DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering
PhD Thesis Proposal

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Hill Conference Room

Characterization of Electrochemical and Rheological Correlations in Flowable (Semi-solid) Electrodes for Energy Storage Applications

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Abstract

In recent years, flowable (semi-solid) electrodes have attracted much interest as an alternative approach to both flow-assisted and stationary electrode designs. These systems utilize suspensions of solid electroactive particles in certain electrolytes to store charge. Hence, unlike flow batteries, energy densities independent of the electrolyte solubility limit can be achieved at ease. At the same time, contrary to stationary electrode designs, the flowable nature of the slurry electrodes offers scalable, grid-level operation for many conventional energy storage chemistries by offering flow cell integration and decoupling of power and energy ratings.

The proposed work aims to bridge a critical gap between electrochemical and rheological understanding of flowable (semi-solid) electrodes by identifying which parameters affect the particle arrangements (dispersion) that occur within suspended electroactive particles under various operating conditions. More specifically, a framework that governs parameters such as size and shape of the conductive additive particles, mixing protocol, ionic strength, synthesis route, and concentration of the electroactive particles will be developed. By using the established framework, guidelines that can help design better performing cell architectures and slurry formulations will be developed. Outcomes of the proposed work will address a critical gap between electrochemical and rheological communities that is necessary to develop better performing flowable systems not only for energy storage applications but also for an ever-growing flowable (semi-solid) systems field that has found many applications.