

EFFICIENCY ENHANCEMENT BY MIXED CATION EFFECT IN DYE SENSITIZED SOLAR CELLS BASED ON POLY(ETHYLENE OXIDE)

E.M.B.S. Ekanayake

Postgraduate Institute of Science

University of Peradeniya

Peradeniya

Sri Lanka

The enhancement of power conversion efficiencies of quasi-solid-state dye-sensitized solar cells (DSSCs) based on nano-porous TiO_2 photo-anode was investigated by using a binary system of two different iodide salts.

Gel-type electrolytes, based on poly(ethylene oxide) (PEO) host polymer and binary iodide salt mixture that consists of potassium iodide (KI) and tetrapropylammonium iodide ($\text{Pr}_4\text{N}^+\text{I}^-$), were prepared by incorporating, ethylene carbonate (EC) and propylene carbonate (PC) as plasticizers.

The DSSCs of configuration Glass/FTO/ TiO_2 /N-719 Dye/electrolyte/Pt/FTO/glass were fabricated using different gel electrolytes by varying salt composition in the binary iodide salt mixture in order to optimize the performance of the solar cells. With 100 wt% KI and 100 wt% ($\text{Pr}_4\text{N}^+\text{I}^-$) efficiencies under AM 1.5 illumination are 3.87% and 3.75%, while 16.67: 83.33 wt% KI: $\text{Pr}_4\text{N}^+\text{I}^-$ salt mixture shows the highest efficiency of 4.44%. This is an efficiency enhancement of about 15% compared to the higher efficiency end member. DC polarization measurements establish the predominantly ionic behavior of the electrolytes, and show that the variation of efficiency with salt composition correlates with the change in short circuit photocurrent density (J_{SC}), which appears to be governed by the iodide ion conductivity. It is also found that J_{SC} correlates with the iodide ion transference number estimated from DC polarization data taken with non-blocking iodine electrodes. This mixed cation effect may be used to obtain efficiency enhancement in DSSCs based on polymeric, gel or solvent electrolytes.