Application of Gel Polymer Electrolytes Based on Ionic Liquids in Lithium-Sulfur Batteries

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Abstract

In this study, a gel polymer electrolyte (GPE) based on polymer ionic liquid (PIL) is used in a solvent-free and in a hybrid electrolyte configuration for Li-S batteries. Results obtained in the solvent-free configuration show a high discharge capacity in the first cycle and excellent coulombic efficiency during cycling. Capacity fading and polarization increase during cycling are explained based on the XPS and EIS measurements. The results of the present study are indicating that the increase of various internal resistance contributions and capacity fading are related with an accumulation of polysulfides in the GPE-PIL layer or/and on the surface of the lithium anode. Within a hybrid battery configuration, the thickness of the GPE-PIL layer is thinner, and the volume where polysulfides can be trapped is smaller. Such a configuration shows better cycling stability. The hybrid configuration outperforms cycling stability of the conventional configuration with a liquid electrolyte. This is explained by increased internal resistance in the conventional configuration while the polarization in the first 100 cycles is constant in the hybrid configuration. Additionally, the hybrid configuration exhibits excellent C-rate performance.