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Electrodeposition of CdS window layer on ZnS buffer layer for solar cell applications

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The efficiency of the CdS/CdTe solar cell is accompanied by the layer thickness of CdS due to its high light absorption coefficient. At lower thickness, more photons can reach the absorber material and hence increases the short circuit current density (J_{sc}) of the device resulting a device with improved efficiency. This work comprises a study on structure and topography of electrodeposited CdS on glass/FTO and glass/FTO/ZnS substrates using a three-electrode cell. The electrodeposition conditions of ZnS on FTO has been previously reported. For the electrodeposition of CdS, an electrolyte consisted of 0.01 mol/L $Na_2S_2O_3$ and 0.1 mol/L $CdCl_2$ at a pH of 1.7 and temperature of 55 °C was used under a deposition potential of -0.68 V. The deposited CdS thin films were analyzed by X-ray diffraction, atomic force microscopy techniques, and by photoelectrochemical cell measurement. The X-ray diffractograms revealed that CdS in both devices has mixed structures of cubic and hexagonal phases. The surface morphology observed under AFM of CdS grown on two substrates were found to be significantly different and larger grains were observed for glass/FTO/CdS. Hence, more CdS seeds have been formed on glass/FTO/ZnS substrate, resulting higher number of grains in reduced size. According to the PEC cell measurement, the FTO/ZnS/CdS layer has higher open circuit voltage (V_{oc}=0.45V) than that of the FTO/CdS layer (V_{oc}=0.33V), representing minimal pinholes and short paths through the grain boundaries. Therefore, the conventional CdS window layer can be successively replaced by ZnS/CdS in CdS based solar cells.

Key words: *Electrodeposition, CdS, ZnS, buffer layer, characterization*

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