Evaluation on electrochemical properties of lithium-ion battery–based PMMA-PLA blend incorporation of [EDIMP] TFSI hybrid gel polymer electrolyte

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ABSTRACT

This study focuses on developing a novel hybrid gel polymer electrolyte (HGPE) for lithium-ion batteries. The HGPEs comprise a hybrid polymer of polymethyl methacrylate (PMMA) and polylactic acid (PLA), doped with 20 wt.% lithium bis (trifluoromethylsulfonyl) imide salt (LiTFSI) and incorporated with various contents of ionic liquid, namely ethyl-dimethyl-propylammonium bis(trifluoromethylsulfonyl)imide ([EDIMP]TFSI) is successfully prepared, and the lithium-ion batteries performance was investigated. This work aims to investigate the influence of the ionic liquid on the electrical properties, cation transference number (t_{Li^+}), electrochemical stability window, and charge-discharge performance of the PMMA-PLA based HGPE systems. Among the different samples tested, the HGPE containing 20 wt.% [EDIMP]TFSI (E-TFSI 20) exhibited the most promising results. It achieved an optimum ionic conductivity of 3.90×10^{-3} S cm^{-1}, an increased t_{Li^+} from 0.63 to 0.79, and an extended electrochemical stability window from 4.3 to 5V. Temperature dependence studies revealed that all the HGPE systems followed the Arrhenius characteristic, and their activation energies were calculated. Dielectric studies revealed ionic behavior and suitable capacitance with varying frequencies of the HGPEs system. The most favorable electrolyte was selected based on the highest ionic conductivity observed in each HGPE systems. It was utilized in a Li metal|HGPEs|graphite cell configuration. The discharge capacity of the cells using LiTFSI 20 and E-TFSI 20 electrolytes were measured as 152.06 mAh g^{-1} and 71.15 mAh g^{-1}, respectively, at a current density of 3.72 A g^{-1}.

KEYWORDS

Hybrid polymer; Ionic liquid; Lithium transference number; Potential stability

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