Enhancement of proton conduction in carboxymethyl cellulose-polyvinyl alcohol employing polyethylene glycol as a plasticizer

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ABSTRACT

The present study deals with the enhancement of proton transport and conduction properties of solid polymer electrolyte (SPE)-based carboxymethyl cellulose (CMC) blended with polyvinyl alcohol (PVA) doped with ammonium nitrate (NH_4NO_3) and plasticized with various compositions of polyethylene glycol (PEG). The SPE system was successfully prepared using an economical method, the solution casting technique, and analysed by Fourier transform infrared spectroscopy and electrical impedance spectroscopy. The infrared spectra show that interaction had occurred at O–H and COO^- from CMC when PEG was added which prevailed the enhancement of ion dissociation. Glass transition measurement highlighted that the interaction between CMC–PVA–NH_4NO_3 and ethylene carbonate at 8 wt% give the most plasticization effect that achieved the lowest T_g. The highest conductivity of the SPE system achieved at ambient temperature was 1.70×10^{-3} S cm^{-1} for a non-plasticized sample, and further enhanced to 3.00×10^{-3} S cm^{-1} when 8 wt% PEG was incorporated into the SPE system. The sample with the highest conductivity was found to obey the Arrhenius behaviour with a function of temperature. The ionic conductivity of the SPE system was shown to be primarily influenced by a number of ions (η), ion mobility (μ) and diffusion coefficient (D).

KEYWORDS

CMC–PVA–NH_4NO_3; Ionic transport; PEG

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