IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project title:

Nano-structured Silane Coatings for Magnesium Alloys in Biomedical Implant Applications

Project number: IMURA0102

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Research Academy theme/s

1. Nanotechnology
2. Biotechnology and Stem Cell Research

The problem

Magnesium and its alloys corrode rapidly. Silanes, while used extensively as coupling agents, have been little studied on magnesium surfaces. This work will develop new silanes as well as a new sol-gel route for processing into hybrid, thin (nanoscale) films, to be used as durable corrosion resistant coatings on magnesium alloys, for specific and value-added applications such as biodegradable orthopaedic implants, where corrosion occurs on contact with human body fluid. Such coatings can be suitably tailored/functionalized by suitable additives, such as alumina, ceria or silica for other advanced applications such as aerospace applications. Other critical advantages of silanes coatings as well as sol-gel processing include the environmentally friendly nature of the chemicals used as well as the processing steps.

The successful application of silane coating for corrosion resistance involves exposure of the metal surface to hydrolysed silane (silanol) and condensation at the metal-silanol interface to result ina a strong covalent bonding. This process has been successfully achieved for a few metallic systems, such as aluminium alloys and galvanised steels. However, the easily hydrolysable nature of the Mg-O bond poses a challenge and necessity to develop suitable silanes tailor-made for magnesium alloys. This project will attempt to overcome this challenge.

Project aims

The proposed work aims to develop novel molecularly designed silanes for coating magnesium alloys, tailored towards effective and durable corrosion resistance. The **principal aims** of this project are:

(a) Development of novel silanes as well as a sol-gel processing route for thin (nanoscale) hybrid coatings for durable and effective corrosion resistance of magnesium alloys,
(b) Tailoring such coatings for application of magnesium alloys as biodegradable orthopaedic implants, with an aim of improving biocompatibility and wear resistance, and
(c) Tailoring such coatings for the magnesium alloy for other critical aerospace applications.

Expected outcomes

(a) Utilisation of a suitable sol-gel processing route for developing a family of silanes, that are capable of providing effective and durable corrosion-resistant coatings on magnesium alloys,
(b) Incorporation of nanoparticles in the silane-based coatings for biocompatibility and wear resistance.