

Synthesis and characterization of Kesterite $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) Nanoparticules and thin films for solar cells applications

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Abstract

Quaternary compounds $\text{Cu}_2\text{ZnSnS}_4$ based solar cells possess an excellent properties such the cost of preparation and its nontoxic constituting elements make them suitable absorber materials for photovoltaic applications. This material crystallizes with kesterite structure in the tetragonal space group I4. In this context, we were synthesized the $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) powder by mechanical allowing process from the mixture of elemental Cu, ZnS, Sn and S precursors in a cylindrical steel vial under argon atmosphere. Thin films were prepared by direct thermal evaporation of fine-grained powder from a tungsten crucible onto precleaned glass substrates, using a Balzers coating unit. Morphology and structure properties are analyzed by scanning electron microscopy (SEM) and X-ray diffraction. The SEM micrographs show that the films are polycrystalline with small grains. The X-ray diffraction studies revealed that all the deposited films exhibit kesterite structure with constants lattice $a=5.374 \text{ \AA}$ and $c=10.824 \text{ \AA}$. The transmittance characteristics of the samples have been studied using double beam spectrophotometer in the wave length range 400-2400 nm. The absorption coefficient has been found to be very high and is of the order of 10^4 - 10^5 cm^{-1} . The optical bandgap of the various thin films of CZTS was observed in the range 1.45-1.6 eV.