

# SRI LANKAN EXPANDED GRAPHITE AS A COUNTER ELECTRODES FOR DYE-SENSITIZED SOLAR CELLS

D.N. LIYANAGE<sup>1,2</sup>, K.D.M.S.P.K. KUMARASINGHE<sup>1,2</sup>, G. R. A. KUMARA<sup>1,\*</sup> AND R.M.G. RAJAPAKSE

<sup>1</sup>National Institute of Fundamental Studies, Hantana Road, Kandy 20000, Sri Lanka

<sup>2</sup>Postgraduate Institute of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka

<sup>3</sup>Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka

Corresponding author, e-mail: grakumara2000@yahoo.com

## ABSTRACT

Dye-sensitized solar cell (DSC) is a device which converts solar energy in to electricity with use of low-cost technology compared to silicon based solar cell. Basically, standard DSCs consist of transparent conductive oxide (TCO)/ Mesoporous semiconductor film / dye / electrolyte / Pt counter electrode. The energy conversion efficiency for liquid type DSCs have been improved up to 12% by researchers with a number of attempts. The main drawbacks of this type DSCs are leakage and evaporation of liquid electrolyte due to poor sealing and possibility of corrode with Pt counter electrode (CE). Quasi solid polymer electrolyte and solid state hole conductors are used to address these undesirable problems. Though the liquid electrolyte replace with gel polymer or solid state electrolyte, it reduces the mobility of the ion in the media and leads to less efficiency than liquid electrolyte.

To overcome these adverse problems, Sri Lankan expanded graphite has been used as CE. Dyed TiO<sub>2</sub> nanoparticle in working electrode (WE) filled with liquid electrolyte (I<sup>-</sup>/I<sub>3</sub><sup>-</sup>) and excess electrolyte is smoothly wiped off. Then, thin layer of expanded graphite (derived from Sri Lankan Natural Vein-type Graphite) is placed on the top of the surface to seal the pores and it is covered with metal piece. The fabricated device can be expressed as fluorine doped tin oxide (FTO)/ TiO<sub>2</sub> nanoparticles/N719/ I<sup>-</sup>/I<sub>3</sub><sup>-</sup>/ expanded graphite film/ titanium metal. The pressed expanded graphite on TiO<sub>2</sub> surface restricts leakage and evaporation of liquid electrolyte and act as a CE with effective ion mobility in liquid medium. To prevent corrosion problems related to Pt CE, expanded graphite can be used as a low-cost alternative material having excellent conducting properties. The cells show solar energy conversion parameters of 14.4 mA/cm<sup>2</sup> Current density ( $J_{sc}$ ), 0.712 V open circuit voltage ( $V_{oc}$ ) and 0.70 Fill factor (FF) with overall efficiency 7.17%.

**Keywords:** Dye-sensitized solar cell, Expanded Graphite, Counter Electrode, Liquid Electrolyte.