IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	Electrochemical and photoelectrochemical reduction of water and CO2 to fuels	
Project Number	**IMURA0795**	
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Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** 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***	*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

There is an urgent need for disruptive changes in the present fossil fuel based economy. One of the most appealing options is to use sunlight or electricity from other renewable sources for synthesis of hydrogen or small hydrocarbons for fuel applications. In this context, the research problem can be defined as identifying suitable catalysts (mostly transition metal oxides) for both electrochemical and photoelectrochemical reduction of carbon dioxide and/or water to fuels such as methane/hydrogen/formic acid/methanol etc. Among the electrocatalysts for reduction of carbon dioxide primarily copper based mixed oxides will be explored. For photo-electrochemical reactions involving both reduction of water/carbon dioxide bismuth vanadates, titania and other oxides with be explored. IThe research would include synthesis of nanoparticles, characterizations (both material and electrochemical) and evaluation. Research would involve sophisticated experiment on two tracks (1) electrochemical and (2) photo-electrochemical.

Project aims

The aim of the project is as follows:

1. *Development (synthesis and characterization) of transition metal oxides*
2. *Evaluation of the transition metal oxides both for electrochemical and photoelectrochemical reduction of carbon dioxide*
3. *Quantification of reduction products*
4. *Develop fundamental understanding on reduction reactions*

Expected outcomes

On of the main aspects of this project is identification of suitable catalysts to facilitate reduction of carbon dioxide and water to hydrogen and hydrocarbons etc. by electrochemical or photoelectrochemical means. Other than scientific research articles the project will try to aim for a working prototype.

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

The project directly address the "Clean energy" theme of the academy wherein one of the gols of the project is to develop materials for efficient conversion of carbon dioxide/water to fuel.

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.

Masters of Technology in Ceramic Technology, Chemical engineering, materials science; Master of science in Chemistry. Hands on skill on material synthesis specially of oxides and basic understanding of material characterization, and hands on skill in electrochemical experiments is a must.

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.

Novel Functional Materials, Energy, Energy Storage, Energy Materials, Electrochemistry, Green chemistry and renewable energy