IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Chemical Looping – Metal Oxide Development & Hydrodynamics**	
Project Number	**IMURA0700**	
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IITB Department:	Department of Energy Science and Engineering	

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*

The research problem

IITB-Monash Academy has developed a new process for the production of Ammonium Nitrate from ammonia based on chemical looping of the metal oxide. Operation of the process is hampered by the hydrodynamics of the metal oxide powder at high temperature. Further development is required to obtain a suitable metal oxide that can operate in a circulating reactor system at the required temperature without sintering. Prior work has demonstrated several metal oxides are capable of performing the reaction.

Project aims

Define the aims of the project

1. Design of a laboratory scale flow reactor system (both hot and cold system) allowing the powder to feed into and out of the reactor.
2. CFD modeling of the flow reactor system (hot and cold) to predict the space velocities and contact time between metal oxides and gases
3. Develop a suitable way to manufacture the metal oxides with the appropriate particle size resistant to sintering at the reaction temperature in an ammonia atmosphere
4. Investigate mixed metal oxide systems for NO formation and establish mechanism of oxygen transfer
5. Assess sintering/agglomeration propensity of the metal oxide(s)

Expected outcomes

Highlight the expected outcomes of the project

1. A laboratory scale flow reactor system which can demonstrate the continuous NH3 oxidation process *(Work completed at IITB)*
2. An understanding of the underlying hydrodynamics of the reactor system and the Residence Time Distributions (RTDs) of metal oxides and gases. *(Work completed at Monash and IITB)*
3. Development of a suitable metal oxide which is resistant to sintering at the reaction temperature in an ammonia atmosphere. This could be a mixed metal oxide. (*Work completed at IITB)*

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 is an advanced manufacturing process. This is one of the first works which proposes to use chemical looping for the manufacture of a chemical. It will also use advanced modelling and simulation in developing the flow reactor system.

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.

Chemical Engineering, Mechanical Engineer, Materials Engineering, Energy Engineering

Bachelor or Masters Degree

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.

Chemical Looping, Oxygen Carriers, NH3 oxidation, Ostwald Process