

Investigation on electrical conduction mechanism of plasticized carboxymethyl cellulose-NH₄Br solid bio-polymer electrolytes

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1. Background

Since the introduction of solid polymer based electrolytes in 1973, numerous polymers are particularly interesting especially bio-polymer have been investigate (Kadir et al., 2014; Samsudin et al., 2012; Buraidah et al., 2011). The main interest in developing solid-state polymer electrolyte lies in the hope that such systems will avoid many of the problems encountered when using electrochemical devices with liquid constituents. The costly and rare raw materials that are required, along with expensive materials processing, make for steep barriers to overcome when it comes to power source development. In arrears to the fact given the development of plasticized solid bio-polymer electrolytes (SBEs) has been accomplished in this work by incorporating various composition of plasticizer with CMC-NH₄Br via solution casting method. The plasticized biopolymer–salt complex ionic conduction and electrical properties of the SBEs have been analyzed through impedance measurement. The ionic conductivity at room temperature for the CMC-NH₄Br SBEs system was achieved at $\sim 10^{-4}$ S cm⁻¹ when 25 wt. % NH₄Br was added and were improved to ($\sim 10^{-3}$ S cm⁻¹) with introducing of plasticizer in SBEs system. The temperature dependence of the prepared SBEs system exhibits Arrhenius behavior. The Jonschers power law was used to study the ac conductivity data and the conduction mechanism studies shown the highest conducting CMC SBEs system can be best represented by OLPT model (PEG), SPH model (glycerol) and QMT model (EC).

2. Methods

CMC was dissolved in distilled water. Then, the solution was added with 25 wt. % of NH₄Br (due to the optimum composition CMC-NH₄Br that provide highest in ionic conductivity from the previous report) (Samsudin et al., 2014) and mixture was stirred continuously until complete dissolution become homogenous. Varied amount of plasticizers namely PEG, glycerol and EC were added with different wt. % (interval of 2). The solution was then poured into different Petri dishes and left to dry at room temperature for the