CHARACTERIZATION OF TETRAHEDRITE Cu₁₀Cd₂Sb₄S₁₃ MONOGRAIN MATERIALS GROWN IN MOLTEN CdI₂ AND LiI

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Cd-substituted tetrahedrite Cu₁₀Cd₂Sb₄S₁₃ (TH-Cd) monograin powders (MGPs) was performed by the molten salt synthesis-growth method using two different fluxes. The influence of nature of the used flux salts on the elemental and phase composition of TH-Cd MGP particles, on their size distribution, morphology, as well as on the rate of particles’ agglomeration, was studied. The Cu₁₀Cd₂Sb₄S₁₃ powder materials were synthesized from CdS (5N) and Cu₂S (5N) and Sb₂S₃ (5N) by isothermal recrystallization method in cadmium iodide (CdI₂) and lithium iodide (LiI) at 495 °C for 336 hours. The mass ratio of precursors to flux salt m_TH-Cd/m_flux was kept 1 : 1. More details about the MGPs growth of TH compound could be found in [1][2].

The X-ray diffraction data of the materials indicated that mainly single phase of tetrahedrite Cu₁₀Cd₂Sb₄S₁₃ compound was formed in both flux salts. XRD pattern of TH-Cd crystals grown in LiI revealed a shift of all diffraction peaks, lower CdS content and a smaller lattice parameter values in comparison with those formed in CdI₂ (Cu₁₀Cd₂Sb₄S₁₃ synthesized in LiI: a=b=c=10.509 Å and in CdI₂: a=b=c= 10.512 Å). Energy dispersive X-ray spectroscopy revealed stoichiometric composition of Cu₁₀Cd₂Sb₄S₁₃ crystals grown in CdI₂ and Cu-poor grown in LiI. Images of scanning electron microscope showed different morphology of TH-Cd crystals formed in CdI₂, and LiI. The produced MGPs were used as an absorber material in MGL solar cells with a structure of ZnO/CdS/Cu₁₀Cd₂Sb₄S₁₃/graphite. The MGL solar cell, based on TH-Cd grown in LiI media showed higher parameters (η of 0.79% was achieved) than the one with TH-Cd grown in CdI₂ (η of 0.13%). Based on these results, we can conclude that Li⁺ from the molten flux (LiI) incorporates into the Cu₁₀Cd₂Sb₄S₁₃ crystals structure and most probably partly replacing Cu⁺ sites in the lattice forming Cu₁₀₋ₓLiₓCd₂Sb₄S₁₃ solid solution.

References