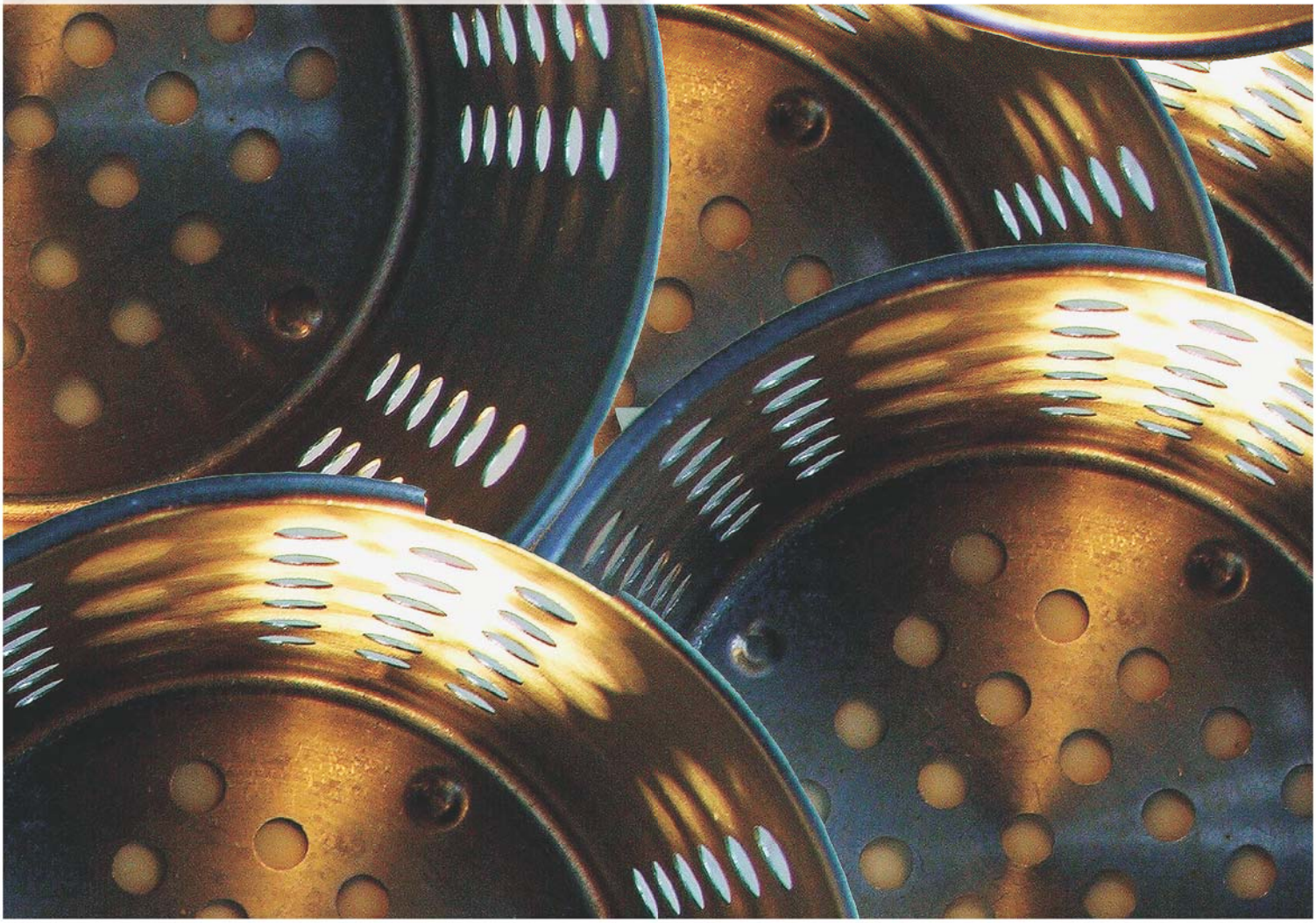
BAOSTEEL-AUSTRALIA
JOINT RESEARCH AND DEVELOPMENT CENTRE

annual report 2011–12



BAOSTEEL

UNSW THE UNIVERSITY OF NEW SOUTH WALES · MONASH University · University of Wollongong · The University Of Queensland AUSTRALIA

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COVER IMAGE *Stainless steel*
The design is based on a photo of a stainless steel cutlery container, cloned to make a collage.

executive reports

> *The Centre is a 'win-win' initiative because it enhances the capacity of our partner universities to conduct innovative research in fields of interest to Baosteel*

FOREWORD
CHAIRMAN, BAOSTEEL GROUP CORPORATION

The Baosteel-Australia Joint Research and Development Centre (BAJC) is a world-first joint venture between Baosteel and four of Australia's leading universities, the University of Queensland, The University of New South Wales, Monash University and the University of Wollongong.

As Baosteel's first research and development centre located outside China, the Centre was launched in April 2011. It is regarded by the company as a milestone, because it provides us with a key platform to promote our central strategic goal of globalisation through collaboration.

Already one of the world's largest steel companies, Baosteel is a growing manufacturing enterprise. Like other companies in the international manufacturing sector, Baosteel must meet the growing 21st century challenges of improving efficiency, value creation for its stakeholders and sustainable practice in all of its activities.

However, Baosteel knows that whereever there are challenges, there are opportunities, and that investment in advanced research and development holds the key to future technological discoveries that will benefit the company, its customers and its university partners.

The Centre is a 'win-win' initiative because it enhances the capacity of our partner universities to conduct innovative research in fields of interest to Baosteel such as advanced materials and manufacturing technology, resources utilisation, energy saving and efficiency, and environmental technology.

By seeking to create fundamental knowledge and exploitable technologies with commercial relevance to the steel industry, this research will invigorate Baosteel by developing new technologies of significance for the company's longer term strategic development and business activities.

The Centre is also forging enduring partnerships between Baosteel and its partner universities that will deliver the company a competitive edge in sustainable development.

By embedding Baosteel into the Australian research and education sector, the Centre is taking us beyond being just a trade corporation consuming Australian iron ore and coal and supplying steel products to Australia, but more importantly, a genuine investor and partner in long-term Australian development and prosperity.

Mr Lejiang XU
Chairman
Baosteel Group Corporation

Baosteel is delighted to be a partner in this venture with the Universities of Queensland, NSW, Monash and Wollongong. I believe Baosteel's commitment to a long-term relationship with the four Australian universities will deliver outstanding, high-impact research, and new technologies that will advance our sustainable industry practices for the benefit of people wherever we operate around the world.

BAJC BOARD CHAIRMEN'S REPORT

Chairman of the Board
Professor Jinghai Li
Vice-President
Chinese Academy of Sciences

Co-chairman of the Board
Professor Max Lu FTSE
Senior Deputy Vice-Chancellor
The University of Queensland

First and foremost, we want to thank Baosteel for its tremendous support and generous sponsorship of the Baosteel-Australia Joint R&D Centre (BAJC).

As we review the BAJC's first year of operations, it is pleasing to see how rapidly this partnership has grown. In just over 12 months, the Centre has grown from the seed of an idea into a fully-fledged, working organisation that is overseeing an innovative research program.

In 2011, the Board and the Technical Advisory Committee established the Centre's management team and launched the first round of projects. Shortly, we will formally approve the second round of projects. This is an outstanding result which could not have been achieved without immense good will between Baosteel and our four Australian university research partners. We would like to pay particular tribute to President Pijun Zhang and his colleagues in the Baosteel Research Institute for their support, and to Centre Director Professor Victor Rudolph, Deputy Director Associate Professor Geoff Wang and the Technical Advisory Committee chaired by Professor Aibing Yu for their excellent leadership and hard work. Already, the Centre is gaining wide recognition for setting a new benchmark for successful international industry- research collaboration.

The University of Queensland was proud to host the launch of the Centre in April 2011, at an official ceremony attended by a high-level government and business delegation from the People's Republic of China. The guests included His Excellency Mr Qinglin Jia, Chairman of the National Committee of the Chinese People's Political Consultative Conference, Baosteel Group Chairman Mr Xu Lejiang, and a number of senior Baosteel executives. Mr Xu signed the agreement between Baosteel and the participating Universities to establish the Centre. One of our main priorities is to leverage Baosteel's funding to access additional funding support, especially through Australian Research Council (ARC) Linkage Projects. It is very pleasing to note that we have already had some success, with a Round One project attracting an AU$575,000 ARC funding grant. We are hopeful that other projects will be successful in the next ARC Linkage announcement, which is imminent.

Baosteel's establishment of the BAJC in partnership with four top Australian universities gives Australian researchers a valuable opportunity to further enhance their international reputation for high-quality research that creates new fundamental knowledge and exploitable technologies for the steel and associated industries.

The Centre's record of achievement in its first year has laid the foundation for an outstanding future. We offer our best wishes to all BAJC managers and project researchers, and look forward to another productive and rewarding year in 2012-2013.

"As the Centre's suite of projects grows, it will seek to integrate experimental and fundamental science, theory and computational modeling to advance technologies in industry sectors of interest to Baosteel that create value and improve our world"

BAJC DIRECTOR'S REPORT

It is just over a year since the BAJC was launched in April 2011, and already the Centre has attracted a total research commitment of over $16.75 million in project funding.

This comprises a cash investment of $5.35 million from Baosteel for 2012-2014, along with cash and in-kind contributions of $11.4 million from the partner institutions.

Remarkable progress has been made over the past few very hectic months. By July 2011, the Centre's organisational arrangements were settled and an initial 13 projects selected from a strong field of applications. Contractual obligations were completed by the end of last year, and all projects started by the beginning of 2012. While they are still in the startup phase, innovative research is already being conducted which holds great commercial promise for Baosteel.

All this was only made possible by the dedicated efforts of a large number of people, including the members of the BAJC Board, the Technical Advisory Committee, and management and support staff at Boasteel and the Universities, who delivered under extremely tight deadlines. Adding to the challenge, project application timelines have been very short and the applicants have been wonderfully responsive in accommodating what must at times have seemed like extreme demands from the BAJC management group.

The momentum will continue over the next few months, as we focus on actively seeking to leverage Baosteel's generous cash grants against other grant opportunities, to increase the size of the research support pool available to researchers and post-graduate students.

The next tranche of projects will be awarded in July 2013 and made ready to start in early 2014. As the Centre's suite of projects grows, it will seek to integrate experimental and fundamental science, theory and computational modeling to advance technologies in industry sectors of interest to Baosteel that create value and improve our world. It is our researchers' commitment to excellence, their creativity and the calibre of their work that will ensure the BAJC's success.

Professor Victor Rudolph
Centre Director
School of Chemical Engineering
The University of Queensland

Planning is now advanced for the 2012 BAJC Conference to be held in Brisbane in December 2012. It will provide a valuable opportunity for the Board, TAC members, research participants and new project recruits to exchange knowledge and ideas.

I look forward to using this occasion to meet up with the many who have made the Centre possible, and those who are contributing to its ongoing success. It will be an honour to thank you all in person.

about the Centre

ABOUT US

The Baosteel-Australia Joint Research and Development Centre is a world-first joint venture between Baosteel, one of the world's largest steel companies, and four leading Australian universities, to conduct research and to provide innovative technologies in areas of interest to Baosteel. It seeks to create an enduring collaboration between Baosteel and the University of Queensland, the University of New South Wales, Monash University and the University of Wollongong.

PARTNERSHIPS

- Baoshan Iron and Steel Corporation Ltd (Baosteel)
- Monash University
- The University of Queensland
- University of New South Wales
- University of Wollongong

MISSION

The mission of the Centre is, through an enduring partnership, to explore and develop new knowledge and technologies in areas of particular significance for Baosteel's longer-term strategic development and business activities.

The Centre's headquarters are located within the University of Queensland's School of Chemical Engineering, Faculty of Engineering, Architecture and Information Technology (EAIT).

PURPOSE

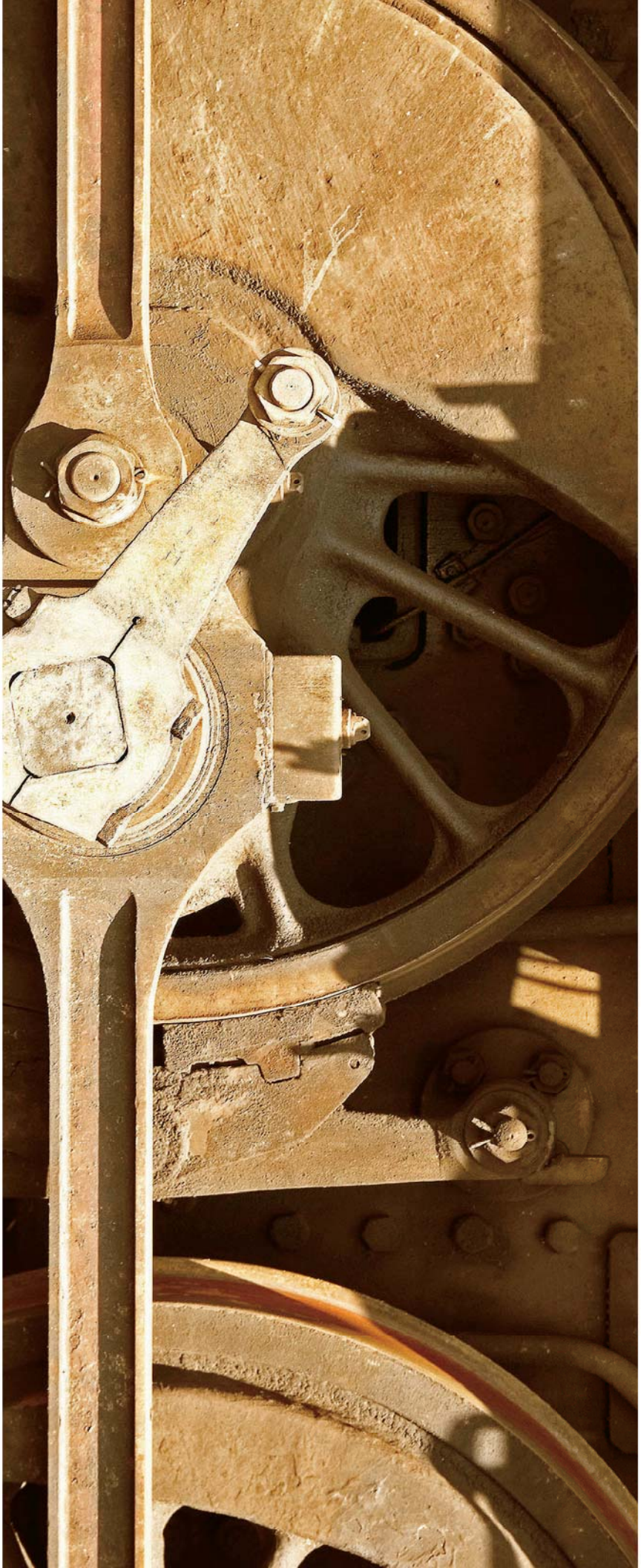
The purpose of the Centre is to create an internationally-recognised centre of research excellence, by harnessing and developing existing and emerging talent within the participant institutes, to fulfill the mission of the Centre.

AIMS

- Conduct strategic research supporting Baosteel's business interests, in approved priority themes including innovative materials, new energy, resource ultilisation and advanced environmental technologies
- Provide strategic consultancies and technical advice for Baosteel's long-term sustainable development.
- Promote the application of innovative technologies for the development of new, high value and low carbon products
- Provide a platform for Baosteel to access the international technical and personnel recruitment marketplace.
- Strengthen academic/technical exchanges between Baosteel and the Australian partner universities, and provide access to other innovations within these universities which may be of interest to Baosteel.

GOVERNANCE

The Baosteel-Australia Research and Development Centre (BAJC) is governed by the Board, which is responsible for setting priority strategic research themes, overseeing the Centre's annual budget, and approving project funding proposals made by the Technical Advisory Committee. The Board also provides guidance and oversight to the Centre Management Team. The Centre's governance structure is laid out in the BAJC agreement between Baosteel and the four Australian partner universities.



THE CENTRE BOARD

The Centre Board is responsible for setting priority and strategic research themes, annual budget, funding rules, approval of project funding. It will provide guidance and oversight to the Centre management team.

The Centre Board consists of 9 representatives, comprising Co-Chairs appointed by Baosteel and the University of Queensland, 4 members from Baosteel including the Board Chair, 2 from UQ including the Co-Chair and the Centre Director, and 1 each from other Participating Institutions. The Centre Deputy Director, who serves as the Centre Board Secretary, and Chair of the Technical Advisory Committee (TAC), have observer status.

PICTURED ABOVE:
Top row from left: Professor Jinghai Li, Professor G.Q. Max Lu, Dr Pijun Zhang, Professor Victor Rudolph, Professor Judy Raper
Bottom row from left: Professor Tam Sridhar, Dr Warwick Dawson, Dr Laizhu Jiang, Dr Jian Yang, Professor Aibing Yu, Assoc Professor Geoff Wang

Professor Jinghai Li
Board Co-Chair
Vice President of Chinese Academy of Sciences
Institute of Process Engineering
Beijing, China

Professor G.Q. Max Lu
Board Co-Chair
Senior Deputy Vice-Chancellor
The University of Queensland

Dr Pijun Zhang
President of Baosteel Research Institute (R&D Centre)
Baoshan Iron and Steel Co. Ltd

Professor Victor Rudolph
Centre Director
School of Chemical Engineering
The University of Queensland

Professor Judy Raper
Deputy Vice-Chancellor (Research)
University of Wollongong
Executive Director
Australian Institute of Innovative Materials

Professor Tam Sridhar
Dean
Faculty of Engineering
Monash University

Dr Warwick Dawson
Director of Research
University of New South Wales

Dr Laizhu Jiang
Senior Chief Engineer
Vice President of Baosteel Research Institute (R&D Center)
Baoshan Iron and Steel Co. Ltd

Dr Jian Yang
Senior Chief Engineer
Baosteel Research Institute
(R&D Center)
Baoshan Iron and Steel Co. Ltd

Professor Aibing Yu (observer)
Federation Fellow and Scientia Professor
Chair of the Technical Advisory Committee
University of New South Wales

Assoc Professor Geoff Wang (observer)
Board Secretary
Centre Deputy Director
School of Chemical Engineering
The University of Queensland

TECHNICAL ADVISORY COMMITTEE

The Technical Advisory Committee (TAC) consists of a Chair, four internationally recognised Australian based academics and experts recommended by the Participating Institutions and approved by the Centre Board, and four technical liaison advisors appointed by Baosteel.

The Chair of the TAC was jointly nominated by Baosteel and UQ and approved by the Centre Board. The main role of the TAC is to conduct technical assessments on the research proposals and makes recommendations for funding to be approved by the Centre Board, and provide technical advice to Baosteel.

PICTURED ABOVE:
Top row from left: Professor Aibing Yu, Dr Pijun Zhang, Professor Shi Xue Dou, Professor David St John, Professor Ian Gentle.
Bottom row from left: Emeritus Professor David Young, Professor Yuri Estrin, Professor Xinhua Wu, Dr Laizhu Jiang, Dr Jian Yang

Professor Aibing Yu
Federation Fellow and Scientia Professor
TAC Chair
School of Materials Science & Engineering
University of New South Wales

Dr Pijun ZHANG
President of Baosteel Research Institute (R&D Centre)
Baoshan Iron and Steel Co. Ltd

Professor Shi Xue Dou
Faculty of Engineering
Director, Institute for superconducting and Electronic Materials
University of Wollongong

Professor David St John
(Replaced by Professor Ian Gentle from 1 April 2012)
Director, Centre for Advanced Materials Processing and Manufacturing
Faculty of Engineering, Architecture and Information Technology
The University of Queensland

Professor Ian Gentle (from 1 April 2012)
School of Chemistry and Molecular Biosciences
The University of Queensland

Emeritus Professor David Young
School of Materials Science & Engineering
University of New South Wales

Professor Yuri Estrin
Department of Materials Engineering
Faculty of Engineering
Monash University

Professor Xinhua Wu
Department of Materials Engineering
Faculty of Engineering
Monash University

Dr Laizhu Jiang
Senior Chief Engineer
Vice President of Baosteel Research Institute (R&D Center)
Baoshan Iron and Steel Co. Ltd

Dr Jian Yang
Senior Chief Engineer
Baosteel Research Institute (R&D Center)
Baoshan Iron and Steel Co. Ltd

MANAGEMENT TEAM

The management team, comprising the Director, a Deputy Director, Baosteel coordinator and an Administrative Officer, is responsible for project call-for-proposals, project coordination and facilitation, project meetings, reporting, budgetary management and IP management.

It provides reporting and secretariat services to the Centre Board, including organising Centre Board meetings and documentation. The management team of the Centre is also responsible for organising the meetings of the Technical Advisory Committee and Centre annual conference, website and hosting visits from Baosteel personnel.

Professor Victor Rudolph

Centre Director
The University of Queensland

Assoc Professor Geoff Wang

Centre Deputy Director
The University of Queensland

Mr Yongzhu Ma

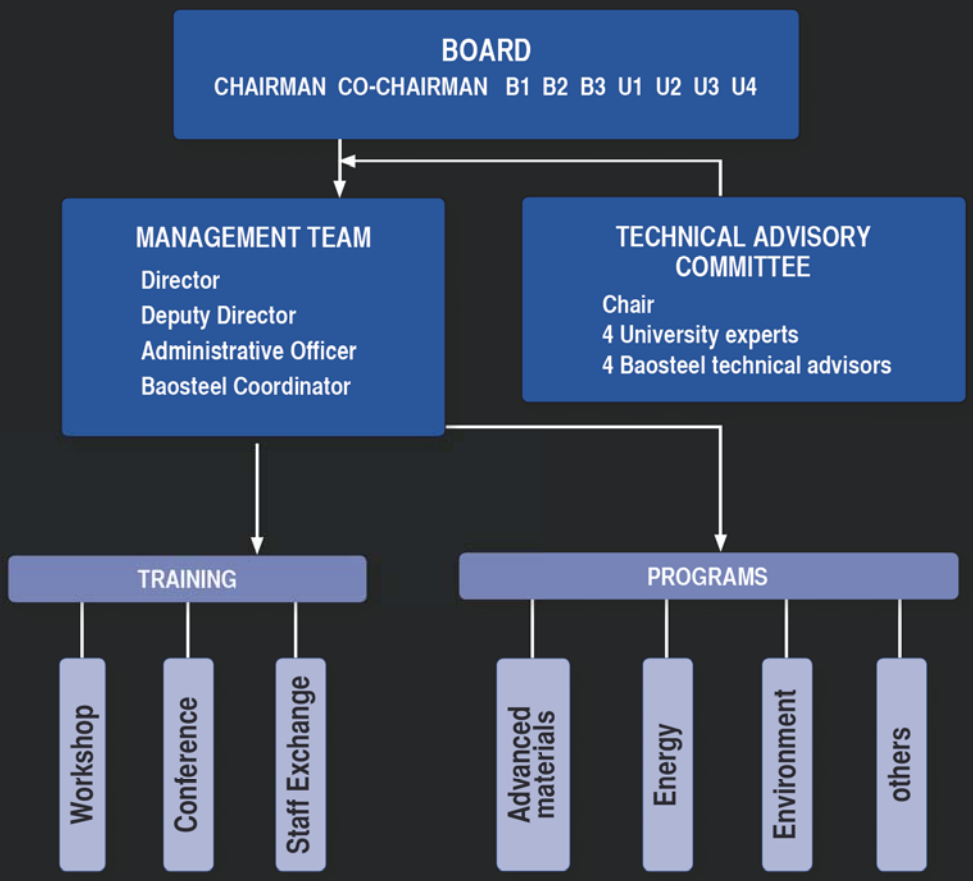
Baosteel Coordinator
Research Engineer
Baosteel Research Institute
(R&D Center)
Baoshan Iron and Steel Co. Ltd

Ms Grace Cheng

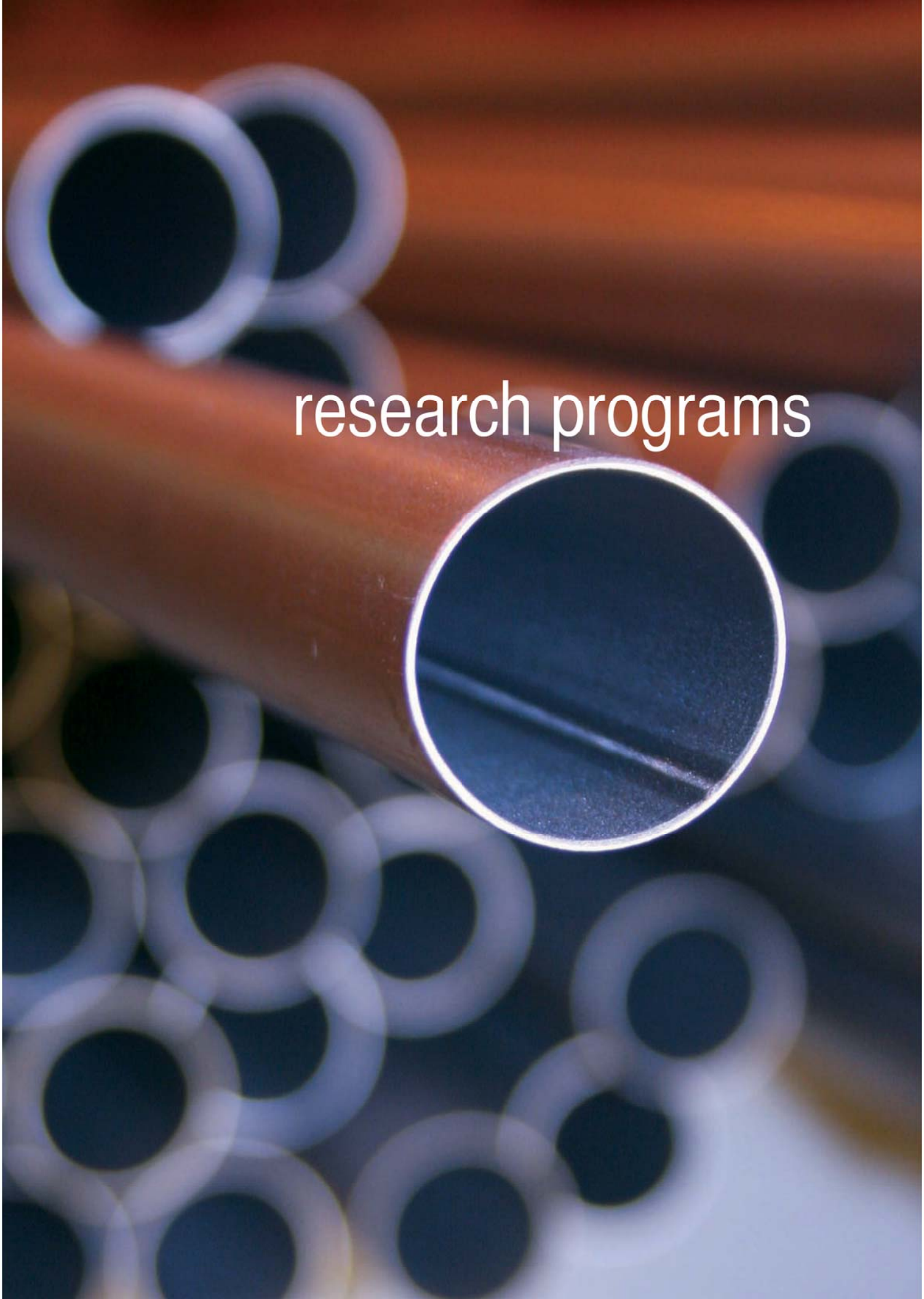
Administrative Officer
The University of Queensland

PICTURED ABOVE:
Top row from left: Professor Victor Rudolph, Assoc Professor Geoff Wang
Bottom row from left: Mr Yongzhu Ma, Ms Grace Cheng

BAOSTEEL-AUSTRALIA ORGANISATIONAL STRUCTURE



B1–B3: Baosteel board appointments U1–U4: University partners board appointments


research programs

PROJECT SUMMARY: BAJC CASH FUNDING

PROJECTS FUNDED*
(12 projects in 2011, $5.35m (over 3 years))

Project	No
Materials for energy storage	2
Li batteries	1
Thermo-electric materials	1
Light metals	3
Ferrous metal manufacturing	2
Modelling metallurgical processes	2
Flue gas treatment/utilisation	1

* 2 have received additional funding; another being finalised

FUNDING DISTRIBUTIONS BASED ON FIELDS/THEMES

	Field/theme	Fund	%
1	Materials	$3,375,000	63.08
2	Energy	$1,315,000	24.58
3	Environment	$440,000	8.22
4	Other	$220,000	4.11
	TOTAL	**$5,350,000**	**100.00**

FUNDING DISTRIBUTIONS BASED ON PARTNER INSTITUTIONS

	Total	%	Y1	Y2	Y3
UNSW	$1,389,200	25.97	$530,000	$530,000	$329,200
MU	$1,802,000	33.68	$627,000	$617,000	$558,000
UoW	$1,130,000	21.14	$420,000	$420,000	$290,800
UQ	$1,028,000	19.21	$373,000	$373,000	$282,000
Sum	**$5,350,000**	**100.00**	**$1,950,000**	**$1,940,000**	**$1,460,000**
	Annual Proportion		0.36	0.36	0.28

PROJECT DETAILS

project title

Modelling and optimisation of iron-making processes in Baosteel

project leader

Professor Aibing Yu

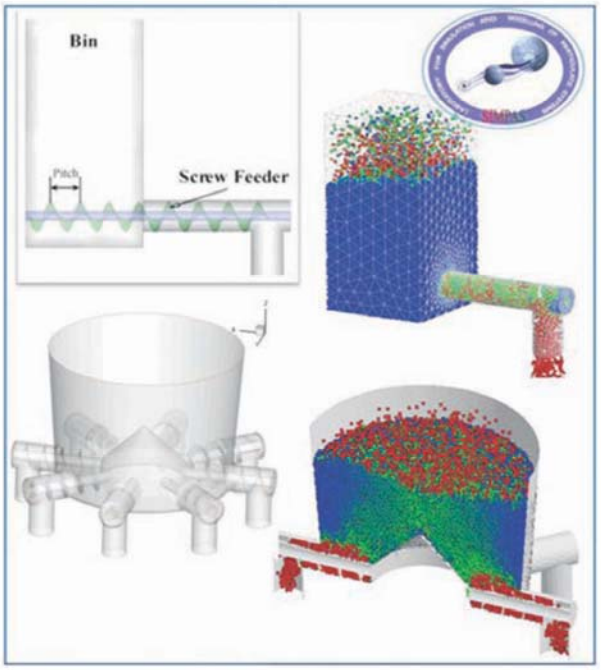
Phone +61 (0)2 9385 4429
Email a.yu@unsw.edu.au

Laboratory for Simulation and Modelling of Particulate Systems (SIMPAS)
School of Materials Science and Engineering
University of New South Wales

Project (BA11009)

PRINCIPAL RESEARCHERS

Dr Shibo Kuang
Dr Qinfu Hou



TECHNICAL OBJECTIVES

This project aims to understand and model the fundamentals governing the multiphase flow and thermochemical behaviour in ironmaking processes including blast furnace (BF) and COREX. It will (1) develop and validate computer models to reliably describe BF and COREX ironmaking processes, (2) investigate the effects of key variables related to raw materials, operational and geometrical conditions, and (3) formulate and test strategies for the design, control and/or optimisation of BF or COREX ironmaking processes under different conditions.

INDUSTRY BENEFITS

By answering fundamental questions about BF and COREX, and identifying strategies to control problems, the outcomes may lead to industrial benefits such as an extended life campaign, better operational control, decreased fuel consumption, improved productivity, and reduced CO2 emission.

HIGHLIGHTS AND ACHIEVEMENTS

- 01/09/2011: Project commenced.
- 16/11/2011: Submitted ARC LP grant application, with financial support from Baosteel and Rio Tinto.
- 15/06/2012: Progress to date includes two parts with respect to BF and COREX processes. For the first part, we have refined our existing BF model for its application to Baosteel BFs by extending the model capability and examining the validity of the extended model. For the second part, as suggested by Baosteel, a simple screw feeding model is first developed and validated for investigating the flow problem related to screw feeder and understanding the effectS of various variables. Then, a full-scale Reduction Shaft model will be developed to simulate solid flow with some preliminary tests conducted.

TOTAL PROJECT VALUE

AU$ 1,780,080

project title

Waste heat recovery from steelworks using advanced thermo-electrical (TE) materials and generator technology

project leader

Professor Shi Xue Dou

Phone +61 (0)2 4221 4558
Email shi_dou@uow.edu.au

Faculty of Engineering
Director
Institute for superconducting and Electronic Materials
University of Wollongong

Project (BA11011)

PRINCIPAL RESEARCHERS

Prof. S.S. Li

Prof. Chao Zhang

RESEARCHERS

Dr S. Aminorroaya

Dr G. Peleckis

POSTGRADUATE STUDENTS

Mr T. Katkus

Ms P. Jood

TECHNICAL OBJECTIVES

Thermo-electrical energy conversion offers an opportunity for efficient capture of waste heat in the steel-making process, providing appropriate TE modules are developed for energy harvesting at high temperatures. This projects seeks to develop TE modules capable in conversion of such energy into electricity in harsh steel works environment. It will investigate, develop and optimise bulk TE modules based on both semiconductor alloys and oxide materials, which have the most potential for efficient energy conversion at high temperatures on industrial scale.

INDUSTRY BENEFITS

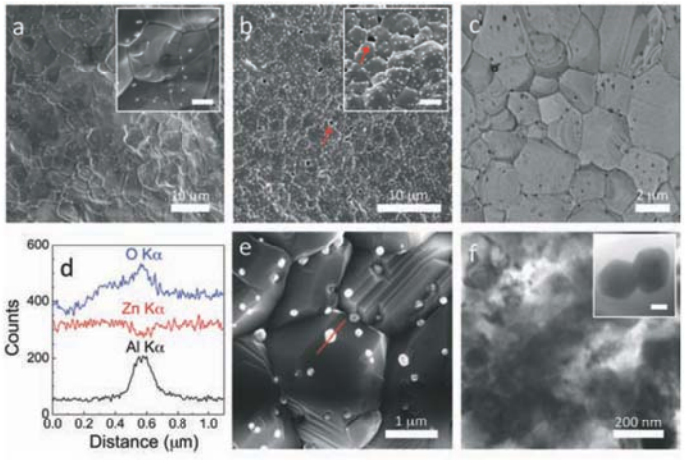
This project will enable Baosteel to become an industry leader in energy-efficient steel manufacturing by using TE power modules and generators to harvest waste energy, cutting its carbon footprint and energy costs.

HIGHLIGHTS AND ACHIEVEMENTS

- Project commenced. August 2011
- Equipment installations. November 2011: ISEM purchased and installed state-of-the-art high temperature Seebeck coefficient and electrical conductivity measurement system (Ozawa Science, RZ2001i)
- Equipment installations: April 2012. ISEM's thermoelectric processing infrastructure was extended by installation of Linseis LSR-3 Seebeck coefficient measurement system and LFA 1000 thermal conductivity measurement system.
- Equipment installation: April 2012. ISEM installed a 10 tonn, 4000 A spark plasma sintering system. The system will allow fabrication of extremely dense thermoelectric materials.
- Personnel: June 2012. ISEM finalised recruitment of two research fellows, Dr Z. Li and Dr J. S. Im.
- Equipment development: June 2012. Critical structural components for home-built TE module testing system were manufactured. The equipment is undergoing final assembly.
- Research: January/June 2012. California Institute of Technology. Improved TE properties were observed in nanostructured PbTe-PbS system.
- Publications: Results of preliminary work on zinc oxide thermoelectric material were published (P. Jood, Nano Letters 11, 4337 (2011); P. Jood, Journal of Materials Research, in print, 2012).

TOTAL PROJECT VALUE

AU$ 1,184,490



project title

Study of homogenisation and recrystallisation effects in forged Ti- 64 ingot and research in powder HIPping (Hot Isostatic Pressing) of Ti-64 powder

project leader

Professor Xinhua Wu

Phone +61 (0)3 990 55247
Email xinhua.wu@monash.edu

ARC Centre of Excellence for Design in Light Metals
Department of Materials Engineering
Faculty of Engineering
Monash University

Project (BA11002)

PRINCIPAL RESEARCHERS

Prof. Chris Davies
Dr Colleen Bettles

POSTGRADUATE STUDENT

Mr Kai Zhang

TECHNICAL OBJECTIVES

Ti-6Al-4V (Ti-64) is a candidate titanium alloy to replace high strength steel in aircraft applications. This substitution can provide considerable weight savings and lower maintenance costs, due to the lower density and higher corrosion resistance of Ti alloys over steel. However, the processing routes can be complex, and therefore costly, and the properties obtained are highly microstructure sensitive. Furthermore, in larger components, there are problems around non-uniformity. This project aims to improve the homogeneity of Ti-6Al-4V (Ti-64) alloys, gain a satisfactory understanding of industrial-scale Ti-6-4 billet processing and the mechanical properties of of Ti-64 billets and HIPped Ti-64 powder materials, and deliver the know-how to achieve fatigue properties in HIPped Ti-64 powder material equivalent to forged ingots. It will apply experimentation and modelling to investigate the recrystallisation behaviour of largeTi-64 billet and Ti-64HIPped powder under different strain distributions, with different thermal histories.

INDUSTRY BENEFITS

As a participant in China's key national 'large aircraft' scientific project, Baosteel is interested in developing improved landing gear materials. This project aims to improve the quality and lower the commercial production costs of Ti -64 alloys, enabling potential weight savings of more than 500 kg in commercial airliners, and manufacturing cost reductions of up to 50 per cent.

HIGHLIGHTS AND ACHIEVEMENTS

- January 2012: Project commenced.
- January 2012: Commenced research into grain structure of Ti-6-4 ingot material.
- March 2012: Commenced research on the microstructural and compositional characterisation of another Ti alloy, as requested by Baosteel.
- April 2012: Received forged Ti-6Al-4V ingot from Baosteel and commenced microstructural characterisation of this material.

TOTAL PROJECT VALUE

AU$ 1,875,100

project title

Development of highly formable magnesium sheet

project leader

Professor Jian-Feng Nie

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Email jianfeng.nie@monash.edu

Department of Materials Engineering
Faculty of Engineering
Monash University

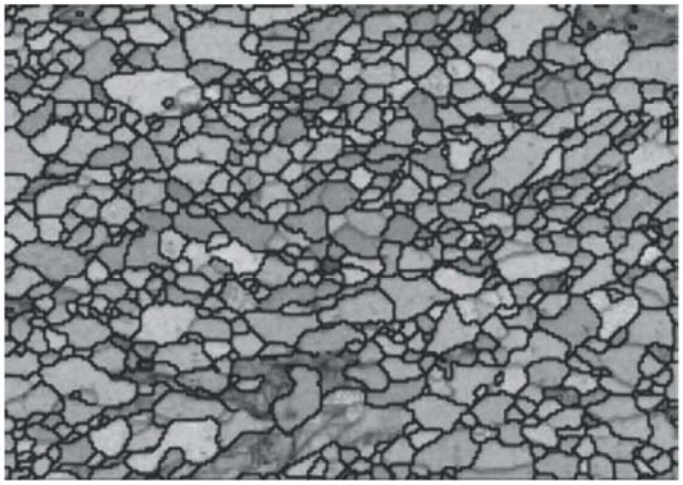
Project (BA11003)

PRINCIPAL RESEARCHERS

Prof. Chris Davies
Assoc. Prof. Nick Birbilis

POSTGRADUATE STUDENTS

Mr Zhuoran Zeng
Mr Xiaojian Xia



TECHNICAL OBJECTIVES

One of the technical problems restricting the use of magnesium sheet alloy is that it is difficult to form it at temperatures below 150 degrees C. This project aims to deliver a cost-effective magnesium alloy, that has superior formability, and thermo-mechanical processing parameters, for fabricating stronger, highly-formable and corrosion-resistant magnesium sheet at near room temperatures with satisfactory environmental performance and coatability. The research will involve processing, characterisation and evaluation of micro-alloyed Mg-Zn-Gd, Mg-Zn-Ca and Mg-Ca-Zn materials that are produced under different alloy compositions and thermo-mechanical processing conditions.

INDUSTRY BENEFITS

This project is strategically and commercially important for establishing Baosteel as a producer of value-added lightweight magnesium sheet products for use in the automotive, rail transport and computer industries. The project will also advance Australia's research capacity, and promises to boost international demand for Australian magnesite.

HIGHLIGHTS AND ACHIEVEMENTS

- August 2011: Project commenced.
- August 2011: Zhuoran Zeng (first-class honours) started his PhD, with the support of Monash Graduate Scholarship and International Postgraduate Research Scholarship.
- October 2011: Xiaojian Xia (first-class honours) started his PhD, with the support of Monash Graduate Scholarship.
- November 2011: Completed alloy casting
- November 2011: Submitted ARC Linkage grant proposal.
- December 2011: Completed preliminary processing, evaluation and characterisation of alloy samples.
- March 2012: Identified promising alloy composition for fabricating formable magnesium alloy sheet.
- May 2012: Identified an outstanding postdoc for this project.

TOTAL PROJECT VALUE

AU$ 1,695,059

project title

Scalable production of graphene-based bulk nanomaterials for advanced energy storage

project leader

Professor Dan Li

Phone +61 (0)3 9905 9673
Email dan.li2@monash.edu

Department of Materials Engineering
Faculty of Engineering
Monash University

Project (BA11006)

PRINCIPAL RESEARCHERS
Prof. George Simon
Dr Zhe Liu

RESEARCH FELLOW
Dr Yanzhe Wu

TECHNICAL OBJECTIVES

The project aims to address the industrial challenges inherent in the cost effective and scalable production of graphene and its bulk assembly for the high performance energy storage devices. The key technical objectives include; the exfoliation of graphite into corrugated graphene sheets, the processing of exfoliated graphene into thin films and the assembly of graphene thin films into a new generation of energy storage devices with high performance.

INDUSTRY BENEFITS

The project will develop patentable new technologies for the emerging, highly profitable energy storage market, providing Baosteel with an opportunity to open up a new portfolio of high value-added products for the clean energy sector.

HIGHLIGHTS AND ACHIEVEMENTS

- January 2012 Project commenced.
- June 2012: Completed initial proof of principle of processing route.
- Commenced research into the direct exfoliation of pristine graphite to graphene nanosheets.
- Methodologies identified involving sonication, solvent and continuous processing of graphite to graphene nanomaterial.
- Commenced experimental research on the optimisation of relevant parameters.

TOTAL PROJECT VALUE

AU$ 1,152,038

project title

Innovative approaches to investigating the formation of thin-gauge metallic strip directly from the molten state

project leader

Professor Michael Ferry

Phone +61 (0)2 9385 4453
Email m.ferry@unsw.edu.au

School of Materials Science and Engineering
University of New South Wales

Project (BA11001)

PRINCIPAL RESEARCHERS

Dr Kevin Laws
Dr Zakaria Quadir

RESEARCH FELLOW

Dr Wanqiang (Martin) Xu

TECHNICAL OBJECTIVES

Twin roll casting (TRC) is a complex net-shape casting process that produces thin-gauge metallic strip directly from molten steel alloy. However, the process makes it difficult to alter critical variables that occur during manufacture. This project seeks to understand and control the development of the microstructures and subsequent properties they generate that cause flaws of the final product. It will use a powerful substrate immersion research technique, coupled with laboratory-scale pilot plant TRC experiments, to investigate the effect of key processing parameters on the development of as-cast structures and reduce defects in various types of metallic strip.

INDUSTRY BENEFITS

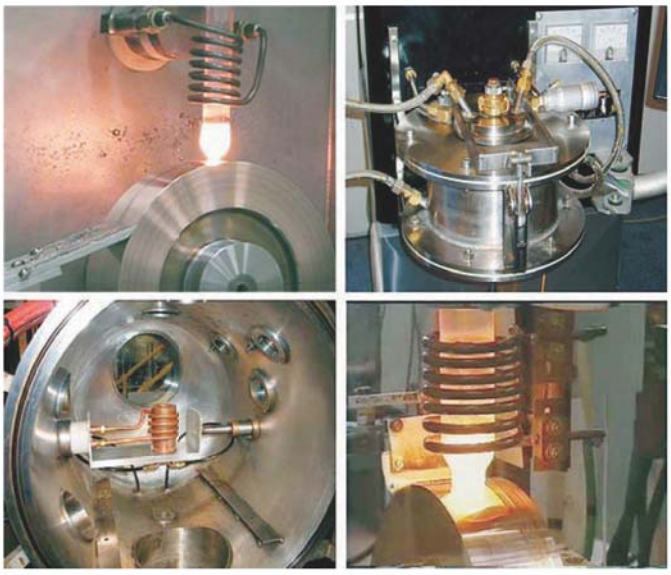
Metallic sheet production has an estimated annual global market of over US$1 trillion in the construction, automotive, packaging, aircraft and aerospace industries. The project will identify more efficient processes to manufacture high-quality sheets from metals and alloys of specific interest to Baosteel.

HIGHLIGHTS AND ACHIEVEMENTS

- 7-8 November 2011: Initial UNSW 2011/2012 Baostrip research team meeting.
- January 2012: Project formally commenced.
- Jan-May 2012: Dr Xu of UNSW's School of Materials joined the project, and has conducted a detailed structural analysis of TRC steel strip.
- 21 May 2012: Resulting technical report presented to Baostrip Research team.

TOTAL PROJECT VALUE

AU$ 1,415,572



project title

Creating a viable titanium business for Baosteel – Enabling low cost fabrication of high performance titanium and its alloys from powder

project leader

Associate Professor Ma Qian

Phone +61 (0)7 3365 4185
Email ma.qian@uq.edu.au

School of Mechanical Engineering
The University of Queensland

Project (BA11014)

PRINCIPAL RESEARCHERS

Dr Ming Yan
Dr Peng Yu
Prof. Graham B Schaffer
Prof. Xinhua Wu

POSTGRADUATE STUDENTS

Commencing October 2012

TECHNICAL OBJECTIVES

Commercial applications of Ti alloys are limited because of the high cost of producing quality Ti alloys and products. This project seeks to develop commercially viable, lower-cost, medium to high-strength titanium alloys, by applying advanced alloy design and manufacturing technologies to enable the fabrication of high-performance Ti products from inexpensive Ti powder.

INDUSTRY BENEFITS

Research outcomes will provide Baosteel with the fundamental knowledge and unique technology to manufacture low-cost, high performance Ti products for a wide range of applications in the automotive, marine engineering, medical, chemical processing and other industries.

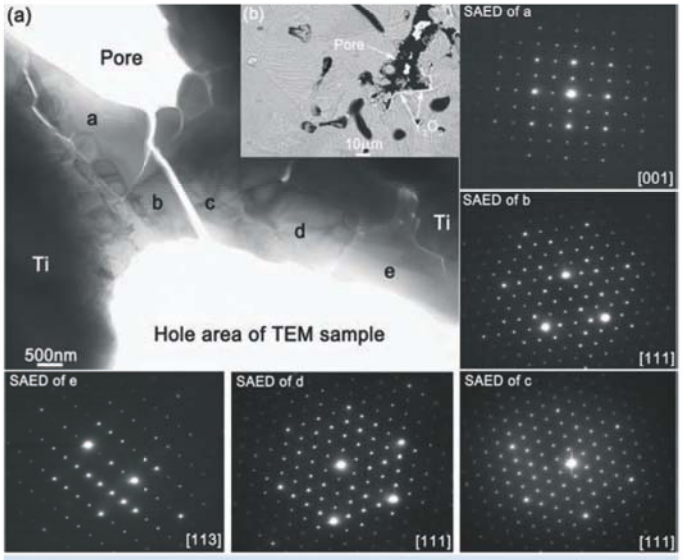
HIGHLIGHTS AND ACHIEVEMENTS

2012: Project commenced.

- 1 January 2012: Conducted fundamental research on scavenging oxygen from inexpensive Ti powder during sintering.
- 15 April 2012: Applied findings of the above research to preliminary fabrication of net-shaped small complex Ti parts using a commercial metal injection moulding machine.

TOTAL PROJECT VALUE

AU$ 780,620



As-sintered Ti-1.5Fe-2.25Mo-0.6Y

project title

Advanced materials for new-generation high energy storage

project leader

Professor Ian Gentle

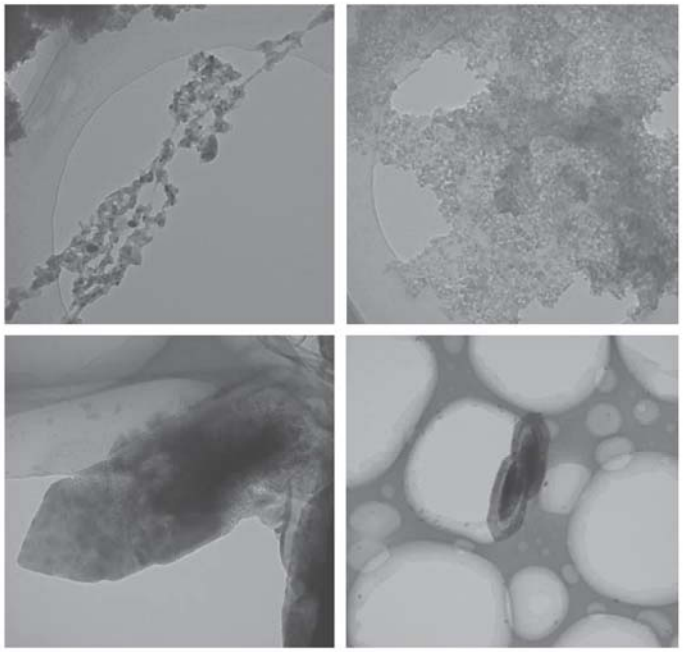
Phone +61 (0)7 3365 4800
Email i.gentle@uq.edu.au

Surface Chemistry Group
School of Chemistry and Molecular Biosciences
The University of Queensland

Project (BA11016)

PRINCIPAL RESEARCHERS
Dr Da-Wei Wang

POSTGRADUATE STUDENTS
Mr Kuang-Hsu (Tim) Wu
Mr Qingcong Zeng



TECHNICAL OBJECTIVES

New-generation lithium-sulphur batteries (LSBs) promise to be a safer, cheaper, environmentally-friendly replacement for lithium-ion batteries, but have not been commercialised mainly due to the low number of charge-discharge cycles. This project aims to produce carbon-supported sulphur cathodes with excellent stability and high specific energy, and incorporate them into practical high-energy LSBs. Using innovative LSB technology developed at UQ, a novel class of core-shell structured carbon particles with a mesoporous core and a microporous shell will be created, to enhance the energy and stability of the sulphur cathode.

INDUSTRY BENEFITS

The high-performance cathode material to be developed in this project promises breakthroughs in the commercialisation and use of LSBs for clean energy storage and supply, particularly for use in electric vehicles. Other potential applications of the research include backup power for wind and solar power plants, and emergency power for disaster areas. A successful outcome will help position Baosteel as a leader in clean energy technology research and development.

HIGHLIGHTS AND ACHIEVEMENTS

- December 2011: Project commenced.
- Feb-May 2012: Impregnation of sulphur in the mesoporous voids of commercial carbon particles by carbon disulphide method.
- June 2012: Prepared multi-shell conducting polymer/carbon/sulphur particles by chemical grafting to oxidised carbon particles.
- June 2012: Stability over 300+ cycles demonstrated for test cathodes using both commercial and multi-shell cathode samples in coin cells.

TOTAL PROJECT VALUE

AU$ 1,100,322

project title

Hybrid composite metal laminates with designed cores for high manufacturability

project leader

Professor Mark Hoffman

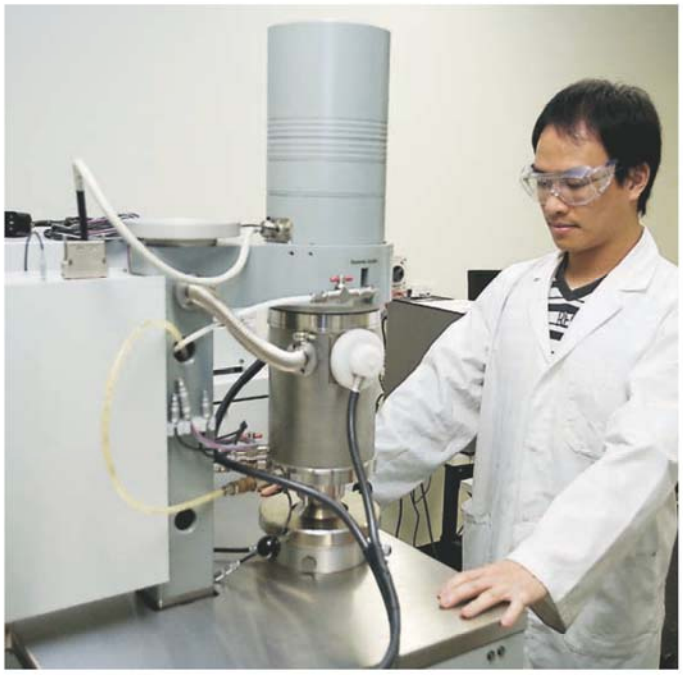
Phone +61 (0)2 9385 4432
Email mark.hoffman@unsw.edu.au

School of Materials Science and Engineering
University of New South Wales

Project (BA11018)

PRINCIPAL RESEARCHER
Dr Tania Vodenitcharova

POSTGRADUATE STUDENTS
To be appointed



TECHNICAL OBJECTIVES

This project aims to develop new, cost-effective light-weight metal laminate materials with high strength and formability. The research will address current formability problems by designing lattice cores which enable the material to be shaped into panels with high strength to weight ratios. Truss core architecture will be topologically designed, and core-sheet bonding investigated using computational simulation techniques to create optimised truss elements, ascertain post-deformation behaviour, and develop bonding techniques.

INDUSTRY BENEFITS

This project promises Baosteel significant opportunities in the metal manufacturing sector. Potential commercial applications of the research include light-weight, high-strength and -stiffness materials which could be used to manufactures as flooring and cabin structures for trains and high-speed ferries, aeroplane flooring and internal frames, and motor vehicle chassis. These products promise to deliver significant improvements in passenger safety and comfort and greater fuel efficiency.

HIGHLIGHTS AND ACHIEVEMENTS

- 2011: Project commenced.
- 18 November 2011: UNSW project team visited Baosteel and held discussions with Baosteel Automobile Steel Research Centre to help identify key research priorities.
- 15 June 2012: Produced a report on project architecture.
- 1 March – 15 June 2012: Undertook finite element modelling to identify yield and buckling points of metal-core foam laminates.

TOTAL PROJECT VALUE

AU$ 1,069,780

project title

Control strategies of surface quality of stainless steels

project leader

Professor Zhengyi Jiang

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Email jiang@uow.edu.au

School of Mechanical, Materials and Mechatronic Engineering
University of Wollongong

Project (BA11017)

PRINCIPAL RESEARCHER
Dr Dongbin Wei

POSTDOCTORAL FELLOW
Dr Jingwei Zhao

POSTGRADUATE STUDENTS
Ms Xiawei Cheng
Mr Liang Hao

TECHNICAL OBJECTIVES

This project aims to investigate and solve the problem of common surface defects in stainless steels, such as cracking and deep marks in continuously cast slab, and surface oxidisation, which occur during the production process. The project will conduct fundamental research into these problems, focusing on the rolling processes, and develop effective control strategies to improve the quality of stainless steels. Research will include physical simulation tests at UOW's high-tech facilities, and industrial tests at Baosteel.

INDUSTRY BENEFITS

By identifying the causes of surface defects in stainless steel products and developing improved and optimum hot and cold rolling processes, this project will improve quality and reduce the production costs of Baosteel's high-tech, value-added products including stainless steel strips and plates.

HIGHLIGHTS AND ACHIEVEMENTS

- October 2011: Project commenced.
- March 2012 Detailed research plan and primary experimental scheme finalised.
- May 2012 First batch of samples manufactured by Baosteel and delivered to UOW.
- May 2012 Rig to simulate oxidation behaviour during hot strip rolling successfully designed and manufactured, for delivery to UOW in June 2012.

TOTAL PROJECT VALUE

AU$ 1,234,686

project title

Identifying pathways to step change improvements in energy efficiencies and reduced CO_2 emissions through the use of innovative chemistries for iron-making

project leader

Professor Peter Hayes

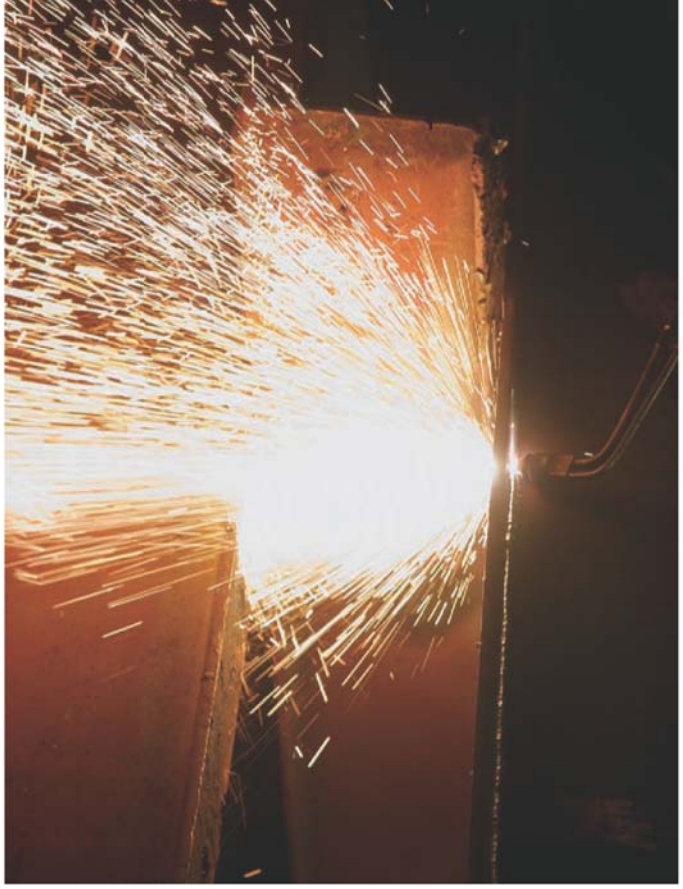
Phone +61 (0)7 3365 3551
Email p.hayes@uq.edu.au

Pyrometallurgy Research Centre
School of Chemical Engineering
The University of Queensland

Project (BA11012)

PRINCIPAL RESEARCHERS

Prof. Evgueni Jak



TECHNICAL OBJECTIVES

Iron-making is the most energy-intensive process in steel manufacturing. The aim of this project is to enhance the thermal and chemical efficiency of iron- making by improving the outcomes of a key first step, sintering of the iron ores. Experimental studies will be undertaken to provide fundamental information on the chemical phase equilibria under sinter production conditions. The data will be used to predict the crystal phases that will form during sintering, which will help optimise sinter plant and blast furnace performance.

INDUSTRY BENEFITS

By establishing the fundamental chemical processes that occur during sintering, this project will assist Baosteel to optimise the efficiency and environmental sustainability of its commercial iron-making operations. It will fill major gaps in the scientific knowledge base that will enable Baosteel to practically apply the research outcomes to a wide range of ore sources, process chemistries and temperatures.

HIGHLIGHTS AND ACHIEVEMENTS

- July 2011: Project commenced.
- September 2012: Postgraduate research student identified and will commence studies at UQ.

TOTAL PROJECT VALUE

AU$ 1,100,322

project title

Ethanol from blast furnace offgas (via ARC-L project – Nano and microscale engineering of MoS_2-based catalyst for conversion of syngas to ethanol)

project leader

Dr Jorge Beltramini

Phone +61 (0)7 3346 3803
Email jorgeb@uq.edu.au

ARC Center of Excellence for Functional Naomaterials
Australian Institute for Bioengineering and Nanotechnology (AIBN)
The University of Queensland

Project (BALP1100)

PRINCIPAL RESEARCHERS

Prof. G. Lu
Prof. V. Rudolph
Assoc. Prof. G. Wang

RESEARCH FELLOW

Dr Jiuling Chen
Dr Muxina Konarova

TECHNICAL OBJECTIVES

Steel-making produces large quantities of residual H2 and CO, which can be converted into value-added commercial ethanol if problems achieving suitably high yields, selectivity and product market value are overcome. This project addresses these issues through innovations directed at: (a) high selectivity through new catalyst development; (b) very close control of the reaction temperature using high thermal conductivity, geometrically structured catalyst support; and (c) microchannel reactor architecture for high throughput. It will capitalise on new advances in micro-process systems, new membrane reactors and the development of new syngas to ethanol catalysts.

INDUSTRY BENEFITS

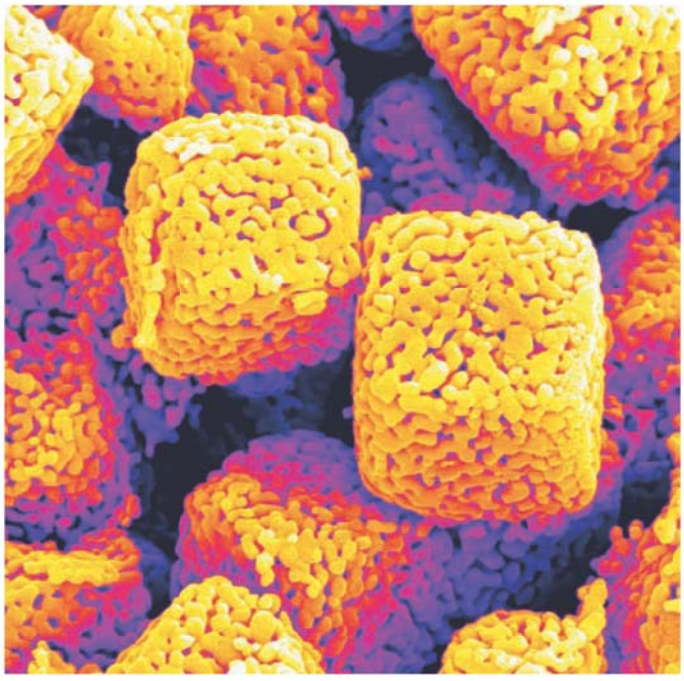
The project promises to enable Baosteel to convert syngas into commercially–viable ethanol for use as a substitute for petrol, offering the company significant new opportunities in the global transport fuel market.

HIGHLIGHTS AND ACHIEVEMENTS

- January 2012: Project commenced.
- 2010: Approved by ARC
- October 2011: Baoshan Iron & Steel confirmed as the project's industry partner.
- December 2011: Built a high-pressure reaction rig to test the catalysts at pressures of up to 6.5 MPa.
- December 2011: Tested two recently-developed $NiMoS_2$-2 and $CoMoS_2$-2 catalysts at Dalian Institute of Chemical Physics at the Chinese Academy of Sciences.
- June 2012: Conducted a series of other catalyst tests, including the development of a novel method for MoS_2 catalysts synthesis.
- Project received an ARC-LP grant of $575,000.

TOTAL PROJECT VALUE

AU$ 2,380,342



financial report

FINANCIAL SUMMARY

Financial Statement for the period from 07 April 2011 to 30 June 2012

BAJC Grantors

Baoshan Iron & Steel Co Ltd
The University of Queensland
The University of New South Wales
Monash University
University of Wollongong

INCOME (CASH)

Grant and Collaborative Research		
	Baosteel R & D Fund	1,950,000
	Baosteel management support	312,000
	The University of New South Wales management support	50,000
	Monash University management support	50,000
	University of Wollongong management support	50,000
	The University of Queensland management support	100,000
	The University of Queensland – refurbishment for BAJC Office	283,730
	Total Cash from partners	2,795,730
	ARC Linkage Grants	92,500

INCOME (IN-KIND SUPPORT)

Approved projects 2011-12		
	Baosteel	75,000
	The University of New South Wales	1,053,928
	Monash University	965,112
	University of Wollongong	381,288
	The University of Queensland	1,192,320
	Total In-kind Contribution	3,667,648
TOTAL INCOME (INCLUDING CASH FUND)		**6,555,878**

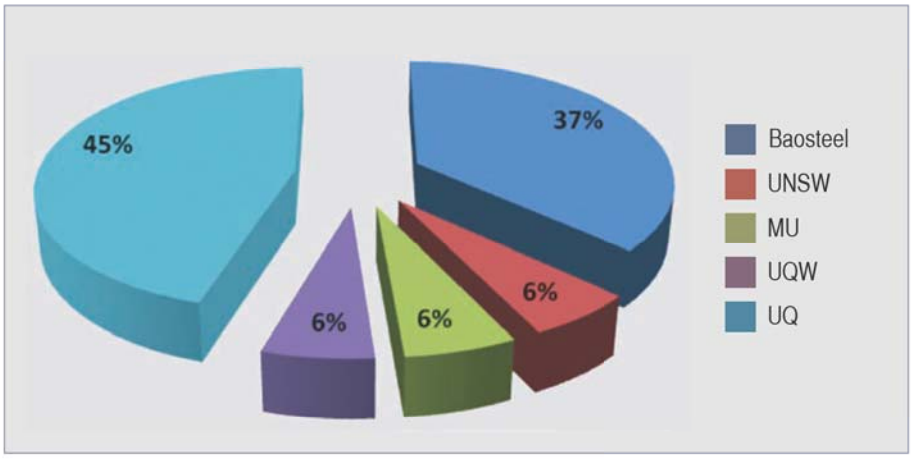
Financial Statement (continued)

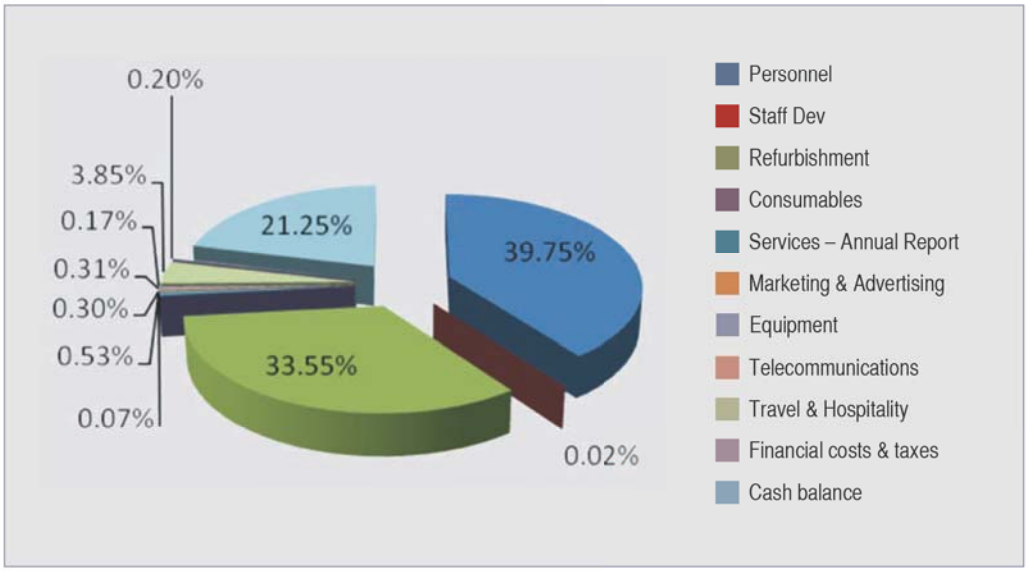
EXPENDITURES

Grant and Collaborative Research		
	Payment in **cash** to collaborative approved projects **	950,000
	Allocated **in-kind fund** to collaborative approved projects	3,667,648
	Allocated **ARC Linkage fund**	92,500
Baosteel Centre – Management		
	Salaries	336,186
	Staff costs	150
	Building facilities charges for BAJC new office refurbishment	283,730
	Consumables (stationery, printing)	587
	Services (Professional consultancy)	5,040
	Marketing & Advertising	2,528
	Equipment for Office	2,664
	Telecommunications	1,504
	Travel and Hospitality**	32,558
	Financial costs & taxes	1,697
	Total Expenditure (including Grant & research fund allocation)	**5,376,827**
Operating Result**	**Cash Balance as at 30 June, 2012****	**1,179,051**

**Note: Cash balance includes 2012 distribution cash fund $1m to be paid to BAJC approved projects.
Travel and Hospitality (excluding BAJC end of 2012 BAJC annual conference expenses)

BAJC Operation Fund 2011–2012





PROJECT FUNDS

RESEARCH FUND – CASH

Cash Funding Sources	
Baosteel R & D Fund	1,950,000
ARC Linkage Grants – leveraged	92,500
Total Cash	**2,042,500**
Funding Distributions	
BA110001 - UNSW	75,000
BA110002 - MU	125,000
BA110003 - MU	100,000
BA110006 - MU	75,000
BA110009 - UNSW	125,000
BA110011 - UOW	125,000
BA110012 - UQ	100,000
BA110014 - UQ	0
BA110016 - UQ	75,000
BA110017 - UOW	100,000
BA110018 - UNSW	50,000
BALP1100 - UQ via ARC-LP	92,500
Total cash allocation	**1,042,500**
Cash Balance as at 30 June, 2012	**1,000,000**

Cash balance includes 2012 distribution cash fund of $1m to be paid to BAJC approved projects (invoiced in June 2012).

ALLOCATION OF TOTAL GRANT FUNDING BETWEEN PARTICIPANT INSTITUTIONS (BAJC Fund only)

	2011/12 Budget	YTD Actual
The University of Queensland	400,000	175,000
The University of New South Wales	500,000	250,000
Monash University	600,000	300,000
University of Wollongong	450,000	225,000
Total	**1,950,000**	**950,000**

$1m fund (Budget-YTD) being paid to BAJC approved projects (invoiced in June 2012)

IN-KIND FOR PROJECTS

RESEARCH FUND – IN-KIND CONTRIBUTIONS (based on Project Scopes)

Baosteel	75,000
The University of New South Wales	1,053,928
Monash University	965,112
University of Wollongong	381,288
The University of Queensland	1,192,320
Total In-kind Contributions	**3,667,648**

CONTACT DETAILS

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Deputy Director: Associate Professor Geoff Wang

Admin Officer: Ms Grace Cheng

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