Information on Postgraduate Research Scholarship - Ref: M34Impact-MSE5			
Faculty:	Engineering and Science	**Department:**	Computing and Mathematical Sciences
Lead Supervisor:	Dr. Qingwei Bai		
Project Title:	Electromagnetic Control of Metal Solidification: Multiscale Multiphysics Modeling from Dendritic to Bulk Scales		
Project Description:	The solidification of liquid alloys is a critical step in the manufacture of advanced components for aerospace and automotive applications. Previous studies have shown that interface-driven forced convection induced by electromagnetic fields (EMF) can significantly refine grains, mitigate solute segregation, and favourably modify the morphology of intermetallic compounds. However, this controlled flow is influenced by multiple parameters and strongly coupled with the solidification process, and its evolution and quantitative mechanisms remain poorly understood, which poses a key bottleneck to precise control of solidification microstructures. This PhD project, building on research initiatives from the UK National Synchrotron Radiation Centre (DIAMOND Light Source project) and the German DAAD project, aims to develop multiscale models spanning from the dendritic scale to the bulk scale to characterize magnetohydrodynamic behaviour under time-varying electromagnetic fields, and to uncover the key dynamic mechanisms governing microstructure evolution through advanced modelling and experimental insights. It further seeks to establish a green, energy-efficient electromagnetic field-controlled solidification strategy, enabling efficient and sustainable manufacturing across casting, welding, and additive manufacturing, and contributing directly to Net Zero targets. We are seeking a highly motivated PhD candidate to join an interdisciplinary research project at the intersection of electromagnetism, solidification science, transport phenomena, and computational materials science. The successful candidate will work on the following key objectives: **(1) Development of Multiphysics Coupling Models** • Establish comprehensive multiphysics models to capture the interactions among: electromagnetic fields, thermal fields, fluid flow, and solute transport. • Develop efficient computational coupling strategies to integrate these physical processes. • Apply advanced numerical methods to construct dendrite growth models, including: Phase-field, CA, et al. **(2) Multiscale Experimental and Modelling** • Combine dendritic-scale X-ray experiments with ingot-scale casting experiments to establish a multiscale numerical model		

	and elucidate solidification dynamic relationships bridging from Dendritic to Bulk Scales. • Use model-based analysis to reveal how electromagnetic fields influence solute redistribution, dendritic growth and microstructure transformation. **(3) Controlled Fabrication of Target Crystal Structures under EMF** • Employ solidification techniques and advanced digital tools (e.g., AI, COMSOL Multiphysics, and Python) to design and fabricate metal crystals with tailored configurations, such as columnar, equiaxed, or single-crystal structures. • Quantitatively evaluate and demonstrate EMF potential impact on future industrial applications. The University of Greenwich, situated on the scenic banks of the Thames, offers an exceptional environment for research and professional development. This studentship is fully funded by the University's £9M Research England-funded M^{3}4Impact expansion programme. This project forms a key part of the Computational Science and Engineering Group's (CSEG) objectives, and you will be fully integrated into the M^{3}4Impact doctoral cohort. Your supervisor, Dr Qingwei Bai and co-supervised by Prof. Andrew Kao, whose group will provide guidance in both experimental techniques and modelling simulation. You will benefit from the group's expertise in advanced modelling, synchrotron data processing, and AI. Moreover, our group has established an extensive international collaboration network, including partners such as HZDR in Germany, institutions in France, Latvia, and the universities and enterprises across China, providing you with opportunities to engage in collaborative research abroad.
Duration:	4 years, Full-Time Study or 7 years, Part-Time Study

Bursary available (subject to satisfactory performance):
Rates below are for full time (FT) mode.
Year 1: £24,780 (£20,780 UKRI rate + London weighting = £2,000 + Enhanced bursary = £2,000)
Year 2: In line with UKRI rate + London weighting = £2,000 + Enhanced bursary = £2,000
Year 3: In line with UKRI rate + London weighting = £2,000 + Enhanced bursary = £2,000
Year 4*: In line with UKRI rate + London weighting = £2,000 + Enhanced bursary = £2,000

In addition, the successful candidate will receive a contribution to tuition fees, equivalent to the University Home Rate, currently £5, 006 (FT), for the duration of their scholarship. International applicants may need to pay the remainder tuition fee for the duration of their scholarship**.

This fee is subject to an annual increase.

* The bursary is for 3 years with a potential extension of up to a maximum of 12 months. Funding extensions may be granted if the student demonstrates, to the satisfaction of the M^{3}4Impact Principal Investigators and PhD supervisors, that the thesis can be completed during the granted extension period.
** For exceptional international applicants the tuition fees may be covered by the M^{3}4Impact

Person Specification of Essential (E) or Desirable (D) requirements:

Criteria:	E or D
Education and Training:	
• 1st Class or 2nd class, First Division (Upper Second Class) honours degree or a taught master's degree with a minimum average of 60% in all areas of assessment (UK or UK equivalent) in a relevant area (e.g., Computer Science, Physics, Materials Science, Engineering) or equivalent professional experience.	E
• For those whose first language is not English and/or if from a country where English is not the majority spoken language (as recognised by the UKBA), a language proficiency score of at least IELTS 6.5 (in all elements of the test) or an equivalent UK VISA and Immigration secure English Language Test is required, if your programme falls within the faculty of Engineering and Science a language proficiency score of at least IELTS 6.5 overall with a minimum of 6.0 in all elements of the test or an equivalent UK VISA and Immigration secure English Language Test is required. Unless the degree above was taught in English and obtained in a majority English speaking country, e.g. UK, USA, Australia, New Zealand, etc, as recognised by the UKBA.	E
Experience & Skills:	
• Previous experience of undertaking research (e.g., undergraduate or taught master's dissertation).	E
• Strong programming skills with **numerical approaches** (e.g., FEM, FVM, FDM) or solidification **modelling** (e.g., Phase-field, CFD, CA, FDM, MHD).	E
• Solid understanding of **materials science**, particularly transport phenomena in solidification, phase transformations, and microstructure evolution.	E
• Experience with solidification techniques (e.g., X-ray imaging, Synchrotron radiation, image processing, or materials characterisation methods).	D
• Strong analytical and problem-solving skills, with experience in using advanced digital tools (e.g., COMSOL, MATLAB, Python, and AI techniques) to address complex interdisciplinary research problems.	D
• A track record of high-quality peer-reviewed publications, conference papers, or patents with potential technology transfer.	D
Personal Attributes:	
• Highly ambitious, eager to take on challenging interdisciplinary research objectives, with a commitment to achieving high-quality results.	E
• Collaborates effectively in interdisciplinary and international teams, adapting to diverse research environments.	E
• Capable of critically assessing complex multiphysics problems and creating innovative modelling approaches.	E
• Remains positive, focused, and determined in the face of challenges.	D
Other Requirements:	
• This scholarship may require Academic Technology Approval Scheme (ATAS) approval for the successful candidate if from outside of the EU/EEA.	E
• The scholarship must commence by 01 October 2026.	E
Closing date for applications:	*midnight UTC on 1st June 2026*
For further information contact:	**Dr Qingwei Bai (Q.Bai@greenwich.ac.uk)**

September 2021

Making an application:
Please read this information before making an application. Information on the application process is available at: https://www.gre.ac.uk/research/study/apply/application-process. Applications need to be made online via this link. **No other form of application will be considered**.

All applications **must include** the following information. **Applications not containing these documents will not be considered.**

- **Scholarship Reference Number ("M34Impact-MSE5")**– included in the personal statement section together with your personal statement as to why you are applying
- **a CV including 2 referees** *
- **academic qualification certificates/transcripts and IELTs/English Language certificate if you are an international applicant or if English is not your first language or you are from a country where English is not the majority spoken language as defined by the UK Border Agency** *

**upload to the qualification section of the application form. Attachments must be a PDF format.*

Before submitting your application, you are encouraged to liaise with the Lead Supervisor on the details above.