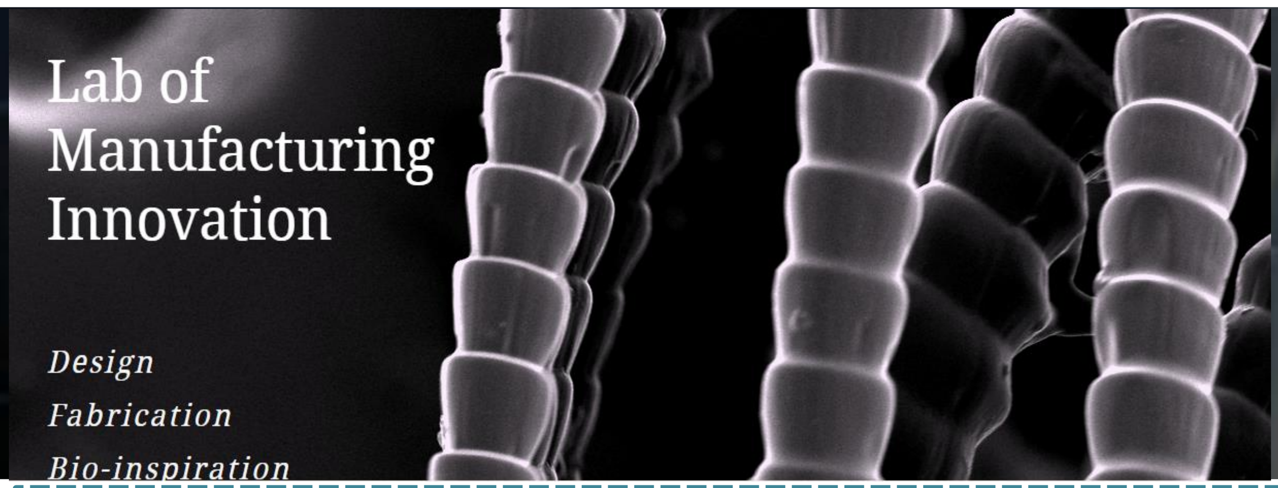

Additive Manufacturing of Solid-State Electrolyte with Enhanced Electrochemical Performance for Lithium-Ion Batteries

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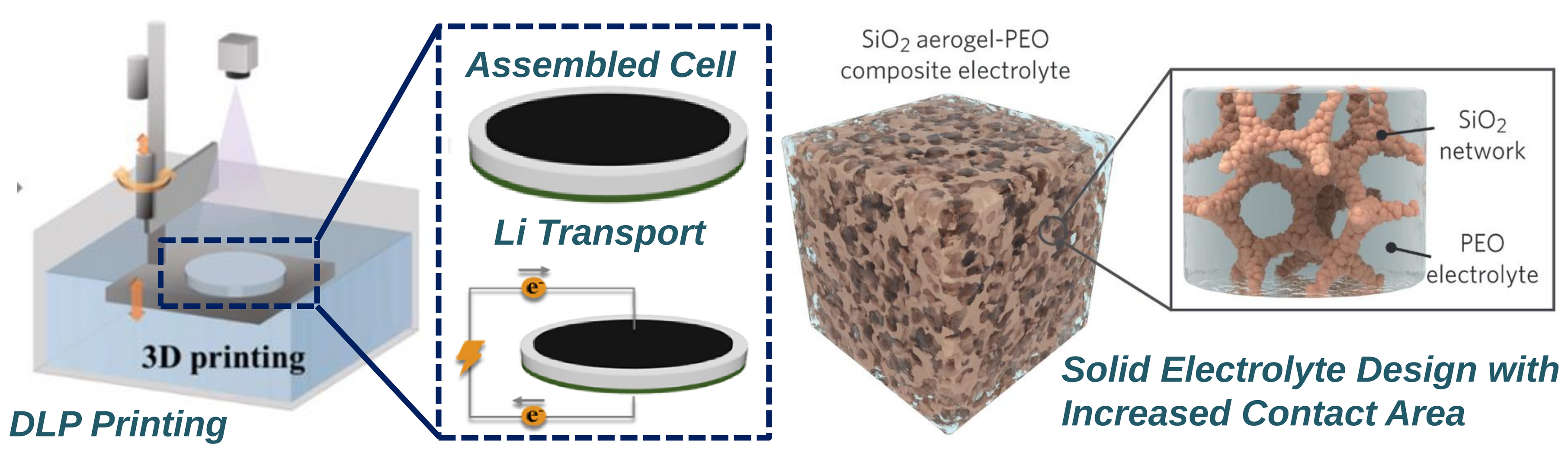
1. Motivation & Overview

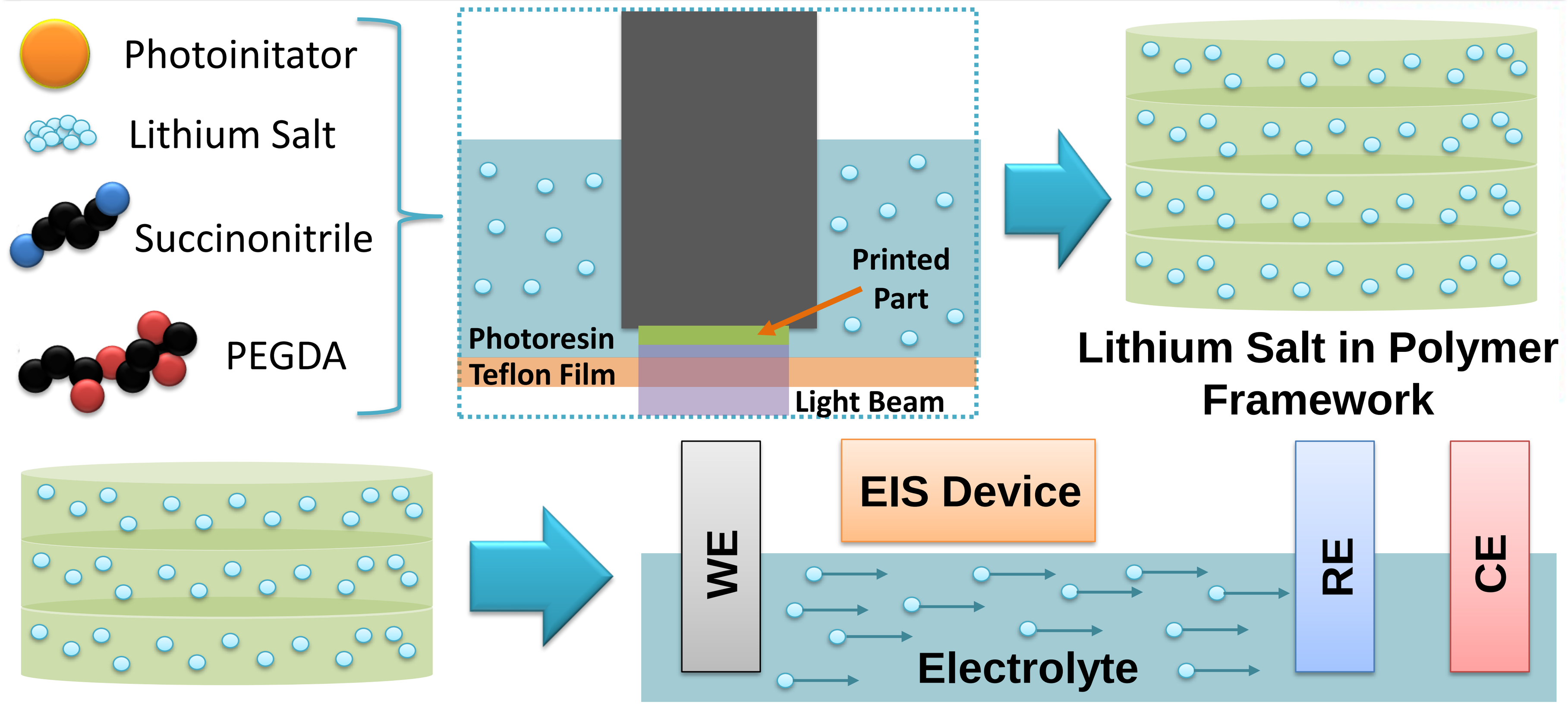
Additive manufacturing creates intricate polymer-based electrolytes for better lithium-ion battery performance, optimizing polymer and salt concentrations to improve ion transport to silicon anodes, advancing electric vehicle battery technology for higher energy density and safety. In LIBs, the electrolyte enables lithium-ion movement between electrodes during charging and discharging, storing and releasing energy. Acting as a separator, it prevents short circuits while facilitating efficient ion transport. Current methods for printing electrolytes face challenges in balancing ionic conductivity with mechanical strength and ensuring uniform coverage in complex structures, limiting performance and safety. To meet industry demands for next-gen LIBs, research aims to develop high-conductivity electrolyte morphologies, addressing scalability and enhancing performance and safety.



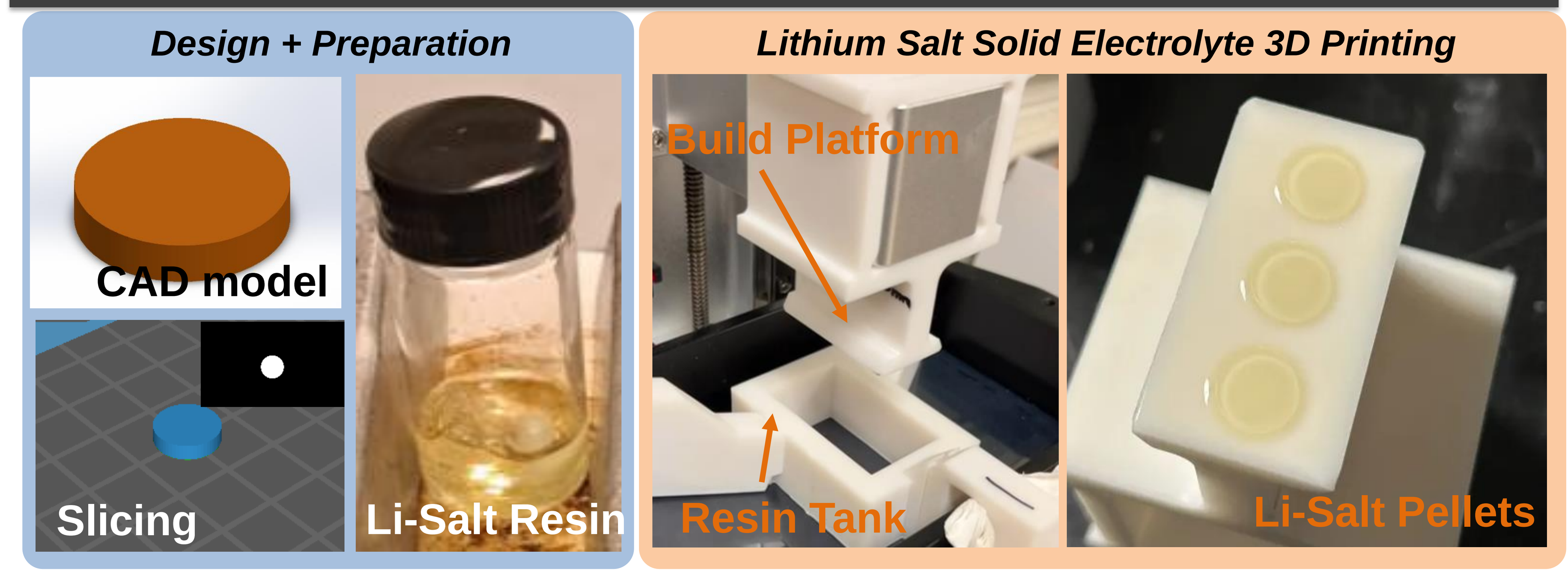
2. Abstract

Recent development in additive manufacturing (AM) technologies, particularly direct light processing 3D printing, present notable advantages such as high resolution and rapid printing times, allowing for the fabrication of polymer components with intricate morphologies compared to traditional manufacturing methods. Leveraging this technology, the objective is to engineer an electrolyte material capable of withstanding the mechanical stresses associated with silicon anodes, while maintaining stable electrochemical performance across numerous charge-discharge cycles. The successful development of such a polymer-based electrolyte, exhibiting enhanced properties, holds the promise of catalyzing the widespread adoption of silicon anodes, thereby facilitating the realization of higher energy density and longer-lasting batteries for a myriad of applications, including electric vehicles and portable electronics

3. Fabrication and Analysis Schematic for Printed Polymer Electrolyte

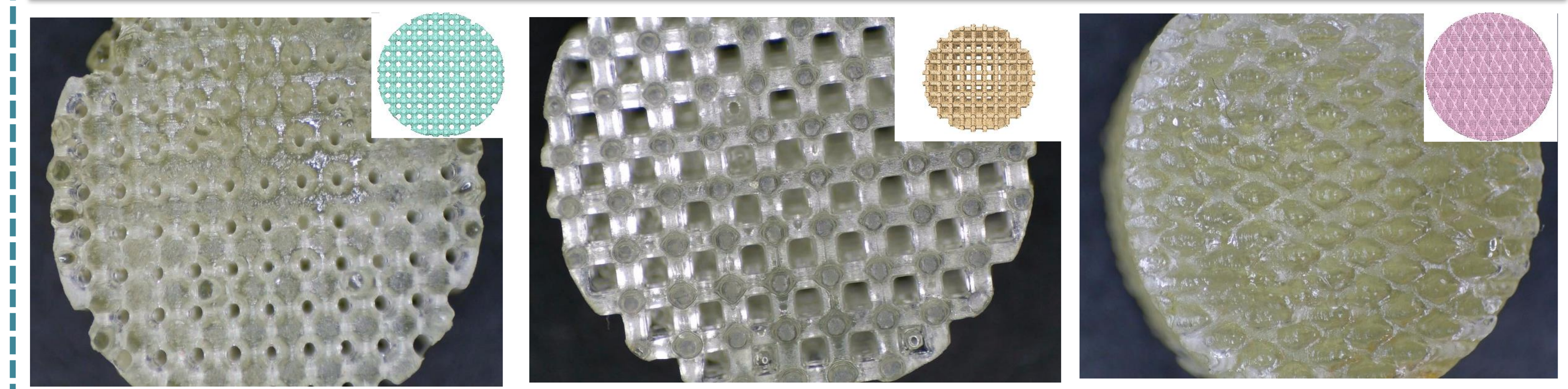


4. 3D Printed Polymer Electrolyte with Lithium Salt



To fabricate lithium salt electrolyte, 10%, 20%, and 40% lithium salt photocurable solutions were synthesized by weighing the required amount of lithium salt, SCN, PEGDA, and photoinitator and homogenizing the resin by magnetic mixing overnight. Pellets were design in Fusion360 with a diameter of 10 mm and height of 2 mm required by the ionic conductivity testing device. Digital model slicing and printing parameters adjustments were conducted utilizing CHITUBOX software. The resin was then coated into a resin tank with the purpose of fabricating the lithium salt electrolyte design. After fabrication, the pellets were carefully removed and cleaned.

5. Geometric Design of 3D Printed Electrolyte



Three different surface morphologies, from left to right Schwartz-P, 2.D X-cell, and cross cell, were investigated as potential designs for the solid electrolyte with lithium salt. Printing parameters were adjusted to ensure high resolution structures based on the curing performance of the PEGDA-based resin. The three designs were successfully fabricated via DLP printing demonstrating the ability to manufacture solid electrolytes with high surface area for ion conduction.

6. Future Work

- Explore varied printing parameters to optimize electrolyte properties for enhanced ionic conductivity and LIB performance.
- The design of coin cell pellets optimizes electrode materials, separator properties, electrolyte composition, and assembly processes for desired lithium-ion battery performance, safety, and reliability.

7. Acknowledgements

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8. References

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