

An Indian-Australian research partnership

Project Title: **Electrodeposition of graphene for the enhancement of electrode devices**

Project Number **IMURA0753**

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IITB Department: DESE

Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST one. For more information, see www.iitbmonash.org)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see www.iitbmonash.org)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Infrastructure Engineering
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	Design

The research problem

Metal electrodes are used extensively in areas of bioengineering (neural electrodes) and electrocatalysis. The PhD project will investigate the electrodeposition of graphene onto metal electrodes to enhance the electrical performance. Important fundamental structure-property relationships will be determined and related to processing conditions. The electrochemistry of graphene and its composites towards improved electrochemical performance will be an important aspect of the project. The origin of the increased capacitance and the number of layers in graphene will also be investigated. The overall project will constitute the use of graphene as an active material and substrate/support for various electrochemical applications.

Project aims

This PhD project will address this significant problem by designing, characterising and evaluating highly stable and biofunctional graphene coatings to

- i) improve the electrical performance of existing commercial neural electrodes,
- ii) actively induce the movement of neurons to the surface of the electrode interface and
- iii) prevent scar formation.

These aims will be achieved by investigating new graphene electrodeposition procedures that will allow permanent integration of electrode devices into the brain. The performance of the novel neural electrodes will be tested using a variety of in vitro electrical tests neural and the biocompatibility assessed using neural cell cultures and ultimately animals models.

Expected outcomes

The outcomes of this PhD project will be:

1. Synthesis and characterisation of new electrodeposited graphene coatings.
2. Biofunctionalisation of the graphene coating that will control neural plasticity and inflammation
3. An understanding of neural network formation in the vicinity of the graphene electrodes using electrophysiology and in vivo recordings.

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

This project will have an impact on the utility of existing and new generation neural electrodes and will establish an important fundamental knowledge base for the creation of new and functional neural networks in the brain.

The PhD project will accelerate novel graphene electrodes to the clinic.

Capabilities and Degrees Required

Degrees that cover both nanotechnology and biotechnology is preferable.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

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.

Graphene
Nanotechnology
Neural electrodes
Brain implants
Brain-machine-interface