Ionic transport studies of solid bio-polymer electrolytes based on carboxymethyl cellulose doped with ammonium acetate and its potential application as an electrical double layer capacitor

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Abstract. CMC-NH4CH3CO2 complexes were characterized via theoretical and experimental approaches using molecular dynamics (MD) calculation, Fourier transform infrared spectrometry (FTIR), X-ray diffraction (XRD), and electrical impedance spectroscopy (EIS) analysis. These analyses successfully disclosed the structural and ion conduction properties of the bio-polymer electrolytes (BPE) system. The FTIR analysis further revealed that an interaction exists between the carboxylate anion group (COO–) from CMC and the H+ substructure of NH4CH3CO2. The ionic conductivity value at ambient temperature was found to achieve an optimum value of 5.07×10–6 S/cm for a system containing 10 wt% NH4CH3CO2. The ionic conductivity improvement was demonstrated via the increment on the amorphous phase of the BPEs system as shown in the XRD analysis upon the inclusion of NH4CH3CO2. Based on the IR-deconvolution approach, the mobility (μ) and diffusion coefficient (D) were found to influence the ionic conductivity and aligned with the theoretical molecular dynamic (MD) calculation. To evaluate the potential application of the CMC-NH4CH3CO2, an electrical double-layer capacitor (EDLC) was fabricated from the BPE and tested using cyclic voltammetry (CV), and charge-discharge (GCD) for 300 cycles and the BPE exhibited a specific of capacitance ~2.4 F/g.

Keywords: biopolymers, theoretical approach, ionic conductivity, transport properties, electrochemical properties