

Transport Properties and Interactions of Ionic Liquid Doped Bio Polymer based Gel Electrolyte for Sodium Rechargeable Batteries

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The interest in gel polymer electrolytes (GPEs) as electrolyte materials for rechargeable thin film batteries has boosted in the last years. In general, different synthetic polymers are used in gel electrolyte preparation, the reports on biodegradable polymers are lacking. In this work, a gel electrolyte was prepared by solvent casting method using NaClO₄ salt and commercially available biopolymer i.e. agar which is extracted from marine algae. The effect of addition of an ionic liquid (IL) in this parent electrolyte was investigated using *N-Butyl-N-methylpyrrolidinium bis(trifluoromethylsulfonyl)imide* (PyR₁₄TFSI). The IL incorporated membranes were transparent, freestanding and flexible. The ionic conductivity of the membranes was obtained using complex impedance spectroscopy whereas the polymer-salt and polymer-IL interactions were investigated using FT-IR spectroscopy. The crystallinity of the electrolytes was investigated by XRD. Our results show that the maximum ionic conductivity of 5.51 x 10⁻⁴ S cm⁻¹ at room temperature can be obtained with the electrolyte having 12 wt% of NaClO₄ without IL. The incorporation of 10 wt% of the PyR₁₄TFSI into this parent electrolyte shows further enhancement in ionic conductivity up to 1.03 x 10⁻³ S cm⁻¹ at room temperature. FTIR results show weak but noticeable changes due to the interactions of IL with the polymer. The reduction of crystalline phases and increase of amorphous nature with the IL is revealed that the IL has a major influence on the transport properties of the electrolyte due to structural modifications associated with the polymer host and also due to the reduction of Na⁺ ion and polymer coordination in the IL incorporated electrolyte.

Keywords: Gel polymer electrolyte, Bio polymer, Agar, Ionic conductivity