



A Brief Resume of the Academic and
Research Staff
in the
Department of Materials Engineering
Monash University
2008

Laure Bourgeois

Senior Research Fellow

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Dr. Laure Bourgeois' research interests revolve around the characterisation and modelling of nanometre-scale structures. The main characterisation tool used is high-resolution transmission electron microscopy. Current work focuses on the following topics:

- Crystallography of solid-state nuclei in precipitation-hardened aluminium alloys.
- Synthesis and structural characterisation of graphitic nanostructures.



Nick Birbilis

Senior Lecturer in Materials Engineering

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Dr. Birbilis' research interests include the broad areas of corrosion and corrosion control. Current focus is centred on microstructure-corrosion relationships, exploring the metallurgical factors that dictate localised corrosion initiation and propagation.

Interests lie in the areas of:

- Advanced electrochemical analysis, including electrochemical AFM/STM and transient techniques
- Kinetic stability of heterogeneous materials, such as aerospace alloys
- Fundamental characterisation of corrosion processes on the nano/micro-scale, employing high resolution microscopy
- Development of corrosion resistant light alloys
- Gradient structures
- Corrosion resistant coatings and claddings



Qi Zhi Chen

Senior Lecturer in Materials Engineering

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Dr Chen was previously employed by the University of Cambridge and the University of Hong Kong. During the course of her PhD studies at the Imperial College London, she independently pioneered a novel Bioglass®-derived scaffold for bone tissue engineering. This scaffold promises to go a long way towards clinical applications. Dr Chen has diverse research interests and is going to develop a multidisciplinary research group. Her current research activities/interests include, but are not limited to:

- **Bone tissue engineering.**
- **Myocardial tissue engineering.**
- **Dynamic Bioreactor.**
- **Nanobiotechnology**
 - Target-specific anti-cancer drug delivery
 - Non-viral gene delivery system
 - Dynamic imaging of a beating heart using magnetic resonance imaging (MRI) combined with nanosized magnetic particles



Yi-Bing Cheng

Professor in Ceramic Engineering

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Professor Cheng specialises in ceramics and composites. His research interests cover the areas of ceramic processing, microstructure development, phase characterisation, and materials applications in aggressive conditions. He has worked for a number of years in the development of non-oxide engineering ceramics and composites, especially sialons. His current research includes the development of nano-structured carbides and nitrides for applications at elevated temperatures. He is a chief investigator of the novel ceramic-polymer composites for fire-performance applications in the Cooperative Research Centre for Polymers. In recent years, he has been involved in the research of nano-TiO₂ based dye sensitive solar cells (DSSCs). His main interest is in the development of nanostructured electrodes to improve the solar cells' performance and manufacturing of flexible DSSCs on polymer substrates.



Wayne D. Cook

Professor in Materials Engineering

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Dr Cook's research interests deal with the relationships between polymer structure, reaction kinetics and mechanical, thermal, electrical and rheological properties. This work involves the investigation of well defined (and stable) materials to provide structure-property fundamentals and the extrapolation of this knowledge as the structure changes due to chemical, thermal, temporal or stress effects. The first research area is polymer networks in which three dimensional structures are formed by crosslinking reactions, often photo-induced. Another area deals with the mechanisms of yielding and methods of toughening of polymers. The third area is that of thermoplastic and/or thermoset polymer blends which studies the effect of the polymer-polymer interaction and processing conditions on the final morphology and properties of the blend. The last area deals with nano-structures in crosslinked polymers produced either by inclusion of nano-fillers into the polymer matrix or by the creation of nano-structures in the matrix by controlled polymerization techniques.

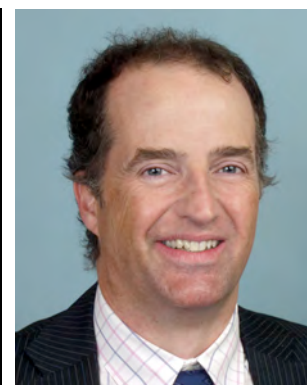
**Chris H. J. Davies**

Associate Professor in Materials Engineering

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Dr. Davies' research interests lie in the field of thermomechanical processing of metals. Always mindful of the product-process linkage, Dr. Davies tries to combine industrial relevance with the application of fundamental knowledge. The approach has led to the use of empirical and phenomenological models, and simulations in the following areas:

- Thermomechanical processing of magnesium alloys
- Microforming
- Microstructural evolution during heat treatment of aluminium alloy 7075
- Computer simulation of recrystallization



Mark Easton

Research Fellow CRC for Cast Metals Manufacturing

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The mechanical properties of polymeric materials and their selection and optimization for specific applications are the main areas of Dr. Edward's research. One particular focus is on the molecular morphology created by particular processing routes such as injection moulding or extrusion, and the effect on properties, to develop constitutive equations which are tractable for design use and which require only relatively simple experimental measurements to characterize a particular material.

Other areas of interest include the use of mechanical relaxation spectra to describe the materials time dependent properties novel ways of achieving high degrees of orientation and property anisotropy (including equal channel angular extrusion), the blending of polymers, the relationship between the microstructure and processing history of immiscible blends and the wear and frictional properties of polymers with industrial applications.

**Graham Edward**

Associate Professor in Materials Engineering

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Joanne Etheridge

Associate Professor

Director, Monash Centre for Electron Microscopy

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Dr Etheridge's research is in the theory of electron microscopy and diffraction and its application to the study of the atomic structure and defect structure of materials. Her research includes:

- The development of diffraction and imaging techniques which provide structural information with ultrahigh spatial resolution.
- The development of methods for the determination of the atomic structures of crystals that overcome the "phase problem" in crystallography.
- The application of electron microscopy to the determination of the local atomic structure of high temperature superconductors, ferroelectrics and related perovskites, with a view to understanding their macroscopic properties.



Yuri Estrin

Professor in Physical Metallurgy

(joint appointment with the ARC Centre of Excellence for Design in Light Metals and CSIRO Division of Materials Science and Engineering)

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Professor Estrin's research is concerned primarily with the mechanical properties of metallic materials, particularly with modelling their mechanical response by using fundamental concepts of crystal plasticity and dislocation theory. Through his involvement in the ARC Centre of Excellence for Design in Light Alloys and the CSIRO Division of Manufacturing and Materials Technology, he participates in various projects aiming at improving the properties of Al, Mg and Ti based light alloys. A particular focus of his research is on producing ultrafine grained light alloys with unique combinations of properties. Strength and plasticity of nanomaterials and their suitability for applications in hydrogen storage systems, surgical implants and micro-electro-mechanical systems (MEMS) are a further significant part of his work. Together with colleagues at UWA and international partners he is also developing novel, geometry-inspired designs of materials and structures with unusual combinations of properties.



John Forsythe

Senior Lecturer in Materials Engineering
Project Leader in the Cooperative Research Centre for Polymers

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Dr Forsythe's research activities focus on the synthesis and modification of novel biopolymers for use in tissue engineering and cell culture. In summary his research can be categorised as follows:

- "Smart" polymer bioconjugates
- Nano-fibrous electrospun scaffolds
- Interaction of stem cells on biopolymer substrates
- Surface modification of Ti implants
- Nano-fabrication of novel drug delivery systems
- UV-curable injectable hydrogels
- Neural Tissue engineering



Maria Forsyth

Professor in Materials Engineering

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Professor Forsyth's research interests revolve around the field of electromaterials science particularly with respect to understanding structure and transport in materials leading to the development of improved devices such as lithium batteries, solar cells etc and also to the control of corrosion processes in metals and metal alloys. Design and characterisation of new electrolyte materials including polymer electrolytes and gels, plastic crystals and ionic liquids are key areas of research in Professor Forsyth's group. Solid state NMR and pulsed field gradient diffusion NMR are primary materials characterisation tools in this work. Corrosion mitigation through control of charge transfer (via chemical surface treatment) at metal interface is a major interest along with corrosion inhibition and corrosion monitoring processes.



Christopher Hutchinson

Senior Lecturer in Materials Engineering

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My research is focused on two principle areas: i) the thermodynamics and kinetics of phase transformations and microstructural changes in the metallic solid state, and ii) the relationship between mechanical properties and microstructure of metals and alloys. This work contains both experimental and theoretical components with an emphasis on model development at the mesoscale. Current research activities can be classified under three topics:

- Recovery, Recrystallization and Grain Growth
- Phase Transformations
- Mechanical Properties

More recent evolving areas of research include the coupling of microstructure and corrosion in engineering alloys and the thermodynamics and kinetics of phase selection during the devitrification of metallic glasses for hard magnetic applications.



Patrick Howlett

Senior Research Fellow

ARC Centre of Excellence for Electromaterials Science
(ACES)

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Dr Howlett specializes in Ionic Liquids (ILs) and their interactions with reactive metal surfaces. His research has involved investigations of ILs as new electrolytes for rechargeable lithium batteries as well as for the generation of protective coatings on magnesium alloys. This research requires the use of electrochemical techniques and the design of electrochemical cells as well as surface characterization techniques such as XPS, ToF-SIMS, Raman, DR-FTIR micro-FTIR and solid-state NMR. Presently his work focuses on understanding the processes which are key in IL film generation to allow the design of new ILs for specific surfaces and applications.



Rimma Lapovok

Senior Research Fellow

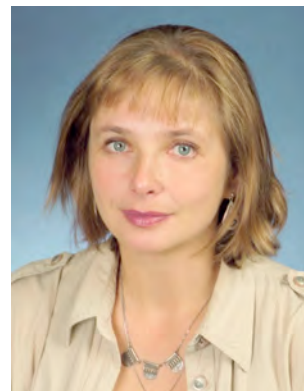
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Dr. Lapovok's research interests include:

- Novel properties of nano- and ultrafine grained light alloys produced by Equal Channel Angular Extrusion (ECAE);
- Constitutive modeling of materials behaviour and superplasticity;
- Micro- and macro models of damage mechanics in application to technological processes of deformation - forging, rolling, extrusion etc,
- FE simulation of non-isothermal plastic flow;
- Phenomenological theories of the fracture of metals.

Dr. Lapovok is a leader of NanoSPD Group (<http://www.nanospd.org/>) and several projects on processing and properties of Light Alloys by ECAE. Dr. Lapovok is a member of Australian Forging Group (AFG) and American TMS society She has also worked on projects on aluminium and magnesium alloys for CAST CRC.



Barry C. Muddle

Professor and Research Director, ARC Centre of Excellence for Design in Light Metals
ARC Federation Fellow

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Professor Muddle's current research interests include solid state phase transformations, interfaces in solids, fundamentals of heterogeneous nucleation, precipitation in and precipitation-hardening of advanced aluminium and magnesium alloys, and surface properties of the light metals. Continuing work on the fundamentals of phase transformations is accompanied by a focus on the evolution of microstructure in advanced aluminium, magnesium and titanium alloys and modelling of the processes of deformation and precipitation hardening in high strength alloys.

Professor Muddle's Federation Fellowship program is at the forefront of international research to determine the factors that control formation and stability of nanostructure in advanced light alloys and foreshadows a major initiative in the development of light metal hybrid structures with critical dimensions on the micro- and nanoscale.



Jien-Feng Nie

Reader in Materials Engineering

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Dr. Nie's research interests include design and development of advanced magnesium alloys, structure/property relationships in light alloys, crystallography of phase transformations in solids and application of electron microscopy and diffraction. His current research efforts include:

- Development of high strength and creep-resistant magnesium alloys
- Microstructures of twin-roll cast and hot-rolled magnesium sheets
- Nanostructured magnesium alloys for hydrogen storage applications
- Creep deformation mechanisms in magnesium alloys
- Strengthening mechanisms in magnesium and aluminium alloys
- Heterogeneous nucleation of strengthening precipitates in magnesium alloys
- Structure and migration of interphase boundaries in solid-solid phase transformations

He has projects supported by the ARC Centre of Excellence for Design in Light Metals and CAST Co-operative Research Centre.



Jenny Pringle

QEII Research Fellow

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Dr Pringle's research focuses on the use of ionic liquids and plastic crystals in dye-sensitised solar cells. Ionic liquids are a new type of solvent that can be non-flammable, non-volatile and very thermally and electrochemically stable, which makes them ideal replacements for volatile organic solvents. The use of ionic liquids or plastic crystals in solar cells would address the problems of solvent evaporation or leakage from solar cells.

We are also interested in the use of ionic liquids for the synthesis of conducting polymers, such as polypyrrole and polythiophene, and the use of these materials in solar cells. Making conducting polymers in ionic liquids can result in improved polymer properties such as morphology.

Dr Pringle is also interested in the use of solid state NMR techniques for the analysis of a wide range of materials.

This work is carried out in collaboration with the ARC Centre of Excellence for Electromaterials Science.



Jeffrey R. Sellar

Senior Lecturer in Materials Engineering

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Dr. Sellar's research centres at present on the relationship between the microstructure and engineering properties of stabilized zirconia (ZrO_2) alloys. The electron microscope is Dr. Sellar's chief 'tool of trade', but recourse to other techniques and modern developments in thermodynamics is often necessary in order to understand the remarkable variety of behaviour of zirconia, found in ceramic alloys. They are, for example, the toughest and hardest of the oxide structural ceramic materials and are able to withstand very severe industrial environments, with properties somewhat like steel. Although extremely resistant to the passage of heat and electricity, they are also able to conduct oxygen ions for applications such as fuel cells and exhaust emission sensors.

**George P. Simon**

Head of Department

Professor in Materials Engineering

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Professor Simon's research interests largely lie in the area of polymer nanocomposites, involving the incorporation of various nanomaterials into macromolecular systems. These include nanotubes, nanoclays, and nanoparticles of titania and silica, and they are included for purposes as diverse as opto-electronic applications, as high value materials in aerospace materials and for making improved solar cell devices. Modification of the materials by a range of methods is also being undertaken to improve their miscibility, adhesion and so on. Another class of interest has been the nano-silica cages, polymers which involve poly(silsesquioxane) (POSS) materials, for reinforcing and functional properties. Dendritic polymers (dendrimers or hyperbranched polymers) are also being studied alone and in blends, to understand the behaviour of these nanostructured materials and their unusual properties, compared to conventional polymers. Other materials also being investigated include liquid crystalline polymers, polymer blends and copolymers –with a view to understanding the relationship between molecular structure, processing and properties. Thermosetting polymers, and in particular toughening and modifying them, has also been an area of interest pursued over many years.



Kiyonori Suzuki

Senior Lecturer in Materials Engineering

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Dr Suzuki's research is primarily directed towards the magnetic properties of non-equilibrium and metastable materials, with particular emphasis placed on nanostructured materials for electromagnetic device applications. Major experimental techniques employed include melt-spinning, sputtering, neutron scattering/diffraction, electron microscopy, thermal analysis, ac-susceptometry and Mössbauer spectroscopy. Recent research topics are summarized as follows:

- Soft magnetic nanostructures with random anisotropy
- Exchange-coupled hard magnetic nanocomposites
- Spin-dependent magneto-transport properties
- Hydrogen storage and hydrogen permeation alloys
- Magnetic characterization of superparamagnetic bionanoparticles

**Peter F. Thomson**

Reader in Materials Engineering

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Dr. Thomson's research interests are in the experimental and numerical modelling of industrial metal working processes, especially of hot and cold rolling and sheet forming. Modelling provides a means of designing thermomechanical processing to produce specified properties. The interaction of macro- and micro- mechanics is especially emphasised in work on the dependence of constitutive behaviour on mode of deformation in hot working. Current research centres on development of processes for control of structure and properties of metals by methods of Severe Plastic Deformation.



Matthew Weyland

Senior Research Fellow

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Dr Weylands' research is centred on the design of experimental technique for transmission electron microscope. His research has pioneered the application of electron tomography for the 3D characterization of nanoscale materials. His current research areas include:

- Possibilities and challenges of Aberration corrected TEM/STEM.
- Atomic resolution 3D reconstruction.
- High resolution scanning transmission electron microscopy (STEM) and electron energy loss spectroscopy (EELS).



Bjørn Winther-Jensen

Senior Research Fellow in Materials Engineering

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Dr Winther-Jensen research interests are focused on two areas within polymer thin films.

Research and development of conducting polymers with high conductivity using chemical oxidative polymerisation methods. The research reaches from the fundamental understanding of the mechanism of conductivity in conjugated systems to implementation of conducting polymers in devices, methods for patterning and printing of conducting polymers and simplification of the production processes.

Surface modification of polymers, glass and metals using plasma-polymerisation for forming functional organic coatings. The use of ultra low power pulsed AC plasma allows formation of polymeric coatings with a very high degree of functionality and also gives control over the polymeric structure on a molecular level. Of special interest is the field of plasma co-polymerisation of monomers with different functionality and the characterisation of these coating as interface to biological systems.



Xiang Xiong

Research Fellow in Materials Engineering

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- Development of nanocomposite hard magnetic alloys, nanocrystalline soft magnetic alloys, and amorphous alloys
- Microstructural characterization using 3-dimensional atom probe (3DAP) and Transmission Electron Microscopy (TEM)
- Development of high performance of SmCo-based permanent magnets.

