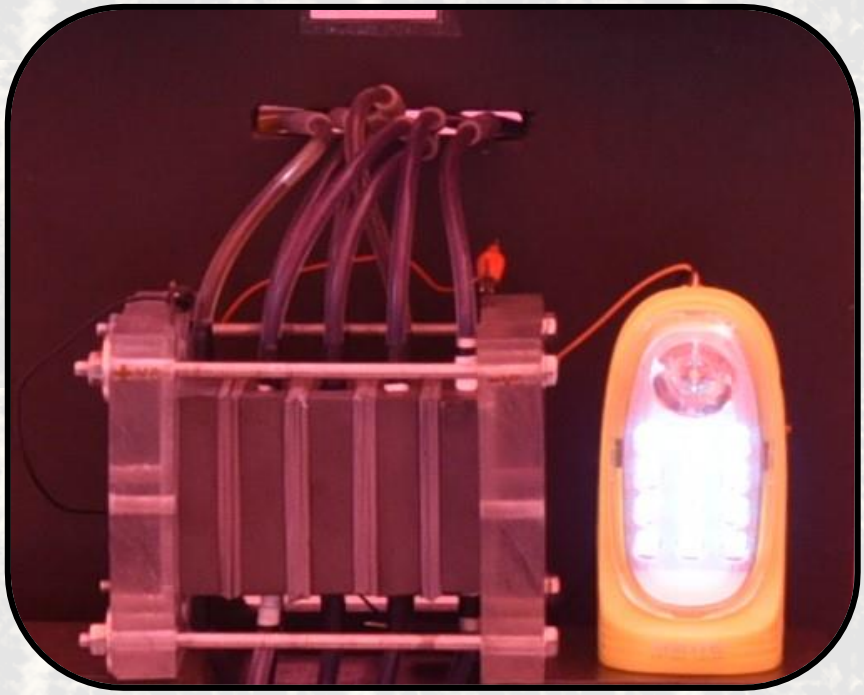
सत्यमेव जयते

Department of Science & Technology
Govt. of India

DST-IIT Delhi, Energy Storage Platform On Batteries *(ESPOB)*



ESPOB at IIT Delhi would bring together different expertise for the development of redox flow battery, ion-battery and photo-electrochemical water splitting technologies using earth abundant materials.

The objectives and deliverables are met via four domain areas: (i) graphene and modified forms of carbon (ii) mixed-metal oxides/ transition metal oxides/ perovskites (iii) organic-inorganic hybrid materials.

(iv) molecular and kinetic simulation and device level modelling

Collaborators

INDIAN INSTITUTE OF SCIENCE

INTERNATIONAL ADVANCED RESEARCH CENTRE FOR POWDER METALLURGY AND NEW MATERIALS

CGCRI CECRI

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ARCI

CSIR-INDIA

immt

CSIR - IICT
Touching Lives

WASHINGTON UNIVERSITY IN ST. LOUIS 1853

Industry Partner

HEROELECTRIC

http://espob.iitd.ac.in

Message

"The collaborative platform provided by the centre would bring best minds together and is expected to lead to research and technology outputs of immense value for clean energy driven growth. This would also accelerate innovation in clean energy domain for cost effective, reliable and robust solutions".

Dr. Harsh Vardhan
Union Minister for Science & Technology, Earth Sciences, Environment, Forests and Climate Change, Government of India

"Accelerated discovery of energy materials has the potential to make clean energy harnessing more efficient and affordable. The centre would develop materials which can address the issues of variability and uncertainty intrinsic to clean energy sources and provide research led disruptive solution".

Prof. Ashutosh Sharma
Secretary to the Government of India, Department of Science and Technology

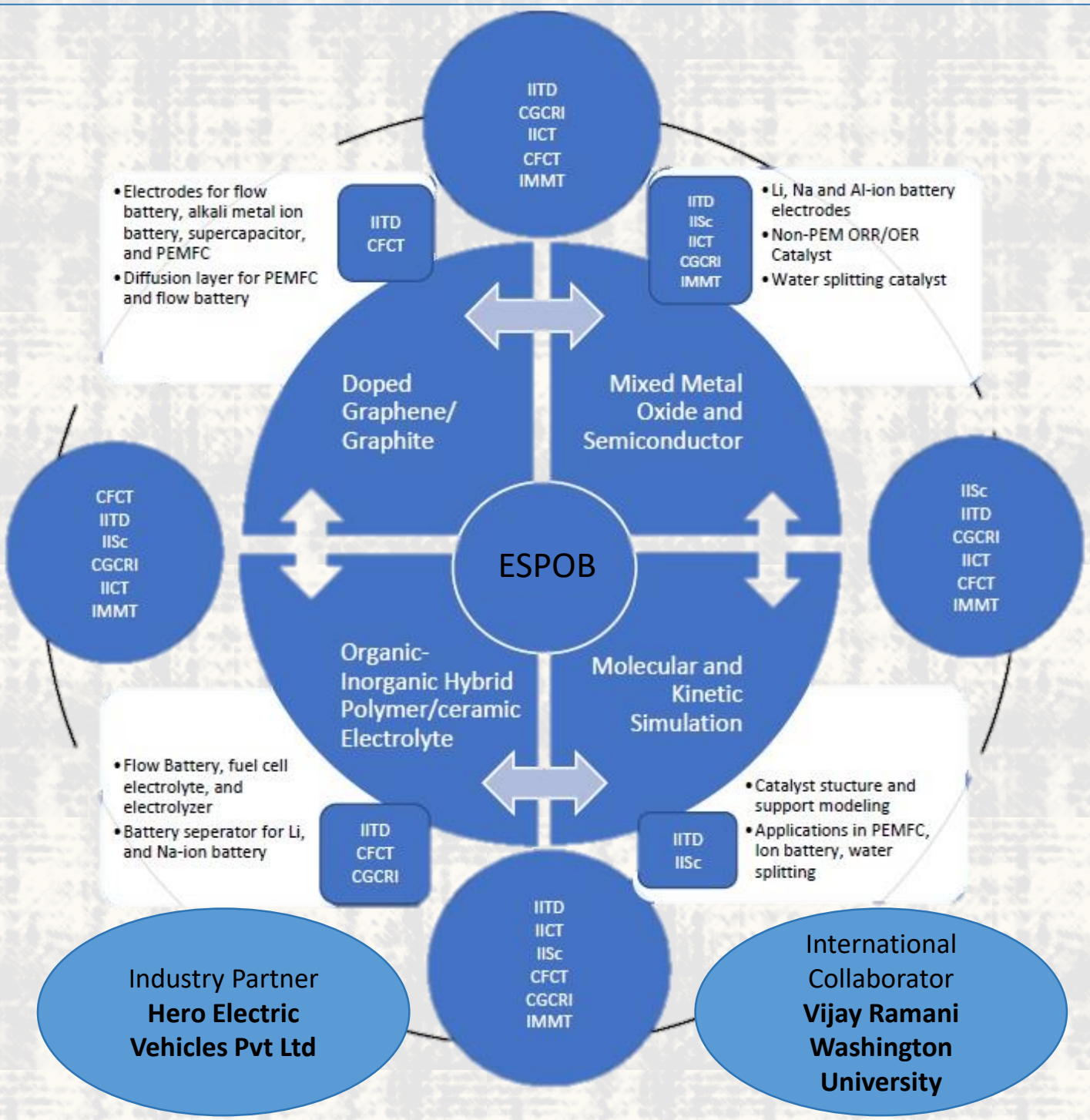
"ESPOB presents an exciting opportunity for researchers engaged in different aspects of electrochemical energy storage to work together. Such an interdisciplinary approach is required to provide sustainable solutions for meeting the ever-growing energy requirements of the nation. IIT Delhi is privileged to host this centre as the nucleating site for providing a leadership role in renewable energy storage research and implementation".

Prof. V. Ramgopal Rao
Director, IIT Delhi

"Materials for Energy Conservation and Storage Platform (MECSP), a theme based initiative by DST to support feasibility assessment of fresh idea/concepts including various emerging and disruptive materials technologies for potential use in energy storage devices. This brings investigators engaged previously in different DST, SERB and Ministries projects to work together to deliver solutions for energy conservation and storage".

Prof. Suddhasatwa Basu
Project Coordinator

Overall Management Structure and Integration Mechanism



Aim and Objectives of the Centre

- Develop next generation materials and India-centric scalable energy storage technology
- Material development work on doped-carbonaceous materials
- Develop low cost and efficient hybrid organic-inorganic membrane
- Create human resource pool by training to electrochemical storage technologies
- Network with industry and other institutions (national and international) with complementary skills
- Disseminate knowledge through short courses and workshops to industry and academia

Overview of Activities at the Centre

➢ ***Doped Carbonaceous materials (doped-graphene, nanotube, nanofiber), porous carbon nanomaterials, composites of carbon with transition metal oxides***

- Developing electrochemical exfoliation of graphite for graphene with very low scatter
- Synthesis of graphene suspension with bilayer or trilayer content greater than 80%
- Build synthesis protocol that can target a level of defect density guided by first principles
- Modelling and electrochemical characterization to examine electrochemical behaviour
- Formulating anode fabrication method to improve capacity retention and cell performance

➢ ***Mixed Metal Oxides, single/multiple transition metal oxides and (Binary/Ternary) Semiconductor***

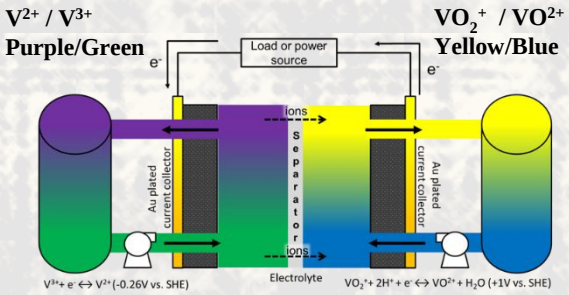
- Synthesis of cathode materials for rechargeable Na-ion, Al-ion Battery and separator for Metal-ion Batteries
- Electrochemical characterization, modelling and design optimization of Li-ion battery cathodes
- Non-PGM based oxygen reduction reaction (ORR) and oxygen reduction reaction (OER) catalysts
- Materials for PEMFC and Electrolyser
- Photo-electrochemical Water Splitting

Ceramic Coated Paper-based Separator for Li-ion Batteries

Overview of Activities at the Centre

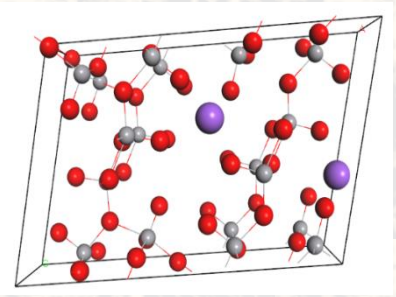
➢ *Organic-Inorganic Hybrid Polymer Electrolyte, ionic liquid based polymer gel electrolytes.*

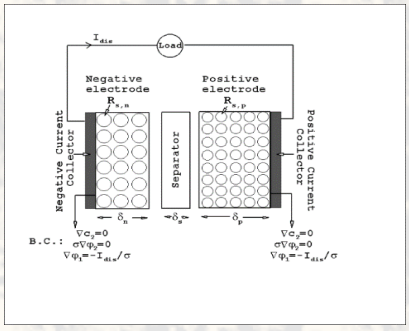
- Hybrid electrolyte for VRFB
- OER-ORR coupling over $NiMnO_x$ based Composite Photo-electrocatalysts
- $NiCo_2O_4$–RGO composite based hybrid material for solar driven water splitting

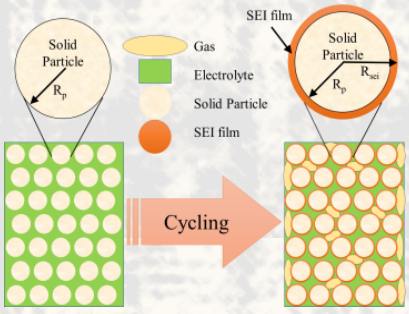


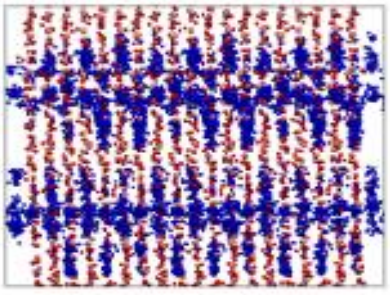
➢ *Molecular and Kinetic Simulation and Device Level Modelling.*

- Study the binding mechanism in pristine, hydroxylated carbon nanotube, and carbon nanotube with glycerine additive to understand the binding energy trends of VO_2^+ over these surfaces
- Understand reactivity trends of several metal and bimetallic catalysts as cathode materials in a PEMFC





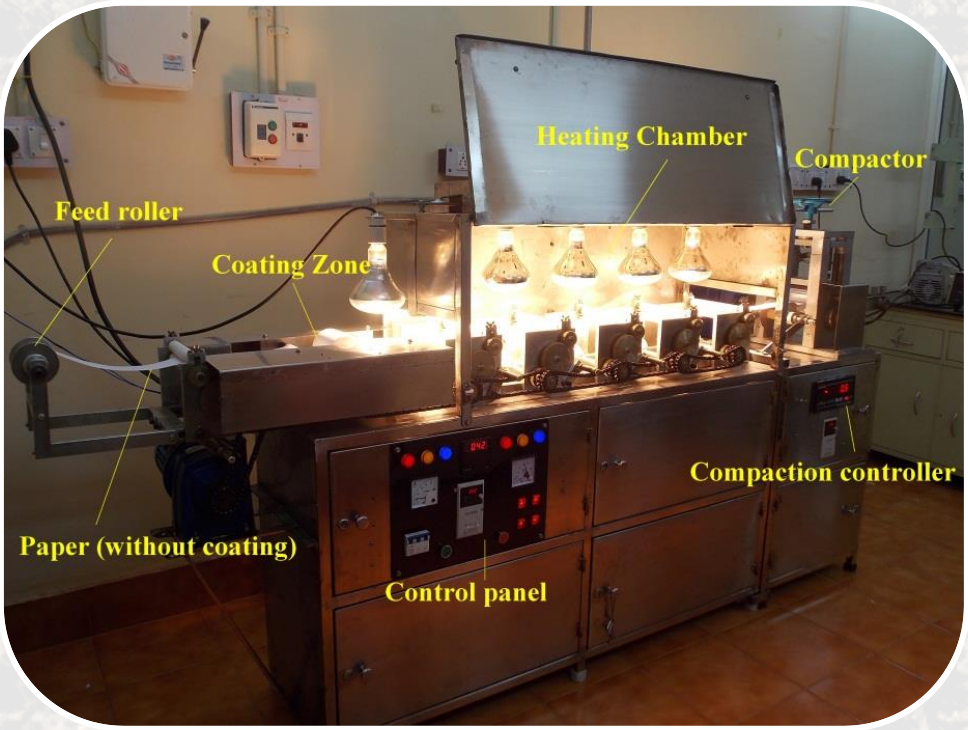




➢ *Recycling of Spent Li-ion Battery.*

- Development of new efficient processes both for metal dissolution and formulating marketable products
- Process identification related to precursor electrode materials
- To recover cobalt, lithium and other metal values from Li-ion spent batteries

Facilities



Semi-automated Ceramic Separator Fabrication Equipment

Rotating Ring Disk Electrode setup

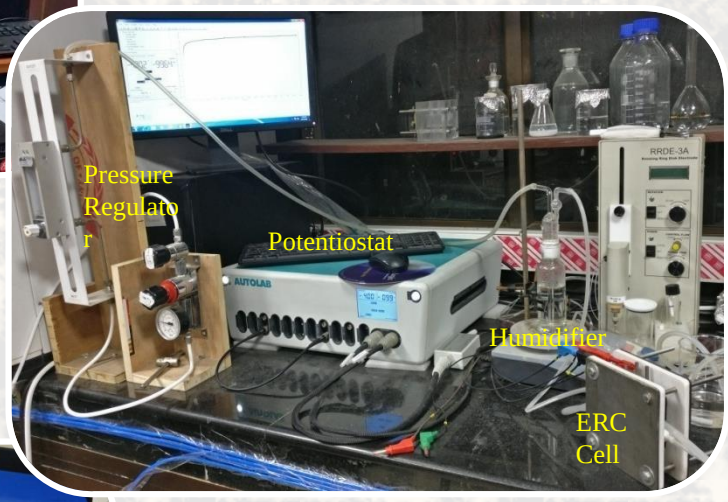
Tape Casting Unit

Fabrication process of cathode material for Na-ion batteries

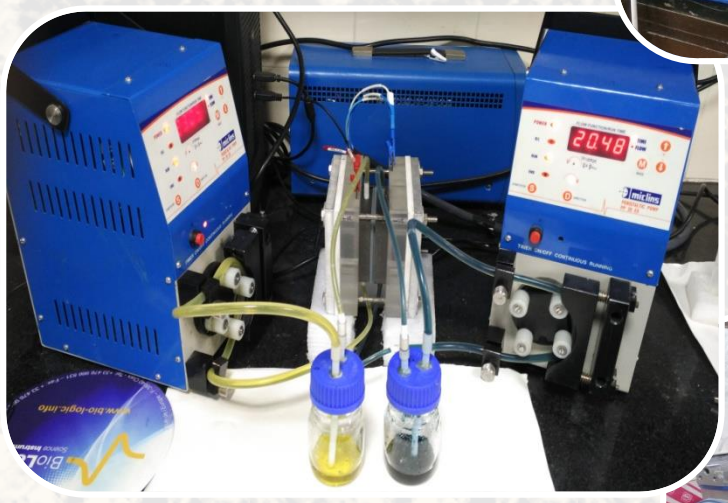
Prototype fuel cell system

Facilities

Gas chromatographer for Product Analysis



Electrochemical CO_2 Reduction Setup



Vanadium Redox Flow Battery

Low temperature Fuel Cell Test Station

Investigators and Collaborators

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