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Investigation of the effect of source temperature on close-spaced sublimated CdTe thin films

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Cadmium telluride (CdTe) is one of the most promising II-VI group semiconductors used to fabricate heterojunction thin-film solar cells. Close-spaced sublimation is one of the best techniques for the deposition of polycrystalline CdTe thin films. In this study, CdTe thin films were deposited on the cleaned FTO glass substrates using the close-spaced sublimation technique by varying the source temperature from 560 °C to 720 °C in steps of 20 °C. The temperature of the substrates, source to substrate separation, and deposition duration were maintained at 540 °C, 4 mm, and 5 minutes respectively. $Ar_{(g)}$ was introduced to the vacuum chamber, keeping the pressure at 7.9 Torr. The deposition was carried out using high purity CdTe powder placed in a graphite crucible. An almost transparent thin CdTe layer was observed at the source temperature of 560 °C. In comparison, a slightly decomposed layer was seen when the source temperature was 720 °C, which could be considered two boundary points in the temperature range selected. The CdTe layer deposited at source temperature 580 °C had a better thickness compared to 560 °C and pinholes could be visible to the naked eye. The average transmittance beyond the absorption edge was decreased with the increment of source temperature. The optical bandgaps of all samples were in the range of 1.48 - 1.50 eV. The crystallinity of the deposited thin films was shown an increasing trend with the increment of source temperature. According to the SEM analysis, the increment of source temperature has led to better grain enhancement. Based on the above characterizations, the optimum source temperature was determined as 660 °C. To further confirm this result, CdS/CdTe full cells were fabricated by depositing the above CdTe layers on thermally evaporated CdS films with back contacts in the order of Cu before Au. Among the CdS/CdTe/Cu/Au cells fabricated for electrical characterization, the highest efficiency was obtained for the source temperature of 660 °C.

Keywords: Cadmium telluride, CdS/CdTe solar cells, Close-spaced sublimation, Source temperature

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