

Polymer-Rich Composite Electrolytes for All Solid-State Li-S Cells

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Abstract

Polymer-rich composite electrolytes with lithium bis(fluorosulfonyl)imide/poly(ethylene oxide) (LiFSI/PEO) containing either Li-ion conducting glass ceramic (LICGC) or inorganic Al₂O₃ fillers are investigated in all solid-state Li-S cells. In the presence of the fillers, the ionic conductivity of the composite polymer electrolytes (CPEs) does not increase compared to the plain LiFSI/PEO electrolyte at various tested temperatures. The CPE with Al₂O₃ fillers improves the stability of Li/electrolyte interphase, while the Li-S cell with LICGC-based CPE delivers high sulfur utilization of 1111 mAh g⁻¹ and areal capacity of 1.14 mAh cm⁻². In particular, the cell performance gets further enhanced when combining these two CPEs (Li | Al₂O₃-CPE/LICGC-CPE | S), reaching a capacity of 518 mAh g⁻¹ and 0.53 mAh cm⁻² with coulombic efficiency higher than 99% at the end of 50 cycles at 70 °C. This study shows that the CPEs can be promising electrolyte candidates to develop safe and high performance all solid-state Li-S batteries.