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An investigation into the effect of rate of stirring of bath electrolyte on the properties of electrodeposited CdTe thin film semiconductors

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Abstract

Electrodeposition (ED) has been recognized as a low cost and scalable technique available for fabrication of CdS/CdTe solar cells. Photovoltaic activity of these electrodeposited semiconductor materials drastically depends on the ED growth parameters namely; electrodeposition potential, concentrations and ratios of concentrations of precursors used to prepare the bath electrolyte, pH of the electrolyte, deposition temperature and rate of stirring of the electrolyte. In order to grow thin films with good photovoltaic properties, it is essential to maintain these variables at their optimum ranges of values during electrodepositions. Hence, this study was conducted to investigate the dependence of the properties of electrodeposited CdTe thin film material on the rate of stirring of the bath electrolyte. The CdTe material was grown on glass/FTO (2×3 cm^2) and glass/FTO/CdS (2×3 cm^2) surfaces in bath electrolytes containing 1.0 mol/L $CdSO_4$ and 1.0 mmol/L TeO_2 solutions at different rates of stirring within the range of 0–350 rpm while keeping the values of pH of the electrolyte, deposition temperature and cathodic deposition potential with respect to the saturated calomel electrode at 2.3, 65 °C and 650 mV respectively. After the heat treatment at 400 °C in air atmosphere, the deposited samples with a good visual appearance were selected and evaluated based on their morphological, elemental, structural, optical and electrical properties in order to identify the optimum range of rate of stirring for electrodeposition of CdTe thin film semiconductors. Results revealed that, rates of stirring in the range of 60–85 rpm in a 100 mL volume of electrolyte containing the substrate and the counter electrodes in the center of the bath with a separation of 2.0 cm between them can electrodeposit CdTe layers exhibiting required levels of morphological, structural, optical and electrical properties on both glass/FTO and glass/FTO/CdS surfaces.

Keywords: Electrodeposition; Cadmium telluride; Stirring rate; Solar energy materials