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Effect of Polyaniline on the Performance of Dye Sensitized Solar Cells Fabricated With Poly (Ethylene Oxide) Based Gel Polymer Electrolytes

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Abstract

Dye sensitized solar cells (DSSCs) mainly consists of a dye adsorbed photo-anode, a counter electrode and a redox electrolyte, in which the electrolyte plays an important role as the charge transport medium. DSSCs generally employ a liquid electrolyte based on I^-/I_3^- redox couple and have impressive energy conversion efficiencies. However, the lack of long-term stability due to liquid leakage, electrode corrosion and photodecomposition of the dye in the solvent medium due to the usage of volatile liquids are some of the major drawbacks preventing large scale practical applications of DSSCs. One solution to this is to introduce polymer gel electrolytes having fast charge transfer processes and low interfacial resistance. Ionically conducting gel electrolytes are promising in improving the power conversion efficiency and stability of quasi-solid-state DSSCs. In this work, polymer electrolytes containing polyethylene oxide (PEO), LiI and I_2 are used as the redox electrolyte and different amounts of polyaniline (PANI) conducting polymer is introduced to the PEO based electrolyte. The effect of incorporating PANI into the PEO based gel electrolyte on solar cell performance was studied. Ionic conductivity measurements and FTIR studies were done for the PANI incorporated gel electrolyte samples. The gel polymer electrolyte without PANI showed a conductivity of $1.32 \times 10^{-2} \text{ Scm}^{-1}$ at room temperature and with the incorporation of PANI, the conductivity increased and a maximum conductivity of $1.75 \times 10^{-2} \text{ Scm}^{-1}$ was obtained for 1.0 wt. % PANI added sample. PANI can form interconnected channels within the PEO polymer matrix. These conducting channels formed by PANI chains function as pathways for electron transfer and can improve the reduction reaction of triiodide ions in the DSSC. The resultant DSSC made with 1.5 wt % PANI incorporated PEO based gel electrolyte showed a maximum efficiency of 6.56% in comparison with the efficiency of 5.00% obtained for a PANI free gel electrolyte based DSSC.

Keywords: Dye sensitized solar cell, electrolyte, conducting polymer, polyaniline.