Effect of antimony concentration on optical, electrical and structural properties of copper antimony sulphide thin films deposited by spray pyrolysis technique

Abstract:

Copper antimony sulphide ($CuSbS_2$) is a semiconductor with narrow band gap and a potential absorber material for applications in various optoelectronic devices like infrared detectors and solar cells. In this paper, $CuSbS_2$ thin films were deposited by spray pyrolysis technique on glass substrates at a temperature of 300°C, using cupric chloride, antimony chloride, and thiourea as precursors. The samples were prepared by varying the antimony concentration (0.1M, 0.15M, and 0.2M) at a pressure of 3.5 bar and a solution flow rate of 2 ml/min for 5 minutes, while the precursor solutions of Cu:S molar ratio (0.1:0.2) was maintained. Elemental, morphological, optical, and structural characterization of these films was done from data obtained from energy dispersive X-ray fluorescence (EDXRF), UV-VIS spectrophotometer, scanning electron microscope (SEM) and X-Ray diffraction (XRD) respectively. The prepared thin films were polycrystalline with a preferential peak at (111). Electrical properties of the thin films were obtained by simulating the UV-VIS spectra in SCOUT software using the Drude and Kim oscillator model. Deposited films have a band gap range of 1.84 – 1.98 eV, conductivity range of 199.59 – 204.67 $\Omega^{-1}cm^{-1}$, and carrier concentration range of 1.12×10^{19} - 1.27×10^{19} cm^{-3}.

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