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Composition Effect on CZTS Properties Prepared by Solid State Reaction

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Cu_2ZnSnS_4 (CZTS) is one of the most promising and emerging quaternary absorber materials for thin film solar cells because of its low-cost, non-toxic constituents, ideal direct band gap and high absorption coefficient. In this work, we studied the effect of zinc excess on the crystallization of Cu_2ZnSnS_4 compound. For this purpose, we synthesized by solid state reaction three CZTS crystals initially with 0.2, 0.4 and 0.6 wt.% of zinc excesses. The CZTS crystals were analyzed using X-ray fluorescence (XRF) to determine chemical composition, X-ray diffraction (XRD) to examine structural properties and Raman scattering for vibrational properties. The composition ratio of [Cu]/([Zn]+[Sn]) is in the range of 0.81-097 while the [Zn]/[Sn] ratio varies from 0.97 to 1.33. The sample with 0.6 at% zinc excess, thus, can be considered optimal for reaching high efficiencies in CZTS based thin films solar cells. XRD profiles exhibit major peaks at 2θ=28.45°, 47.35° and 56.12° for the three samples. These peaks are attributed respectively to the (112), (220) and (312) kesterite planes (JCPDS N°:04-003-8920). The lattice parameters a and c calculated from XRD analysis were respectively 5.429Å and 10.870Å. However, ZnS and $Cu_4Sn_7S_{16}$ secondary phases were found. Furthermore, segregation of $Cu_{2-x}S$ phase occurs, as can be seen in Fig.2. Raman scattering spectrum of the sample with 0.6 wt.% excess zinc depicts a weak band at 471cm^{-1} corresponding to the $Cu_{2-x}S$ phase. Even so, the kesterite phase was confirmed bythe presence of four strong bands at 247cm^{-1}, 294cm^{-1}, 333cm^{-1} and 364cm^{-1}.

Biography:

Khelfane Amar was born on 18/03/1979 in Bouira, Algeria. He graduated from magister in 2012, a physical option for materials and components at the USTHB University in Algiers. He worked as a physics teacher in high school for two and a half years before joining the CRTSE Research Center in Algiers in December 2014 where he worked as a researcher inBulk Semiconductors Crystal Growth team (CSM) working in photovoltaic materials of 3rd generation $Cu_2Zn(Ge)SnS_4$.