

An Indian-Australian research partnership

**Project Title:**

**Development of Self-Healing coatings**

**Project Number**

IMURA0307

Monash Supervisor(s)

Raman Singh (Professor)

*Full names and titles*

Monash Primary Contact:

[raman.singh@monash.edu](mailto:raman.singh@monash.edu), +61 3 9905 3671

*Email, phone*

Monash Head of  
Department:

Assoc Prof Karen Hapgood  
Karen.hapgood@monash.edu

*Full name, email*

Monash Department:

Chemical Engineering Department

*Full name*

Monash ADRT:

Prof Emanuele Viterbo,  
emanuele.viterbo@monash.edu

*Full name, email*

IITB Supervisor(s)

A.S. Khanna (Professor)

*Full names and titles*

IITB Primary Contact:

khanna@iitb.ac.in

*Email, phone*

IITB Head of Department:

Prof. Rajiv O. Dusane  
rodusane@iitb.ac.in

*Name, Email,*

IITB Department:

Metallurgical Engineering & Materials Science

*Full name*

## 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](http://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

Paints are extensively used for modification of substrates either for aesthetic appearance or for corrosion protection. During their service life, the paint films undergo changes in mechanical properties leading to formation of micro-cracks, occurring deep within the polymer matrix, which would be difficult to be observed and repaired. These micro-cracks subsequently propagate and expose substrate to atmospheric moisture and oxygen. This action allows direct access for corrosive agents to the metallic surface, resulting in accelerated disbonding of the paint and flake formation from the metal coating interface. Hence, a concept of self-healing in the areas of the cracks can be extremely attractive for extending paint durability.

## Project aims

The primary aims of the project will focus on,

1. Development of microcapsules with variety of healing materials such as epoxy, DCPD, and acrylates with UF, MF and MUF as shell material with varying microcapsule size and wall thickness.
2. Development of suitable catalyst and organic solvents as healing agents, for incorporation into the microcapsules.
3. Incorporation of the self-healing-agent filled microcapsules into the system and testing their stability in the various systems with respect to time, shear and temperature.
4. Evaluation of corrosion resistance, weathering resistance and mechanical properties of the final coating and coated alloys.

## Expected outcomes

The primary role of self-healing coatings is to mitigate corrosion. To date, the development of self-healing polymeric materials has been largely based on mimicking of biological healing. The interest in designing self-healing materials (for paints) has provided an attractive basis for smart/multi-functional materials which can heal autonomously, without need of application of any external measures. The ability to heal them will enable structures with longer lifetimes, improved performance and lesser maintenance.

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

Self healing coating involves a detailed knowledge of nano-technology as we are going to deal with nano additives on which various corrosion inhibitors would be attached which on breaking or cracking of coating would help in regenerating new coating.

## 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.*

Coating facilities (available at IITB)

Electrochemical testing facilities (available both at IITB and Monash)

Materials characterisation facilities (FTIR, XPS, SIMS, SEM/EDXS): available at IITB, Monash and at other institutions in Australia.

Intellectual resource: Both Prof Khanna and Prof Singh's groups have worked extensively on coatings.