Proton (H^+) transport properties of CMC–PVA blended polymer solid electrolyte doped with NH_4NO_3

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Abstract

This present work investigated the proton (H^+) conduction behavior of the blended polymer solid electrolyte (BPSE) derived from carboxymethyl cellulose (CMC) and polyvinyl alcohol (PVA) that was doped with ammonium nitrate (NH_4NO_3). The properties of this CMC-PVA-AN BPSE were evaluated using Fourier transform infrared spectroscopy (FTIR), transference number measurement (TNM), thermal gravimetric analysis (TGA), differential scanning calorimetry (DSC), X-ray diffraction (XRD), scanning electron microscopy (SEM), and electrical impedance spectroscopy (EIS). We found that doping (NH_4NO_3) improved the chemical and thermal stability of the CMC-PVA BPSE. The highest ionic conductivity (~10^{-3} S/cm) of the BPSE at ambient temperature was achieved with a CMC:PVA:NH_4NO_3 composition of 56:14:30 wt%. This was due to the interplay of segmental motion between the CMC and PVA and also the H^+ hopping mechanism as revealed by FTIR. XRD and morphology analysis showed that the peak intensity decreased which implied an increase in its amorphous nature. Based on the transport properties, the CMC-PVA-AN BPSE conduction mechanism was governed by number of ions, ionic mobility and also free ions diffusion coefficient. The proton transference number (t_{H^+}= 0.42) in the present study indicated that the charge transport in the BPSE was predominantly due to the H^+ carrier conduction.

Keywords

Blended polymer, Conductivity, Transport properties, Proton (H^+) carrier