ABSTRACT - POSTER

Flow-Optimized Powders for 3D-Printed Solid-State Batteries

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Solid-state batteries (SSBs) offer improved safety, higher energy density, and longer cycle life compared to conventional lithium-ion batteries. However, their widespread implementation is hindered by manufacturing challenges including complex architectures, sensitive interfaces and high production costs[1]. Additive manufacturing (AM) presents a promising route to fabricate intricate, multilayered batteries with precise control over composition and microstructure[2]. Nevertheless, inadequate flowability, morphological irregularities and low packing densities of electrochemically active powders present significant obstacles to effective additive manufacturing and hinder final device performance.

This work explores a scalable strategy combining spray drying and grinding to engineer spherical, flowable powders optimized for AM techniques. By tuning the ratio of milled to raw particles, additive content, and drying parameters, the process yields particles with controlled size distribution, mechanical robustness, and surface properties - while maintaining the phase purity and charge transfer properties of the original materials.

We demonstrate how this approach enhances the rheological and morphological properties of electrochemically active powders, such as NMC, improving their compatibility for multi-material powder bed fusion. Powder rheology is characterized by measuring avalanche angles and cohesion indexes using a Granudrum while morphology is assessed by scanning electron microscopy. The optimized powders are selectively deposited and compacted into pellets via die pressing. These pellets are compatible with integration into solid-state battery assemblies.

[1] A. Sazvar, M. Hajibandeh, P. Vafaei, E. Hosseinzadeh, and M. Jabbari, “Review of recent progress in sintering of solid-state batteries: Application and modelling,” *J Energy Storage*, vol. 101, p. 113863, Nov. 2024, doi: 10.1016/J.EST.2024.113863.

[2] N. Fonseca *et al.*, “3D Printing-Enabled Design and Manufacturing Strategies for Batteries: A Review,” *Small*, vol. 19, no. 50, p. 2302718, Dec. 2023, doi: 10.1002/SMLL.202302718.