Abstract No: PO-03

Fabrication of FTO/CBD-CdS/ED-CdTe/Cu/Au solar cells and boosting its performance by $CdCl_2$ treatment

G. K. U. P. Gajanayake[1], D. S. M. De Silva [1*], H. Y. R. Atapattu[2] and A. A. I. Lakmal[3]

[1]Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka
[2]Department of Instrumentation & Automation Technology, Faculty of Technology, University of Colombo, Sri Lanka
[3]Department of Physics, Faculty of Science, University of Peradeniya, Sri Lanka
sujeewa@kln.ac.lk*

The thin film CdS/CdTe solar cells are promising cost-effective clean energy generating devices against the global energy crisis. Chemical bath deposition (CBD) and electrodeposition (ED) were recognized as being simple and low-cost techniques over a range of growth techniques available for development of CdS and CdTe thin films respectively. The use of aforesaid two techniques successively in fabrication of glass/FTO/CBD-CdS/ED-CdTe solar cells was not reported. This attempt is to do so and moreover, to assess the effect of $CdCl_2$ treatment in performance enhancement of the device produced. In preparation of thin CBD-CdS layers on FTO glass substrate, a bath consisted of $Cd(CH_3COO)_2$ (0.033 mol/L), $CS(NH_2)_2$ (0.667 mol/L), $CH_3CO_2NH_4$ (1.0 mol/L) and NH_4OH (25%) was employed at 90 ℃. Annealed (375 ℃ for 30 min) CBD-CdS samples were subjected to CdTe deposition by ED system equipped with a three electrodes system. Herein, the CdS thin films were specifically developed enabling them to withstand in a highly acidic bath during the ED process. The ED bath used consisted of $CdSO_4$ (1.0 mol/L) and TeO_2 (1.0 mmol/L) at pH 2.3 and 65 ℃. The potential of -0.650 mV was maintained between the reference and working electrodes during each deposition (3 hrs). Samples were sprayed with $CdCl_2$ solution (1.0 mol/L) for 2 s and then annealed (390 ℃ for 15 min). Back contacts (Cu/Au) were deposited on the $CdCl_2$ treated glass/FTO/CBD-CdS/ED-CdTe devices by thermal evaporation. The devices were characterized under the illumination of AM 1.5 (100 mW/cm^2). The efficiencies of the $CdCl_2$ treated devices were found to be higher (6.23%) than untreated ones (2.66%). A significant variation in J_{sc}, V_{oc}, and FF values was observed in $CdCl_2$ treated devices (24.68 mA/cm^2, 664 mV, and 38.0%) over untreated devices (14.95 mA/cm^2, 531 mV, and 33.5%). The SEM analysis revealed remarkable increment in CdTe grain sizes (~140 nm to ~591 nm) with less grain boundaries in the CdTe sample upon $CdCl_2$ treatment, thus leading to improved photovoltaic performance. This work demonstrated that CdS and CdTe can be synthesized using cost effective methods of CBD and ED respectively and, the FTO/CBD-CdS/ED-CdTe/Cu/Au device efficiency can be significantly improved by the $CdCl_2$ treatment.

Keywords: CdS/CdTe solar cell, Chemical bath deposition, Electrodeposition, $CdCl_2$ treatment

Acknowledgment
This work was supported by the State Ministry of Skills Development, Vocational Education, Research and Innovations, Sri Lanka under the Edu-Training program on Prototype Manufacturing of Solar Panels.