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## Effect of sulfurization temperature on the phase purity of $\text{Cu}_2\text{SnS}_3$ thin films deposited via high vacuum sulfurization

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### Abstract

In this study, the deposition of  $\text{Cu}_2\text{SnS}_3$  (CTS) thin films was carried out at different sulfurization temperatures in the range of 350 – 550 °C under high vacuum of 1 Pa using the sputtered Cu/Sn/Cu metal precursor layers in the sulfur vapor atmosphere. In order to reduce the Sn loss, a particular metal stack of Cu/Sn/Cu was used. Single phase monoclinic (M)-CTS thin film was obtained at 500 °C. The high intensity Raman modes at 292  $\text{cm}^{-1}$  and 350  $\text{cm}^{-1}$  further confirmed the formation of M-CTS. The M-CTS thin film sulfurized at 500 °C showed a composition of  $\text{Cu/Sn} = 1.89$  and an optical band gap energy of 0.94 eV. Hall effect measurement of the film sulfurized at 500 °C with Cu/Sn ratio of 1.82 showed an electrical resistivity of 7.30  $\Omega\text{-cm}$ , carrier concentration of  $6.29 \times 10^{17} \text{ cm}^{-3}$ , and mobility of 1.36  $\text{cm}^2/\text{Vs}$ . Our results indicate that the copper-poor composition with a stacking order of Cu/Sn/Cu is favored in order to attain the single phase M-CTS.

**Keywords:** M-CTS thin film; High vacuum sulfurization; Phase purity; Reduction of Sn loss

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