northeastern University, PR China* MSc
Tianjin University, PR China PhD *UniSA*

Principal Supervisor: Dr Igor Ametov

Thesis Title: *Effect of slurry rheology on coarse particle recovery*

In this study, the factors that affect the detachment of coarse particles from bubbles under flotation related conditions, with a specific focus on the effect of viscosity of the suspending medium, were explored. It was shown that the stability of bubble particle aggregates and flotation recovery of coarse particles may be increased by increasing the pulp viscosity.

Graduate Position: Research Associate, Ian Wark Research Institute, University of South Australia

Kai Ying Yeap

BChemEng(Hons) *Adelaide* PhD *UniSA*

Principal Supervisor: Prof Jonas Addai-Mensah

Thesis Title: *Stimulus responsive flocs formation, interfacial chemistry and water minimization in dewatering of talc suspensions*

Fine clay tailings from hydrometallurgical and mineral ores separation operations characteristically dewater slowly. Conventional polyacrylamide-based flocculants commonly used to achieve rapid dewatering of tailings produce poorly consolidated sediments despite the recent advances in thickener technology.

The present work demonstrates how judicious selection of process variables and stimuli at both primary and secondary dewatering stages may lead to dramatic enhancement of dewaterability of talc pulps.

Graduate Position: Metallurgist, BHP Billiton, South Australia

Hardi Ys

BSc *Syah Kuala University, Indonesia* MSc
Andalas University, Indonesia PhD *UniSA*

Principal Supervisor: Prof Hans Griesser

Thesis Title: *Antibacterial coatings for biomedical devices by covalent grafting of serrulatane diterpenes*

This thesis reports novel molecular coatings to prevent the attachment of bacteria to biomedical device surfaces and the subsequent biofilm formation and infection. Coating either an established antibiotic or an antibacterial compound extracted from an Australian plant onto polymer surfaces produced highly effective bacteria-resistant materials.

Graduate Position: Lecturer, Tadulako University, Palu, Central Sulawesi, Indonesia



Left to right: Mr Colin Hall; Senator The Hon Kim Carr, Minister for Innovation, Industry, Science and Research; and The Hon Julia Gillard MP, Prime Minister at the Innovation Australia - Clean Technology Showcase, held in Canberra on 18 August 2011. Photo courtesy of AusIndustry.

Seminar Program

VISITING SPEAKERS

A/Prof Ben Boyd

Monash Institute of Pharmaceutical Sciences, Monash University, Melbourne, Australia

Understanding, controlling and exploiting nanostructures in self assembled lipid systems for drug delivery

Prof David G Castner

National ESCA and Surface Analysis Centre for Biomedical Problems, Departments of Chemical Engineering and Bioengineering, University of Washington, Seattle, USA

ToF-SIMS characterization of patterned protein surfaces

Dr Martin Cole

Interdisciplinary Nanoscience Centre, Aarhus University, Denmark

Protein patterns of steer stem cell differentiation

Prof Jinming Duan

Xi'an University of Architecture and Technology, Xi'an, PR China

Rapid determination of nine haloacetic acids in water using ultra-performance liquid chromatography tandem mass spectrometry in multiple reactions monitoring mode

Dr Shenggen Hu

CSIRO Energy Technology, Australia

Applications of EIS to process monitoring in mineral processing

Dr Beat Keller

EMPA, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland

Materials characterization using Time of Flight Secondary Ion Mass Spectrometry

Dr Rogério Manica

Institute of High Performance Computing, Singapore

Bubbles and drops

Prof Helmut Moehwald

Max Planck Institute of Colloids and Interfaces, Potsdam, Germany

Functional and responsive films and coatings

Prof Ian Tucker

School of Pharmacy, University of Otago, New Zealand

Delivering drugs to the brain: current status and the effect of some bile salts on membrane permeability

Visitors to the Institute

Extended Visits

Dr Valentina Belova
Department of Interfaces, Max Planck Institute
of Colloids and Interfaces, Potsdam, Germany

Dr Beat Keller
EMPA, Swiss Federal Laboratories for Materials
Science and Technology, Dübendorf, Switzerland

Emeritus Prof Ron Martin (Wark Adjunct
Research Professor)
Department of Chemistry, University of Western
Ontario, Canada

Dr Libin Tong
Norman B Keevil Institute of Mining
Engineering, University of British Columbia,
Vancouver, Canada

Short Term Visits

Dr Terry Blake
Surface Science Kodak (retired), United
Kingdom

A/Prof Ben Boyd
Monash Institute of Pharmaceutical Sciences,
Monash University, Melbourne, Australia

Prof David G Castner
National ESCA and Surface Analysis Centre for
Biomedical Problems, Departments of Chemical
Engineering and Bioengineering, University of
Washington, Seattle, USA

Dr Martin Cole
Interdisciplinary Nanoscience Centre, Aarhus
University, Denmark

Dr Frédérique Cunin
Institut Charles Gerhardt, Montpellier, France

Prof Jinming Duan
Xi'an University of Architecture and Technology,
Xi'an, PR China

Dr Shenggen Hu
CSIRO Energy Technology, Australia

A/Prof Bernhard Klein
Norman B Keevil Institute of Mining
Engineering, University of British Columbia,
Vancouver, Canada

Prof Robert Lamb
School of Chemistry, University of Melbourne,
Australia

Dr Rogério Manica
Institute of High Performance Computing,
Singapore

Prof Daniel Mireku-Gyimah
University of Mines and Technology, Ghana

Prof Helmut Moehwald
Max Planck Institute of Colloids and Interfaces,
Potsdam, Germany

Prof Magnus Nydén
Department of Chemical and Biological
Engineering, Chalmers University of Technology,
Sweden

Prof Cyril O'Connor
Centre for Minerals Research, University of Cape
Town, South Africa

Dr Wayne Stange
AMIRA International, Melbourne, Australia

Prof Marcus Textor
Laboratory for Surface Science and Technology,
ETH Zurich, Switzerland

Prof Ian Tucker
School of Pharmacy, University of Otago, New
Zealand

Prof Brian Vincent
University of Bristol, United Kingdom

Dr David Wyatt
Respiratory New Product Introduction Centre
of Excellence, GlaxoSmithKline PLC, United
Kingdom

Overseas Student Visits

Ms Natascha Adamovic
University of Vienna, Austria

Ms Manpreet Bariana, Mr Karan Gulati and
Mr Tushar Kumeria
Amity University, India

Ms Perrine Colliat-Dangus
Bordeaux Institute of Technology, France

Ms Paula Corbi Garcia
University Rovira i Virgili, Tarragona, Spain

Ms Vanessa Dao
École Polytechnique Fédérale de Lausanne,
Switzerland

Mr Joseph Gordon
University of Mines and Technology, Ghana

Ms Annette Herrmann and Ms Ulrike Wieborg
University of Erlangen-Nuremberg, Germany

Mr Seongpyo Jeon and Mr Yongjin Shin
Korea University, Korea

Mr Leon Jong
Wageningen University, The Netherlands

Mr Dongwoo Kang
Hanyang University, Korea

Mr Nasrullah Khan
GC University Lahore, Pakistan

Ms Melinda Krebsz
Eötvös Loránd University, Budapest, Hungary

Ms Romina Lambertucci
Universidad Tecnológica Nacional, Argentina

Ms Hanna Lilja
Tampere University of Technology, Finland

Ms Lisa Lotte
Technische Universität Dortmund, Germany

Mr Celio Marques
Escola Politécnica Da Universidade De São
Paulo, Brazil

Mr Leonardo Mattos
Universidade Federal De Minas Gerais, Brazil

Ms Rebecca McVicker
National University of Ireland, Galway, Ireland

Ms Shahla Pazokifard
Iran Polymer and Petrochemical Institute, Iran

Ms Colombage Kshanthi Kalyani Perera
University of Moratuwa, Sri Lanka

Mr Saminathan Ramakrishnan
Bharathidasan University, India

Ms Céline Richard
École Normale Supérieure, France

Mr Gabor Rozipal
Budapest University of Technology and
Economics, Hungary

Mr Daniel Sauerbrunn
Universität Konstanz, Germany

Ms Tanja Scholz
Dresden University of Technology, Germany

Conference Attendance and Invited Lectures

*Oral / †Poster

Prof Jonas Addai-Mensah, *A/Prof David Beattie, Dr Jason Connor, *Dr Sarah Harmer, *†Dr Marta Krasowska, *Dr Agnieszka Mierczynska-Vasilev, *Dr Satomi Onishi, *Dr Craig Priest, *Prof John Ralston, Dr Rossen Sedev, *Prof Dayang Wang, *Dr Catherine Whitby, *Ms Lorena Del Castillo and *Mr Jin Sung Park

The 5th Biennial Australian Colloid and Interface Symposium, Hobart, Australia, 30 January - 3 February 2011

*Prof Jonas Addai-Mensah

Paydirt's 2011 Uranium Conference, Adelaide, Australia, 21-22 March 2011

*Prof Jonas Addai-Mensah

ALTA 2011 Nickel-Cobalt-Copper, Uranium and Gold Conference, Perth, Australia, 23-28 May 2011

*Prof Jonas Addai-Mensah, *†Dr Saeed Farrokhpay, *A/Prof Dusan Losic, *†Dr Ataollah Nosrati, *†Mr Keith Quast, †Mr Eric Agorhom, Mr Trent Albrecht, *Ms Moom Aw, Mr Yusuf Ferdosi, *Mr Clement Owusu, †Mr Ishmael Quaioco, *Mr Bogale Tadesse and †Mr Yang Yu
CHEMECA 2011, Sydney, Australia, 18-21 September 2011

*Prof Jonas Addai-Mensah, *Dr Sarah Harmer, †Prof William Skinner and *Dr Massimiliano Zanin

PROCEMIN 2011, 8th International Mineral Processing Seminar, Santiago, Chile, 30 November - 2 December 2011

*A/Prof David Beattie

ACOV9, 2011 Australasian Conference on Vibrational Spectroscopy, Wellington, New Zealand, 22-24 November 2011

*Dr Bryan Coad, *Prof Hans Griesser (invited oral presentation), *Dr Neil Poulter, *Prof Clive Prestidge, *Prof Namita Roy Choudhury, *Prof Dayang Wang and *Mr Lachlan Hyde

ICMAT 2011, International Conference on Materials for Advanced Technologies, Singapore, 26 June - 1 July 2011

*†Dr John Denman

SIMS XVIII, 18th International Conference on Secondary Ion Mass Spectrometry, Riva del Garda, Italy, 18-23 September 2011

Mr Simon Doe, Dr Luke Parkinson and Prof Clive Prestidge

AusBiotech 2011, Adelaide, Australia, 16-19 October 2011

*A/Prof Naba Dutta, *Prof Namita Roy Choudhury and *Prof Dayang Wang

PacRim 9, 9th International Meeting of the Pacific Rim Ceramic Societies, Cairns, Australia, 10-14 July 2011

*A/Prof Naba Dutta

6th World Congress on Biomimetics, Artificial Muscles and Nano-Bio, Cergy-Pontoise, France, 25-27 October 2011

*Mr Yusuf Ferdosi

220th ECS Meeting and Electrochemical Energy Summit, Boston, USA, 9-14 October 2011

*A/Prof Daniel Fornasiero and †Dr Agnieszka Mierczynska-Vasilev

22nd World Mining Congress and Expo, Istanbul, Turkey, 11-16 September 2011

*Prof Hans Griesser (invited oral presentation)
32APS, 32nd Australasian Polymer Symposium,
Coffs Harbour, Australia, 13-16 February 2011

*Prof Hans Griesser
International Nanotribology Forum, Hoi An,
Vietnam, 23-27 May 2011

*Prof Hans Griesser (invited oral presentation)
eCM XII: Implant Infection, Davos, Switzerland,
22-24 June 2011

*Prof Hans Griesser (invited oral presentation)
2nd International Nanomedicine Conference,
Sydney, Australia, 14-16 July 2011

*Prof Hans Griesser (invited oral presentation)
National Conference of the Association of
Australian Plant Societies, Adelaide, Australia,
6 October 2011

*Prof Hans Griesser (invited oral presentation),
Mr Marek Jasieniak and Ms Htwe Mon
Wound CRC National Workshop, Tweed Heads,
Australia, 12-14 October 2011

*+Mr Karan Gulati and *+Mr Tushar Kumeria
ICSS 2011, 1st International Conference on
Small Science, Sydney, Australia, 15-18 August
2011

*Mr Colin Hall
2011 AVS International Plasma Workshop,
Taipei, Taiwan, 22-25 March 2011

*Mr Colin Hall
AutoCRC Technical Conference 2011,
Melbourne, Australia, 7 July 2011

*Dr Marta Krasowska (invited oral presentation)
and *Dr Mihail Popescu (invited oral
presentation)

Microparticles in Stokes Flow Symposium,
Warsaw, Poland, 20-24 August 2011

*Dr Marta Krasowska (keynote oral
presentation), *Dr Rossen Sedev and *+Dr
Catherine Whitby
ECIS 2011, 25th European Colloid and Interface
Society Conference, Berlin, Germany,
4-9 September 2011

*A/Prof Sunil Kumar
54th Annual Society of Vacuum Coaters
Technical Conference, Chicago, USA,
16-21 April 2011

*A/Prof Sunil Kumar
ICMCTF 2011, 38th International Conference
on Metallurgical Coatings and Thin Films, San
Diego, USA, 2-6 May 2011

+Dr Xiaokong Liu, *Dr Angel Tan and +Dr
Haolan Xu
Australian Nanotechnology Network Early
Career Symposium, Sydney, Australia,
21-22 November 2011

+Mr Regis Mejjard
Nanophotonics for Sensing and Nonlinear
Optics Workshop, McLaren Vale, South
Australia, 24-26 August 2011

*Prof Thomas Nann
AMN-5, 5th International Conference on
Advanced Materials and Nanotechnology,
Wellington, New Zealand, 7-11 February 2011

*Prof Thomas Nann (session chair), *Prof John Ralston and *Dr Catherine Whitby (symposium co-organiser)

The Hunter Legacy Symposium, Newcastle, Australia, 1-3 June 2011

*Prof Thomas Nann

Towards Global Artificial Photosynthesis Conference, Lord Howe Island, Australia, 14-18 August 2011

*Prof Thomas Nann

3rd CUTSE 2011 International Conference, Miri, Malaysia, 8-9 November 2011

*Prof Thomas Nann

The Nanomaterials Zing Conference, Riviera Maya, Mexico, 28 November - 2 December 2011

*Dr Mihail Popescu and *Dr Rossen Sedev
CECAM Modeling Wetting Phenomena: From Particle Based Models to the Continuum Workshop, Lausanne, Switzerland, 14-16 September 2011

†Dr Neil Poulter

ASBTE 2011, 21st Annual Conference of the Australasian Society for Biomaterials and Tissue Engineering, Queenstown, New Zealand, 27-29 April 2011

*Prof Clive Prestidge

3rd PharmSciFair Conference, Prague, Czech Republic, 13-17 June 2011

*Prof Clive Prestidge

NanoFormulation 2011 Conference, Singapore, 26 June - 1 July 2011

*Prof Clive Prestidge

5th Annual AUS-CRS Meeting, Hamilton Island, Australia, 21-22 October 2011

*Prof Clive Prestidge, *Dr Angel Tan, †Ms Yamini Akkamsetty, †Ms Moom Aw and †Ms Rokhsana Yasmin

2011 APSA Annual Conference, Adelaide, Australia, 11-14 December 2011

*Dr Craig Priest and *Dr Jingfang Zhou

2nd Australian and New Zealand Micro and Nanofluidics Symposium, Sydney, Australia, 28-29 April 2011

†Dr Craig Priest

8th Liquid Matter Conference, Vienna, Austria, 6-10 September 2011

*Dr Craig Priest and *Prof John Ralston

ISEC 2011, 19th International Solvent Extraction Conference, Santiago, Chile, 3-7 October 2011

*Prof John Ralston

6th International Conference on Phosphate Beneficiation, Kun Ming, PR China, 6-11 March 2011

*Prof John Ralston

241st ACS National Meeting & Exposition, Anaheim, USA, 27-31 March 2011

*Prof Namita Roy Choudhury

International Conference on Advances in Polymer Science and Rubber Technology (APSRT 2011), Kharagpur, India, 3-5 March 2011



Prof Dayang Wang.

*Dr Spomenka Simovic (invited oral presentation)
Biopharm Conference, Belgrade, Serbia,
24-28 October 2011

*Dr Benjamin Thierry (invited oral presentation)
12th Australasian Prostate Cancer Conference
(APCC), Melbourne, Australia, 3-5 August 2011

*Dr Benjamin Thierry
IWNA 2011, 3rd International Workshop on
Nanotechnology and Application, Vung Tau,
Vietnam, 10-12 November 2011

*Prof Dayang Wang
SEB-2011, 2nd Symposium on Enzymes and
Biocatalysis, Dalian, PR China, 25-30 April 2011

*Prof Dayang Wang
ICMREE 2011, International Conference
on Materials for Renewable Energy and
Environment, Shanghai, PR China,
20-22 May 2011

*Prof Dayang Wang
13th Chinese National Symposium on Colloid
and Interface Chemistry, Taiyuan, PR China,
20-23 July 2011

Publications

B - Book Chapter

Bear, J, Charron, G, Fernandez-Arguelles, MT, Massadeh, S, McNaughter, P & Nann, T, 'In Vivo Applications of Inorganic Nanoparticles', *BetaSys, Systems Biology of Regulated Exocytosis in Pancreatic β -Cells*, New York, 185-220, (9-7814-4196-9552), (Sangdun Choi, Ed(s)), 2011

Farrokhpay, S, 'New development in paint and coatings technology', *Paints: Types, Compounds and Applications*, New York, 141-149, (9-7816-1761-8130), (Stephanie M Sarrica, Ed(s)), 2011

Griesser, H, Vasilev, K, Ys, H & Al-Bataineh, S, 'Modifying biomaterial surfaces with bioactives to control infection', *Surface Modification of Biomaterials: Methods, Analysis and Applications*, Cambridge, UK, 284-308, (9-7818-4569-6405), (Rachel Williams, Ed(s)), 2011

Malysa, K, Zawala, J, Krzan, M & Krasowska, M, 'Bubbles rising in solutions; Local and terminal velocities, shape variations and collisions with free surface', *Bubble and Drop Interfaces*, Brill, Leiden, 243-292, (978-9004174955), (R Miller & L Liggieri, Ed(s)), 2011

Thierry, B & Majewski, P, 'Superparamagnetic Magnetite Nanoparticles', *Encyclopedia of Nanoscience and Nanotechnology*, ASP - American Scientific Publishers, USA, 533-544, (158-8831884), (Hari Singh Nalwa, Ed(s)), 2011

Wang, H & Nann, T, 'Upconverting Nanoparticles', *Lanthanide Luminescence: Photophysical, Analytical and Biological Aspects*, Berlin Heidelberg, 114-132, (9-7836-4221-0228), (OS Wolfbeis, Ed(s)), 2011

C1 - Refereed Journal Article

Acres, RG, Harmer, SL, Shui, HW, Chen, C-H & Beattie, DA, 'Synchrotron scanning photoemission microscopy of homogeneous and heterogeneous metal sulfide minerals', *Journal of Synchrotron Radiation*, 18, (4), 649-657, 2011

Ahn, H & Wang, D, 'Synthesis and electrochemical properties of porous Pt wire electrodes for methanol electro-oxidation', *Solid State Sciences*, 13, (8), 1612-1615, 2011

Al-Bataineh, S, Szili, E, Mishra, A, Park, J, Eden, G, Griesser, H, Voelcker, NH, Short, R & Steele, D, 'Design of a microplasma device for spatially localised plasma polymerisation', *Plasma Processes and Polymers*, 8, (8), 695-700, 2011

Altalhi, T, Ginic-Markovic, M, Han, N, Clarke, S & Losic, D, 'Synthesis of carbon nanotube (CNT) composite membranes', *Membranes*, 1, (1), 37-47, 2011

Anakok, OF, Ndi, CP, Barton, MD, Griesser, HJ & Semple, SJ, 'Antibacterial spectrum and cytotoxic activities of serrulatane compounds from the Australian medicinal plant *Eremophila neglecta*', *Journal of Applied Microbiology*, 112, (1), 197-204, 2011

Aw, MS, Simovic, S, Addai-Mensah, J & Losic, D, 'Polymeric micelles in porous and nanotubular implants as a new system for extended delivery of poorly soluble drugs', *Journal of Materials Chemistry*, 21, (20), 7082-7089, 2011

Aw, MS, Simovic, S, Addai-Mensah, J & Losic, D, 'Silica microcapsules from diatoms as new carrier for delivery therapeutics', *Nanomedicine*, 6, (7), 1159-1173, 2011

Aw, MS, Simovic, S, Yu, Y, Addai-Mensah, J & Losic, D, 'Porous silica microshells from diatoms as biocarrier for drug delivery applications', *Powder Technology*, 223, 52-58, 2011

Barnes, T, Kempson, I & Prestidge, C, 'Surface analysis for compositional, chemical and structural imaging in pharmaceuticals with mass spectrometry: A ToF-SIMS perspective', *International Journal of Pharmaceutics*, 417, (1-2), 61-69, 2011

- Beaussart, A, Mierczynska-Vasilev, AM, Harmer, SL & Beattie, DA, 'The role of mineral surface chemistry in modified dextrin adsorption', *Journal of Colloid and Interface Science*, 357, (2), 510-520, 2011
- Brito E Abreu, SI & Skinner, W, 'Predicting the surface chemistry contribution to the flotation recovery of chalcopyrite by ToF-SIMS', *Minerals Engineering*, 24, (2), 160-168, 2011
- Brito E Abreu, SI & Skinner, W, 'ToF-SIMS-derived hydrophobicity in DTP flotation of chalcopyrite: Contact angle distributions in flotation streams', *International Journal of Mineral Processing*, 98, (1-2), 35-41, 2011
- Chan, CP, Choudhury, N & Majewski, P, 'Fabrication and characterisation of self-assembled monolayers of N-[3-(trimethoxysilyl)propyl]diethylenetriamine on silica particles', *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 377, (1-3), 20-27, 2011
- Chipfunhu, D, Zanin, M & Grano, S, 'The dependency of the critical contact angle for flotation on particle size - Modelling the limits of fine particle flotation', *Minerals Engineering*, 24, (1), 50-57, 2011
- Del Castillo, LA, Onishi, S & Horn, RG, 'Inhibition of bubble coalescence: Effects of salt concentration and speed of approach', *Journal of Colloid and Interface Science*, 356, (1), 316-324, 2011
- Del Castillo, LA, Onishi, S, White, L, Carnie, SL & Horn, RG, 'Effect of disjoining pressure on terminal velocity of a bubble sliding along an inclined wall', *Journal of Colloid and Interface Science*, 364, (2), 505-511, 2011
- Desai, S, Shepherd, RL, Innis, PC, Murphy, P, Hall, C, Fabretto, R & Wallace, GG, 'Gel electrolytes with ionic liquid plasticiser for electrochromic devices', *Electrochimica Acta*, 56, 4408-4413, 2011
- Ding, L, Yang, G, Xia, F, Lenehan, C, Qian, G, McFadden, A, Brugger, J, Zhang, X, Chen, G & Pring, A, 'A LA-ICP-MS sulphide calibration standard based on a chalcogenide glass', *Mineralogical Magazine*, 75, (2), 279-287, 2011
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Prostate Cancer Foundation of Australia
Southern Cross University
University of Newcastle
University of New South Wales

Western Australia

CSIRO Minerals
Magotteaux Australia Pty Ltd
Newcrest Resources Inc
ZBB Technologies Ltd

Queensland

Australian Coal Association Research
Program
Consolidated Tin Mines Limited
CSIRO Livestock Industries
Nano-Nouvelle Pty Ltd
Queensland University of Technology
University of Queensland
Wound Management Innovation CRC
Xstrata Copper Ltd
Xstrata Technology
Xstrata Zinc Australia

