An investigation on the abnormal trend of the conductivity properties of CMC/PVA-doped NH_4Cl-based solid biopolymer electrolyte system

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ABSTRACT

The present work was carried out to investigate the abnormal trend of electrochemical properties of solid biopolymer electrolytes (SBEs) system-based carboxymethyl cellulose (CMC) blended with polyvinyl alcohol (PVA)-doped NH_4Cl. The SBEs system was prepared via solution casting technique and analyzed through Fourier transform infrared (FTIR) spectroscopy, thermogravimetric analysis (TGA), X-ray diffraction (XRD) analysis, and electrical impedance spectroscopy (EIS). Complexation was observed with the changes of peaks at 1065 cm^{-1}, 1598 cm^{-1}, 2912 cm^{-1}, and 3396 cm^{-1} that corresponds to C–O–C, C=O of COO^- stretching, C–H stretching, and O–H stretching, respectively, of CMC/PVA blend system upon the addition of NH_4Cl. The decrease of the amorphousness and the increase of weight loss demonstrated the abnormal observation of the ionic conductivity when (1–5 wt%) NH_4Cl was added in the SBEs system which was lower than the un-doped SBEs system. It was also observed that the highest ionic conductivity at 8.86×10^{-5} Scm^{-1} was achieved by the sample containing 6 wt% of NH_4Cl. The temperature dependence of the SBEs system is found to be governed by the Arrhenius rule. Through the IR deconvolution technique, the conductivity of CMC/PVA-NH_4Cl SBEs system was shown to be primarily influenced by the ionic mobility and diffusion coefficient of the ions.

Keywords Solid biopolymer electrolytes (SBEs) · Abnormal conductivity · Thermal stability · Amorphous phase