Post deposition surface treatments to enhance the quality of polycrystalline CdTe thin films for photovoltaic applications

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Materials Chemistry and Physics 213 (2018) 406e413

A B S T R A C T

Cadmium telluride (CdTe) is one of the topmost thin film polycrystalline materials used in the photovoltaics (PV) industry today and post deposition surface treatment has been a major step used in the production process for improving the photovoltaic quality of the CdTe material. In the present study, several post deposition surface treatment processes including $CdCl_2$ treatment were carried out on CdTe material and the properties of the materials were then analyzed with the intension of gaining an understanding of the effect of the post deposition process on the material properties and identifying better post deposition treatment processes that can be used to improve the PV quality of the material. In this study, CdTe thin films were potentiostatically electrodeposited using the typical three electrode electrolytic cell consisted of a saturated calomel reference electrode and a high purity graphite counter electrode. $3CdSO_4.8H_2O$ and TeO_2 were used as the cadmium and the tellurium precursors respectively and CdTe layers were electrodeposited on fluorine doped tin oxide (FTO) glass substrates and glass/FTO/CdS surfaces at pre-identified growth conditions namely; cathodic deposition potential of 650 mV, pH of 2.3 and temperature of 65 °C. Subsequently, deposited samples were annealed in air with $CdCl_2$ and thereafter, comparable samples of glass/FTO/CdTe and glass/FTO/CdS/CdTe were subjected to surface etching with diluted HCl (DH), Br_2-CH_3OH (BM), HNO_3-H_3PO_4 (NP), $K_2Cr_2O_7$-H_2SO_4 (DS) and $K_2Cr_2O_7$-CH_3OH (DM). Surface treated samples were then characterized for their electrical, optical, elemental, morphological and structural properties using photo-electrochemical cell measurements, optical absorption spectroscopy, energy dispersive X-ray spectroscopy, scanning electron microscopy and X-ray diffraction spectroscopy respectively. The study reveals that, post deposition surface treatments with BM and NP etchings enhance the material qualities of polycrystalline CdTe layers to be used for fabrication of PV devices.

Keywords: Cadmium telluride; Thin films; Surface treatments; Electrodeposition; Solar cells