Polymer Blends of Poly(ethylene oxide) and Phosphonium Ionenes As Solid Polymer Electrolyte Membranes for Lithium Ion Batteries

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Solid polymer electrolytes offer potential improvements to lithium ion batteries that include extending their operating temperature range and improving the safe use of the batteries by inhibiting lithium dendrite formation. Because solid polymer electrolytes replace traditional liquid electrolytes as the lithium ion transport medium and also act as the electrode separator, these materials must offer good ionic conductivity along with providing good interfacial contact with the electrode material. This work presents the synthesis and characterization of polymer blends comprised poly(ethylene oxide) and phosphonium ionenes. Ionenes are a class of polycation that includes positive charges within the polymer backbone. Because the positive charge is a part of the polymer chain, the spacing and distribution of these charges have a significant impact on the properties of ionenes. This research focuses on determining the role of charge spacing and distribution of charges along the backbone of phosphonium ionenes on their ability to transport lithium ions. To accomplish this, phosphonium ionenes are blended with low molecular weight poly(ethylene oxide) (e.g. less than 3,000 g/mol) at mass ratios of 20:1, 10:1, and 5:1. The resulting blended solid polymer electrolyte membranes are evaluated for their thermal, mechanical and electrochemical properties along with their charge/discharge performance in coin cell batteries. The dependence of phosphonium ionene structure as well as the composition of SPE blends will be presented.