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HyLiST

Hybrid Lithium Metal-based Scalable Solid-State Battery Manufacturing

ADVANCING DRY-PROCESSED SOLID POLYMER ELECTROLYTES FOR LITHIUM METAL BATTERIES

AUSTRIAN INSTITUTE OF TECHNOLOGY

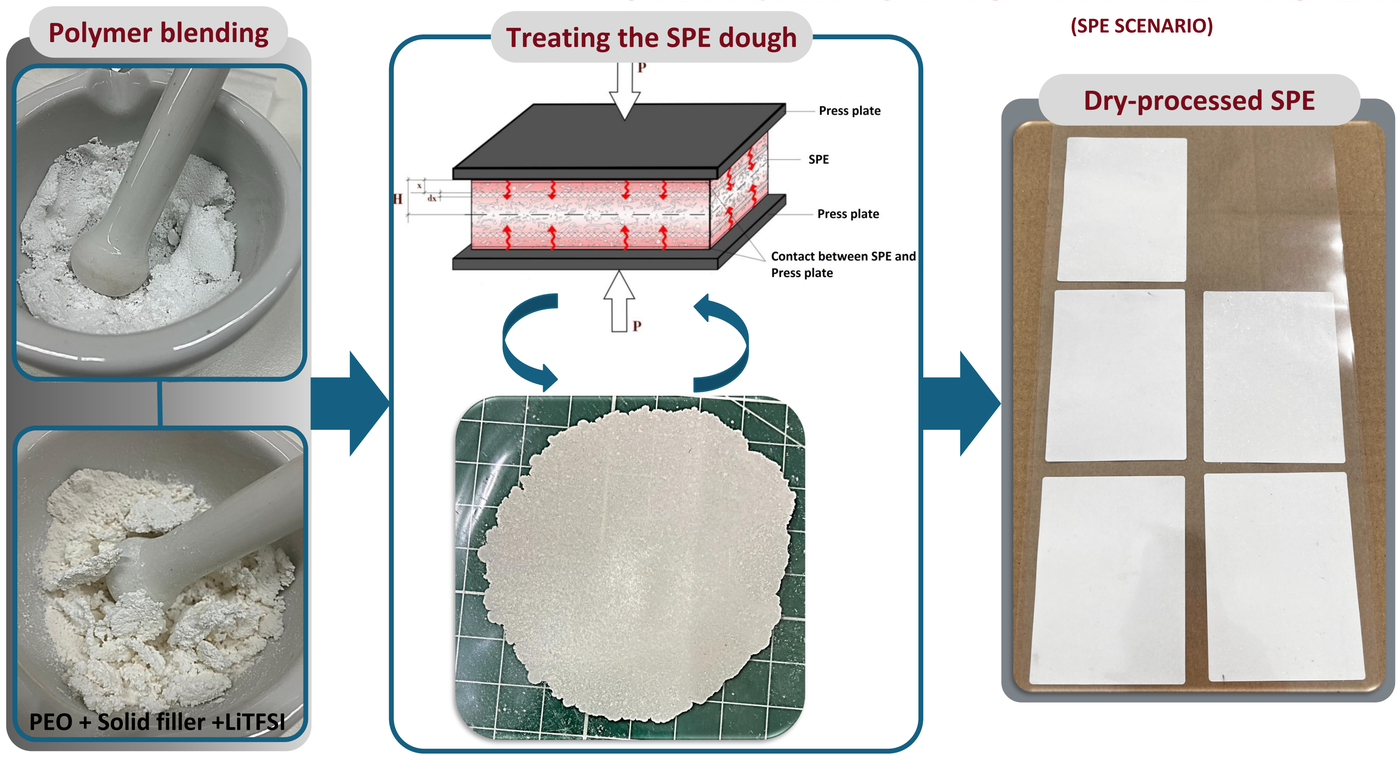
TOMORROW TODAY

IMPORTANCE

Solid polymer electrolytes (SPEs) are a promising route to safer and more stable lithium metal batteries, but conventional solvent-based fabrication leaves harmful residues, increases energy use, and limits scalability. In this work, a **solvent-free hot-pressing** method was applied to polyethylene oxide (PEO)-based SPEs, enabling homogeneous, dense films without pore formation. Electrochemical testing demonstrated stable **Li|SPE|Li** cycling at elevated temperatures and effective integration into **Li|SPE|NCM811** pouch cells. These results confirm the feasibility **of dry-processed SPEs for industrial applications**, highlighting a sustainable pathway to scalable solid-state battery manufacturing.

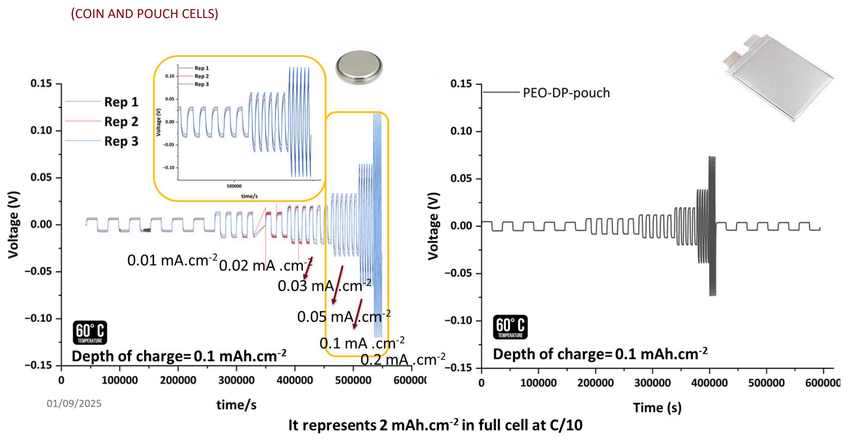
SWITCHING FROM A WET TO DRY PROCESS

(SPE SCENARIO)



SYMMETRICAL CELL CYCLING

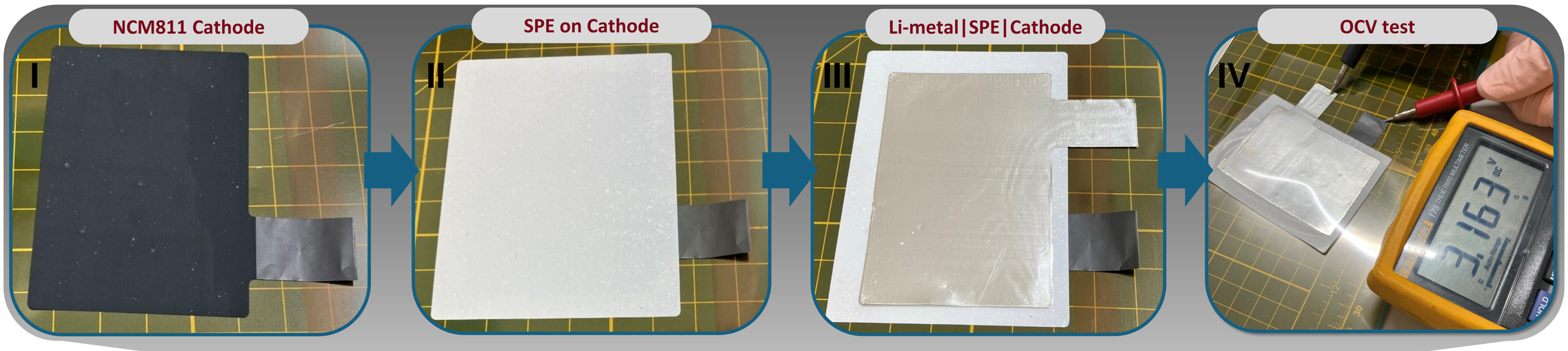
(COIN AND POUCH CELLS)



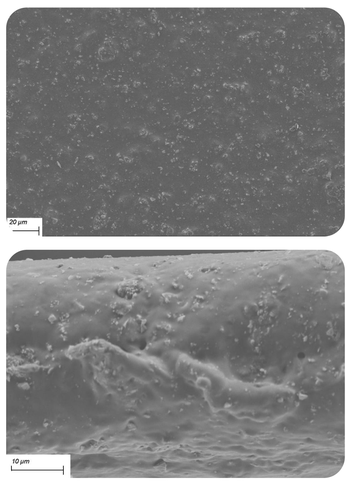
Symmetrical cells: Stable Li|SPE|Li plating/stripping with no shorting or premature failure up to 0.2 mA·cm^{-2}.

Pouch cells: Reduced overpotential compared to coin cells, attributed to minimized edge effects in the pouch configuration.

HOW POUCH CELLS ARE BORN!



PEO + Solid filler +LiTFSI



Surface SEM Of SPE

Cross-section SEM Of SPE

FULL CELL CYCLING

(POUCH CELLS)

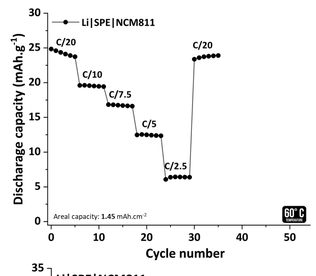
Stable cycling

Both rate-capability and long-term tests confirm reliable cycling performance up to 140 cycles.

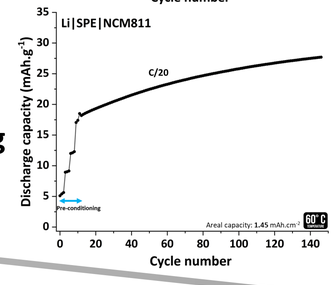
Capacity retention

Lower than expected capacity is attributed to the cathode design, where the conventional ionically non-conductive binder (PVDF) restricts access to active material.

Rate capability



Long-term cycling



TAKE HOME MESSAGE

- **Dry processing of thermoplastic polymers (e.g., PEO) is an environmentally friendly route** that avoids toxic, flammable solvents and requires only minor changes to existing manufacturing lines.
- **This method improves safety and simplifies electrolyte preparation**, paving the way for scalable polymer-based solid-state batteries.
- **Initial results confirm strong potential of dry-processed polymer electrolytes,** demonstrating stability and feasibility for industrial application.
- **Conventional ionically non-conductive binders in cathodes limit performance**; replacing them with ionically conductive polymer binders is essential.
- **Future direction**: Ionically conductive thermoplastic binders will enable dry-processed cathodes, improve ion transport, and make large-scale solid polymer battery manufacturing more practical than ever.

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