BEHAVIOR OF PHASE TRANSITION IN NEAR INVERSION ZONE OF $Pb_{1-X}Sn_XTe$

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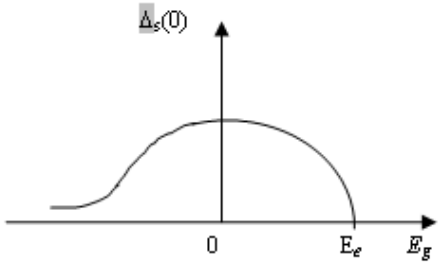
The correlation of temperature of phase transition of the heterojunction $Pb_{1-x}Sn_xTe$ *in* a vicinity of inversion tone were observed. The temperature dependence of resistivity on the composition with low carrier concentration *(ρ <10^{19}cm^{-3})* has been investigated. The interzone interaction on the basis of model of seqnetoelectrics, observed from coulomb model of interzone interaction is considered.

The surface structure of crystals is interesting in most respects. For example, it is interesting to know the crystals compound between the structural surface of pure and nature, and the forming energy surface complexes adsorbent–adsorbate. The special interest, surface property represents in compound with high concentration of carriers in chalcogenides of lead (Pb).

We have observed the correlation of temperature dependence of ferroelectrical phase transition T_n and the width of band gap E_g in composition of $Pb_{1-x}Sn_xTe$ in near inversion zone (x=0,4÷0,6). The temperature dependence of resistivity ρ in composition with low concentration of carriers (p<10^{19} sm^{-3}) and range of x=0,2÷0,75 was investigated. The investigations were carried out by horizontal method with alternating current at temperature of 120 K in a vicinity of T_n anomaly increase of ρ takes place, which is more clearly observed in the samples with low concentration of carriers. Correspondence of anomaly ρ of ferroelectrical phase transition in these compositions was convince showed by Kobayashy and others [1,2], where simultaneously with the measuring was fixed the softening of ferroelectrical mode by the method of non-elastic scattering of neutrons. According to anomaly in the temperature dependence ρ was determined T_n.

The non – monotonic dependence of T_n on the composition (minimum in the region of inversion zone) was revealed. Results obtained from the inversion zone correspond to well-known published data.

Interpretation of results was made on the basis of interzone models of ferroelectricity. Due to work [3], it is necessary to take into account the coulomb pair of electrons from different zones which becomes essentially at $E_g \le E_l$ in the near inversion side by side with the electron-phonon interaction. This leads to effective overregulation of E_g and as the result of that, to non-monotonic dependence T against x.



As a rule the coulomb interzone interaction in the model of ferroelectricity isn't considered. As the fixed slit $E_g > E_l$, where E_l - is the energy of coulomb exciton, and electron-hole pair is impossible [3], and the consideration of coulomb interaction doesn't lead to new effects, but simply result in the overregulation of interzone electron-phonon bond constants [4]. If $E_g \le E_l$, then electron-hole pair leads to reorganization of spectrum in a vicinity of min_l and max_{l_2}. All zones of exciton slits appreciably become inessential for structural transition. Exclusion may be the incident of small values of E_g, or may be in $Pb_{1-x}Sn_xTe$ where exciton slit is $\Delta s \ge E_g$ [5]. This coulomb interaction may lead to qualitative changes. Over $E_g \le E_l$, the interzone coulomb interaction leads to exciton pair and reorganization of spectrum (T=0) [4];

$$E(p) = \pm[\varepsilon^2(p) + \Delta_s^2(p)]^{1/2} \qquad (1)$$

where $\varepsilon(p) = \varepsilon_1 = -\varepsilon_2$, but Δ_s- exciton slit. Considering, that $\varepsilon(p) = \varepsilon_{g/2} + p^2/2m$ and $\Delta_s(p)$ is the function of E_g, and in a vicinity $p=0$ can be defined for $E_g \neq 0$, $E_g < E_l$.

$$2\Delta_s(0) = E_l[2(1 - E_g/E_l)]^{1/2} \qquad (2)$$

where $\varepsilon_l = 6{,}8\,(me^4/m_0e_0^4)$ эВ; e_0 and m_0 – are the mass and charge of free electrons. In solid solutions of chalcogenides $m << m_0$, usually $m \approx 10^{-2}m_0$, and ℓ_{can} appreciably increase ℓ_0 [6], that is E_l can reach some tens of electron-volt. In a vicinity E_g=0 $\Delta_s(0) = 5{,}5\,(m_l/m_0\varepsilon_0)$ eV; and over E_g< 0 (semi-metal) $\Delta_s(0)$ exponentially diminish with the growth of $|E_g|$. Qualitative dependence of $\Delta_s(0)$ on E_g is represented in the figure 1. Without account coulomb interaction of temperature of transition can be represented in the form [7].

$$T_c(E_g) = T_c(0) - \alpha E_g^n, \qquad (3)$$

where $T_c(0)$, α and n uniquely are defined with the structure of spectrum.

As seen, in $E \to 0$ T_l increases reaching maximum values of E_g=0. Thus, over $E_g > E_l$, $E_g \to E_l$ and T_c increase, reaching maximum values over $E_g = E_l$. The further diminishing of E_g connects with the coulomb interaction and T_c must decrease, accepting minimum values over $E_g = 0$. Over $E_g < 0$ takes place inversion of zone and E_g is always over zero, Δ_s quickly decreases, T_c increases. Consequently, in a vicinity of non-slit conditions T_c adepts minimum not

maximum values. In chalcogenides $Pb_{1-x}Sn_xTe$ is the width of forbidden zones-function of x, consequently, in solid solutions T_c (x) must behave itself appreciably non-monotonous.

Of course, detail investigations (concentration and temperature dependence, forms to right and left from $E_g \approx 0$) represent a great interest for arrangement and development of interzone models of ferroelectricity.

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İNVERSİYA ZONASINDA $Pb_{1-x}Sn_xTe$ HETEROQURULUŞLARIN FAZA KEÇİDİ

İnversiya zonasında $Pb_{1-x}Sn_xTe$ heteroquruluşların faza keçidinin temperatur korrelyasiyasına baxılmışdır. Birləşmənin $(Pb_{1-x}Sn_xTe)$ xüsusi müqavimətinin konsentrasiyadan asılılığı tədqiq olunmuşdur.

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ПОВЕДЕНИЕ ФАЗОВОГО ПЕРЕХОДА В $Pb_{1-x}Sn_xTe$ ВБЛИЗИ ИНВЕРСИИ ЗОН

Найдена корреляция температуры фазового перехода в составах $Pb_{1-x}Sn_xTe$ в окрестности инверсии зон. Исследована температурная зависимость удельного сопротивления составов с малой концентрацией носителей ($\rho < 10^{19}$ *см*$^{-3}$). Рассмотрено межзонное взаимодействие в модели сегнетоэлектричества, исходя из модели кулоновского межзонного взаимодействия.

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