IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Carbon based smart nanocomposite material as electrode material for supercapacitors**	
Project Number	**IMURA1179**	
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Monash Co-supervisor(s) (Name, Email Id, Phone)		
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Monash ADGR (Name,Email)	Timothy Scott	*Full name, email*
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IITB Department:	MEMS	

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	*Artificial Intelligence and Advanced Computational Modelling*
2	*Circular Economy*
3	*Clean Energy*
4	*Health Sciences*
5	*Smart Materials*
6	*Sustainable Societies*
7	*Infrastructure*

The research problem

Depleting energy sources has stressed the demand and supply for the current and future energy requirements. In order to achieve these objectives, a lot of stress is being laid on use of renewable energy sources. Unfortunately the intermittent nature of renewable energy sources is unable to synchronize the demand and supply of energy. Thus energy storage systems hold the key to synchronize this and enable in efficient use of renewable energy. In order to achieve this the recent concept being explored is realization of hybrid energy storage devices. These devices use the better of both batteries as well as supercapacitors, resulting in devices with high energy and power densities. Carbon in various forms like graphene, CNTs and other nanoforms hold significant potential.

Project aims

Define the aims of the project

1)The aim of the project would be to synthesize carbon based smart nanocomposites and characterize them using state of the art materials characterization techniques

2) These smart nanocomposites will be functional and be stimuli responsive.

2) Electrochemical characterization of the nanocomposites in three electrode configuration

3) Device fabrication and two electrode electrochemical characterization under normal and other environmental conditions.

What is expected of the student when at IITB and when at Monash?

The Synthesis part and basic electrochemical characterization including materials characterizations will be performed at IITB, advanced electrochemical characterizations and possibly device testing will be performed at Monash University.

Expected outcomes

The expected outcome would be development of a novel carbon based nanocomposite with high specific capacitance and long cycling life.

A device thereof leading to potential IP and high impact research publications

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

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The project is listed involves development of smart material system which will be used for energy storage. Thus the project actually falls under two themes. Smart materials and Clean energy.

Potential RPCs from IITB and Monash

Provide names of the potential research progress committee members (RPCs) and describe why they are most suited for the proposed project

IIT Bombay side

Prof. Vankatasailanathan Ramadesigan (DESE) works in energy storage systems

Monash Side

Prof. Parama Banerjee is Electrochemist as well

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.

The student should have a masters in Science/Technology in the area of chemistry/materials engineering/energy engineering/chemical engineering or any other relevant area
Prior experience working in this area is desirable but not mandatory.

Necessary Courses

Name three tentative courses relevant to the project that the student should complete during his/her coursework at IITB (the student will require to secure 8 point in these courses)

Some suggested courses are

MM656:- Simulation and optimization

MM719:- Introduction to Ab-initio Methods in Materials Modelling

MM717:- Electrochemical Materials Science

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.

K**eywords** relating to this project to make it easier for the students to apply.

Energy Storage, Supercapacitors, Carbon, nanocomposites