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COST-EFFECTIVE CIGS THIN FILMS: ELECTRODEPOSITION AND CHARACTERIZATION FOR EFFICIENT SOLAR CELLS

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The present work explores the electrodeposition of copper indium gallium diselenide (CIGS) thin films using a non-aqueous electrolyte at a higher working temperature of 130 °C. The cyclic voltammetry (CV) experiment revealed a broad potential window beyond -0.8 V relative to the Ag/AgCl reference electrode, suitable for CIGS deposition. X-ray diffraction (XRD) analysis confirmed the formation of a tetragonal chalcopyrite structure in the annealed layers, while secondary phases, such as CuSe and In_3Se_4, were observed in as-prepared films deposited at higher potentials. Upon annealing, all layers became highly crystalline, with the removal of secondary phases depicting the formation of the tetragonal structure of CIGS. The annealing process enhanced the crystallinity and confirmed the presence of the A_1 mode of the tetragonal structure in CIGSe films. The uniform and compact morphology seen in films deposited at higher potentials suggests their potential for solar cell applications. Furthermore, the annealing process enhanced the crystallinity and supports the formation of nearly stoichiometric CIGS films. These findings contribute to the advancement of cost-effective and efficient thin-film solar cell technology, offering a promising avenue for sustainable and renewable energy solutions.

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Keywords: $CuIn_{1-x}Ga_xSe_2$, Electrochemical Deposition, Post-heat Treatment, Rapid Thermal Annealing, Thin Film Solar Cells