The correlation of free ions with the conduction phase of 1-Ethyl-3-methylimidazolium chloride in gel polymer electrolyte-based PMMA/PLA blend doped with LiBOB

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ABSTRACT

In an effort to produce a lithium-ion battery for application in electronic devices, a gel polymer electrolyte (GPE) system was blended with poly(methyl methacrylate) (PMMA) and polylactic acid (PLA) doped with lithium bis(oxalato) borate (LiBOB) and incorporated with various compositions of 1-ethyl-3-methylimidazolium chloride (EMIM(Cl)) ranging from 0 wt.% to 24 wt.%. This study focused on the determination of free ions with the effect of the addition EMIM(Cl) in the PMMA/PLA-LiBOB through Fourier transform infrared (FTIR) spectroscopy and x-ray diffraction. The inclusion of EMIM(Cl) in the GPE systems was proven by the emergence of a new peak in the FTIR analysis. The changes that occurred in the FTIR spectra confirmed the complexation between the doped polymer blend with ionic liquid. The ionic liquid helps enhance the dissociation of the Li^+ cation from the loosely bound Li^+---BOB^- and facilitates the transport of ions via the ion hopping mechanism. Consequently, the crystallinity of GPE samples becomes suppressed and reaches the optimum ionic conductivity up to 10^{-3} S cm^{-1} at room temperature for samples with 18 wt.% composition of EMIM(Cl). FTIR deconvolution shows that the ionic conductivity trend aligns with ion mobility and diffusion rates. The findings revealed that the present GPE-based PMMA/PLA–LiBOB doped with EMIM(Cl) has excellent potential to be applied as an energy storage device, especially a Li^+ battery.

KEYWORDS

Gel polymer electrolyte; Ion hopping; Ion transport; Lithium ions

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