SRI LANKAN NATURAL GRAPHITE AS A LOW COST COUNTER ELECTRODE FOR DYE-SENSITIZED SOLAR CELLS

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Dye-Sensitized Solar Cells (DSCs) are considered as the most prominent low-cost alternative to the conventional silicon-based solar cells. They have several components; interconnected nanoparticulate semiconductor metaloxide photoanode, a dye, an electrolyte and a counter electrode. Among other components, counter electrode uses the most expensive material, Platinum (Pt) which is a burden in large scale applications. Therefore, it is important to find cheaper alternatives.

Here, the replacement of Pt counter electrode by a graphite electrode is presented. Graphite is introduced as the counter electrode material due to its readily availability, low-cost, good catalytic activity, good conductance and high stability to most of the electrolyte. Different techniques were studied to fabricate graphite counter electrode such as Spray Pyrolysis, Screen Printing and Doctor-blade method. Only the doctor-blade method was succeeded. The graphite paste was prepared by using 1.5:1 ratio of ball-milled Sri Lankan graphite (40-50 μm): organic binder (morphol) mixed with deionized water. The mixture was placed on a hot plate at 80 °C while stirring to evaporate excess water. Using the doctor-blade method, a graphite layer was prepared on the fluorine-doped tin oxide substrate and sintered at 350 °C for 30 minutes. The sheet resistance was found around (50-60) Ω/cm^2. Photoanode was prepared by adsorbing dye N719 on to the TiO_2 layer fabricated using spray pyrolysis and 0.1 M LiI, 0.05 M I_2, 0.6 M dimethylpropylimidazolium iodide, tertiarybutylpiridine in methoxypropionitrile was used as the electrolyte.

Optimum composition, optimum thickness and the optimum sintering temperature for the fabricated graphite layer were determined. The catalytic activity of the counter electrode was measured by *I-V* characterization and morphology of surface was examined by Atomic Force Microscope (AFM). Using the X-Ray Diffraction (XRD) pattern the crystallographic structure of the electrode material was obtained. For the optimized graphite electrode, the graphite layer on FTO had a film thickness of 510 μm with a sheet resistance of 53 Ω/cm^2. DSC with graphite counter electrode showed a power conversion efficiency of 5.97% (J_{SC}=13.13 $mAcm^{-2}$, V_{OC}=0.698 V, fill factor=0.65) whereas one with the Pt counter electrode showed 8.36%. Therefore, counter electrode fabricated using graphite may be a good alternative to the Pt electrode in DSCs and further improvements can be foreseen.