

# Materials ARC Grants at UoW 2005

## Discovery Grants

**Chief Investigator(s):** Prof RJ Dippenaar  
Dr L Strezov  
Dr DJ Phelan

2005 \$	2006 \$	2007 \$	Total \$
\$75,000	\$73,000	\$75,000	<b>\$223,000</b>

**Project Title:** Competitive nucleation and growth during rapid solidification of steel

**Category:** 2913—METALLURGY

**Project Summary:** This research will assist in maintaining Australia at the forefront of research into strip casting of steel. Fundamental understanding and new modelling capabilities will help to promote the take-up of this energy/emission/cost efficient revolutionary process. It will furthermore provide, through the development of a novel experimental technique, new research capabilities for Australian researchers in other fields such as rapid solidification of advanced materials, e.g. hard magnets and thermoelectric alloys.

**Australian Postdoctoral Fellow:** Dr DJ Phelan

**Chief Investigator(s):** Dr AI Minett

2005 \$	2006 \$	2007 \$	2008 \$	2009 \$	Total \$
\$150,000	\$135,000	\$140,000	\$140,000	\$140,000	<b>\$705,000</b>

**Project Title:** Novel Carbon Nanotube Composite Materials: Elucidation of key properties for device development

**Category:** 2918—INTERDISCIPLINARY ENGINEERING

**Project Summary:** As the former co-director of CSIRO Nanotechnology indicated to the Sydney Morning Herald in 2003, 'Nanotechnology will lead us into a very different future.' The proposed research on nanomaterial interactions and biomolecular incorporation protocols will provide a foundation for future bioelectronic devices. Imagine healthcare of human diseases when nanocomponents enable the design of new platforms for devices that give point-of-care diagnosis, or the impact on the semiconductor industry with the creation of flexible electronics. Educational outreach is an important aim of the project, providing effective research training for early career researchers.

**Queen Elizabeth II Fellow:** Dr AI Minett

**Chief Investigator(s):** Dr AV Pan  
Mr S Zhou  
Dr Y Genenko  
Prof TH Johansen

2005 \$	2006 \$	2007 \$	Total \$
\$120,000	\$115,000	\$100,000	<b>\$335,000</b>

**Project Title:** Development of new technology for coated conductors able to carry "over-critical" current densities

**Category:** 2914—MATERIALS ENGINEERING

**Project Summary:** The superconductivity phenomenon has extremely attractive feature, that superconductors can carry non-dissipative currents, enabling us to reduce energy consumption by up to 50%. The new advanced method suggested in this project might give a new, fresh and inexpensive boost to not only domestic superconducting industry, but also worldwide. The development of new high performance superconductor technology would significantly promote fundamental understanding and knowledge of the poorly investigated "long-range" magnetic interaction between magnetic and superconducting materials. The University of Wollongong would lead the world research community in this practically important and scientifically intriguing area.

**Australian Postdoctoral Fellow:** Mr S Zhou

**Chief Investigator(s):** A/Prof GM Spinks  
Prof HR Brown

2005 \$	2006 \$	2007 \$	Total \$
\$95,000	\$75,000	\$80,000	<b>\$250,000</b>

**Project Title:** Single molecule actuators.

**Category:** 2914—MATERIALS ENGINEERING

**Project Summary:** The study of actuation processes in single molecules will lead to the development of improved advanced materials for Australian industry and, ultimately, to the more futuristic and exciting nanotechnologies. The research will improve our understanding of how polymer artificial muscles function, so that these materials can be further developed to meet the demand from industry. Applications include biomedical devices, robotic applicators and various machine parts. In addition, the research will also contribute to one of the greatest promises of nanotechnology: the development of molecular machines. We will demonstrate the mechanical forces and movements possible from single molecules so that the design of useful nano-machines can begin.

**Chief Investigator(s):** Prof GG Wallace  
Dr J Chen  
Dr GF Swiegers

2005 \$	2006 \$	2007 \$	Total \$
\$129,000	\$116,000	\$116,000	<b>\$361,000</b>

**Project Title:** Supported Molecular Catalysts for Methanol Oxidation and Other Reactions

**Category:** 2501—PHYSICAL CHEMISTRY (INCL. STRUCTURAL)

**Project Summary:** Knowledge arising from these fundamental studies has the potential to place Australia at the forefront of this important area of materials science and catalysis. We expect to make discoveries that will be useful not only in the area of catalysts for the direct methanol fuel cell, but also in systematising and developing the whole field of bio-mimetic supported electrocatalysts. Relevant findings in these exciting areas will be relayed to researchers and commercialised where appropriate. This multidisciplinary project will also provide an excellent environment for research training.

**Chief** Dr G Wang

**Investigator(s):** Dr KK Konstantinov  
Prof Dr J Ahn  
Dr XQ Yang  
Dr Z Xiao

2005 \$	2006 \$	2007 \$	Total \$
\$80,000	\$78,000	\$80,000	<b>\$238,000</b>

**Project Title:** Synthesis of nanowires and application as nanosensors for chemical and biological detections

**Category:** 2914—MATERIALS ENGINEERING

**Project Summary:** This project is expected to bring significant scientific, economic and social benefits. We will develop a number of techniques for the controlled growth of nanowires and making functional nanoscale systems such as nanosensors. The nanosensors will have important applications in chemistry and biology. Some chemical species can be detected by nanosensors on molecular scale. The nanosensors could be used for early diagnostics of cancer disease, detection of viruses, and genomic DNA screening. The nanosensors could also provide a molecular tool for probing living cells without destroying them, through which we can track life within cells in real time.

**Chief Investigator(s):** Dr X Wang

2005 \$	2006 \$	2007 \$	2008 \$	2009 \$	Total \$
\$210,000	\$210,000	\$210,000	\$120,000	\$120,000	<b>\$870,000</b>

**Project Title:** Exploration for new materials for spintronics

**Category:** 2914—MATERIALS ENGINEERING

**Project Summary:** The scope for use of spintronic materials in practical applications will be enormous and there will be a huge market for spintronic devices. In fact, giant magnetoresistance spintronic materials are already used in practical applications such as magnetic recording and storage devices. The success of this project will certainly lead to a discovery of novel magnetic semiconductor spintronic materials and better understanding of spin dependent magnetic interactions. It will enhance the international competitiveness and export power of Australian industry in the areas of information technology, quantum computing, magnetic recording and magneto-electronics.

**Queen Elizabeth II Fellow** Dr X Wang

## ***Linkage Projects***

**Chief Investigator(s):** Prof SX DOU; Dr MJ Qin; Dr AV Pan; Dr X Wang; Prof EW Collings

2005 \$	2006 \$	2007 \$	Total \$
\$169,612	\$170,861	\$174,831	<b>\$515,304</b>

**APA(I) Awards:** 2

**Industry Partner(s):** Hyper Tech Research Inc  
Alphatech International Ltd

**Title:** Development of Magnesium Diboride Superconductor Wires with High Upper Critical Field for MRI Applications

**Category:** 2914—MATERIALS ENGINEERING

**Summary:** The aim of the program is to demonstrate the superconducting magnesium diboride (MgB<sub>2</sub>) wires with improved upper critical field (H<sub>c2</sub>) appropriate for large-scale applications. The basic idea will be based on the two-gap superconductivity to add well-distributed impurities which will act as scatterers, increasing resistivity, and thus H<sub>c2</sub>. The core innovation of this proposal is based on the recent breakthrough in MgB<sub>2</sub> that was made by the CIs through nano-SiC particle doping, which achieved a record high H<sub>c2</sub> in bulk form and enhancement of critical current density, J<sub>c</sub>, in magnetic fields by an order of magnitude. The expected outcome is the development of superconducting MgB<sub>2</sub> wires and coils with high H<sub>c2</sub> and J<sub>c</sub> for MRI applications.