Magnetotransport and conductivity mehanisms in $Cu_2ZnSn_xGe_{1-x}S_4$ single crystals

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Abstract. Resistivity, ρ(*T*), and magnetoresistance (MR) are investigated in the $Cu_2ZnSn_xGe_{1-x}S_4$ single crystals, obtained by the chemical vapor transport method, between $x = 0–0.70$, in the temperature range of $T \sim 50–300$ K in pulsed magnetic field of B up to 20 T. The Mott variable-range hopping (VRH) conductivity is observed within broad temperature intervals, lying inside that of $T \sim 80–180$ K for different x. The nearest-neighbor hopping conductivity and the charge transfer, connected to activation of holes into the delocalized states of the acceptor band, are identified above and below the Mott VRH conduction domain, respectively. The microscopic electronic parameters, including width of the acceptor band, the localization radius and the density of the localized states at the Fermi level, as well as the acceptor concentration and the critical concentration of the metal-insulator transition, are obtained with the analysis of the ρ(*T*) and MR data. All the parameters above exhibit

extremums near $x = 0.13$, which are attributable mainly to the transition from the stannite crystal structure at $x = 0$ to the kesterite-like structure near $x = 0.13$. The detailed analysis of the activation energy in the low-temperature interval permitted estimations of contributions from different crystal phases of the border compounds into the alloy structure at different compositions.

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