CHARACTERIZATION OF TETRAHEDRITE $Cu_{10}Cd_2Sb_4S_{13}$ MONOGRAIN MATERIALS GROWN IN MOLTEN CdI_2 AND LII

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Cd-substituted tetrahedrite $Cu_{10}Cd_2Sb_4S_{13}$ (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 $Cu_{10}Cd_2Sb_4S_{13}$ powder materials were synthesized from CdS (5N) and Cu_2S (5N) and Sb_2S_3 (5N) by isothermal recrystallization method in cadmium iodide (CdI_2) and lithium iodide (LiI) at 495 °C for 336 hours. The mass ratio of precursors to flux salt $m_{TH\text{-}Cd}/m_{flux}$ 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 $Cu_{10}Cd_2Sb_4S_{13}$ 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 CdI_2 ($Cu_{10}Cd_2Sb_4S_{13}$ synthesized in LiI: a=b=c=10.509 Å and in CdI_2: a=b=c= 10.512 Å). Energy dispersive X-ray spectroscopy revealed stoichiometric composition of $Cu_{10}Cd_2Sb_4S_{13}$ crystals grown in CdI_2 and Cu-poor grown in LiI. Images of scanning electron microscope showed different morphology of TH-Cd crystals formed in CdI_2, and LiI. The produced MGPs were used as an absorber material in MGL solar cells with a structure of ZnO/CdS/$Cu_{10}Cd_2Sb_4S_{13}$/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 CdI_2 (η of 0.13%). Based on these results, we can conclude that Li^+ from the molten flux (LiI) incorporates into the $Cu_{10}Cd_2Sb_4S_{13}$ crystals structure and most probably partly replacing Cu^+ sites in the lattice forming $Cu_{10-x}Li_xCd_2Sb_4S_{13}$ solid solution.

References

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