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$Cu(In_{1-x}Ga_x)Se_2$ Thin Film Fabrication by Powder Process

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Chalcopyrite-type Cu(In,Ga)Se2 (CIGS) is one of the most attractive compound semiconductor materials for thin film solar cells. Among various approaches to prepare the CIGS thin film, the powder process offers an extremely simple and materials-efficient method. Here, we present the mechano-chemical synthesis of CIGS compound powders and their use as an ink material for screen-printing. During the synthesis process, milling time and speed were varied in the range of 10~600 min and 100~300 rpm, respectively. Both phase evolution and powder characteristics were carefully monitored by X-ray diffraction (XRD) method, scanning electron microscope (SEM) observation, and particle size analysis by scanning mobility particle spectrometer (SMPS) and aerodynamic particle sizer (APS). We found the optimal milling condition as 200 rpm for 120 min but also found that a monolithic phase of CIGS powders without severe particle aggregation was difficult to be obtained by the mechano-chemical milling alone. Therefore, the optimized milling condition was combined with an adequate heat-treatment (300oC for 60 min) to provide the monolithic CIGS powder of a single phase with affordable particle characteristics for the preparation of CIGS thin film. The powder was used to prepare an ink for screen printing with which dense CIGS thin films were fabricated under the controlled selenization. The morphology and electrical properties of the thin films were analyzed by SEM images and hall measurement, respectively.

Keywords: CIGS, light absorbing layer, mechano-chemical process, heat-treatment, selenization, thin film