

THE TEMPERATURE DEPENDENCE OF MAGNETOPHONON
EFFECT IN InSb

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It was observed that the magnetoresistance in some semiconducting materials exhibits an oscillating behavior when the magnetic field is swept within a range of several kG with a proper speed ^{1,2,3}). The peaks in the magnetoresistance, or better to say in the second derivative with respect to magnetic field because this quantity is measured, are due to the resonant scattering of electrons by optical phonons. The amplitude of peaks depends strongly on temperature. That is due to the fact that two important quantities which govern the magnetophonon effect - so is called this phenomenon, i.e. the electron mobility and the number of excited optical modes of vibrations, are functions of temperature.

The following relation holds

$$\hbar\omega_0 = N\hbar\omega_c, \quad N = 1, 2, 3, \dots, \quad (1)$$

where ω_0 is the frequency of optical phonons and ω_c is the cyclotron frequency ($\omega_c = eB/m^*$).

In order to see the influence of temperature on magnetophonon effect, the amplitude of the peak in magnetoresistance which corresponds to $N = 3$ was measured as a function of temperature from 80 K to 190 K. The temperature was measured with a copper - constantan thermocouple with an accuracy of ± 1 K. The thermocouple was moun-

ted in the vicinity of the unclamped single crystal of n-type InSb with the following characteristics:

$N_D - N_A = 8 \cdot 10^{13} \text{ cm}^{-3}$, $\mu = 5.1 \cdot 10^5 \text{ cm}^2 \text{V}^{-1} \text{S}^{-1}$ at 77 K, dimensions $1 \text{ mm} \times 1 \text{ mm} \times 8 \text{ mm}$ with the 1 mm^2 plane parallel to crystallographic (100) plane. The crystal was supported by the copper wires which provided the electric connections to the crystal.

The results are shown in Fig.1 . A broad maximum is observed at about 100 K. When the temperature reached approximately 200 K the signal became to be unobservable, while at the low temperature side the amplitude of the magnetoresistance peak was only slightly lower than at 80 K.

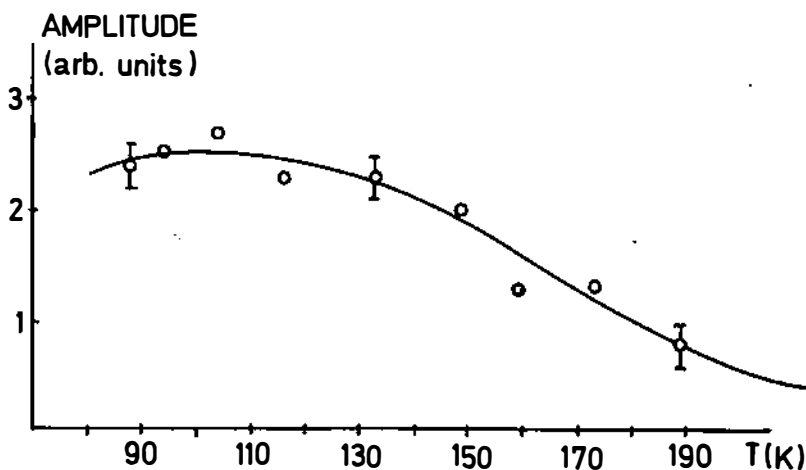


Fig.1 The temperature dependence of the magnetoresistance peak's amplitude, corresponding to $N = 3$.

The measurements below 77 K are in progress. Similar behavior was observed also for the magnetoresistance peaks which belong to other values of N .

The cyclotron effective mass for electrons was also calculated using Eq.1, combined with the expression for ω_c . The result is close to the m^* value which was obtained from cyclotron resonance experiment.

REFERENCES

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