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Effect of Thermal Annealing on Electrodeposited CdS and CdS/CdTe Heterojunction

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At present CdS/CdTe based solar cells have a significant commercial impression due to its low-cost, scalability, manufacturability and simplicity. Nevertheless, it is essential to elevate the optoelectronic qualities of CdS and CdTe materials and the interface properties of CdS/CdTe heterojunction and ultimately the efficiency of the solar cells. In this regard thermal annealing is one of the key steps to be considered in order to enhance the material and heterojunction properties. Hence, in this study, the effect of thermal annealing on electrodeposited CdS and CdS/CdTe heterojunction was investigated.

CdS and CdTe semiconductor layers were potentiostatically electrodeposited on bare fluorine doped tin oxide (FTO) glass substrates and FTO/CdS respectively using the typical three electrode electrolytic cell. For both layers, saturated calomel electrode and high purity (99%) graphite rod were used as reference and counter electrodes respectively. 0.10 mol/L $CdCl_2$ and 0.01 mol/L $Na_2S_2O_3$ were used as Cd and S precursors respectively to produce CdS thin films while 1.35 mol/L $CdSO_4$ and 1.0 mmol/L TeO_2 were used as Cd and Te precursors respectively for CdTe. CdS layers were grown at cathodic deposition potential of 660 mV at pH 1.6 and temperature of 55 °C. Afterwards, one set of electrodeposited CdS samples was conveyed for fabrication of CdS/CdTe heterojunction. CdTe layers were grown on CdS layers at cathodic deposition potential of 650 mV at pH 2.3 and temperature of 65 °C. Subsequently, thermal annealing was carried out for both CdS and CdS/CdTe at three different temperatures; 390, 400 and 410 °C, for each annealing three different time periods; 10, 15, 20 min were considered. After the process of annealing all the samples were inspected for their optical, electrical and morphological properties using the techniques of optical absorption spectroscopy, photo-electrochemical cell and scanning electron microscopy respectively. According to the results, the optimum annealing conditions which yielded good optoelectronic qualities for CdS and CdS/CdTe were found to be 400 °C, 15 min and 390 °C, 15 min respectively.

Keywords: *Electrodeposition, CdS, CdS/CdTe heterojunction, Thermal annealing, Solar cells*

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