IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Printed energy storage devices**	
Project Number	**IMURA0447**	
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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

The research problem

Define the problem:

There is a an increasing interest in developing flexible, lightweight energy storage devices as they have high potential to open up new applications and increase the versatility of integrated power sources. Smaller consumer electronics including phones, RFID tags, wireless sensor, solar modules, medical diagnostic kits, military applications, all could benefit from integrated power-supply forms. These integrated systems also offer additional advantage of allowing using any empty space within the devices for power storage without being constrained by limited product size. In this context, employing printing technologies for the manufacturing of such power storage devices will not only facilitate cheap mass production processes, but will also provide enormous flexibility for product functionality and designs. Additionally, printed energy storage devices become more important with the emergence of Printed Electronics as they can be manufactured

on the same printing line.

Recently, lots of research is being done on printed thin-film batteries and different kinds of printing techniques like screen printing, extrusion printing, dispensing, inkjet printing, flexography are adopted to manufacture these power sources. The systems adopted were similar to the traditional battery systems that are mostly based on zinc/manganese dioxide, zinc/air , zinc/silver, nickel/hydrogen , nickel/metal hydride , lithium ion and, and organic radical chemistries. Out of these well-known battery concepts, zinc/manganese dioxide system is very promising due to its simplicity and environmental sustainability. It would therefore be employed for fabricating thin film battery by using different kinds of printing techniques.

Project aims

Define the aims of the project

Broadly, the project aims to achieve following objectives:

- Printable ink/paste formulation for different layers, understanding ink rheology, ink wettability as well as ink dispersing qualities.
- Substrate surface characterization
- Extensive electrochemical characterizations and printing optimizations to achieve better printing quality on variety of substrates.
- Understanding about the interfacial issues and integration of constituent layers
- Lamination and Encapsulation
- Battery Characterization

Expected outcomes

Highlight the expected outcomes of the project

- Demonstration of printed battery
- Knowledge generation, Publications and Patents
- Long lasting collaboration

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.

In this project, both the materials and processes involve nanotechnology. The materials will be mostly nanoparticle inks and understanding their printing process requires a significant understanding of fluidics and the obtained nanomorphology. Further the project aims to fabricate devices to store energy via cleaner routes.

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.

We are looking for one Ph.D. student with following background:

1. B-Tech or M.Tech in Materials Science & Engineering/ Chemical Engineering
2. M.Sc in Physics and Chemistry

3. Previous experience in ink formulation, printing and/or electrochemistry will be a good asset.