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Dye sensitised photoelectrochemical solar cells with polyacrylonitrile based solid state electrolytes

Photoelectrochemical solar cells based on nanostructured dye-sensitised titanium dioxide have attracted world-wide attentin as a low cost lalternative to conventional sillicon solar cells. On of the major drawbacks of this type of solar cell is the long term stability due to leakage problems arising from the use of a liquid electrolyte. There have been some attempts to replace the liquid electrolyte with a solid polymer eletrolyte but the conversion efficiencies of such cells are much lower. We now report the fabrication of such solar cells using polyacrylonitrile containing plasticisers and an 1/13 redox couple with conversion efficiencies approaching those with acetonitrile as the electrolyte.

Polacrylonitrile (PAN), tetrapropyl ammonium iodide, iodine, ethylene carbonate (EC) and propylene carbonate(PC) at various rations were used to get the optimal characteristics for solar energy conversion. The dye used was cis-di(thiocyanato)-N, N-bis(2,2-bipyridyl-4,4'-dicarboxylicacid)-ruthenium (11) dihydrate [RuL2(NCS)2.2H2O]. The room temperature (298K) conductivity for the optimised electrolyte was observed as

2.95x10-3Sm-2. The highest Isc (3.72mAcm-2) and the highest overall efficiency of 3% (at 600Wm-2) were also obtained for the cell fabricated using the above electrolyte composition. In general higher Isc values are observed when the weigh of PC is greater than EC for a fixed weight of PAN. When the dc conductivity of the electrolyte was determined between two blocking electrodes it was found to decrease with time and then reach a constant value. This is consistent with the predominantly ionic nature of the electrolyte. The transference numbers calculated from these data are tion=0.8959 and te =0.1041.

Isc, and overall efficiency of a similar cell fabricated with acetonitrile as the electrolyte were 4.09m/Acm-2 and 4% respectively. Thus the development of a PAN based electrolyte for fabrication of solar cells of this type is an attractive possibility.