

## **EFFECT OF THE TYPE OF CONDUCTING GLASS SUBSTRATE ON ELECTRODEPOSITED CdS AND CdTe THIN FILMS**

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### **ABSTRACT**

Thin film CdS/CdTe solar cells produced by the technique of electrodeposition (ED) on conducting glass substrates have become one of the leading applications of photovoltaics due to its high energy conversion efficiency via absorption of solar energy in a wider range within the solar spectrum. In previous studies, it has been established that the quality of CdS and CdTe thin films depends upon several growth parameters namely; the deposition potential, precursor concentrations & their ratios, pH of the electrolyte, deposition temperature and the rate of stirring of the electrolyte during the process of ED. In addition, the effect of conducting glass substrate on properties of the deposited material has been identified as a decisive consequence in achieving photoactive materials. Hence, the present study was carried out to determine the effect of the type of glass substrates on electrodeposited CdS and CdTe thin films. In this study, glass substrates coated with different transparent conducting oxide (TCO) layers namely; fluorine-doped tin oxide (FTO) and indium tin oxide (ITO) were considered and for each type of TCO layer two different sheet resistances (FTO: 7 vs. 13  $\Omega$ /sq and ITO: 7 vs. 15  $\Omega$ /sq) were taken into account. CdS thin layers were electrodeposited on these four types of glass substrates using an electrolyte consisted of CdCl<sub>2</sub> (0.1 mol/L) and Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> (0.01 mol/L) as Cd and S precursors respectively at pH of 1.7 and temperature of 55 °C for 30 minutes under cathodic deposition potential (CDP) of 650 mV vs. a saturated calomel electrode (SCE). Out of twelve replicates of CdS depositions on each type of glass substrate, six replicates from each type (glass/TCO/CdS) were conveyed for electrodeposition of CdTe thin films in an electrolyte consisted of CdSO<sub>4</sub> (1.0 mol/L) and TeO<sub>2</sub> (1.0 mmol/L) as Cd and Te precursors respectively at pH of 2.2 and temperature of 65 °C for 3 hours under CDP of 660 mV vs. SCE. The resulting CdS and CdTe thin films were heat treated at 400 °C for 10 minutes after each deposition and subsequent studies namely; UV-Vis absorption spectroscopy, photo-electrochemical cell analysis, scanning electron microscopy and X-ray diffraction spectroscopy were carried out to determine the optical, electrical, morphological and structural properties respectively of glass/TCO/CdS and glass/TCO/CdS/CdTe samples produced. As results revealed, the CdS and CdTe layers deposited on glass/FTO (7  $\Omega$ /sq) substrates have exhibited better optoelectronic qualities and the study further confirmed the dependence of material quality on type of the conducting glass substrate. Hence, the individual growth parameters optimization for each type of TCO glass substrate is an essential step in electrodeposition of good quality CdS and CdTe thin films for solar cell fabrications.

*Keywords:* Glass substrate, electrodeposition, Cadmium sulfide, Cadmium telluride, Thin film.

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