

DEPENDENCE OF DIELECTRIC PROPERTIES OF SbSI ON TEMPERATURE AND ON HYDROSTATIC PRESSURE

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The dielectric properties of ferroelectric SbSI at atmospheric pressure have previously been investigated in [1-3]. It was shown in [4] and later also in [5, 6] that, at atmospheric pressure, a low-temperature phase transition of the second order takes place in SbSI at $T = -40^\circ\text{C}$, in addition to the ferroelectric phase transition of the first order which takes place at $T = +20^\circ\text{C}$.

We undertook to study the influence of hydrostatic pressure on dielectric properties of SbSI. Of special interest to us was the investigation of the influence of the pressure on dielectric properties of SbSI near the temperature $T = -40^\circ\text{C}$.

The measurements were made in a high-pressure apparatus equipped with a high-pressure chamber whose temperature could be controlled thermostatically. The SbSI single crystals grown from the gaseous phase were investigated. Silver electrodes were fastened onto the ends of the needles and the measurements were made along the c axis. The spontaneous polarization was measured at a frequency of 50 Hz in a field of 2.5 kV/cm. The dielectric permeability was measured with a RFT-1007 bridge at a frequency of 1 kHz in a weak alternating electric field.

From Fig. 1, which shows the isotherms for the dielectric permeability, it can be seen that with increasing pressure the ϵ near the phase transition decreases. Its relative change at the maximum at a pressure of 1500 atm is $\sim 10\%$. A further increase in the pressure does not result in significant changes in the value of ϵ . The decrease in dielectric permeability with increasing pressure near the phase transition is associated with the domain structure of the crystal [7]. The significant decrease in the influence of the pressure on ϵ within the pressure region in excess of 1400 atm is apparently associated with the pre-

sence in SbSI of a low-temperature phase transition. Figure 1 also shows the dependences of $1/\epsilon$ on $p(1'-4')$, from which it can be seen that in the paraelectric phase the dielectric permeability, being a function of the pressure, follows a law which is similar to the Curie-Weiss law with constant p_0 and C^* . As can be seen from Fig. 1, two pressure regions exist in the paraelectric phase in which the dependence of $1/\epsilon$ on p is linear, and, therefore, the Curie-Weiss law is being fulfilled. However, the respective values for C^* and p_0 for these two regions differ somewhat. Upon a decrease in temperature, both of these pressure regions decrease.

Figure 2 shows that increasing the pressure leads to a displacement of the $P_S(T)$ dependence along the temperature axis. The linear displacement of $P_S(T)$ is associated with the displacement of the Curie point with an increase in pressure [8].

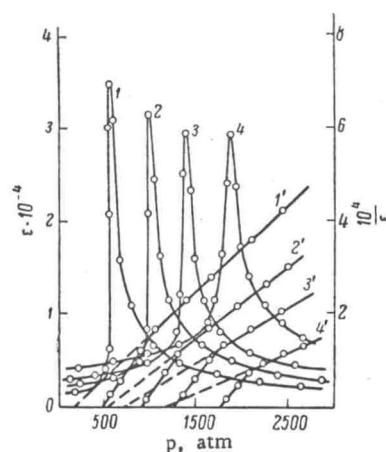


Fig. 1. Pressure dependence of the dielectric constant of SbSI single crystals, measured along the c axis, upon a change in temperature. $T, ^\circ\text{K}$: 1) 271; 2) 254; 3) 239; 4) 220.

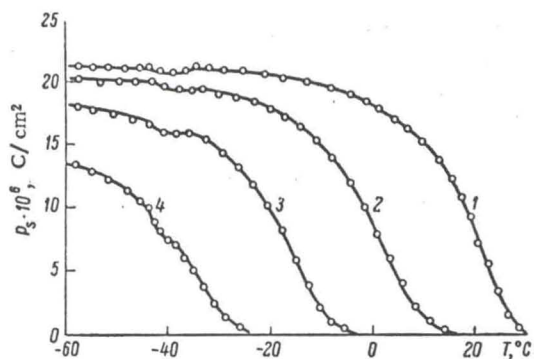


Fig. 2. Temperature dependence of spontaneous polarization of SbSI single crystals upon a change in hydrostatic pressure. p , atm: 1) 1; 2) 400; 3) 900; 4) 1400.

In relation to the new Curie point, the spontaneous polarization value decreases somewhat. This decrease is possibly associated with an additional effect, namely the change in the magnitude of the dipole moment with an increase in hydrostatic pressure. At atmospheric pressure near $T = -40^\circ\text{C}$ an anomaly is observed in the $P_s(T)$ dependence, which is in agreement with the data of [6]. We did not observe any change in the position and the magnitude of this anomaly when the hydrostatic pressure was increased. This makes it possible for us to conclude that hydrostatic pressure does not significantly displace the low-temperature phase transition in SbSI.

The dependence of the displacement of the Curie point on pressure as obtained by us is in good agreement with the data calculated by using the Clapeyron-Clausius relation, which gives the value $(dT_C/dp)_{\text{calc}} = -4.0 \cdot 10^{-2}$ deg/atm, as compared to $(dT_C/dp)_{\text{exp}} = (-3.9 \pm 0.2) \cdot 10^{-2}$ deg/atm.

In a number of samples we observed a slight change in the $T_C(p)$ dependence curve at temperatures below $T = -40^\circ\text{C}$ and at pressures higher than 1400 atm, which may be associated with the boundary of the second-order phase transition going over to the line of the first-order phase transitions at $T = -40^\circ\text{C}$; however, this requires further investigations.

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