

An Indian-Australian research partnership

Project Title: **Synthesis of 2D semi-metal, PtTe₂ for sensing and energy applications**

Project Number **IMURA1156**

Monash Main Supervisor

(Name, Email Id, Phone)

Sudha Mokkalapati

Full name, Email

Monash Co-supervisor(s)

(Name, Email Id, Phone)

Monash Head of

Dept/Centre (Name,Email)

Neil Cameron

Full name, email

Monash Department:

Materials Science and Engineering

Monash ADGR

(Name,Email)

Tim Scott

Full name, email

IITB Main Supervisor

(Name, Email Id, Phone)

M. Aslam

Full name, Email

IITB Co-supervisor(s)

(Name, Email Id, Phone)

IITB Head of Dept

(Name, Email, Phone)

Umasankar S

Full name, email

IITB Department:

Physics

Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? (Please nominate JUST <u>one</u> . For more information, see www.iitbmonash.org)		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	Material Science/Engineering (including Nano, Metallurgy)	1	Clean Energy
		2	Smart Materials

The research problem

Design and synthesize new materials for energy and environmental applications.

2D materials like graphene and transition metal dichalcogenides are promising for sensing and energy applications. However, large area fabrication of 2D materials and their heterostructures remains a challenge. For this reason, applications/studies of 2D materials are still mostly limited to research laboratories. We aim to address this problem by

demonstrating large area synthesis processes for real-world applications.

Project aims

1. *To develop large area synthesis of PtTe₂ and its heterostructures*
2. *To demonstrate soil moisture sensors using PtTe₂ and compare with graphene sensors*
3. *Demonstrate CO₂ reduction using PtTe₂ heterostructures/composites*
4. *Evaluate PtTe₂ for photoelectrochemical water splitting for H₂ generation*

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

The student will focus on materials aspects while at Monash. The material characteristics required for each of the three applications proposed will be determined prior to the start of the students work at Monash. Based on the required characteristics, the synthesis process will be tailored. The material synthesised will be characterised using facilities at the Monash centre for electron microscopy and Monash X-ray platform. The materials synthesis and characterisation experiments will be published as a stand-alone journal article.

The student will focus on device fabrication and characterisation for three different applications while at IITB. Results from each of the three application areas will be published separately as journal articles.

Expected outcomes

1. *New materials and heterostructures (functional materials) with desired electronic and structural characteristics.*
2. *Soil moisture sensors for use in the agriculture sector.*
3. *New materials for environmental protection -CO₂ reduction.*
4. *New materials for efficient photoelectrochemical H₂ generation.*

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

Clean energy: 2D materials like PtTe₂ have largest surface area to volume ratio of any nanomaterial configuration. Added to this property, their surface state free configuration means they are ideal for sensing applications and surface related chemical processes. This project will leverage above properties of 2D materials to demonstrate efficient H₂ generation by water splitting.

Smart materials: 2D materials like PtTe₂ have largest surface area to volume ratio of any nanomaterial configuration. Added to this property, their surface state free configuration means they are ideal for sensing applications and surface related chemical processes. This project will leverage above properties of 2D materials to demonstrate sensors and CO₂ reduction for environmental applications.

Potential RPCs from IITB and Monash

Potential RPCs from Monash:

A/Prof. Nikhil Medekhar

Prof. Murali Sastry

Dr. Sebastian Thomas

Potential RPCs from IITB:

Prof S Dhar

Prof A Alam

Capabilities and Degrees Required

Basic chemistry, nanofabrication, materials characterisation

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)

Introduction to CMP
Nano fabrication and Nano devices
Applied Solid state physics
Analytical Techniques

Potential Collaborators

Potential Monash collaborators:
Prof. Murali Sastry
Dr. Sebastian Thomas
Potential IITB collaborators:
Prof Sourabh Lodha
Prof Amartya Molukhopadhyay

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.

Novel Functional Materials
Energy, Energy Storage, Energy Materials
Nanotechnology, nanoscience
Green Chemistry and Renewable Energy