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Inorganic-polymer composite materials at the positive electrode of Li all solid-state batteries



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destiny

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- Collaboration project between:
 - ICMcb Group 2 "Materials and Batteries"
 - LCPO Group 4 "Polymer Electronic Materials & Devices"
 - IPREM-Pau

All Solid-State Battery (ASSB)

Lithium-Ion Batteries

Anode (-) | Cathode (+)

Solid-State Lithium-Metal Batteries

Lithium-Metal Anode (-) | Cathode (+)

Increasing energy density by utilizing the Li-metal anode, mitigate Li metal dendrites growth, and increasing of the packing density

Safety issues related to liquid electrolyte

Widen the operability of battery in higher & lower temperature also higher voltage

Challenges in ASSB

- Metallic anodes
- Interfaces
- Physical contact

- Inhomogeneous metal deposition/Lithium dendrites growth**
- Interfaces issues** (formation of blocking interface, chemical interfacial energy, parasitic reaction, incompatibility with active materials, etc.)
- Mechanical** (contact loss, fracture, poor solid-solid contact) and **electrochemical** (interface reaction) **stability upon cycling**

Polymer application in batteries

Polymer as soft material has been used widely in battery field, including:

- Line-contact type** (Pvdf)
- Point-contact type** (SBR/CMC)
- Artificial interlayers and protective coatings** (With non-polar groups, With polar groups, With charged groups, With multi-type groups)
- Conducting polymer as storage medium etc.** (Polymer Electrolyte in ASSB)

Positive electrode in ASSB

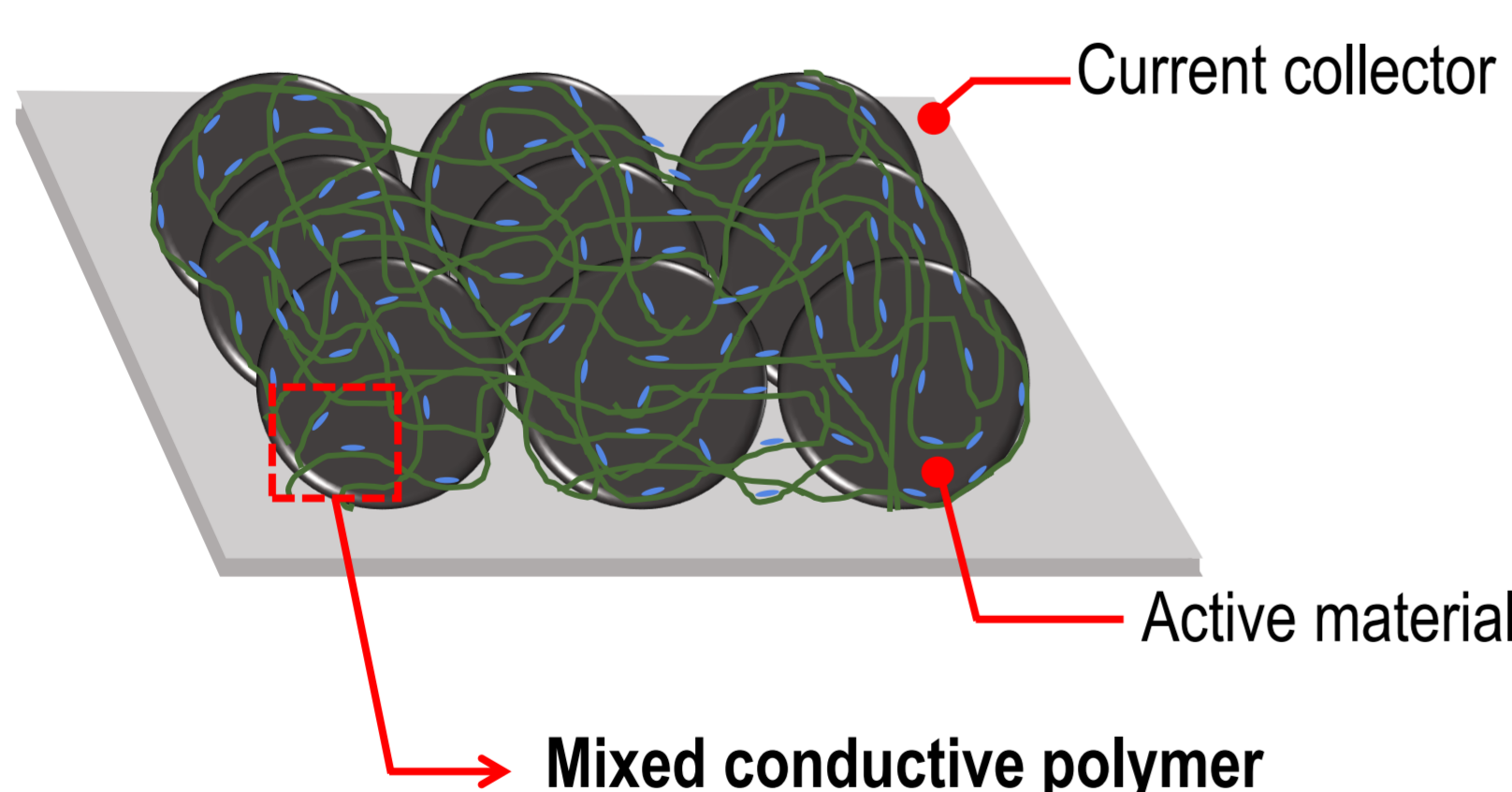
All Solid-State Batteries (ASSB)

Concerns are mainly on the **interface issues**, **structure integrity**, and the needs of adequate **ionic and electronic conductive materials**

Currently, up to **50 wt.% solid electrolyte** and **carbon additive** are added to the positive electrode, **decreasing the energy and power density** of the overall SSB

Goals of the project

Positive Electrodes (Inorganic-polymer composite materials)



- Develop a polymer that will simultaneously act as the binder, the conductive additive (electron conductor) and also the catholyte (Li⁺ ion conductor) in the positive electrode.
- Polymer is expected to bring plasticity and promote the solid-solid interface between positive electrode and the electrolyte in ASSB and buffer the impact of volume change upon cycling.
- Furthermore, polymer will enhance and stabilize the formation of solid electrolyte – cathode (CEI) interface.
- Design a polymer that is applicable for a wide range of positive electrode active materials as well as solid electrolytes

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