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Preparation and Study of the Structural, Optical and Electrical Properties of Cu(In,Ga)Se₂ Thin Films

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Abstract: Thin film samples of Cu(In,Ga)Se₂ (CIGS) were prepared at room temperature by physical vapor deposition (PVD) technique using resistive heating method onto soda lime glass substrates. Deposition conditions were same for all the samples. The prepared samples were annealed in vacuum at temperature of 200 °C for 5, 10, 15, 30 and 60 minutes and were characterized structurally, optically and electrically. The structural analysis indicate the partial formation of quaternary CIGS compounds for the samples which were annealed in vacuum at 200 °C for 30 and 60 minutes. XRD analysis indicate that there is a continuous growth and improvement in the structural formation of ternary (CuInSe₂ and CuGaSe₂) and quaternary CIGS compounds. The thin films after vacuum annealing show low values of transmission and suitable absorption in the wavelength range of interest. The band gap of CIGS absorber layer is estimated to be 1.32 eV by extrapolating the plot of $(\alpha h\nu)^2$ as a function of $h\nu$. The electrical resistivity of all the samples are calculated by using Van der Pauw technique and found to decrease with increase in annealing time. The resistivity of the samples is small; therefore the prepared samples can be used as an absorber layer in the fabrication of thin film solar cells.

Key Words: CIGS, thin films, absorber material, solar cell, optical properties, band gap, electrical properties

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