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Characterization of Cu_3SbS_3 thin films grown by thermally diffusing Cu_2S and Sb_2S_3 layers

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Abstract

Copper antimony sulphide (Cu_3SbS_3) with a p-type conductivity and optical band gaps in the range of 1.38 to 1.84 eV is considered to be a promising solar harvesting material with non-toxic and economical elements. In this study, we reported the fabrication of Cu_3SbS_3 thin films using successive thermal evaporation of Cu_2S and Sb_2S_3 layers followed by annealing in an argon atmosphere at a temperature range of 300-375°C. The structural and optical properties of the as-deposited and annealed films were investigated. The annealed films notably show the crystalline phase of the Cu_3SbS_3, identified from the X-ray diffraction analysis and endorsed by the Raman analysis as well. Whereas their chemical state of the constituent elements was characterized with X-ray photoelectron spectroscopy. The measured highest resistivity of the annealed film was found to be ~0.2 Ω-cm. Hence, our obtained results for the fabricated Cu_3SbS_3 thin films bring to light that Cu_3SbS_3would be a good absorber layer in solar cells due to their low resistivity, a higher value of the optical absorption coefficient (~10^5 cm^{-1}), the low transmittance (<5%) and an optical direct band gap of 1.6 eV in the visible range of the solar spectrum.

Keywords: Thin films, Copper antimony sulphide, XRD, Optical properties, Resistivity

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