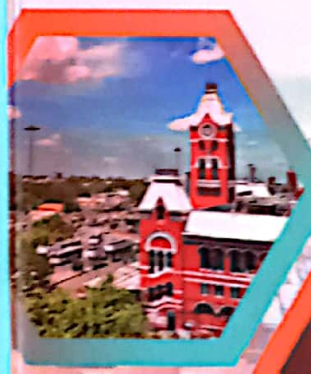

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Effect of Polypyrrole Conducting Polymer on PEO-based Gel Electrolyte for Dye-sensitized Solar Cell Applications

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Abstract

Dye-sensitized solar cells (DSSCs) face challenges with their liquid electrolyte, including issues such as volatility and need of encapsulation, which contribute to a shorter lifespan. As an alternative to these liquid electrolytes, ionically conducting gel polymer electrolytes, especially those based on polyethylene oxide (PEO), provide solutions for these drawbacks.

In this study, we incorporated electronically conductive polymer polypyrrole (PPy) into an electrolyte based on PEO that includes LiI and I_2 and evaluated its effect on conductivity and determined the suitability of this electrolyte for use in DSSCs.

The polymer electrolyte containing 1.5 wt% PPy with PEO showed the highest ionic conductivity of 1.92×10^{-3} S cm^{-1}, correlating with the highest power conversion efficiency of 6.78 % in DSSC under the irradiance of 100 mW cm^{-2}.This represents a notable 27% increase in efficiency compared to the DSSC employing a similar electrolyte without PPy, which exhibited an efficiency of 5.33%. FTIR measurements confirmed the interactions between polymers and salts. The observed increase in conductivity can be attributed to two conflicting factors. Initially, enhanced conductivity is likely a result of decreased crystallinity and a simultaneous rise in the amorphous phase content of the PEO electrolyte. This transformation is induced by the addition of LiI salt and PPy, possibly leading to a "cation trapping effect" by PPy and improved ionic dissociation, thereby generating more iodide (I^-) ions. As the PPy content in the electrolyte increases, "a blocking effect" for iodide ion transport starts, causing a decrease in conductivity.

Key words: Dye-sensitized solar cells, gel polymer electrolyte, conducting polymers, polypyrrole.