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POLYETHYLENE OXIDE (PEO) BASED, ANION CONDUCTING SOLID POLYMER ELECTROLYTE FOR POSSIBLE USE PEC SOLAR CELLS

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Dye sensitised photoelectrochemical (PEC) solar cells require solid state redox electrolyte systems with good conductivity, mechanical strength and compatibility which would lead to minimize major drawbacks of the wet type PEC systems. Even though, replacing liquid electrolyte by solid electrolytes has been successful for batteries, in the field of PEC solar cells, it is still being researched. Although, a number of lithium ion conducting polymer electrolytes based on PEO has been investigated, mainly as electrolyte membranes for batteries, not much work has been reported on PEO based electrolytes containing anions. Iodide ion (I^-) containing polymer electrolytes are important as redox species in PEC solar cells as well as in iodide ion conducting solid-state cells.

In the present work, solid polymer electrolyte membranes were prepared by complexing tetrapropylammoniumiodide ($Pr_4N^+I^-$) salt with polyethylene oxide (PEO) plasticized with ethylene carbonate (EC). Bulk dc conductivity of the samples was extracted from complex impedance plots. To our knowledge, this is the first report of such a plasticized, PEO based anion conductor which does not use the liquid propylene carbonate (PC) as a plasticizer.

For sample preparation, 0.066 g of $Pr_4N^+I^-$ and 0.004 g of I_2 were kept unchanged and the PEO weight varied to find the best conducting PEO : I^-/I_2 redox couple by solvent casting method using the acetonitrile as the solvent. PEO : $Pr_4N^+I^-+I_2$ = 9:1 ratio gave the best room temperature conductivity for the electrolyte system. For samples with this composition, the addition of plasticizer EC was controlled to increase the conductivity further while retaining good mechanical properties. All the electrolyte films were solid, free standing type. In this system, a conductivity enhancement of four orders of magnitude has been observed due to the addition of EC. However, an abrupt increase in conductivity was observed when the EC weight ratio exceeded 60 wt%, most probably due to the change in structural morphology of the system.

The room temperature conductivity for 60 wt% EC sample (PEO + $Pr_4N^+I^-$ + I_2 : EC = 100 : 60) was 5.40×10^{-7} S cm^{-1} and for 70 wt% EC sample it was 4.92×10^{-5} S cm^{-1}. The abrupt increase in conductivity occurring around 60-70 wt% EC could possibly be associated with micro-structural and morphological changes in the host polymer at these compositions. Work is in progress to fabricate and characterize a polymer based PEC solar cell using this electrolyte.

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