

Synthesis of $\text{Cu}_2\text{ZnSnX}_4$ (X = S & Se) ink and thin film by non-vacuum process for low-cost solar cell application

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Solution ink-based methods attempt an important attention for solar cells applications. It is a simple fabrication routes to replace the costly vacuum-based deposition procedures. The best reported prepared by non-vacuum process CZTSSe-based solar cell with 12.6% power conversion efficiency suffers from the use of a toxic and explosive solvent. Keeping this fact in view, the wet ball milling process has been used for the preparation of CZTX nanoparticles. elemental powder of Cu, Zn, Sn, S or Se used as raw materials and butanol solvent. For the ink preparation, a azeotropic solvent, PEG-400 as binder and Tween-80 as surfactant are used. The ink stability was characterized by DLS and Zeta potential. The deposited films by spin coating were annealed at different temperatures in the furnace. The XRD and Raman confirm the crystalline kieserite structure with single phase formation. FESEM-EDX analysis shows that deposited thin films have uniform, large grain sized and stoichiometric. FT-IR analysis used to detect the carbon contented in the samples. The opto-electrical properties were investigated with UV-Vis spectroscopy and Hall measurement.