IRCUWU2021

5th INTERNATIONAL RESEARCH CONFERENCE

"Exploring Potentials in Challenging Periods"

2021
1-2, July

Uva Wellassa University of Sri Lanka

Application of Thermally Reduced Graphene Oxide-based Counter Electrode for Dye-sensitized Solar Cells: A Comparative Study on Sintering Temperature

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A counter electrode (CE) fabricated with thermally reduced graphene oxide synthesized from Sri Lankan graphite is proposed for promising Platinum-free dye sensitized solar cells (DSSC). As it is well known, Sri Lankan natural graphite has become more attractive and demanding in the world due to its high purity and high crystallinity. In a DSSC, a thin film of Platinum (Pt) is generally used as the catalytic material on the CE due to its high conductivity and superior electro-catalytic activity. However, there is a considerable attention to replace Pt based CEs due to their high cost and limited supply. Recently, extensive research has been performed on using carbon materials for the CEs due to their low cost, high conductivity and good catalytic activity. In this study, reduced graphene oxide (RGO) was synthesized and deposited on FTO conducting glass substrate by spray method. To investigate the effect of sintering temperature of the CE on the performance of DSSCs, a series of RGO based CEs were prepared with different sintering temperatures from 100 ^{o}C to 300 ^{o}C by increasing the temperature by 50 ^{o}C intervals. Results confirmed that the DSSCs prepared with sintered CEs exhibit a better photovoltaic performance compared to the DSSCs made with un-sintered CEs essentially due to the enhanced adhesion to the FTO glass substrate in the sintered composite material. DSSCs with CEs sintered at 250 ^{o}C have exhibited the highest efficiency of 4.52 % compared to the DSSC with un-sintered CEs (efficiency=1.35 %). This low cost RGO CE exhibits good stability and acceptable efficiency compared to Pt CE (7.82 %) in DSSCs operating under similar conditions. Synthsized RGO sheets were characterized using scanning electron microscopy, Raman spectroscopy and X-ray diffraction. The electro-catalytic activity of RGO CE was determined by cyclic voltammetry. Results suggested that this CE can be one of the alternatives to the Pt CEs in DSSCs with further modifications.

***Keywords*:** Dye sensitized solar cells; Counter electrode; Reduced graphene oxide; Sintering temperature

Acknowledgement: Financial assistance from National Science Foundation of Sri Lanka (Grant No: NSF-PSF/ICRP/2017/EA&ICT/04 is gratefully acknowledged