and holes do not compensate each other and the Nernst coefficient reaches in the dragging region its theoretical vale $Q \approx (k_0/e)/(u/c)$, which is unusual even if nondegenerate semiconductors are considered.

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* In an unevenly heated **conductor, the magnetic** field produces an electric field perpendicular to the temperature gradient and to the magnetic field.

VANISHING OF THE SHUBNIKOV - DE HAAS EFFECT IN A BISMUTH-ANTIMONY ALLOY UNDER PRESSURE

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As shown in [1-3], the areas of the extremal hole and electronic parts of the Fermi surface of bismuth decrease under pressure. From data obtained by extrapolation towards higher pressures, we can expect the energy-band overlap ϵ_{ov} to vanish at a pressure $P_{cr} = 25$ kbar, and consequently the carrier density also vanishes. It would be of interest to investigate the character of the variation of the frequency and of the amplitude of the quantum oscillations of the electric resistance under pressure near the possible point where the overlap is removed, i.e., to observe the 2.5-order phase transition by oscillation methods. However, the pressures necessary to investigate the oscillation phenomena are as yet unattainable.

At the same time, it was noted in [4-6] that in bismuth-antimony alloys the areas of the extremal sections of the electronic Fermi surface and the carrier density decrease with increasing antimony content in the alloy. At an antimony concentration near 5 at.% the band overlap disappears, and at higher densities the alloy has semiconductor properties in a wide range of temperatures [7]. Thus, in $Bi_{100-n}Sb_n$ alloys with $n < 5$ at.% the carrier density at atmospheric pressure is lower than in pure bismuth, and we can expect an electronic transition to take place in these alloys at pressures below 25 kbar. We have therefore measured the quantum oscillations of the electric resistance in a bismuth-antimony alloy at antimony concentration 3 at.% under hydrostatic pressure.

The single-crystal $Bi_{97}Sb_3$ samples were obtained by zone growing with preliminary equalization in the Semimetal Laboratory of the Leningrad State Pedagogical Institute. The samples for the measurements were cut by the electric-erosion method from the single-crystal ingot and measured 12 x 3 x 1 mm. The sample orientation was checked by x-ray diffraction. The magnetic-field direction could be varied in the plane of the binary and trigonal axes (C_2, C_3).

Figure 1 shows typical plots of the quantum oscillations of the electric resistance

$\partial\rho/\partial H(H)$ with $\bar{H} \parallel C_3$ ($\theta = 0°$), pertaining to the hole ellipsoid; these oscillations were measured by a modulation method at 1.4°K for one of the samples (the oscillations were observed also at different directions of the magnetic field, with $\theta \leq 60°$). With increasing pressure, the frequency of the quantum oscillations, which dtermines the area of the minimal extremal section of the hole ellipsoid, decreases and the oscillations disappear when $P > P_{cr}$. This phenomenon was observed in two samples. It must also be noted that when $P < P_{cr}$ all the oscillation amplitudes are of the same order of magnitude, whereas for $P > P_{cr}$ no oscillations are noted even when the gain is increased by ~10 times.

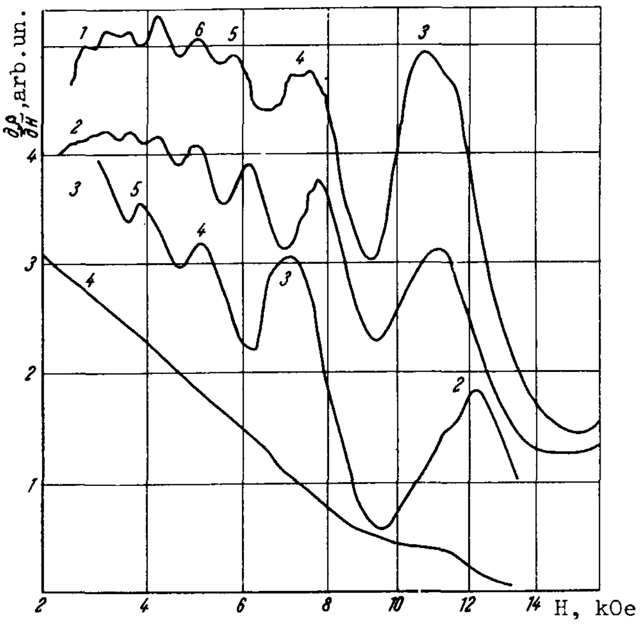

Fig. 1. Typical plots of the quantum oscillations of the electric resistance $(\partial\rho/\partial H)(H)$ at T = 1.4°K and at different pressures ($\bar{H} \parallel C_3$). 1 - P = 1 bar, 2 - P = 4.7 kbar, 3 - P = 8.9 kbar, 4 - P = 10 kbar. The maxima are labeled with the numbers of the oscillations.

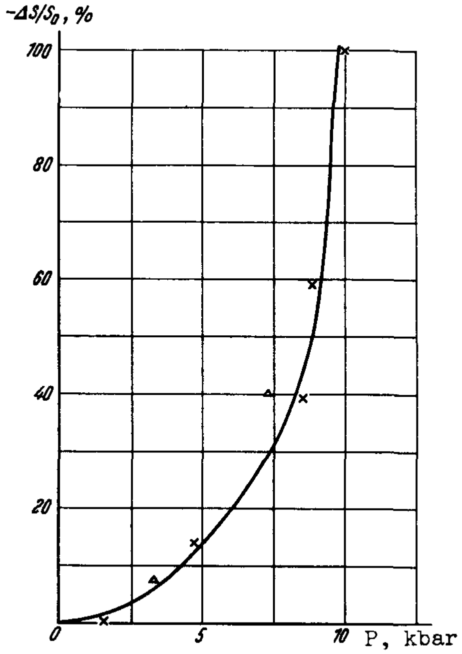

Fig. 2. Relative variation in the area of the minor section of the hole ellipsoid of one of the samples with the pressure.

The reversible vanishing of the oscillations is apparently evidence that we have observed in a bismuth-antimony alloy under pressure, by an oscillation method, the 2.5-order phase transition predicted theoretically in the case of metals by I. M. Lifshitz [8].

The results agree with the galvanomagnetic measurements of Brandt and Ponomarev [7].

As expected, elimination of the overlap of the energy bands was observed in the alloy at much lower pressures than in pure bismuth.

It should be noted that at present we still do not understand the mechanism causing the decrease in the carrier density at atmospheric pressure when the bismuth is alloyed with antimony. It was shown by x-ray diffraction [9] that a small antimony impurity (up to 15 at.%) has practically no effect on the parameter u which describes the displacement of the sublattices comprising the bismuth lattice, nor does it affect the ratio of the axes c/a, but it does cause a small similar decrease in the dimensions of the crystal lattice. At the same time, it is precisely the deviations of the parameter u and of the ratio c/a from the values corresponding to the primitive cubic lattice which determines the main singularities of the electron spectrum of bismuth [10].

The influence of the antimony impurity on the electron spectrum of the bismuth is equivalent to the action of hydrostatic compression. Deviations from this equivalence are manifest, for example, by the different character of the dependence of the relative change in the area of the minor extremal section of the hole ellipsoid (when $\bar{H} \parallel C_3$) under pressure for the pure bismuth and for the $Bi_{97}Sb_3$ alloy. For pure bismuth this relation is nearly linear [3], whereas for the alloy it is essentially nonlinear (Fig. 2).

If we introduce P_{eq}, defined by the relation

$$[S(P_{eq})]_{Bi} = [S(P)]_{Bi_{97}Sb_3},$$

where S is the area of the minor extremal section of the hole ellipsoid when $\bar{H} \parallel C_3$, then, as shown in Fig. 3, the $P_{eq}(P)$ relation is likewise nonlinear, with $P_{eq}(0) = 9$ kbar.

Thus, the pressure exerts a different influence on the spectrum of pure bismuth and that of the bismuth-antimony alloy. Further research is needed to determine the causes of this difference.

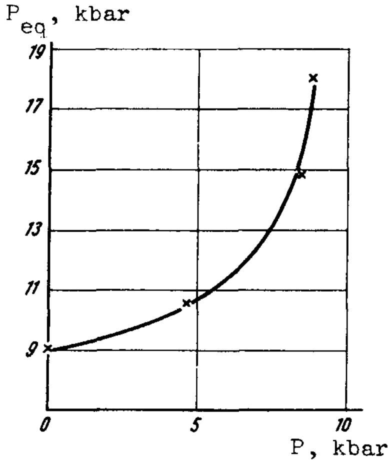

Fig. 3

In conclusion, we consider it our pleasant duty to thank Academician L. F. Vereshchagin for interest in the work, Professor G. I. Ivanov for supplying the samples, and G. P. Pushtarik for determining the sample orientations.

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