Abstract No: PS-19

Influence of ZnS buffer layer on CdS/CdTe based solar cells

H. M. L. U. Madhuwanthi[1], G. D. K. Mahanama[2] and D. S. M. De Silva[1*]

[1]Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka
[2]Department of Physics, Faculty of Science, University of Ruhuna, Sri Lanka
sujeewa@kln.ac.lk*

Among thin film materials, cadmium sulfide (CdS) is the best suited window material as a heterojunction partner in cadmium telluride (CdTe) based solar cells due to its wide and direct band gap. In order to enhance the solar cell efficiency, a buffer layer such as zinc sulfide (ZnS) having a relatively wider band gap can be introduced into the conventional CdS/CdTe heterojunction solar cell by reducing the thickness of CdS thin layer. ZnS/CdS is an alternative to the conventional CdS window layer since it admits and transmits the maximum amount of photons to the junction to increase the short circuit current density (J_{sc}) and the efficiency of the solar cell. The electrodeposition of ZnS on fluorine doped SnO_2 glass (FTO) has been previously reported and this work focuses on the electrodeposition of intrinsic CdS layers on both FTO substrate and FTO/ZnS substrate, using a three electrode cell. The electrolyte used was consisted of 0.01 mol/L $Na_2S_2O_3$ and 0.1 mol/L $CdCl_2$ at pH of 1.7 at 55 °C and the deposition potential was varied between -0.68 to -0.72 V. The samples prepared were annealed at 400 °C for 15 minutes. Both thin film structures, FTO/CdS and FTO/ZnS/CdS were analyzed by the UV-Visible spectrophotometry and photoelectrochemical (PEC) cell performance to investigate the optical absorbance and its electrical properties. The optical absorption of the samples was fallen within 2.30-2.46 eV that agree with the typical band gap energy of CdS. Among the two structures, FTO/ZnS/CdS shows lower optical absorbance in 300-900 nm region, which has been recognized as a characteristic feature for a window layer in a solar cell. For the PEC cells, made with FTO/CdS, the J_{sc} and $J_{sc}\times V_{oc}$ values were between (18.0-1.60) $\times 10^{-6}$ A cm^{-2} and (5.94-0.38) $\times 10^{-6}$ AVcm^{-2} respectively, while for the cells made with FTO/ZnS/CdS, these values were (14.8-2.50) $\times 10^{-6}$ A cm^{-2} and (6.66-0.90) $\times 10^{-6}$ AVcm^{-2}. Although the J_{sc} of the FTO/ZnS/CdS based cell was relatively low, the product of $J_{sc}\times V_{oc}$ was high due to its high V_{oc}. The ZnS buffer layer facilitated the electrodeposition of well adhered, compact and pinhole free CdS window layer compared to the deposition of CdS on bare FTO. Hence, the implanting of a ZnS buffer layer on CdS/CdTe based solar cell can enhance the optoelectronic properties of the final solar cell device.

Keywords: Electrodeposition, CdS, ZnS, Buffer layer, PEC study

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