SAND2021-13586C

Thermal Stability of Solid-State Battery Components with Liquid Electrolyte

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Solid-state batteries (SSBs) offer the promise of increased safety, high energy density, and reduced charge time. Interfacial resistance between the solid electrolyte and the electrodes remains a critical challenge, significantly impacting rate capability and performance. One solution to this challenge is the inclusion of a small amount of liquid electrolyte at the interface. However, there are concerns regarding the impact of liquid electrolyte on safety. To date, no experimental data has been presented on the safety implications of liquid electrolyte use to facilitate interfacial ion transfer in SSBs.

The results of thermal stability testing and characterization on SSB components, including Ta-doped LLZO, with liquid electrolyte, will be presented. Thermal characterization was carried out on individual and combinations of components utilizing a differential scanning calorimeter (DSC). This allowed for the determination of the components' and component combinations' exothermic and endothermic heat release values and the temperatures at which those heat releases occurred. Testing the thermal stability of different component combinations offered the ability to elucidate side reactions that occurred in response to material interactions, due to contact and/or gases generated, and their respective heat releases. In addition, coin cells were assembled to obtain various states of charge (SOC) and the subsequent materials were harvested and tested with DSC. This gave the heat release as a function of SOC. For all thermal stability tests, scanning electron microscopy (SEM) was used to determine morphological changes in the SSB components. X-ray diffraction (XRD) was used to examine changes in the solid electrolyte crystal structure and chemical composition. The thermal stability testing of SSB components and characterization of those components presented here offers insight into the safety benefits provided by the utilization of solid electrolytes in Li-ion batteries.

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