

An Indian-Australian research partnership

Project Title: **Design synthesis and application of novel hole transport layers**

Project Number **IMURA0615**

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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)

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. **Clean Energy**
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research
7. Humanities and Social Sciences

The research problem

Define the problem

Optoelectronic devices are multi-layered in nature to ensure a precise control of electron and hole dynamics across the entire device architecture. Interfacial layers that enable either low or high electrical resistance at a specific interfaces are the backbone for myriad of optoelectronic devices, including solar cells and light emitting diodes. Hole Transport layers are a particular class of such interlayer material, which act to effectively block electrons and permit holes to be

readily transported across an interface. Unlike electron transport layers, the area of hole transport materials is underdeveloped. In fact, one of the most used hole injection materials is Spiro-OMeTAD, which has been used for over 20 years. In this project we will focus on developing novel hole transport materials that can be used as simple and cost-effective hole injection layers for solar cells. We will employ these across a number of different thin film solar cell structures based on organic bulkheterojunction, perovskite and inorganic absorbing layers.

Project aims

Define the aims of the project

- Design and synthesis of novel hole transport materials that are cost effective and have variable electronic properties for use incorporation into solar cells.
- Determine a viable strategy to provide stable p-type doping of such materials for long term device integration.
- Assess these materials in solar cell fabricated with organic bulkheterojunction, perovskites and inorganic absorbing layers.

Expected outcomes

Highlight the expected outcomes of the project

The expected outcome of the project will be in terms of better understanding of the structure-property relationship in interlayer materials and device performance. It could also lead to the development of better performing optoelectronic and photovoltaic devices.

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.

Clean energy is on the 6 themes under which this project will fall. Photovoltaic devices are one the cleanest energy devices wherein sunlight is used to generate the electricity. The development of novel hole injection layers is an important area for a number of emerging photovoltaic classes. As such, this project will provide broad impact across the photovoltaic community.

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.

Candidate should have the right bend of mind to work in this interface area wherein both synthetic as well as device fabrication and characterization skills are required. An ideal candidate will be one with strong background in Chemistry as well as in Materials Science with some exposure to semiconductor physics

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.

Please provide a few key words relating to this project to make it easier for the students to apply.

Synthesis of hole transport materials, photovoltaic devices, device physics.

