INVESTIGATION OF THE ELECTRICAL PROPERTIES OF p-$(SnTe)_{0.1}$, $(PbSe)_{0.9}$ COMPOUNDS

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Abstract: *In the following work, the epitaxial layers of* $(SnTe)_{1-x}(PbSe)_x$ *x=0,9 p-type compounds were investigated in the temperature range of 77÷800 K and concentration* $9\cdot10^{17} - 1{,}9\cdot10^{19}\, sm^3$.

Keywords: *electrical conductivity,* thermoelectric power, *Hall's constant* R_H, *Nerst-Ettingshausen transverse phenomenon, inert gas, Keyng's model*

The dependence of the kinetic parameters of the tested samples on temperature and concentration is shown in Figures 1 and 2. The phenomenon of the density of states at the Fermi level is based on the joint measurement of the mass transport processes of electrical conductivity, thermoelectric power, Hall constant R_H, Nerst-Ettingshausen transverse phenomenon Qs. These measurements are appropriate for the turbulent state of a porous gas in a weak magnetic field ($\mu^2\beta^2 Б << 1$).

$$m_d^0 = \frac{eh^2(3\pi^2 p)^{2/3}}{\pi^2 k_0^2 T}(\alpha - \frac{Q}{R_H\delta}) \qquad (1)$$

Currently, the $A^{IV}B^{VI}$ type is the most common Keying two-zone model for compounds. Based on this, the connection of the energy of the carriers to the wave vector has the following form.

$$E = \frac{h^2k^2}{2m_0} + \frac{\varepsilon_g}{2}(\sqrt{1+\frac{8k^2p^2}{3\varepsilon_g^2}} - 1) \qquad (2)$$

Here p is the matrix element of the impulse element.

If we consider the energy binding of the effective mass,

$$\frac{1}{m^*} = \frac{1}{h^2k}\frac{d\varepsilon}{dk} \qquad (3)$$

Also free electron mass m_0

$$\frac{1}{m_{d_0}} = \frac{1}{m_0} + \frac{4P^2}{3h^2\varepsilon_g} \qquad (4)$$

is expressed. The relationship between the effective mass and the concentration of p-type cavities was obtained.

$$\text{p:}\ \frac{m_d^*}{m_0} = \frac{1}{\frac{m_0}{m_{d_0}^*} - 1} \qquad (5)$$
$$1 + \frac{}{\sqrt{\frac{1+2h^2k^2(\frac{1}{m_{d_0}^*} - \frac{1}{m_0})}{\varepsilon_g}}}$$

Here $k^2 = (3\pi^2 p)^{2/3}, (m_d^*, m_{d_0}^*)$ - the effective mass of the density of states above the Fermi level and the valence band, ε_g- the forbidden band width $\varepsilon_{g150K} = 0{,}17eB$ [1] and the effective mass $m_{d_0}^* = 0{,}07m_0$ for the state was calculated according to the formula (5) and the m values are determined to be compatible with Kane's 2-zone model and the theoretical and experimental results calculated for acoustic scattering.

$$\alpha(0) = -\frac{k_0}{e}\left[\frac{i'_{1,2}(\eta,\beta)}{i^0_{1,2}(\eta,\beta)}\right] \qquad (6)$$

$$P = \frac{2m_{d_0}^*(k_0T)^{2/3}}{3\pi^2h^3} I^0_{\frac{3}{2},0}(\eta,\beta) \qquad (7)$$

Here $I^k_{l,m}(\eta,\beta)$, two-parameter Fermi integrals (6), $\eta = \frac{\varepsilon_F}{k_0T}$ the given Fermi level, $\beta = \frac{k_0T}{\varepsilon_g}$ is the non-parabolic parameter of the zone

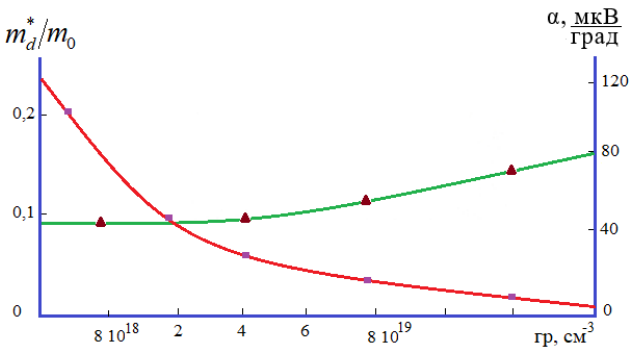

Figure 1. *Kinetic parameters of the tested samples depend on temperature and concentration.*

At a temperature of 150 K of mobility, it was found that the acoustic scattering effect of the cavities is high. Figure 1 shows the agreement between theoretical and experimental results. This means that Kane's two-zone model of the zonal structure of p-$(SnTe)_{0,1}$,$(PbSe)_{0,9}$ solid solutions is correct in all studied intervals of concentration. Figure 1. It shows that the valence band of p-$(SnTe)_{0,1}$,$(PbSe)_{0,9}$ has a less complicated structure in the given R_H, α and Q temperature bonds.

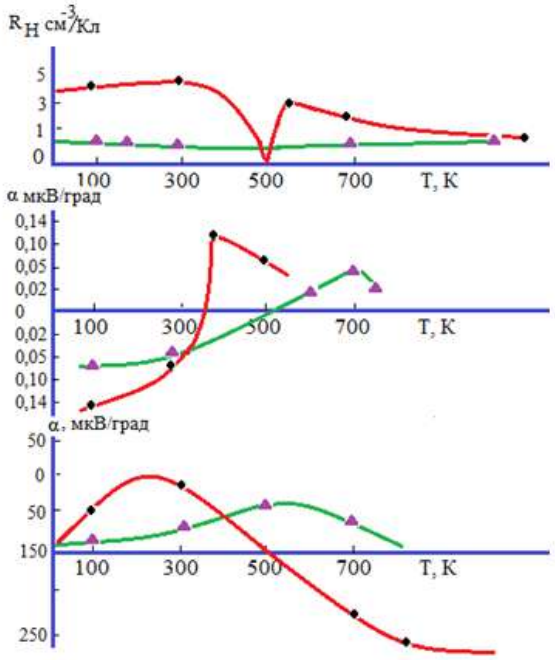

Figure 2. *Temperature relations of R_H, α and Q of p-$(SnTe)_{0,1}$,$(PbSe)_{0,9}$ solid solutions.*

The value of R_H changes to a small value due to the temperature change of the Hall effect before the onset of specific conductivity. The inversion of the sign of the Hall phenomenon is related to the mobility of electrons. The extremes of the temperature connections of α and a sharp change in the sign of Q, a rapid increase in the number of non-primary current carriers occur with the onset of specific conductivity.

Experimental Methodology

$Pb_{0,82}Sn_{0,18}Te$ single crystals were shown and investigated using the byg' phase method in Hall mobility. These samples have a hollow semiconductor and have a concentration of $n^{-}10^{18}-10^{19}$ cm^3. Reduction of the concentration of current carriers and formation of conductivity inversion was achieved by isothermal heating of the material in steam, using a sample saturated with metal. The composition of the examined samples was observed in the optical width, and the current conductivity and Hall effect were checked by means of simple compensation. As a result of checking the concentration dependence of μ. If pure alloy conductance μ, R and derive from δ. At temperatures close to room temperature, the effect of current carriers is important.

Discussion of Results

The μ dependence of temperature $E_g(T)$ and concentration on any dependence of the propagation mechanisms of the tested conductors was calculated. The propagation of the conductors in the optical domain was considered in the ion mixture and μ without the parameters driving the conductors from below. Conditional conductors in the acoustic background should be subjected to the deformation potential E in such a way that the temperature change as a result should be consistent with the experimental indicators, considering all conductor samples as good.

Figure 3 shows that in the interval $1\cdot10^{16} \le n \le 1\cdot10^{12}$ cm^{-3}, μ does not depend on p at all. μ was observed that with increasing temperature, the decrease of , and its degree of dependence on temperature is obtained. $\mu \approx T_0^{\approx a} (a \approx 2,5)$.

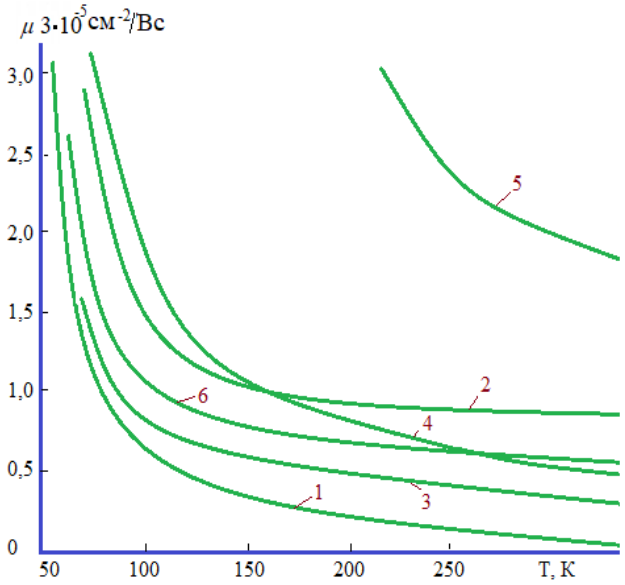

Figure 3. *Temperature dependence of mobility μ.*

From μ the theoretical and experimental results of the dependence of temperature on concentration, it can be seen that the difference between them is noticeable only during the mixed conductor. (3rd curve) E=40eV.

This nature of the function $E_g(T)$ is in some way compatible with the results of our work. The difference between the theoretical and experimental values is due to the high temperature, which is a phenomenon in the tensor component, and the mass does not obey the

temperature. As shown in Figure 3, to describe the temperature dependence of μ, it is necessary to take into account the dispersion of conductors in acoustic and optical vibration. The effect on mobility at the temperatures under consideration is negligible, both in the conditional conductor in the ion mixture and in other conductors. First, μ in order to determine the mobility, the following additional condition should be introduced in the optical zone and diffusion in the ion mixture

$$\Delta\mu = \frac{\varphi^{(1)}_{\beta\beta}(0)}{\varphi^{(0)}_{\beta\beta}(0)} = \frac{(\pi h e_0)^2 N_1 \sum^{(0)}_{\beta\beta}(\gamma_i^2)}{h\omega_0 N_0 m_\beta T_1 \chi^2_{\beta\beta}(0)} \left(\frac{1}{\chi_\infty} - \frac{1}{\chi_0}\right)^{-1}, N_0 = \left[\exp(\gamma_0) - 1\right]^{-1} \quad (8)$$

Where $N_1 = 5 \cdot 10^{16} см^{-3}, T_0 = 77K$, $\varphi^{(0)}_{\beta\beta}(0) = 0,004$, $\varphi^{(0)}_{\beta\beta}(0) = 1,57$, $\Delta\mu = 0,0025$, $\mu = 0,25$ have values.

The second curve, which shows the results showing the dependence of K on temperature in Figure 4, is plotted against K(T) for n-Ge. However, the results show that K in the acoustic background scattering of conductors does not depend on temperature at all. ($K=K_M$) and $K(T_0)$ dependence is explained by propagation in the optical zone. When the temperature decreases, the scattering anisotropy increases (K, increases) and the general parameter $K=K_M/K_1$ decreases, which is observed in any near-isotropic near-isotropic scattering mechanism. The concentration dependence of K and μ is given in Figure 4. It can be seen that the scattering mechanism and E=40eV experimental results in the case of mixed type

$Pb_{1-x}Sn_xTe$ are close to the theoretical indications. The experiments showed that the kinetic coefficient for lead chalcogenide can be described in a wide range of temperatures ($50<T_0<300K$) taking into account the optical and acoustic vibration of conductors with a concentration ($n<10^{17}cm^{-3}$) .

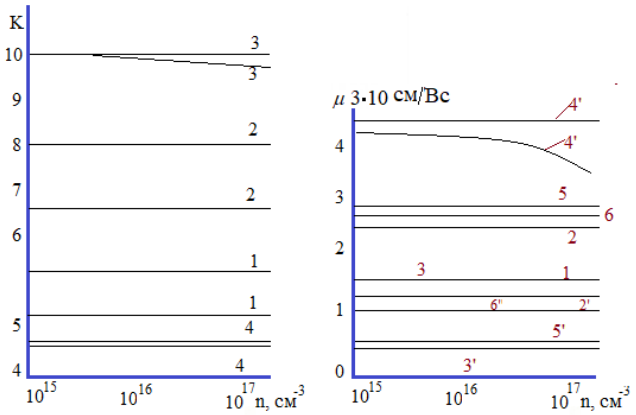

Figure 4. *Concentration dependence of K and* μ

$(SnTe)_{1-x}(PbSe)_x$ solid alloy (PbSnTe) and (PbSnSe) is characterized by changes in the temperature and other parameters. But there are some of these works, in which the kinetic effects in SnTe-PbSe solid mixtures are investigated. Therefore, a quarter of the concentration and electrical properties of the wide temperature range of zonal structures are easily obtained.

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