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Figure 1

Figure 1: Figure 1

Figure 2

Figure 2: Figure 2

Abstract

Full Text

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OPTICAL OBSERVATION OF A PHASE TRANSITION IN SbSJ SINGLE CRYSTALS

(Presented by Academician A. V. Shubnikov on 22 XI 1965)

At room temperature ($T \simeq 300^{\circ}$K), the edge of the intrinsic absorption of SbSJ single crystals lies near λ 630 mμ. In works ([1],[2]) it was shown that the ferroelectric phase transition in these crystals is accompanied by a long-wavelength shift of the intrinsic-absorption edge and, correspondingly, by a decrease in the width of the forbidden band by ~ 0.06 eV.

Fig. 1. Phase boundaries in SbSJ for three different temperatures:
a –10°, b –12°, c –18°

Fig. 2. Bands observed in SbSJ at 25°

This phenomenon makes it possible to carry out optical observation of the phase transition.

The method of optical observations used in the present work was as follows. The specimen was placed in a glass vacuum thermostat equipped with molybdenum leads for electrical and temperature measurements and with two plane-parallel windows for optical observations. The investigations were carried out on thin ($0.8 \times 0.2 \times 7$ mm^3) plates whose surfaces corresponded to the (110) faces. The SbSJ crystals were grown from the gas phase by the previously published method ([3]).

Illumination of the specimens with monochromatic polarized light was carried out perpendicular to the (110) face. With the aid of a monochromator

In UM-2, a spectral band was selected that corresponded to the edge of intrinsic absorption at the given temperature (taking into account the direction of polarization of the light). Observation and photography were carried out with a microscope at a magnification of 200×. The results are presented in Fig. 1. As was to be expected, in the region of the Curie temperature a structure of alternating bands is observed, the light bands corresponding to the ferroelectric phase and the dark ones to the paraelectric phase.* The phase boundaries correspond to the (101) planes. It is noteworthy that the two phases coexist over a relatively broad temperature interval, which for different crystals varied from 1 to 15°. When the temperature is raised, before the transition from the ferroelectric region to the paraelectric one, the phase boundaries shift, leading to the growth of regions of the paraelectric phase. Application of an electric field with a strength of ~ 200 V/cm leads to the opposite displacement of the phase boundaries and, correspondingly, to growth of regions of the ferroelectric phase. After the field is removed, the picture is restored. For some crystals, at temperatures $\gtrsim 25°$, the structure shown in Fig. 2 was observed; its nature remains unclear. It is possible that it is caused by a periodic distribution of impurity along the c axis of the crystal and by the existence of macroregions with a shifted Curie point. The authors of the present article intend to continue studying these structures for SbSJ, SbSBr, and BiSBr.

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CITED LITERATURE

[1] G. Harbeke, *J. Phys. Chem. Solids*, **24**, 957 (1963).
[2] V. M. Fridkin, K. Gulyamov et al., *FTT*, **8**, no. 6 (1966).
[3] L. M. Belyaev, V. A. Lyakhovitskaya et al., *Izv. AN SSSR, Ser. Neorganicheskie materialy*, **1**, no. 12, 2478 (1965).
[4] S. Kawada, M. Ida, *J. Phys. Soc. Japan*, **20**, 1287 (1965).
[5] T. Mori, H. Tamura, E. Sawaguchi, *J. Phys. Soc. Japan*, **20**, 1294 (1965).
[6] D. Meyerhofer, *Phys. Rev.*, **112**, 413 (1958).

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* After the present communication had been written, we became aware of two Japanese works ([4,5]) in which an analogous structure was discovered in the region of the phase transition of SbSJ. The authors ([4,5]) carried out observation by the Meyerhofer method ([6]) and, apparently, used the change of the optical indicatrix during the phase transition.

Note: Figure translations are in progress. See original paper for figures.