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Investigation on favourable ionic conduction based on CMC-K carrageenan proton conducting hybrid solid bio-polymer electrolytes for applications in EDLC

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Abstract

In the present work, a proton-conducting hybrid solid biopolymer electrolytes (HSBEs) system was successfully prepared via the solution casting approached. The HSBEs comprised of CMC blended with kappa carrageenan and doped with NH_4NO_3. The HSBEs system was characterized to evaluate the structural and the proton conduction properties using FTIR, XRD and EIS techniques. The FTIR analysis showed that a complexation occurred between the CMC-KC and H^+ moiety of the NH_4NO_3 via the –OH, C–O–C as well as $–COO^-$ groups with associated changes observed to their wavenumbers and peak intensities. At the 80:20 ratio of the CMC:KC hybrid system, the optimum value of the ionic conductivity was found to be ~10^{-7} S/cm. However, the addition of 30 wt % of NH_4NO_3 to the system markedly increased the ionic conductivity to ~10^{-4} S/cm due to the increase in the amorphous phase in the HSBEs system as revealed by the XRD analysis. Meanwhile, the IR-deconvolution approach revealed an increase of the protonation (H^+) from NH_4NO_3 towards the co-ordinating site on the hybrid CMC-KC system and this in turn, led to the increment in the ionic mobility and diffusion of ions for transportation. An EDLC was fabricated using the highest conducting HSBEs sample developed in the present study and it exhibited favourable characteristics as a capacitor with a reasonably good stability with regards to its electrochemical properties.

Keywords

Hybrid polymer; H^+ carrier; Ionic conductivity; Electrochemical properties