Agar-Based Gel Polymer Electrolyte with KI and Tetrapropylammonium Iodide Salts for Dye-Sensitized Solar Cell

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At present, energy consumption is rising predominantly, thus low cost, renewable, and environmentally benign energy resources drag attraction extensively. Although many researches have been done on polymer electrolytes, there is a captivating direction to explore bio-polymer electrolytes in a quasi-solid state. In the present work, a novel gel polymer electrolyte was prepared by a hot press method utilizing tetrapropylammonium iodide (Pr_4NI) and potassium iodide (KI) as the binary iodide salt system. Agar bio polymer was combined with the glycerol and formaldehyde solvents to obtain the quasi-solid state polymer plasticizer matrix. The KI and tetrapropylammonium iodide weight ratio in the electrolyte was altered while keeping the masses of other ingredients constant to optimize the solar cell performance. Gel electrolytes displayed quite high viscosity while retaining a gel-like consistency at ambient temperature. Fourier transform infrared spectroscopy results indicate a peak heightens gradually at 750 cm^{-1} with increasing Pr_4NI salt amount. Electrical impedance spectroscopy was used to deduce the ionic conductivity of each electrolyte. The highest ionic conductivity of 3.39 mS cm^{-1} is achieved by the electrolyte sample only with KI at 26 °C as the contribution for ionic conductivity from small K^+ cation is higher compared to the bulky Pr_4N^+ cation. The uniform shape of cyclic voltammetry curves of each electrolyte during 12 consecutive cycles with 5 min time steps revealed the stability of electrolytes. A dye-sensitized solar cell was assembled by inserting the highest conducting gel polymer electrolyte having Glass/FTO/TiO2/N719-Dye/GPE/Pt/Glass configuration. The dye-sensitized solar cell fabricated with the highest conducting electrolyte displayed an efficiency of 0.36% with J_{SC} of 1.31 mA cm^{-2}, *VOC* of 0.4 V, and fill factor of 0.68.

*Keywords***:** Biopolymer, Gel polymer electrolyte, Agar, Tetrapropylammonium iodide, Dye-sensitized solar cell