IITB-Monash Research Academy

An Indian-Australian research partnership

Indian Institute of Technology Bombay | MONASH University

Project Title:	**Magnesium Alloys as Biodegradable Human Implant Devices: Circumventing Human Body Fluid-assisted Catastrophic Fracture**	
Project Number	**IMURA0877**	
Monash Main Supervisor (Name, Email, Phone)	Prof. Raman Singh Raman.Singh@monash.edu	*Full name, Email*
Monash Co-supervisor(s) (Name, Email, Phone)	N/A	
Monash Head of Dept/Centre (Name, Email)	Prof. Chris Davies Chris.Davies@monash.edu	*Full name, email*
Monash Department:	Department of Mechanical & Aerospace Engineering	
Monash ADGR (Name, Email)	Prof. Emanuele Viterbo, Emanuele.viterbo@monash.edu	*Full name, email*
IITB Main Supervisor (Name, Email, Phone)	Prof. M.J.N.V. Prasad, mjnvprasad@iitb.ac.in	*Full name, Email*
IITB Co-supervisor(s) (Name, Email, Phone)	Prof. Vijayshankar Dandapani, v.dandapani@iitb.ac.in	*Full name, Email*
IITB Head of Dept (Name, Email, Phone)	Prof. K. Narasimhan	*Full name, email*
IITB Department:	Metallurgical Engineering and Materials Science	

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.

Mg alloys also possess the best mechanical compatibility with human bones, as well the required mechanical strength. However, in such use, the alloys must possess adequate resistance to cracking/fracture under the simultaneous action of the corrosive human body fluid and the mechanical loading characteristics of human body (e.g., stress corrosion cracking (SCC) and corrosion fatigue (CF).

Project aims

The principal aims of the project are:

1. *In-vivo* testing for establishing the nature of corrosion films and corrosion rate of the Mg alloys under physiological conditions, and their influence on cracking under *in-vivo* loading spectrum.

2. Identification of alloy(s) with the required resistance to the simultaneous presence of the dynamic mechanical loading (stress corrosion cracking (SCC) and corrosion fatigue (CF)) in human body fluid, and establish if the alloys will require surface coating to achieve the required SCC and CF resistance.

Expected outcomes

1. Understanding the stress corrosion cracking (SCC) and corrosion fatigue (CF) characteristics of a few specific Mg alloys
2. Identification of an alloy and its suitable microstructure for resistance to stress corrosion cracking (SCC) and corrosion fatigue (CF) in simulated human body fluid.

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

Identification of a suitable alloy for resistance to stress corrosion cracking (SCC) and corrosion fatigue (CF) ifor implant applications.

Capabilities and Degrees Required

List the ideal set of capabilities:

Magnesium alloys or alloys in general
Stress corrosion cracking (SCC)
Corrosion fatigue (CF)
Mechanical testing

Potential Collaborators

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, Bioimplants, Stress corrosion cracking (SCC), Corrosion fatigue (CF), Simulated human body fluid