OSCILLATIONS OF THE RESISTIVITY OF BISMUTH FILMS UPON DEFORMATION

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It is known that the deformation of bulky bismuth samples (in particular, hydrostatic compression [1 - 3]) changes the magnitude of the band overlap. In thin films, where the conditions of size quantization of the energy spectrum of the electrons are realized, a change of the band overlap should lead to a nonmonotonic dependence of the kinetic coefficients on the deformation parameter [4]. This nonmonotonicity is conected with the jumplike change of the density of the electronic states on the Fermi surface when the band overlap changes.

We present in this paper the results of a measurement of the resistivity ρ of bismuth films sputtered on mica and deformed by bending. The method of producing this deformation

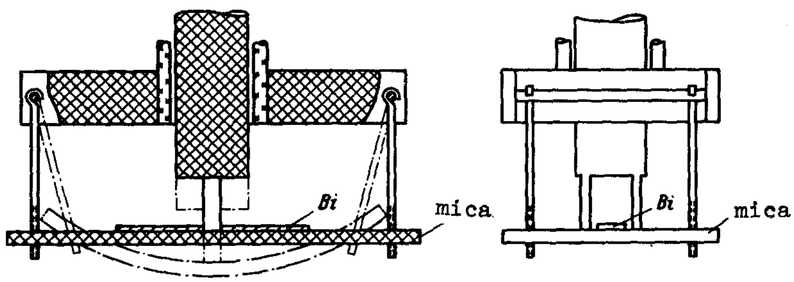

Fig. 1

is clear from an examination of Fig. 1. This method makes it possible to produce both compression and tension in the sample (depending on whether the film is on the internal or external side of the mica)[1]. The resistivity was measured as a function of the sag ℓ. The measurements were made at temperatures 78 and 300°K. The range of thickness (d) was 500 - 50,000 Å.

The main results consist of the following. A nonmonotonic decrease of the film resistance is observed under compression, and an increase, likewise nonmonotonic, is observed under tension at T = 78°K (Fig. 2, d = 1900 Å, various samples). When the temperature is increased to 300°K, the change of resistance by defromation is greatly decreased. The nonmonotonic character of the $\rho(\ell)$ dependence is indistinguishable against the background of the small change of ρ.

The oscillatory character of the $\rho(\ell)$curves is dependably registered up to thicknesses of approximately 10,000 Å. At higher values of d, the oscillations become indistinguishable

[1] I take this opportunity to thank N. E. Alekseevskii for a discussion of the method used to produce the deformation.

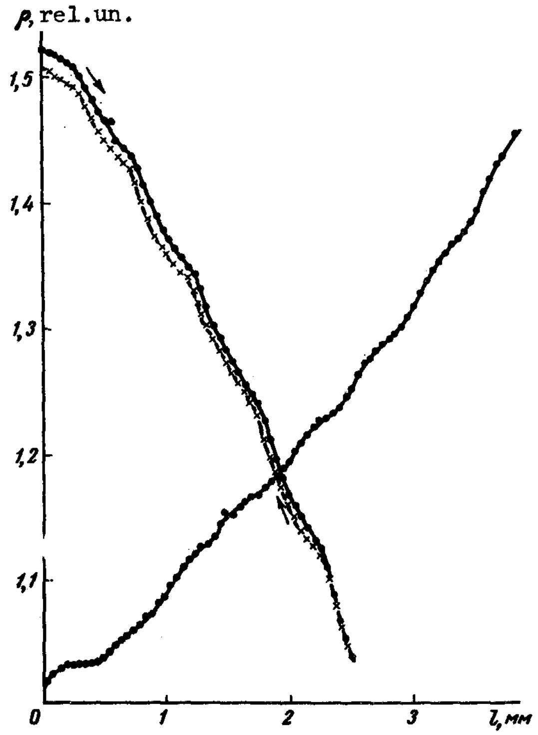

Fig. 2

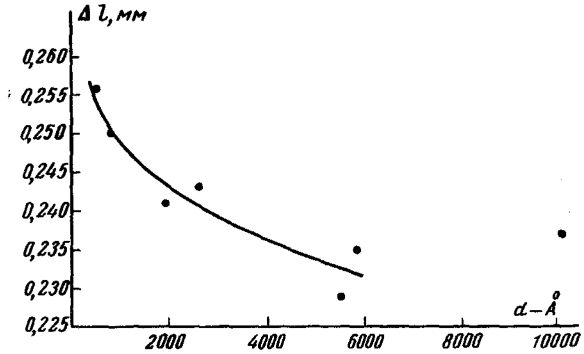

Fig. 3

No change of resistance was observed in a silver film 3000 Å thick subjected to a similar deformation.

Figure 3 shows the dependence of the period of the oscillations $\Delta\ell$ on the thickness of the bismuth film. Attention is called to the very slight decrease of the period with increasing d. When the thickness is changed from 500 to 5000 Å, the change of $\Delta\ell$ amounts to approximately 10%.

In our opinion, the foregoing results can be interpreted on the basis of the quantum size effect (it is difficult to conceive of any other cause of the nonmonotonic variation of ρ). The observed weak $\Delta\ell(d)$ dependence is connected, in all probability, with the change in the shapes of the energy bands following such a complicated deformation.

The author thanks V. G. Rybalko for help with the experiments.

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ABSORPTION OF SOUND IN MOLTEN SEMIMETALS

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It is shown in a number of recent theoretical papers devoted to the absorption of low-frequency sound in metals that the main contribution to sound absorption in dislocation-free metallic single crystals is made by the conduction electrons (see, e.g., [1]). It is of considerable interest, in this connection, to trace the influence of various types of structural realignments on the absorption of sound in metals. To this end, we measured the