Проведенные исследования влияния величины удельной проводимости на величину барьера Шоттки позволят сделать следующие выводы:

1. Величина барьера Шоттки зависит от удельной проводимости полупроводников контактирующих с алюминием, а величина работы выхода, скорее всего, зависит от структуры кристалла.

2. При контакте антимонида индия (InSb) с алюминием образуется барьер Шоттки для дырок, а при контакте с алюминием арсенида индия (InAs), арсенида галлия (GaAs) и сульфида кадмия (CdS) образуется барьер Шоттки для электронов.

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INFLUENCE OF POLYTYPY ON PHASE TRANSITIONS IN TiGaSe_2 CRYSTALS

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Abstract. It is shown that, in the C-polytype of TiGaSe_2 crystals, the structural PT, which occurs at a temperature of $T \sim 108$ K, is accompanied by an abrupt change in the value of the parameter c ($\Delta c \sim 0.004$ Å). For the 2C- TiGaSe_2 polytype, the c (T) dependence shows only one clearly pronounced maximum at the temperature T_{c2} . Moreover, at temperatures that are $T_1 \sim 30$ K higher and $T_2 \sim 5$ K below T_{c2} , the Curie-Weiss law is fulfilled. The absence of a fourfold increase in the parameter from the unit cell for 2C- TiGaSe_2 samples in the temperature range $T = 100\text{--}300$ K indicates that spontaneous polarization is the order parameter of the ferroelectric PT

Keywords: phase transitions, phase, temperature, polytype, crystal

A distinctive feature of crystals of a ferroelectric semiconductor thallium-gallium diselenide (TlGaSe₂) is the complexity and uncommonness of physical processes, in particular, phase transformations occurring in them when the temperature changes in the temperature range $T = 100 - 300$ K. It has been reliably established (using various experimental methods, including neutron diffraction and X-ray diffraction) the existence of two structural phase transitions (PT) in TlGaSe₂ crystals: a second d -order phase transition associated with the formation of an incommensurate phase at temperature T (with a wave vector $k_i = (8; 8; 0.25)$, where $k_i = 0.02$ is the incommensurability parameter), and a ferroelectric PT of the first kind, which occurs at a temperature T_c and is accompanied by a fourfold increase in the size of the unit cell along the direction perpendicular to the layers. According to the data of different authors, the values of the temperatures of these PT are somewhat different and lie within the limits $T_i = 117-120$ K and $T_c = 107-110$ K. opinion does not exist to date. One of the possible reasons for the ambiguity of the experimental data obtained by different researchers may be the polytype caused by the layered structure of the TlGaSe₂ crystal lattice. Since the interaction between the layers in these crystals is carried out by weak forces of the van der Waals type, the layer packets can easily shift relative to each other. In this case, polytypes are formed, which differ in the number of layer packets, i.e. parameter of the unit cell with: C-TlGaSe₂, 2C-TlGaSe₂, 3C-TlGaSe₂. Using the neutron diffraction method, it was found that in the 10C-TlGaSe₂ polytype, in contrast to C-TlGaSe₂, structural phase transitions associated with the multiplication of the parameter c , in in the temperature range $T = 90-300$ K do not occur [1]. Later, X-ray diffraction studies did not reveal any changes in the structure of the 8C-TlGaSe₂ polytype in the indicated temperature range [2]. However, until now, targeted studies of the effect of polytype on temperature phase transformations in TlGaSe₂ crystals have not been carried out. Since it was recently found that PTs in the C- and 2C-polytypes of TlInS₂ (an isostructural analogue of TlGaSe₂ crystals) differ not only in the number, temperature position, but also in the order parameter [3], comparative X-ray -diffractometric studies and measured the dielectric constant of the polytypes C-TlGaSe₂ and 2C-TlGaSe₂.

X-ray diffraction patterns of single-crystal samples reflected from the (001) cleavage planes were obtained using an automated setup based on a DRON-4-07 diffractometer. The accuracy of determining the value of the parameter c of the crystal unit cell was no worse than 0.002 Å. A more detailed procedure for X-ray diffraction studies and processing of diffractograms is presented in [3]. The dielectric constant was measured at a frequency of 1 MHz using an E7-12 AC bridge. The relative measurement error did not exceed 0.5% . The temperature, as in the case of X-ray diffractometric studies, was measured with a copper-constantan thermocouple (accuracy 0.1 K) and maintained constant with an accuracy of 0.5 K using a VRT-2 thermostat. Measurements in (T) were carried out in the quasi-static heating mode at a rate of ~ 1 K / min. The samples were plates made from TlGaSe₂ ingots grown by the modified Bridgman method. For measurements in, the same rectangular plates were used as in X-ray studies, their typical dimensions are $5 \times 8 \times 2 \text{ mm}^3$.

It is shown that in the C-polytype of TlGaSe₂ crystals, the structural phase transition, which occurs at a temperature of $T \sim 108$ K, is accompanied by an abrupt change in the value of the parameter c ($\Delta c \sim 0.004$ Å). An insignificant value, Δc , as well as the absence of a noticeable temperature hysteresis ($\Delta T < 0.5$ K) indicate that this transition is a weakly pronounced first-order phase transition. At $T_i \sim 119$ K, a significant kink was found in the temperature dependence of the parameter c of this polytype, which confirms the presence of a second-order phase transition. For the 2C-TlGaSe₂ polytype in the temperature range $T = 90-300$ K, no abrupt changes in the value of the parameter c were found; only a smooth change in the slope of the $c(T)$ dependence was revealed. A decrease in temperature from room temperature to $T = 95$ K does not lead to qualitative changes in the diffraction spectrum of this polytype - only changes in the intensity of structure lines of the (00l) type are observed, which indicates the absence of structural phase transformations associated with a change in translational symmetry along the direction perpendicular to the layers. The $c(T)$ curve for C-TlGaSe₂ exhibits two anomalies, a maximum at $T = 118$ K and a significant break at $T_c = 108$ K. Of the second kind from the initial to the incommensurate phase, and an improper ferroelectric PT of the first kind from the incommensurate to the commensurate phase, respectively. For the 2C-TlGaSe₂ polytype, the $c(T)$ dependence shows only one clearly pronounced maximum at the temperature T_{c2} . Moreover, at temperatures that are $T_1 \sim 30$ K higher and $T_2 \sim 5$ K below T_{c2} . the Curie-Weiss law is fulfilled. This behavior of the dielectric constant with temperature is typical of intrinsic ferroelectric phase transitions. This

fact, as well as the absence for the same 2C-TlGaSe₂ sample in the temperature range $T = 100\text{--}300$ K of a fourfold increase in the unit cell parameter c indicates that in the 2C-TlGaSe₂ polytype, as well as in 2C-TlInS₂ crystals [3], the order parameter of the ferroelectric PT is spontaneous polarization. As for the existence of an incommensurately modulated structure in 2C-TlGaSe₂ crystals, it is possible that it arises as a result of a phase transition occurring at a temperature of $T \sim 245$ K, the existence of which was repeatedly reported earlier [4, 5].

Thus, the data obtained indicate a significant effect of polytype on the physical mechanism and temperature position of structural phase transformations occurring in TlGaSe₂ crystals

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THERMO-FIELD PULA-FRENKEL EFFECT IN TlFeS₂ CRYSTALS

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Abstract. Based on the study of the dependence $\sigma \sim (E^{1/2})$, it was shown that the current in the nonlinear region (taking into account the thermal-field effect of Poole-Frenkel) is due to a weak field effect, both when measured in parallel and perpendicular to the crystallographic axis crystal TlFeS₂. The calculated values of the concentration of ionized centers N_i , the mean free path λ , and the values of the Frenkel coefficient in the shape of a potential well in TlFeS₂ crystals have been determined.

Keywords: electrical conductivity, crystal, electric field, ionization, capture centers

The one-dimensional (1D) character of the structure of TlFeS₂ crystals is one of the attractive features of crystals of this family. The compound crystallizes in the monoclinic space group C_2/t with unit cell parameters $a = 11.64$ Å, $b = 5.31$ Å, $c = 10.51$ Å, and $\gamma = 144.6^\circ$. In non-standard notation (I 11 2 / m), the lattice parameters are written as $a = 6.83$ Å, $b = 10.51$ Å, $c = 5.31$ Å and $\gamma = 98.6^\circ$ while the chains are FeS₄ tetrahedra with common faces located along the c axis [1, 2, 3, 4]. The magnetic properties of the TlFeS₂ crystal were studied in detail; in these works, the presence of one-dimensional antiferromagnetic ordering was established, and the presence of hopping conductivity was also established [5, 6, 7, 8, 9].