Charge Transport and Thermo-Emf in the $TlFe_{0.975}Ga_{0.025}S_2$ Solid Solution

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It was shown that in the system $TlFeS_2$ – $TlGaS_2$ the series of solid solutions $TlFe_{1-x}Ga_xS_2$ (x = 0.01; 0.025; 0.05 and 0.075) is formed. On the basis of radiographs of polycrystalline samples of these solid solutions at room temperature by Rietveld full profile analysis unit cell parameters of these crystals were calculated. It is shown that with increasing concentration of gallium the parameter *a* decreases , *b* increases, and parameter *c* almost remains unchanged. The goal of this report is the investigation of the thermoelectric properties, the temperature-dependent conductivity of $TlFe_{1-x}Ga_xS_2$ (x = 0.025) solid solution and the establishment of conduction mechanism. Electrical conductivity and thermopower were measured in the temperature range of 80 – 355 K. On the temperature dependence of dark ohmic conductivity of the investigated solid solution an exponential section was observed in the temperature range 180-355 K. The slope of this plot was 0.1 eV. With decreasing temperature, the activation energy of conductivity has not constant slope, i.e. continuously decreased with decreasing temperature up to 80 K. The conductivity of this type when the activation energy decreases monotonically with temperature, provided jumps of charge carriers on states lying near the Fermi level. We estimated the density of localized states (N_F) in the $TlFe_{0.975}Ga_{0.025}S_2$: $N_F = 2.9 \times 10^{19}$ eV^{-1} cm^{-3} and average distance of carriers jumps at low temperatures : R_{av} = 62 Å. In the temperature range 80 – 150 K the sign of thermopower was positive, which indicates that $TlFe_{0.975}Ga_{0.025}S_2$ hasp-type conductivity. At T = 150 – 355 K $TlFe_{0.975}Ga_{0.025}S_2$ has n-type conductivity. The temperature coefficient of activation energy of conductivity has been calculated for studied solid solution from temperature dependence of thermopower (2.98×10^{-4} eV/K).