

Electrodeposition of CdS thin films using different sulfur sources for CdS/CdTe solar cells

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Cadmium Sulphide (CdS) and Cadmium Telluride (CdTe) are two promising photovoltaic materials for thin film solar cells. CdS is a wide band gap n-type semiconductor, which can act as a window layer. The function of CdS is to allow energetic shorter wavelength photons to pass for the incidence at the hetero-interface with minimum absorption loss. The high optical band gap of CdS (~2.42 eV) assists this function. Among the different techniques, electrodeposition is one of the most suitable low cost methods, because the material can be deposited on the desired area of the substrate thus providing a film of reproducible quality. CdS films were prepared by electrodeposition technique from CdCl₂ as cadmium precursor and Na₂S₂O₃ or (NH₄)₂S₂O₃ as sulfur precursor in aqueous medium. For the electrodeposition of CdS three electrode system was employed using glass/FTO as the working electrode (cathode), saturated calomel electrode as a reference electrode and high purity graphite rod as a counter electrode (anode). Electrochemical deposition method through the influence of the concentration of precursor species, deposition potential, deposition temperature and pH offers excellent control over the properties of thin CdS layers using a potentiostatic approach. The changes in the morphology and properties of the films prepared from different sulfur sources were studied. The CdS layers grown using Na₂S₂O₃ as sulfur precursor show thickness below 100 nm. V_{oc} and J_{sc} obtained for initial solar cells with CdS films grown using Na₂S₂O₃ as sulfur precursor had higher values compared to that of CdS semiconductor layers grown using (NH₄)₂S₂O₃. The photoelectrochemical (PEC) cell measurements were used to identify the electrical conductivity type of the layers and it was found that as grown and heat treated material layers were of n-type for both CdS layers which were grown using different sulfur sources. Upon heat treatment, the material layers show enhanced PEC signal indicating improved optical properties. The optical absorption measurements were carried out in order to evaluate the band gap of the resulting materials. All samples exhibit a band gap value of 2.42±0.08 eV without any noticeable differences as expected. Electrodeposited CdS films were characterized by XRD for determination of bulk structure and SEM for surface analysis.

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