Structural and ionic conduction study of enhanced bio-polymer electrolytes based carboxymethyl cellulose doped NH_4Br

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1. Background/ Objectives and Goals

The increasing interest in green energy storage materials for electrochemical devices with the development of polymer as electrolytes candidate has attracted great attention recently. It can offer a number of high-value opportunities, provided that lower costs can be obtained besides environmental friendly. Due to this matter, this work presents the discovery on proton conducting bio-polymer electrolyte (BPE) by incorporating various composition of plasticizer namely ethylene carbonate (EC) with biopolymer–salt complexes carboxymethyl cellulose (CMC)–NH_4Br.

2. Methods

A series of BPE samples were prepared by using solution casting technique contain with CMC firstly was dissolved in distilled water. Then, the CMC solution was added with 25 wt. % NH_4Br (highest conducting sample from previous report) and the mixture was stirred continuously. Various amounts with the interval of 2 wt. % of EC were added to produce the plasticized electrolyte system. The solution was then poured into several glass Petri dishes and left to dry at room temperature for the films to form. The BPE system formation has been analyzed through Fourier Transform Infrared (FTIR) spectroscopy, Thermo Gravimetric Analysis (TGA), impedance spectroscopy and transference number measurement (TNM).

3. Expected Results/ Conclusion/ Contribution

The highest conducting CMC bio-polymer electrolytes (BPE) was achieved at 1.12×10^{-4} S cm^{-1} with addition of 25 wt. % NH_4Br and was enhanced to 3.31×10^{-3} S cm^{-1} when plasticized with 8 wt. % EC. The temperature analysis shows that the ionic conductivity increases when increased with temperature and exhibits Arrhenius behavior where the samples thermally activated as proven by TGA. Rice and Roth transport properties analysis shows that the conductivity of BPE system was found to be dependent on the number of mobile ions and the mobility of the ions. It has been shown that the conducting species in this

present work are predominantly due to proton (H^+) which was confirmed via FTIR and TNM analysis. The results suggest that BPE system is highly potential to be applied in electrochemical devices, i.e. proton battery and electrical double layer capacitor cell.

Keywords: bio-polymer material, polymer electrolytes, conducting species (H^+), ionic conductivity