IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	Micro-structural and Micro Spectroscopic Investigation of Bulk-heterojunciton Organic Solar Cells	
Project Number	**IMURA0696**	
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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	*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

Under this project, candidate will study the role of packing of organic semiconductors in overall

solar cell performance. In order to get the insight about the influence of packing of these molecules in solid film, structural analysis will be carried out in Monash University and spectroscopic investigation will be carried out in IITB. Devices fabrication and characterization will be done on either of the place. Structural analysis will be combination of various x-rays (soft and hard) diffraction based technique (GIWAXS, NEXAFS, GISAXS etc) using Australian Synchrotron source. Whereas spectroscopy on devices will include high-sensitivity photocurrent and electroluminescence spectroscopy in Vis-NIR ranges to determine intramolecular vs intermoelcular disorder. Pump-probe spectroscopy to find the kinetics of photo-induced polarons and excitons.

References:

1) "Correlation between Photovoltaic Performance and Interchain Ordering Induced Delocalization of Electronics States in Conjugated Polymer Blends" N. Chandrasekaran et al ***ACS Appl. Mat. & Inter*** Vol. 8, p-20243 (2016)
2) "Impact of Fullerene Mixing Behavior on the Microstructure, Photophysics, and Device Performance of Polymer/Fullerene Solar Cells" W. Huang et al ***ACS Appl. Mat. & Inter***. Vol. 8, p – 29608 (2016)
3) "Influence of Fullerene Acceptor on the Performance, Microstructure, and Photophysics of Low Bandgap Polymer Solar Cells" W. Huang et al ***Adv. Energy Mat.*** (2017)

Project aims

Define the aims of the project

Aims to connect the structural properties to optoelectronic properties of bulk-heterojunction organic semiconductor blend based solar cells.

Expected outcomes

Highlight the expected outcomes of the project

High efficiency low cost organic photo-voltaic cells.

Fundamental understanding of influence of packing of two molecular materials and their interfacial kinetics.

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.

Solar cells using nanostructured organic semiconductor materials find to fit in Energy and Nanotechnology theme.

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.

M.Sc. Physics,

M.Tech. (materials science, photonics, electrical engineering, nano-technology)

B.Tech. Engineering Physics, Electrical engineering

Knowledge with Solar cells, lasers, optics is preferred.

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 www.iitbmonash.org)** relating to this project to make it easier for the students to apply.

Energy, Materials Science, Device-physics, Spectroscopy