FULLY-FUNDED PHD PROJECTS IN METALLURGY & CORROSION AVAILABLE NOW

LIVING IN MELBOURNE, AUSTRALIA AND THE RESEARCH ENVIRONMENT AT MONASH UNIVERSITY

Monash University is located in Melbourne, Australia. It is Australia's largest University, ranked in the top 50 universities in the world, and the Department of Materials Science & Engineering (MSE) is the top-ranked MSE department in Australia. The successful applicants will be embedded within the Metallurgy & Corrosion Cluster which consists of ~8 academic staff members, ~ 70 PhD students and 30 post-docs. Whilst the students will be directly supervised by the academics listed for each individual project, they become part of a highly collaborative and collegial cohort of researchers where communication and interaction with other researchers and sharing of expertise and experiences is highly valued. The Metallurgy & Corrosion Cluster at Monash especially values and encourages diversity in its participants – diversity in all senses of its meaning. We recognise and value the contribution to science that arises from different opinions, from people of different backgrounds and experiences, and try to encourage this at every opportunity. As a result, our PhD students become highly competent researchers with excellent communication and teamwork skills and are highly sought after for post-doc positions at the top research institutions in the word or future leaders in industry.

Metallurgy research Monash is one of the top-ranked fields of research at Monash and is one of the best known and highly ranked groups in the world (https://www.shanghairanking.com/rankings/gras/2020/RS0227). Monash has a wide range of world class infrastructure to support your research including the Monash Centre for Electron Microscopy (https://www.monash.edu/researchinfrastructure/mcem), the Monash X-Ray Platform (https://www.monash.edu/researchinfrastructure/x-ray), and co-located at Monash University is the Australian Synchrotron (https://www.ansto.gov.au/facilities/australian-synchrotron). All the facilities required for your project can be found at Monash.

Melbourne is the 2nd largest city in Australia, with a population of ~4.5 million and is frequently voted one of the most liveable cities in the world (https://www.invest.vic.gov.au/why-melbourne/a-worlds-livable-city). It is the arts and culture capital of Australia and Melbournians are passionate about food, coffee, culture and sport. Melbourne is a highly multicultural city and people from all around the world make Melbourne their home. This is reflected in the diverse cuisine and languages one can find when walking around Melbourne. Melbourne is a waterfront city located on Port Phillip Bay and intersected by gardens, walking and riding paths and within day trip driving distance to wine regions, surf beaches and countryside (the bush!). Melbourne hosts more than 5 large universities, leading to a large and lively student population and is the host to major international sporting events such as the Australian Open and the Australian Grand Prix.

MONASH University

PROJECT #1: THE DEVELOPMENT OF NEW LEAD-FREE BRASSES

Department of Materials Science and Engineering, Monash University (Melbourne, Australia)

Supervisors: Professor Christopher Hutchinson, Dr Sebastian Thomas
Application deadline: accepting applicants immediately
Fully Funded PhD Project: open to all nationalities

About the project

A key use of Brass in society is for the fabrication of fittings for plumbing applications. Under almost every house will be brass fittings in the water circulation systems. These fittings are usually manufactured by a series of thermo-mechanical processing steps: elevated temperature forging, heat treatments, machining, cold deformation, etc. For the last 30 yrs these were made from well-characterized and well-understood brasses containing ~33-39% zinc (Zn) and ~1.5-3.5% lead (Pb). The additions of Pb play a critical role in machinability.

In response to health concerns surrounding Pb leaching from brass plumbing fittings into drinking water, a new law was enacted in 2010 in California that limited Pb in brass plumbing fittings to a maximum of 0.25%. This law catalysed national interest surrounding Pb-free fittings and became USA national law in 2014. This law is now being replicated in many countries and is soon to be implemented in Australia.

The removal of the vast majority of Pb from plumbing brass has created huge challenges in the manufacturing of brass plumbing fittings and the last 5-10 years has seen the emergence of several new 'Pb-free' alloys. One of these new grades contains Silicon (Si) (e.g. 3-4%) and these brasses exhibit interesting properties but the microstructures are more complex than traditional brasses, have not been studied in detail or optimized with respect to composition and processing, and the optimum manufacturing steps are not yet well understood.

This project is focussed on the development of new Si-Brasses to replace Pb-containing Brasses for potable water applications. The project is a direct collaboration with a large Australian industrial partner based in Melbourne, Reliance Worldwide, who provides brass components throughout Australia and exports to both Nth America and Europe. The candidate will interact frequently with the industrial partner and will have the opportunity to visit the industrial processing sites in Melbourne.

Interested candidates:

This project is open to students of any nationality although the ability to obtain a student visa to enter Australia is required. The candidate should have a 1st class Undergraduate or Masters degree (or equivalent) in Materials Science and Engineering, Metallurgy or a related discipline. A strong background in metallurgy, microstructural characterisation and/or mechanical testing is advantageous.

To express an interest please provide: (1) a curriculum vitae (CV) including your academic transcripts, (2) a cover letter summarising your research interests and suitability for the position, and (3) the contact details of two referees.

Please send to: Professor Christopher Hutchinson – christopher.hutchinson@monash.edu, Dr Sebastian Thomas – sebastian.thomas@monash.edu

https://www.monash.edu/engineering/christopherhutchinson
https://www.monash.edu/engineering/sebastianthomas

Funding Notes:

This is a fully funded PhD project of 3.5 yrs duration. Reasonable relocation costs will be provided as well as student healthcare coverage for non-Australian citizens. The successful candidate will have the opportunity to participate in an international conference and a domestic conference as part of their candidature.

MONASH University

PROJECT #2: THE EFFECTS OF ATOMIC SCALE CLUSTERS ON THE STRENGTH AND PLASTICITY OF ALUMINIUM ALLOYS

Department of Materials Science and Engineering, Monash University (Melbourne, Australia)

Supervisors: Professor Christopher Hutchinson, Dr Sebastian Thomas
Application deadline: accepting applicants immediately
Fully Funded PhD Project: open to all nationalities

About the project

Aluminium (Al) alloys are the second most used engineering alloy in the world today (after steels). They are used in applications where their the lightweight, environmental resistance or thermal/electrical conductivity properties are particularly important. As a result, we often find Al alloys used in transportation applications and with the electrification of transport, this use will continue to increase. Traditionally, Al alloys can be broken into two classes – the higher strength grades that contain precipitates (2xxx, 6xxx and 7xxx grades), and the lower strength grades that have excellent formability (3xxx, 5xxx). Each of the classes has their advantages and disadvantages – the alloys containing precipitates are stronger than those without, but the corrosion resistance and ductility of those without precipitates is usually better.

Recently, a new type of Al alloy was created by the supervisors [1] that is somewhat in between these two traditional classes. It is as strong as the precipitate strengthened alloys but the strength is provided high a high density of atomic scale clusters. It is perhaps better described as an inhomogeneous solid solution and exhibits some properties of both classes of traditional Al alloys.

This project is focussed on developing an understanding of the strength and plasticity of these new types of Al alloys that are strengthened primarily by clusters.

This project is conducted in collaboration with Dr Baptiste Gault at the Max Planck Institute (MPI) in Dusseldorf and the candidate will have the opportunity to visit and interact with the MPI during their candidature.

[1] WW Sun, Y Zhu, R Marceau, L Wang, Q Zhang, X Gao, CR Hutchinson, "Precipitation Strengthening of Aluminum Alloys by Room Temperature Cyclic Plasticity", Science, 363, pp. 972–975, 2019.

Interested candidates:

This project is open to students of any nationality although the ability to obtain a student visa to enter Australia is required. The candidate should have a 1st class Undergraduate or Masters degree (or equivalent) in Materials Science and Engineering, Metallurgy or a related discipline. A strong background in metallurgy, microstructural characterisation and/or mechanical testing is advantageous.

To express an interest please provide: (1) a curriculum vitae (CV) including your academic transcripts, (2) a cover letter summarising your research interests and suitability for the position, and (3) the contact details of two referees.

Please send to: Professor Christopher Hutchinson – christopher.hutchinson@monash.edu, Dr Sebastian Thomas – sebastian.thomas@monash.edu

https://www.monash.edu/engineering/christopherhutchinson
https://www.monash.edu/engineering/sebastianthomas

Funding Notes:

This is a fully funded PhD project of 3.5 yrs duration. Reasonable relocation costs will be provided as well as student healthcare coverage for non-Australian citizens. The successful candidate will have the opportunity to participate in an international conference and a domestic conference as part of their candidature.

MONASH University

PROJECT #3: THE EFFECTS OF ATOMIC SCALE CLUSTERS ON THE CORROSION OF ENGINEERING ALLOYS

Department of Materials Science and Engineering, Monash University (Melbourne, Australia)

Supervisors: Dr Sebastian Thomas, Professor Christopher Hutchinson,
Application deadline: accepting applicants immediately
Fully Funded PhD Project: open to all nationalities

About the project
Aluminium (Al) alloys are typically used in aerospace, automobile and naval applications for light weighting purposes, owing to their high strength to weight ratios. They can be classified broadly into two types based on alloying additions namely, solid solution alloys and precipitation-strengthened alloys. In the former, 'soluble' alloying elements in Al lead to solid-solution strengthening. In the latter, alloying elements form metallic compounds (phases/precipitates) during thermal processing ("baking") and these precipitates strengthen the alloy. There is often a trade-off in terms of strength vs corrosion resistance in high-strength Al alloys. For precipitation-strengthened alloys, precipitates and precipitate-free zones (PFZ) can trigger micro-galvanic corrosion, so increased strengths may come at the cost of poor corrosion performance. Similarly, solid solution alloys tend to have lower strengths compared to precipitation strengthened alloys but have higher corrosion resistance, owing to their relatively homogenous precipitate-free microstructures.

Recently, Hutchinson and co-workers (Science, 2019) discovered that cyclic deformation of Al alloys at room temperature can lead to high strengths, due to mechanically-induced formation of fine atomic solute clusters. Such cyclically deformed Al alloys were found to achieve strengthening, without thermal processing. Their microstructures are thus free from precipitates and PFZs. The solute cluster-strengthened alloys can therefore potentially offset the trade-off between strength vs corrosion resistance, which impacts traditional Al alloy systems.

This project will investigate effects of solute clusters on corrosion and stress corrosion cracking in Al alloys. It will create new knowledge on designing alloys that achieve their mechanical and corrosion properties from atomic solute clusters. The PhD candidate will learn to 'process' alloys to create solute cluster-based micro/nano-structures. He/she will learn to use highly advanced characterisation techniques such as scanning transmission electron microscopy (STEM), and atom probe tomography (APT) to visualise, and quantify atomic solute clusters. The student will be trained to perform advanced corrosion testing of such alloys, to develop new correlations between solute clusters and corrosion performance in engineering alloys. He/she will also perform mechano-chemical, and mechano-electrochemical testing to investigate stress corrosion cracking performance of these novel alloys. The project will be in collaboration with the Max-Planck Institute (Germany). The student will therefore have the opportunity to experience research cultures in different countries, and laboratories.

Interested candidates:
This project is open to students of any nationality although the ability to obtain a student visa to enter Australia is required. The candidate should have a 1st class Undergraduate or Masters degree (or equivalent) in Materials Science and Engineering, Metallurgy or a related discipline. A strong background in metallurgy, microstructural characterisation and/or mechanical testing is advantageous.

To express an interest please provide: (1) a curriculum vitae (CV) including your academic transcripts, (2) a cover letter summarising your research interests and suitability for the position, and (3) the contact details of two referees.

Please send to: Dr Sebastian Thomas – sebastian.thomas@monash.edu, Professor Christopher Hutchinson – christopher.hutchinson@monash.edu,

https://www.monash.edu/engineering/christopherhutchinson
https://www.monash.edu/engineering/sebastianthomas

Funding Notes:
This is a fully funded PhD project of 3.5 yrs duration. Reasonable relocation costs will be provided as well as student healthcare coverage for non-Australian citizens. The successful candidate will have the opportunity to participate in an international conference and a domestic conference as part of their candidature.

MONASH University

PROJECT #4: ARCHITECTURED STEELS AND SUPERALLOYS THROUGH ADVANCED POWDER METALLURGY

Department of Materials Science and Engineering, Monash University (Melbourne, Australia)

Supervisors: Professor Michael Preuss (Monash), Professor Christopher Hutchinson (Monash), Dr David Stewart (Rolls-Royce, UK)
Application deadline: accepting applications immediately with a preferred start date no later than March/April 2023
Fully Funded PhD Project: open to Australian, UK or US citizens only

About the project

Conventional engineering alloys are strengthened by solid solution strengthening, precipitation strengthening, dislocation strengthening or grain refinement. Recently, researchers have started to explore the idea of deliberately designing materials with chemical and microstructural heterogeneities as a strategy to improve mechanical performance. Powder metallurgy approaches are an interesting way to create such heterostructured alloys using mixes of conventional alloys as a starting material. Hot isostatic processing (HIP) and additive manufacturing (AM) are processing approaches that are starting to be explored as means of creating new heterostructured materials, with the prospect of new combinations of properties.

Currently, both HIP and AM processing only use pre-alloyed powder of a single composition. This project will use commercial alloys powders and physically mix them to generate new, multi-phase metal-metal composites with the aim of accessing combinations of mechanical properties, electromagnetic behaviour and representative environmental durability not achievable by conventional manufacturing methods.

This project is funded by and will involve close collaboration with Rolls Royce, UK. The successful PhD candidate will have the opportunity for multiple visits to the UK as part of their PhD to utilise research facilities within the Henry Royce Institute (https://www.royce.ac.uk/) and will be able to attend international conferences.

Interested candidates:

This project is open to Australian, UK or USA nationalities only. The candidate should have a 1st class Undergraduate or Masters degree (or equivalent) in Materials Science and Engineering, Metallurgy or a related discipline. A strong background in metallurgy, microstructural characterisation and/or mechanical testing is advantageous.

To express an interest please provide: (1) a curriculum vitae (CV) including your academic transcripts, (2) a cover letter summarising your research interests and suitability for the position, and (3) the contact details of two referees.

Please send to: Professor Michael Preuss – michael.preuss@monash.edu, Professor Christopher Hutchinson – christopher.hutchinson@monash.edu

https://www.monash.edu/engineering/michaelpreuss
https://www.monash.edu/engineering/christopherhutchinson

Funding Notes:

This is a fully funded PhD project of 3.5 yrs duration. Reasonable relocation costs will be provided as well as student healthcare coverage for non-Australian citizens. The successful candidate will have the opportunity to participate in an international conference and a domestic conference as part of their candidature.

PROJECT #5: THE DESIGN OF FE-BASED GALLING RESISANT HARDFACING ALLOYS

Department of Materials Science and Engineering, Monash University (Melbourne, Australia)

Supervisors: Professor Christopher Hutchinson (Monash), Professor Michael Preuss (Monash) and Dr David Stewart (Rolls-Royce, UK)
Application deadline: accepting applications immediately with a preferred start date no later than March/April 2023
Fully Funded PhD Project: open to Australian, UK or US citizens only

About the project

The current benchmark for existing galling resistant hardfacing alloys are Cobalt-based Stellite alloys. There are a range of applications where Co-based materials are less desirable and one example is in a nuclear reactor because of the possibility of activating Co. It would be desirable to have an excellent hard-facing material based on Fe.

This project is a collaboration with Rolls Royce to develop a new Fe-based hardfacing alloy that can resist galling under relevant operating conditions. The approach will be based on an austenitic matrix and will tailor the strain hardening behaviour of the matrix and examine how this depends on chemistry and influences the galling performance.

This project is funded by and will involve close collaboration with Rolls Royce, UK. The successful PhD candidate will have the opportunity for multiple visits to the UK as part of their PhD to utilise research facilities within the Henry Royce Institute (https://www.royce.ac.uk/) and will be able to attend international conferences.

Interested candidates:

This project is open to Australian, UK or USA nationalities only. The candidate should have a 1st class Undergraduate or Masters degree (or equivalent) in Materials Science and Engineering, Metallurgy or a related discipline. A strong background in metallurgy, microstructural characterisation and/or mechanical testing is advantageous.

To express an interest please provide: (1) a curriculum vitae (CV) including your academic transcripts, (2) a cover letter summarising your research interests and suitability for the position, and (3) the contact details of two referees.

Please send to: Professor Christopher Hutchinson – christopher.hutchinson@monash.edu, Professor Michael Preuss – michael.preuss@monash.edu,

https://www.monash.edu/engineering/christopherhutchinson
https://www.monash.edu/engineering/michaelpreuss

Funding Notes:

This is a fully funded PhD project of 3.5 yrs duration. Reasonable relocation costs will be provided as well as student healthcare coverage for non-Australian citizens. The successful candidate will have the opportunity to participate in an international conference and a domestic conference as part of their candidature.

MONASH University

PROJECT #6: THE DESIGN OF NEW HIGH STRENGTH STEELS FOR USE AS REINFORCING BAR IN CONCRETE

Department of Materials Science and Engineering, Monash University (Melbourne, Australia)

Supervisors: Professor Christopher Hutchinson, A/Prof Amin Heidarpour
Application deadline: accepting applications immediately for a planned PhD commencement March/April 2023
Fully Funded PhD Project: open to all nationalities

About the project
One of the major applications of recycled steels, is for reinforcing bar in concrete. The quantities of steel used for this purpose are enormous and reinforcing bar represents a significant mass of the concrete structures in which it is used.

This project is focussed on the development of new higher strength reinforcing steel bar for use in concrete. The project will involve thermo-mechanical process design as well as chemistry adjustment to control the plastic yielding behaviour, the strain hardening and the ultimate tensile strength of the new steels developed. The project will include a detailed analysis of the contributions to strain hardening (both dislocation based contributions and kinematic hardening) in these ferrite/pearlite steels and how the different constituents contribute to the shape of the elastic-plastic transition and subsequent strain hardening behaviour of reinforcing bar steel.

This project is a direct collaboration with a large Australian industrial partner, Infrabuild, who fabricates steel reinforcing bar. The candidate will interact frequently with the industrial partner and will have the opportunity to visit the industrial processing sites near Melbourne.

Interested candidates:
This project is open to students of any nationality although the ability to obtain a student visa to enter Australia is required. The candidate should have a 1st class Undergraduate or Masters degree (or equivalent) in Materials Science and Engineering, Metallurgy or a related discipline. A strong background in metallurgy, microstructural characterisation and/or mechanical testing is advantageous.

To express an interest please provide: (1) a curriculum vitae (CV) including your academic transcripts, (2) a cover letter summarising your research interests and suitability for the position, and (3) the contact details of two referees.

Please send to: Professor Christopher Hutchinson – christopher.hutchinson@monash.edu, A/Prof Amin Heidarpour – amin.heidarpour@monash.edu

https://www.monash.edu/engineering/christopherhutchinson
https://www.monash.edu/engineering/aminheidarpour

Funding Notes:
This is a fully funded PhD project of 3.5 yrs duration. Reasonable relocation costs will be provided as well as student healthcare coverage for non-Australian citizens. The successful candidate will have the opportunity to participate in an international conference and a domestic conference as part of their candidature.

PROJECT #7: BUILDING A CONCEPT FOR HYDROGEN-TOLERANT ALLOYS

Department of Materials Science and Engineering, Monash University (Melbourne, Australia)

Supervisors: Professor Michael Preuss (Monash)
Application deadline: accepting applications immediately for a planned PhD commencement March/April 2023
Fully Funded PhD Project: open to all nationalities

About the project

With the anticipated transition from natural gas to hydrogen to combat climate change, new challenges for engineering materials are created. Today, the mechanical properties of most engineering alloys degrade quickly in a hydrogen environment, known as hydrogen embrittlement, requiring the development of new engineering materials concepts for an infrastructure to safely store, transport and combust hydrogen.

This project will explore a new concept of creating hydrogen reservoirs within an engineering alloy to store the picked-up hydrogen without affecting the mechanical properties. To explore this concept, we will utilise well-known two-phase titanium alloys where the minority beta-phase can be utilised as a reservoir. The mechanical performance and phase-specific properties will be studied using novel in-situ loading methodologies. This will be achieved by undertaking loading experiments inside electron microscopes and at large-scale research facilities (for example https://www.diamond.ac.uk/, https://www.esrf.fr/, https://www.ansto.gov.au/facilities/australian-synchrotron).

The project is part of a collaboration with researchers from the University New South Wales, Sydney, and TIMET, a large titanium manufacturer based in the UK and the US. The PhD candidate will have the opportunity to present their work and interact with the industrial partner and other companies due to the very high industrial interest in this field of research. In addition, the candidate will have the opportunity to undertake one-week experiments at international facilities in Europe or the US.

Interested candidates:

This project is open to students of any nationality although the ability to obtain a student visa to enter Australia is required. The candidate should have a 1st class Undergraduate or Masters degree (or equivalent) in Materials Science and Engineering, Metallurgy or a related discipline. A strong background in metallurgy, microstructural characterisation and/or mechanical testing and/or physical science is advantageous.

To express an interest please provide: (1) a curriculum vitae (CV) including your academic transcripts, (2) a cover letter summarising your research interests and suitability for the position, and (3) the contact details of two referees.

Please send to: Professor Michael Preuss – michael.preuss@monash.edu

https://www.monash.edu/engineering/michaelpreuss

Funding Notes:

This is a fully funded PhD project of 3.5 yrs duration. Reasonable relocation costs will be provided as well as student healthcare coverage for non-Australian citizens. The successful candidate will have the opportunity to participate in an international conference and a domestic conference as part of their candidature.