Abstract No: 449 ***Natural Sciences***

GEL-POLYMER-LIQUID COMPOSITE ELECTROLYTE SYSTEM FOR HIGHLY EFFICIENT DYE-SENSITIZED SOLAR CELLS

E.N. Jayaweera[1, 2], C.S.K. Ranasinghe[1, 2], G.R.A. Kumara[2]*, W.M.N.M.B. Wanninayake[1, 3], K.G.C. Senarathna[1, 2], K. Tennakone[4] and R.M.G. Rajapakse[2]

[1] Postgraduate Institute of Science, University of Peradeniya, Sri Lanka
[2] Department of Chemistry, Faculty of Science, University of Peradeniya, Sri Lanka
[3] Department of Physics, Faculty of Science, University of Peradeniya, Sri Lanka
[4]Department of Physics, Georgia State University, Atlanta, USA
**grakumara2000@yahoo.com*

Lower mobility of the redox species and the poor pore-filling of the electrolyte within the dye-coated, interconnected semiconductor nanoparticle network result in lower conversion efficiencies for quasi-solid electrolyte-based dye-sensitized solar cells (DSCs), when compared to those of the liquid electrolyte-based counterparts. In order to address the poor pore-filling problem associated with gel polymer electrolytes, a simple modification to the electrolyte has been introduced. A polyacrylonitrile (PAN)-based quasi-solid gel-polymer electrolyte/liquid electrolyte system has been introduced as an alternative to the gel polymer electrolyte of the DSCs. The PAN-based, gel polymer electrolyte containing I_2 and $Pr_4N^+I^-$ and the plactisizers [ethylene carbonate (EC) and propylene carbonate (PC)] was prepared. Here, the liquid electrolyte comprising of 0.1 M LiI, 0.05 M I_2, 0.6 M dimethylpropylimidazolium iodide, tert-butylepiridine in methoxyacetonitrile, was injected into the pores of the dye-coated TiO_2 film, the excess electrolyte was wiped off and the gel-polymer electrolyte was pressed in between the working and the counter electrodes. The injected liquid electrolyte results in improved pore-filling, whereas the gel polymer electrolyte facilitates the sealing of the liquid electrolyte. The following DSCs were prepared to study the effects of different electrolyte systems on the DSC performance: (a) FTO/TiO_2/N719 dye/PAN polymer electrolyte/Cr-coated, lightly-platinized FTO (b) FTO/TiO_2/N719 dye/hot-pressed PAN polymer electrolyte/Cr-coated, lightly-platinized FTO, (c) FTO/TiO_2/N719 dye/liquid electrolyte/PAN polymer electrolyte/Cr-coated, lightly-platinized FTO and (d) FTO/TiO_2/N719 dye/liquid electrolyte/Cr-coated, lightly-platinized FTO. The light-to-electricity conversion efficiencies of 4.1%, 5.2%, 8.4% and 9.8% were obtained for the DSCs (a), (b), (c) and (d), respectively, under AM 1.5 illumination. Therefore, the simultaneous use of both the liquid electrolyte and the gel polymer electrolyte can be utilized to improve the conversion efficiency of the DSCs as well as their long-term stability.

Financial assistance given by the National Science Foundation of Sri Lanka (NSF/Fellow/2011/02) is acknowledged.