INVESTIGATION OF THE MOSSBAUER EFFECT IN A SOLID SOLUTION OF BARIUM STANNATE IN BARIUM TITANATE

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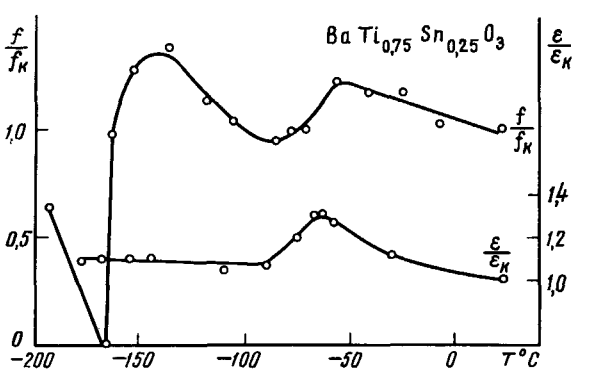
The ferroelectric properties of solid solutions of barium stannate in barium titanate were investigated in detail in [1]. At the same time, the Mossbauer effect in these compounds has not been adequately studied. However, in a number of known investigations the Mossbauer spectra were determined on Sn^{119} and Fe^{57} impurity nuclei in $BaTiO_3$ [2,3]. There is relatively little information on the Mossbauer effect in the region of the ferroelectric phase transition from the paraelectric state (cubic lattice) into the ferroelectric state (rhombohedral lattice). We present below the results of such investigation in the solid solution $BaTi_{0.75}Sn_{0.25}O_3$ of barium stannate in barium titanate.

The solid solution samples were prepared by a standard ceramic method. The initial materials were tin dioxide, barium oxide, and titanium dioxide, which were fired at 1350°C for three hours.

The dielectric constant was measured by a bridge method at 2000 Hz.

The Mossbauer spectra of the investigated samples were obtained with a setup of the electrodynamic type. The source was tin dioxide. The spectrum was registered with a type AI-100 multichannel analyzer. The channel scale was determined from the absorption spectrum of Fe_2O_3, using Co^{57} in a chromium matrix as the source.

The temperature measurements were made with a cryostat of foamed polystyrene. The required temperature was established by blowing liquid-nitrogen vapor on the absorber.



Temperature dependence of the relative probability of the Mossbauer effect, f/f_k, and of the relative dielectric constant, ϵ/ϵ_k, for $BaTi_{0.75}Sn_{0.25}O_3$.

The figure shows the temperature dependence of the relative magnitude of the Mossbauer effect, f/f_k, and of the relative dielectric constant, ϵ/ϵ_k, for the solid solution $BaTi_{0.75}Sn_{0.25}O_3$. The value of f/f_k was determined from the ratio of the area under the absorption curve at a given temperature to the area of the absorption curve at room temperature. The relative dielectric constant was determined as the ratio of ϵ at the given temperature to the corresponding value at room temperature. It is seen from the ϵ/ϵ_k curve that the temper-

ature of the phase transition from the paraelectric state to the ferroelectric one is ~-65°C. Attention is called to the fact that the investigated compound has a gently sloping ϵ/ϵ_k dependence, showing the phase transition to be smeared out.

The relative probability of the Mossbauer effect, f/f_k, first increases as the temperature decreases from room temperature to that of the phase transition (-65°C), owing to the decrease in the amplitude of the thermal vibrations, and then decreases even before the phase transition sets in.

Attention is called to the temperature interval from -145 to -165°C, in which the relative probability of the Mossbauer effect first decreases rapidly, after which it begins to increase. At the same time, the dielectric constant hardly decreases in this temperature interval. Thus, the anomalous change of f/f_k in this temperature region remains as yet unclear.

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[2] V. V. Chekin, V. P. Romanov, B. I. Verkin, and V. A. Bokov, ZhETF Pis. Red. 2, 186 (1965) [JETP Lett. 2, 117 (1965).
[3] V. G. Bhide and M. S. Multani, Phys. Rev. 139, 1983 (1965).

PHOTOMAGNETIC EFFECT IN n-InSb IN THE CASE OF ELECTRON HEATING

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Observation of an oscillatory photoconductivity and of the photomagnetic effect in p-InSb was reported in the literature earlier [1-3] and was attributed to the heating of the electrons by the radiation [3-5]. Similar effects were observed in electronic n-InSb [6]. However, the oscillations of the photomagnetic effect cannot be interpreted on the basis of simple heating of the photoelectrons, since the photomagnetic effect in n-InSb is determined by the coefficient of ambipolar diffusion, i.e., in practice, by the hole diffusion coefficient.

An interpretation becomes possible if the background of equilibrium electrons is taken into account besides the hot photoelectrons.

Let us consider qualitatively a very simple case. During the course of excitation of an electron-hole pair, practically all the excess energy of the light quantum is transferred to the electron. Owing to the strong interaction with the optical phonons, the photoelectrons. Owing to the strong interaction with the optical phonons, the photoelectrons go immediately into the energy interval 0 - $\hbar\omega_e$ ($\hbar\omega_e$ is the energy of the longitudinal optical phonon). Assume that they retain their energy in this interval. We then have two groups of electrons, namely electrons in equilibrium with the lattice temperature and the hot photoelectrons. The quasineutrality condition leads to the occurrence of an electric field when the hot electrons diffuse inside the sample (their flux is q_{n1}). This field produces a flux of cold electrons (q_{n2}) in a direction opposite to that of q_{n1}. The fluxes q_{n1} and q_{n2} cancel each other to a considerable degree, their difference being equal to the hole flux q_p