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Hot Electron Longitudinal Magnetoresistance in Hydrostatically Stressed Ge

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In a previous paper (1) the results of the measurement of the longitudinal magnetoresistance (LMR) in n-Ge at T = 77 ^{o}K with collinear electric E and magnetic H fields applied along the [110] crystallographic direction were given. It was observed that the negative LMR occurs at E ≈ 2 kV/cm. The presence of the negative LMR was explained by the increase of the electron concentration in ⟨111⟩ valleys due to the decrease of the number of electron transitions into ⟨100⟩ valleys under the influence of H. In accordance with this explanation the negative LMR should be also present when $\vec{E} \parallel \vec{H} \parallel [100]$. However, the results reported in (2) at electric fields up to 2.5 kV/cm and also our results at higher fields showed no negative LMR. We suppose that the absence of negative LMR in this case can be explained as follows: caused by the magnetic field the relative decrease of the electron mobility prevails over the relative increase of electron concentration.

The qualitative consideration shows that while decreasing the energy separation between the valleys ⟨111⟩ and ⟨100⟩, conditions can be created under which the effect of concentration increase in the valleys ⟨111⟩ due to magnetic field action will obscure the effect of mobility decrease in these valleys, i.e. the magnetoresistance will become negative.

In this work the energetic separation was decreased by the hydrostatic pressure P. Measurements were performed up to E = 5 kV/cm and P = 10 kbar by means of a dc pulse-modulated bridge at T = 77 ^{o}K. n-Ge samples with $\varrho_{300\,^{o}K} = 5\ \Omega$cm were dumb-bell shaped.

The experimental dependence of $(\varrho^{H}(E) - \varrho^{o}(E))/\varrho^{o}(E)$ on E for H = 3 kOe and P = 1 bar (1) and P = 7 kbar (2) and P = 10 kbar (3) are plotted in Fig. 1. As it is seen from Fig. 1 for P = 7 kbar and in the electric field range from 2 to 5 kV/cm the negative LMR appears. The disappearance of the negative LMR at P = 10 kbar

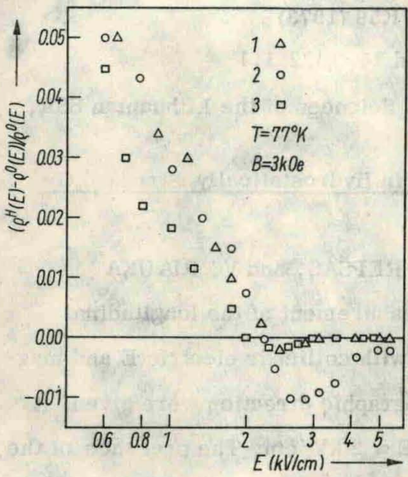

Fig. 1

is slightly unexpected. May be that at higher pressures the maximum rate of change of the electron concentration in ⟨111⟩ valleys caused by the decrease of the average energy of electrons due to the influence of H occurs at weaker electric fields than at 7 kbar where the change of electron mobility with H is more important.

A more detailed analysis of the obtained experimental results as well as their comparison with the calculations is to be published later.

References

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