Dye Sensitized Solar Cell using Polymer Electrolytes based on Poly(ethylene oxide) with an Ionic Liquid

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Novel Solar Cells based on dye-sensitized nanocrystalline porous TiO_2 film have been investigated intensively and have attracted widespread attention [1-2]. These cells usually employ a liquid electrolyte containing an I^-/I_3^- redox couple in an organic solvent. However, the use of a liquid electrolyte results in the difficulty in the cell sealing and the decrease in the cell performance or life time during long-term operations due to evaporation or leakage of organic solvent. Polymer

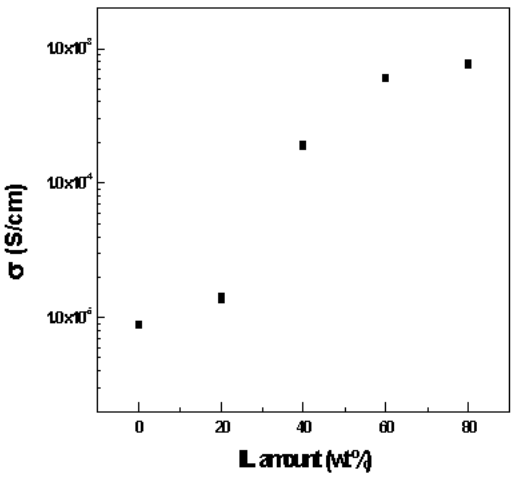

Figure 1. Composition dependence of room temperature ionic conductivity of (PEO:KI/I_2)+ wt% IL polymer electrolyte films.

electrolytes with ionic liquid (IL) may be suitable alternative to be used as electrolyte in DSSC application. In PEO- polymer electrolytes the high crystallinity/low ambient conductivity (σ) acts as a barrier, which affects the mobility of I^-/I_3^- species in polymeric medium and overall efficiency. In this paper, we used a low viscosity ionic liquid 1-ethyl 3-

methyl imidazolium thiocyanate in order to modify the conductivity of the polymer electrolyte (PEO:KI/I_2) and to obtain the high efficiency. The doping of IL enhanced ionic conductivity (σ) of the polymer electrolyte, which attained maximum ($\sigma \sim 7.62 \times 10^{-4}$ S/cm) at 80 wt% of IL concentration (Fig. 1). Beyond this it was harder to get stable films. XRD confirmed that the intensity of the sharp PEO crystalline peaks decreased when IL was added. The DSC studies confirmed the reduction in crystallinity by adding ionic liquid (Fig. 2) and supported our XRD and conductivity data. The efficiency of solar cell using aforesaid material was 0.6 % at 1 sun irradiation.

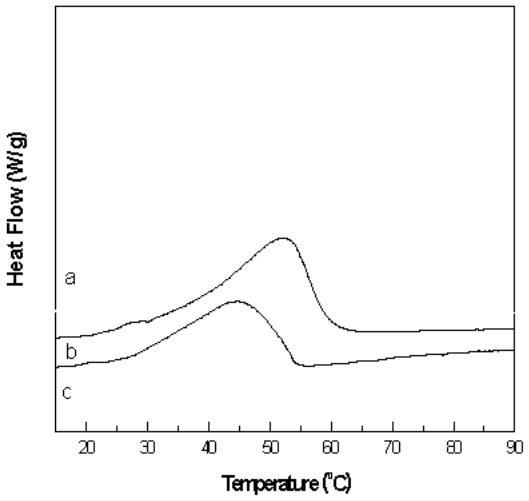

Figure 2. DSC curves of (a) PEO:KI/I_2; (b) PEO:KI/I_2+40 wt% ionic liquid and (c) PEO:KI/I_2+80wt % ionic liquid polymer electrolyte films.

References

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[2] Hagfeldt, A.; Gratzel, M. *Chem. Rev.* **1995**, 95, 40.