IITB-Monash Research Academy

An Indian-Australian research partnership

Indian Institute of Technology Bombay | MONASH University

Project Title:	Electrochemical reduction of carbon dioxide on transition metal oxides	
Project Number	**IMURA0620**	
Monash Main Supervisor (Name, Email Id, Phone)	Prof.Jie Zhang, jie.zhang@monash.edu, +61 3 9905 6289	*Full name, Email*
Monash Co-supervisor(s) (Name, Email Id, Phone)		
Monash Head of Dept/Centre (Name,Email)	Kellie Tuck Kellie.Tuck@monash.edu	*Full name, email*
Monash Department:	School of Chemistry	
Monash ADRT (Name,Email)	Peter Betts peter.betts@monash.edu	*Full name, email*
IITB Main Supervisor (Name, Email Id, Phone)	Arindam Sarkar, a.sarkar@iitb.ac.in, 022-25767233, 9820827233	*Full name, Email*
IITB Co-supervisor(s) (Name, Email Id, Phone)		
IITB Head of Dept (Name, Email, Phone)	Prof. K. V. Venkatesh, head.che@iitb.ac.in, 022-25767200	*Full name, email*
IITB Department:	Department of Chemical Engineering	

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

There is a growing concern on increasing concentration of atmospheric carbon dioxide. Worldwide, active research is being undertaken to convert carbon dioxide to useful fuels and chemicals which can act as fuel and chemical feedstock. One of the techniques is electrochemical reduction of carbon dioxide to formic acid, methanol, etc. However, the success of this technique depends on the catalyst and over time several metallic alloys have been reported to do the reduction. Some recent work in our group suggest that transition metal oxides also potentially act as electrocatalysts for reduction of carbon dioxide. The research problem concerns development (synthesis and characterization) of a new class of nanoparticles of transitional metal oxides and evaluation of their potential for electrochemical reduction of carbon dioxide.

Project aims

Define the aims of the project

The aim of the projects are following:

1. Development (synthesis and characterization) of transition metal oxides
2. Evaluation of the transition metal oxides for electrochemical reduction of carbon dioxide
3. Quantification of reduction products
4. Develop a fundamental understanding on how the oxidation state and the bond distances affect the reduction of CO2.

Expected outcomes

Highlight the expected outcomes of the project

The expected outcomes are following

a) A novel class of electroctalaysts for efficient reduction of carbon dioxide
b) Fundamental understanding on the nature of carbon dioxide reduction vis-a-vis the physical properties of the catalyst

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 address the clean energy theme as the reaction products can be used as fuel or feed stock, thus providing a carbon neutral process for energy conversion and chemical industry. The project deals on development of nanomaterials and their evaluation as electrocatalysts. Further, it will try to elucidate the influence of the composition of the nanoparticles on the electrochemical reduction of carbon dioxide from a fundamental and scientifically important viewpoint.

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 oxides and basic understanding of material characterization and electrochemistry is a must.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR MonashWebsite 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.

CO2 reduction, transition metal oxide, electrochemistry, synthesis of oxides