

## INVESTIGATION OF THE EFFECTS OF ELECTROLYTE ADDITIVE IN A QUASI-SOLID-STATE ELECTROLYTE FOR SnO<sub>2</sub>/CaCO<sub>3</sub>-BASED DYE-SENSITIZED SOLAR CELLS, SENSITIZED BY INDOLINE D358 DYE

**W.M.N.M.B. Wanninavake<sup>1,3</sup>, K. Premaratne<sup>1,3\*</sup>, G.R.A. Kumara<sup>2,3</sup> and R.M.G. Rajapakse<sup>2,3</sup>**

<sup>1</sup>*Department of Physics, Faculty of Science, University of Peradeniya, Sri Lanka*

<sup>2</sup>*Department of Chemistry, Faculty of Science, University of Peradeniya, Sri Lanka*

<sup>3</sup>*Postgraduate Institute of Science, University of Peradeniya, Sri Lanka*

\**kprema@pdn.ac.lk*

The dye-sensitized solar cells (DSCs) have attracted attention of both scientific and commercial communities, owing to their low production costs, easy fabrication procedures and relatively high energy-conversion efficiencies. The conventional DSCs, which use the liquid electrolytes, suffer from practical limitations, in their long-term stability, due to solvent evaporation, sealing imperfections and electrolyte leakage. The above mentioned practical problems can be circumvented, to a certain extent, by using quasi-solid-state electrolytes instead of liquid electrolytes. In this study, the gel electrolyte was prepared, using polyacrylonitrile (PAN) polymer, with propylene carbonate (PC) and ethylene carbonate (EC) as plasticizers, incorporating I<sup>-</sup>/I<sub>3</sub><sup>-</sup> as the redox couple, lithium iodide as the salt, acetonitrile as the solvent and 4-tertiary butylpyridine (TBP) as the electrolyte additive. The electrolyte additives, such as, TBP, N-methylbenzimidazole (NMBI) and guanidinium thiocyanate (GuNCS) etc. play a significant role in DSCs, in order to improve the open circuit voltage (V<sub>oc</sub>) of the device. Here, TBP was used as the electrolyte additive in this study. The DSCs were fabricated with device structures of FTO/SnO<sub>2</sub>/CaCO<sub>3</sub> composite working electrode/D358 dye/gel electrolyte/lightly-platinized FTO counter electrode. The photovoltaic performances were carried out for the fabricated cells. The ionic conductivities and the diffusion coefficient of the triiodide ions in the gel electrolyte were also studied, by varying the amount of TBP in the gel electrolyte, in order to obtain the optimum conditions. The composite gel electrolyte which consists of 1.85 x 10<sup>-4</sup> mol of TBP gave the best performance. The DSC with optimized gel electrolyte has given a light-to-electricity conversion efficiency of 4.52% along with a short-circuit current density of 12.7 mA cm<sup>-2</sup>, an open circuit voltage of 0.564 V and a fill factor of 0.630. The ionic conductivity, which is governed by both Li<sup>+</sup> ions and I<sup>-</sup> ions in the gel electrolyte and the diffusion coefficient of the triiodide ions in the gel electrolyte are 6.47 x 10<sup>-4</sup> S cm<sup>-1</sup> and 2.76 x 10<sup>-6</sup> cm<sup>2</sup> s<sup>-1</sup>, respectively.

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