Abstract No: 148 ***Physical Sciences***

EFFECT OF QUATERNARY CATIONS ON THE EFFICIENCY OF QUASI-SOLID-STATE DYE-SENSITIZED SOLAR CELLS

H.M.N. Wickramasinghe[1,2], K.M.S.P. Bandara[1,2*], L.R.K.A. Bandara[1], W.M.K.B.N. Wijayaratne[1] and T.M.W.J. Bandara[1]

[1]Department of Physics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka.
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
[*] sashini.bandara@sci.pdn.ac.lk

The electrolyte is one of the main components of Dye-Sensitized Solar Cells (DSSCs). In this study, a gel polymer electrolyte (GPE) was synthesized to maintain prolonged stability of the electrolyte and to enhance the performance of quasi-solid state DSSCs by using the mixed counter ion effect, utilizing four iodides which were LiI, CsI, tetra-hexyl-ammonium iodide (Hex_4NI) and 1-butyl-3-methylimidazolium iodide (BMII). Ethylene carbonate, propylene carbonate, polyethylene oxide, and 4-tertbutylpyridine were also included in the electrolyte. A series of electrolytes was investigated by varying the molar fraction of LiI and CsI. The investigation of the temperature dependence of conductivity revealed that these samples follow the Voggel-Tamman-Fulture behaviour. The sample in which LiI: CsI: Hex_4NI: BMII molar ratio is 72:48:80:25 displayed a maximum conductivity of 12.69 mS cm^{-1} at the ambient temperature. A series of quasi-solid-state DSSCs was constructed by utilizing six-layered TiO_2 photo-electrodes, and the photo-current conversion efficiencies of the cells were studied. DSSCs that contain only either CsI or LiI showed lower efficiencies of 3.68% and 3.48%, respectively. The four-salt system, which consisted of LiI: CsI: Hex_4NI: BMII in molar ratio 96:24:80:25, showed the highest cell efficiency of 6.36%, even though this was not the composition that showed the highest conductivity. This increase in solar cell efficiency can be attributed to the collective contribution of Hex_4N^+, Cs^+, Li^+, and BMI^+ ions because larger cations like Hex_4N^+, Cs^+, and BMI^+ increase open circuit voltage and smaller cations like Li^+ improve charge transport and transfer in the system, increasing short circuit current density. This study suggests that LiI, CsI, Hex4NI, and BMII is a novel iodide salt mixture suitable for fabricating highly efficient DSSCs.

Financial assistance from the University of Peradeniya Sri Lanka, University Research Council (Grant No. 346) is acknowledged.

Keywords: Counter ion effect, Gel polymer electrolytes, High-efficiency DSSCs, Ionic conductivity, Quaternary salt