

An Indian-Australian research partnership



**Project Title:** Design of carbon-metal nano-composites for electrical and magnetic application

**Project Number** IMURA0205 (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](http://www.iitbmonash.org))

Nanotechnology

## The research problem

There are two closely related parts of the proposed project:

(1) Graphene structures, consisting layers of carbon atoms arranged in a honey comb lattice, are of interest because of their promising excellent optical, magnetic and electronic properties. The production of graphene as individual sheets maintains it in a reduced form. The design of a composite system of graphene and metal atoms is a complex process since the strong *van der Waals* interactions between reduced graphene sheets would cause them to collapse and aggregate in the absence of an ideal medium. We propose to do experimental and theoretical studies of graphene-metal atoms complexes. We shall calculate the electronic band-structure of the graphene-Y (Y=Ni, Co and Pt) atom complexes and understand the fundamental nature of the energetically favoured sites on the graphene lattice. It is proposed to prepare these structures in the laboratory and study their magnetic and catalytic properties.

(2) A composite of single wall carbon nanotube (SWCNT) and graphitic shells enclosing magnetic nano particles (NP) (5-15nm) of Co and Fe has been developed at IITB. This material can be cast in the form of freestanding thin sheets that are highly flexible. The magnetic NP are stable and show strong ferromagnetic behaviour. These sheets are conducting as well. We plan to study their magnetic and electrical properties in detail and find out what kind of interactions prevail between the SWCNTs and the NPs and between the NPs themselves (since the separation between the NPs are only a few nanometres). This part of the project will also entail both experimental and computational aspects.

## **Expected outcomes**

*Highlight the expected outcomes of the project*

- Materials with novel electrical and magnetic properties;
- A theoretical understanding of how these properties arise.;
- Computational tools and techniques to assist with the design of these materials