IITB-Monash Research Academy

An Indian-Australian research partnership

Indian Institute of Technology Bombay | MONASH University

Project Title:	**Biocompatible Coatings for Magnesium Alloys in Biomedical Implant Applications**	
Project Number	**IMURA0876**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*	
1	***Material Science/Engineering (including Nano, Metallurgy)***
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*
8	*HSS, Design, Management*

Research 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***
7	*Humanities and social sciences*
8	Design

The research problem

Addressing health issues of an ageing population is among the greatest challenges of current times. In this regard, use of magnesium (Mg) alloys for temporary implant devices (such as pins, wires, screws, plates, stents etc) is emerging as an innovative and extremely attractive approach, since using magnesium alloys will completely avoid the cumbersome procedure of second surgery (which amounts to added duress to patients and added costs, besides possible complications of patient morbidity and infection). Such a surgery is commonly undertaken to remove the temporary implants when they are constructed out of commonly used traditional materials (titanium alloys/stainless steels). What makes Mg alloys a particularly attractive material for temporary/disposable implants is that the degradation (corrosion) products of magnesium are non-toxic to the human body. Therefore, it is possible to allow a Mg alloy (containing only non-toxic alloying elements) to slowly degrade/dissolve within human body (i.e., after they have fulfilled their temporary function), thus avoiding altogether the second surgery. It is intriguing and innovative that in using Mg alloys as temporary implants, in fact, their very susceptibility to rapid dissolution (corrosion) can be advantageously exploited. However, before such application, it will be essential to ensure that the Mg alloy implants do not corrode away too quickly. Another problem with Mg alloy corrosion is the concurrent generation of hydrogen bubbles, which needs to be controlled to a tolerable limit through controlling the corrosion rate. Finding suitable biocompatible coatings is the most attractive solution, which will be investigated through the proposed project.

Project aims

The principal aims of the project are:

1. Development of coating (such as sol-gel based biocompatible organo-silane coatings and graphene based coatings) for effective corrosion resistance of Mg alloys.
2. Suitable chemical or surface modification of the Mg alloy.
3. Assessment of the performance of the coatings developed through (1) and (2) above on Mg alloys for their application as biodegradable orthopaedic implants.

Expected outcomes

1. Development of coatings and coating process for application of Mg alloys as temporary implants.
2. Establishing biocompatibility of the coating for application of Mg alloys as temporary implants

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

The suitability of the developed coating and coating process will be a solid move towards the application of Mg alloys as biodegradable implants.

Capabilities and Degrees Required

List the ideal set of capabilities:

Magnesium alloys or alloys in general
Nanomaterials
Coatings
Biocompatibility

Potential Collaborators

Coatings and Bioimplants companies around the world.

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

Magnesium alloys, Corrosion, Corrosion-resistant coatings, Graphene