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Characterization of Cu_2SnS_3 thin films prepared by sulfurization of co-evaporated Cu–SnS precursor layers

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ABSTRACT

Monoclinic Cu_2SnS_3 thin films were prepared by sulfurizing Cu–SnS precursor layers deposited by a co-evaporation method on soda-lime glass substrates. The morphological, optical and electrical properties of the Cu_2SnS_3 thin films were investigated by scanning electron microscopy, spectral transmittance, and Hall effect measurements. All Cu_2SnS_3 thin films prepared in this study exhibited p-type conductivity and a direct band gap of 0.86–0.87 eV with a high absorption coefficient ($\alpha > 10^4 \text{ cm}^{-1}$). However, carrier concentrations and electrical resistivities varied noticeably, depending on their metallic composition ratios and sulfurization temperatures. The thin film with a metallic composition ratio $[\text{Cu}]/[\text{Sn}] = 1.66$ had a carrier concentration, resistivity, and mobility of $3.12 \times 10^{17} \text{ cm}^{-3}$, $6.37 \text{ } \Omega \cdot \text{cm}$, and $3.14 \text{ cm}^2/\text{V} \cdot \text{s}$, respectively. The temperature dependence of electrical resistivity, carrier concentration, and Hall mobility of this thin film was also obtained from liquid nitrogen temperature to room temperature to examine charge transport properties.

Keywords: Copper tin sulfide; Hall effect, Optical absorption, Raman spectroscopy

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