THE UNIVERSITY OF BRITISH COLUMBIA

Understanding the materials engineering of advanced aluminium alloys for automotive extrusions

Department of Materials Engineering, The University of British Columbia

We are recruiting up to **3 PhD** and **1 Master of Applied Science** studentships as part of a NSERC and Rio Tinto Aluminium co-funded project entitled "Engineered 3D Microstructures for Automotive Applications". This project is led by Professors Warren Poole, Chad Sinclair and Ben Britton and features a range of experimental and computation work to develop the next generation of automotive aluminium alloys and manufacturing strategies that will be used to reduce the weight of electric vehicles.

In this program, we are looking to understand and develop new aluminium alloys that are suitable for automotive structural components and are tailored in terms of the strength and fracture resistance to their application, by a mechanism informed understanding of the influence of processing-structure-property.

As a researcher in our team, you will lead independent research on one of the projects (listed below) in collaboration with the other trainees, research engineers, post doctoral fellows and technical staff within our team. Members of our team will focus on one or more of the following aspects of their work using our facilities: mechanical testing to understand localised deformation of materials, with in situ digital image correlation (DIC) facilities; new 3D focussed ion beam (FIB) scanning electron microscopy (SEM) with analytical characterization tools, including electron backscatter diffraction (EBSD), scanning transmission electron microscopy (STEM), and energy dispersive X-ray spectroscopy (EDS); and computational tools such as crystal plasticity based finite element analysis (FEA) and fast Fourier transform (FFT) based tools.

In addition to your technical work, you will develop professional skills and work with our team and industrial partners to maximise your career development and provide context for your work in how materials engineering can contribute towards the Canadian economy.

Below, we list details of each of these four projects and highlight the primary goals of the package of work, together with essential skills and desired skills. We are hoping to recruit a diverse and inclusive team from a range of backgrounds, so this list is indicative and hopefully provides us an opportunity to signpost our desired expectations. If you feel that you have related skills, or only partially meet this list, please still considering putting together an application and informally getting in touch.

To apply for a studentship to work on a project, please use our Qualtrics application form (https://ubc.ca1.qualtrics.com/jfe/form/SV_eULLlZFu2EQOHyu).

This form will collect information that relates to:

a) a short description of why this project is of interest to you and a brief description of any relevant experience that aligns with the desired or essential skills for the studentship;
b) your prior educational attainment (institution, degree awarded/in progress, and what GPA/or equivalent you have achieved);
c) an up to date copy of your CV.

Project 1 – Quantifying Grain Boundary Fracture in Model Microstructures-

PhD-studentship: with a Graduate Research Assistant (GRA, i.e. stipend) for four years at $30,000 per year

Supervisors: Warren Poole and Chad Sinclair

Project objective - to develop detailed knowledge on how grain boundary fracture occurs and the impact of factors including i) the disorientation between grains, ii) the width of the precipitate free zone and iii) role of Fe based constituent particles located on grain boundaries.

Essential skills – knowledge of strengthening mechanisms in aluminium alloys, experience with mechanical testing and metallography (quantitative optical and electron microscope)

Desired skills – experience with finite element analysis (e.g. using Abaqus, or LS-Dyna), crystal plasticity modelling

Project 2 – The Influence of Grain Size and Shape on Anisotropic Fracture –

PhD-studentship: with a Graduate Research Assistant (GRA, i.e. stipend) for four years at $30,000 per year

Supervisors: Warren Poole and Ben Britton

Project objective - to systematically explore and understand the effect of grain size and morphology on fracture properties, in particular the competition between intergranular and transgranular fracture. This will be achieved using microstructure design, quantitative high spatial resolution large area and 3D microstructural characterization, and *in situ* and *ex situ* mechanical testing.

Essential skills – knowledge of strengthening mechanisms in aluminium alloys, experience with mechanical testing and metallography (quantitative optical and electron microscopy)

Desired skills – experience with finite element analysis (e.g. using Abaqus, or LS-Dyna), crystal plasticity modelling

Project 3 – The Role of Fe Content on Anisotropic Bendability

PhD-studentship: with a Graduate Research Assistant (GRA) stipend for four years at $30,000 per year

Supervisors: Warren Poole, Chad Sinclair and Ben Britton

Project objective - Alloy contamination is an increasingly important consideration as recycled scrap is introduced into the supply chain which invariably leads to an increase in Fe content thereby having negative effects on fracture. The goal of this project is to examine the effect of i) different Fe contents and ii) role of casting process on the distribution of Fe based intermetallics before and after extrusion on mechanical behaviour, in particular fracture properties and their anisotropy.

Essential skills – knowledge of strengthening mechanisms in aluminium alloys, experience with mechanical testing and metallography (quantitative optical and electron microscope)

Desired skills – experience with finite element analysis (e.g. using Abaqus, or LS-Dyna), crystal plasticity modelling

Project 4 – Modelling the formation of the Precipitate Free Zone under Industrial Cooling Conditions

Masters in Applied Science-studentship: with a Graduate Research Assistant (GRA) stipend for two years at $25,000 per year

Supervisors: Warren Poole and Chad Sinclair

Project objective - in aluminium alloys, precipitate free zones can develop near grain boundaries and influence the performance of a polycrystalline bulk material. In this project, you will validate the diffusion controlled, classical nucleation and growth model for the formation of the precipitate free zone developed in collaboration between UBC and INSA Lyon, France.

Essential skills – knowledge of strengthening mechanisms in aluminium alloys, experience with mechanical testing and metallography (optical and electron microscope)

Desired skills – experience with finite element analysis (e.g. using Abaqus, or LS-Dyna), crystal plasticity modelling

In addition to GRA funding, eligible students in Materials Engineering are awarded a portion of the GSI funding each year (historically this has been between $1.5k and $2k per annum), and student are also eligible for teaching assistantships (TAs) on the Materials Engineering and Manufacturing Engineering programs. For candidates who are eligible, we will also support you in applying for external scholarships (e.g. NSERC scholarships).

Potential PhD candidates will typically be required to have a Masters-level degree (or relevant industrial experience) in Materials Engineering or a related discipline (e.g. Mechanical Engineering, Physics, or Chemistry).

Potential MASc candidates will typically be required to have the equivalent of a Bachelor's in Engineering or Science in Materials Engineering or a related discipline (e.g. Mechanical Engineering, Physics, or Chemistry).

Once we have received your informal inquiry and discussed suitability for a project, we will ask you to submit your application to the UBC graduate study application system (for a guide, please see the Materials Engineering website https://mtrl.ubc.ca/graduate/application-process/).

Note that UBC's Faculty of Graduate Studies sets the minimum requirements for admission to any graduate program at UBC. International students should also check their country's specific requirements.

We recognise and value the contributions of the people within our research teams. This motivates us to value equity, diversity and inclusion (EDI) in our supervision, training and research practice. We actively encourage applicants from range of paths and backgrounds, and encourage individuals from currently and historically marginalised communities to apply to work with us. and will work with suitably qualified applicants to deliver a training environment that is reasonable for them. We support applications from those returning from a career break or other roles, and can consider applicants for full time or part time study.