

Fabrication of $\text{CuIn}_{1-x}\text{Ga}_x\text{Se}_2$ thin films by using spray-deposition

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The processes of preparing $\text{CuIn}_{1-x}\text{Ga}_x\text{Se}_2$ (CIGS) thin films for high-efficiency solar cells always include selenization with excess H_2Se gas or Se vapor. Removing toxic gas from this process would greatly simplify it and make it less hazardous. We fabricated $\text{CuIn}_{1-x}\text{Ga}_x\text{Se}_2$ (x : 0~0.5) thin films by using spray-deposition. Firstly, nano-inks were prepared by dispersing CIGS nanoparticles into a solution of ethyl cellulose and terpineol in ethanol. Lastly, the as-deposited CIGS thin films were annealed at in range of 250~500°C under a nitrogen atmosphere in order to improve the crystallization of films and avoid their oxidation. The obtained samples were systematically characterized by X-ray diffraction (XRD), Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), X-ray photoelectron (XPS) and UV-vis spectroscopy. XRD analysis was employed to identify the phase for obtained thin films and particles. TEM and SEM were used to provide the detail information for particle size, structural information and surface morphology respectively. XPS was used to evaluate the chemical composition and bonding of the thin films. Energy band gap was estimated by UV-vis spectroscopy.