Electrochemical deposition and characterization of CdTe thin films

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The semiconductor cadmium telluride (CdTe) has been widely used in applications of photovoltaics, sensors and detectors because of its direct band gap with high atomic number and electron density. With its narrow and direct band gap, stability with high absorption coefficient and other optoelectronic properties, it is the most ideal material for photovoltaic structures. A solar cell made of polycrystalline CdTe thin film is one of the most promising low cost materials for photovoltaic applications. CdTe was grown using different techniques such as physical vapor deposition, chemical vapor deposition, molecular beam epitaxy, close space sublimation, liquid phase deposition and electrodeposition. Electrodeposition has demonstrated numerous advantages due to its simplicity, low cost and scalable manufacturing techniques. CdTe films have been electrodeposited on fluorine doped tin oxide (FTO) coated glass substrates which have sheet resistance less than 20 Ω/sq. A conventional three electrode cell was used for the deposition where a high purity graphite rod and saturated calomel electrode (SCE) were presented as the counter electrode and as the reference electrode respectively. Prior to the deposition of semiconductor layers FTO glass substrates were cleaned by a sequence of steps which included wiping out with detergent, ultrasonic washing in detergent solvents and then with deionised water followed by degreasing using acetone, methanol and isopropyl alcohol. CdTe thin films have been prepared by potentiostatic electrodeposition from acidic solution containing $CdSO_4$, $CdCl_2$ and TeO_2. The deposition mechanism was investigated by cyclic voltammetry. The thickness of the film can be controlled by the charge passed during the deposition, and it is possible to obtain p-type and n-type materials by changing the deposition potential. Photoelectrochemical (PEC) cell measurements were carried out in order to determine the electric conductivity type of electrodeposited layers.The PEC values were determined for both as deposited and heat treated materials.The electrodeposited thin films were characterized and investigated using X-ray diffraction (XRD), scanning electron microscopy (SEM) and UV-visible absorption spectroscopy. The CdTe thin films were found to posses a bandgap of (1.44±0.02) eV, which is in a good accordance with those reported in the literature.

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