

## **Polyaniline (PANI) mediated cation trapping effect on ionic conductivity enhancement in poly (ethylene oxide) based solid polymer electrolytes with application in solid state dye sensitized solar cells**

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### Abstract

The ionic conductivity enhancement in solid polymer electrolytes due to introduction of polyaniline (PANI) conducting polymer is demonstrated using poly(ethylene oxide) (PEO) based solid polymer electrolyte comprising tertpropylammonium iodide (Pr4NI) and iodine (I<sub>2</sub>). The electrolyte with optimized composition has been characterized by ionic conductivity measurements, DC polarization test, Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM) and Differential Scanning Calorimetry (DSC). About eight-fold increase in the ionic conductivity from  $9.33 \times 10^{-6} \text{ Scm}^{-1}$  to  $8.61 \times 10^{-5} \text{ Scm}^{-1}$  at room temperature was obtained by the addition of 1.5 wt% of PANI to the PEO solid polymer host. FTIR measurements suggest that Pr<sub>4</sub>N<sup>+</sup> cations are able to coordinate not only with oxygen atoms of PEO, but also with nitrogen atoms of the PANI polymer effectively immobilizing or “trapping” the bulky Pr<sub>4</sub>N<sup>+</sup> cations and promoting ionic dissociation. DSC studies show that PANI, also acting as a plasticizer, reduces the crystallinity of PEO and lower its melting temperature. The DC polarization tests confirmed the increased iodide ion conductivity evidently mediated by PANI due to the combined effect of cation trapping and plasticizing. Solid state dye sensitized solar cells fabricated with optimized electrolyte composition incorporating PANI exhibited the highest energy conversion efficiency of 5.01% compared to 3.52% for the DSSC without PANI.

### Keywords

PEO: PANI solid polymer electrolyte, Iodide ion conductivity, Cation trapping, Conductivity enhancement, Dye sensitized solar cells