3D Printing of Iron Hydroxide-based Anode with Bioinspired Structures for Lithium-Ion Batteries

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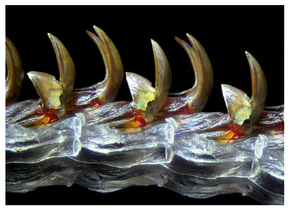
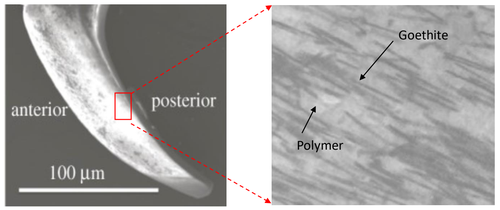
1. Introduction

Over the course of centuries, nature has evolved complex material systems, such as the Bouligand type structure seen in Mantis shrimp and the pseudo-orthogonal structures in weevil rostrums that exhibit remarkable mechanical properties that are attributed to unique microstructures. In a recent study, the teeth of limpets exhibited the strongest mechanical strength, with a linear elastic modulus of 120+/- 30 GPa, through a polymer composite matrix with aligned goethite fibers formed through a biomineralization process. The aligned fiber in a protein-based polymer matrix provides an attractive design inspiration for the mechanical enhancement of lithium-ion battery (LIBs) anodes where conventional fabrication methods encounter a bottleneck in controlling geometric morphologies.



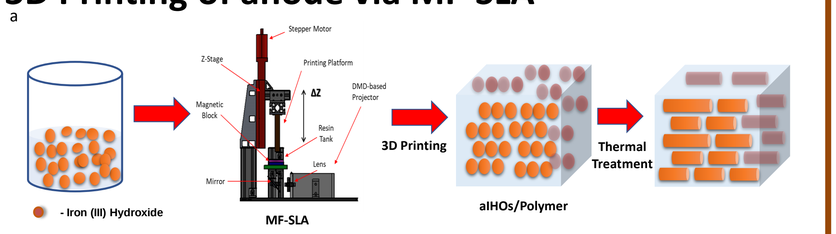


2. Abstract

This proposed research is motivated to address the current manufacturing challenge of LIBs anodes by using a novel 3D printing approach to fabricate highly controlled morphologies within LIBs. Consequently, a magnetically assisted 3D projection based-stereolithography (MF-SLA) was successfully used to rapidly fabrication the LIB anode with enhanced mechanical properties than the conventional anode via bioinspired microscale architectures.

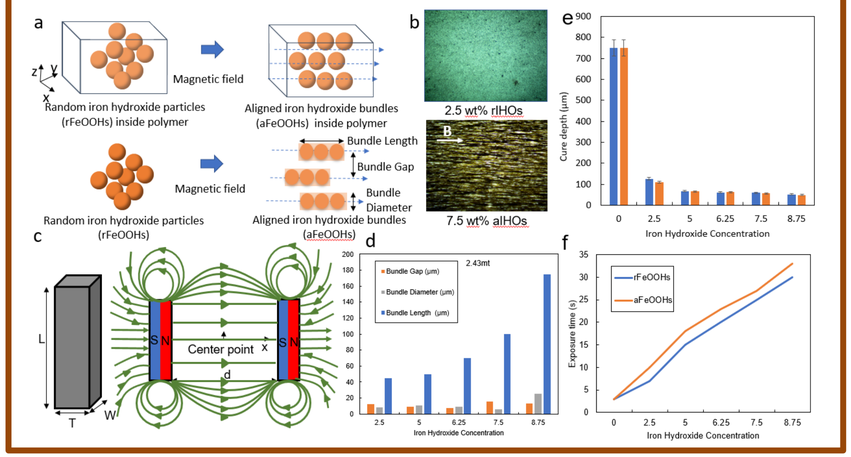
3. Method

3D Printing of anode via MF-SLA

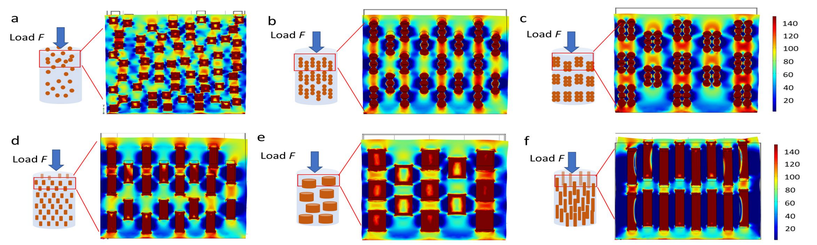


4. Results

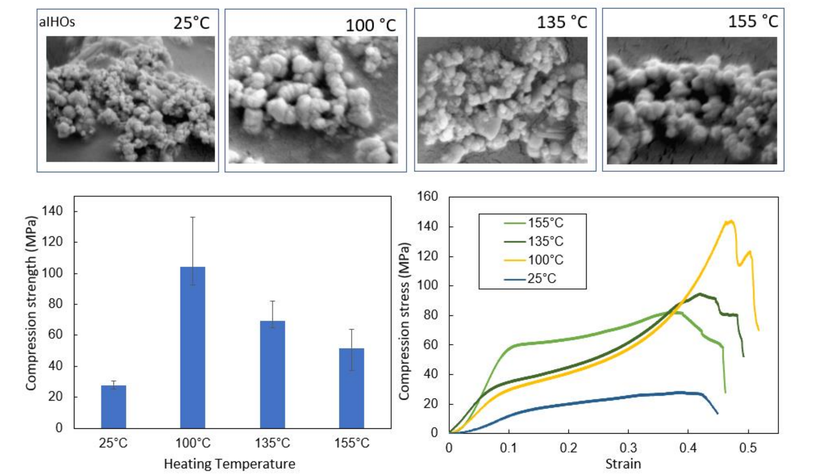
Bundle alignment and Curing Study



Simulation



Post Processing and Compression



5. Summary and Future work

FeOOHs are aligned by the magnetic field during 3D printing, and aligned FeOOHs bundles are further grown to aligned goethite based bundles (aGBs) by rapid thermal treatment after the printing. The mechanical property of printed parts were enhanced.

Acknowledgments

Thanks to the support of FURI program

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Ira A. Fulton Schools of Engineering
Arizona State University