IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title: **Modeling of localised corrosion in light metals**

Project Number **IMURA0259A/B** *(will be inserted by The Academy)*

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Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?

(*Feel free to nominate more than one. For more information, see www.iitbmonash.org)*

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. Clean Energy
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research

The research problem

Define the problem

Corrosion of light metals, in particular magnesium alloys, is a major technical challenge as we seek to lightweight vehicles for road, rail and air travel.
The corrosion of light alloys is driven by chemical and electrochemical heterogeneity of the alloys - which is inherent in the alloy for the development of strength. In recent years, we have developed an understanding of the mechanisms and kinetics of corrosion such processes upon such alloy surfaces, but the work to date is limited to empirical and phenomenological revelations. As such, a mechanistic model for corrosion of such alloys is required to better understand the processes occurring on the microstructural length scale and as a function of time for a range of real and hypothetical microstructures.

Project aims

Define the aims of the project

Problem A for student A:

The project aims to develop a numerical and graphical model that can be used to predict the corrosion of a range of magnesium alloys - based on empirical feedstock data that would be generated a priori and in parallel by others at Monash and at IITB. Mechanistic based models that present appropriate fidelity down to the 100nm length-scale will be used in order to process electrochemical data from bulk alloys, intermetallics and solid solutions.

Problem B for student B:

The project will explore the deployment of a phase field model in the modelling of corrosion. Such models are emerging and have not yet been exploited in the area of corrosion. Similarly, the project aims to develop a numerical and graphical model that can be used to predict the corrosion of a range of magnesium alloys.

Expected outcomes

Highlight the expected outcomes of the project

The outcomes will be numerical and graphical models that can be used to predict the corrosion of a range of alloys based on empirical feedstock data that would be generated a priori and in parallel by others at Monash and at IITB.
The final model will be a tool that can be deployed in future projects to guide alloy design.

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The project will be one that is a true modeling study - addressing advances in computational materials science and bringing a capability to a cross-disciplinary team to address an important area (corrosion)

Additional costs and equipment

Describe below additional costs that would be needed to complete this project.
This would typically include project-related costs (such as consumables).
Computers, desks, conference travel, student travel to Australia, etc should not be included here. They are already provided for...

The project will not require laboratory space, but will require the student to have an appropriately comfortable desk and access to a quality computer and possibly some specialised software. The total costs of all of this are probably in the vicinity of <$3000 AUD

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

The ideal candidate will ideally have had some modeling experience by way of a Masters Degree. It is likely that the ideal candidate will possess strong analytical skills, and may be a graduate of mechanical or chemical engineering, or physics - not necessarily materials (in fact, a materials engineering candidate would need to exhibit strong levels of modeling capability).