10-4

SIZE EFFECTS IN FILMS OF GERMANIUM.

A.F.Kravchenko, B.P.Zot'ev, E.M.Skok, E.V.Skubnevskij.

Institute of Semiconductor Physics,

Academy of Science of USSR

Siberian Branch

Novosibirsk

USSR

When the lineal sizes of cristal are comparable with characteristic lenths of charge carriers, the effects appear which lead up to a dependence of kinetic coefficients from the sizes of semiconductor.

In this report, we present the experimental investigations of the kinetic coefficients in small samples of germanium. The measurments were carried out on thin plates of p-Ge and films p-Ge which have been groun from liquid phase on sapphire in the temperature range 20°K ÷ 300°K. The thickness of samples was changed from 200 to 2 microns, the magnitudes of magnetic and electric fields from 0 to 150 kG and from 0 to 100 v/cm, respectively.

The increase of the magnetoresistance anisotropy and hole mobility anisotropy in the heating electric field, non-linearity of current-voltage characteristic in magnetic field and a dependence of transverse magnetoresistance on the direction of electric and magnetic fields have been founded in thin plates of germanium. The established peculiarities of kinetic coefficients are explained by the cxistance of the size effects caused by comparability of the plate thickness with the cooling path of holes. The holes cooling path of ~ 2 microns and the velocity of their energy relaxation at the surface of $\sim 5 \cdot 10^6$ cm/sec were determined from comparison of the experimental results with a theory.

Increasing of transverse magnetoresistance and decreasing of longitudinal magnetoresistance in strong magnetic field, the arising of anomalous dependencies of hole mobility on electric

field and magnetoresistance on magnetic field were observed on films of germanium, although not observed on bulk samples.The interpretation of results is carried out in terms of a model, assuming the existance of the size effects connected with the cooling path and free path in the enriched surface layer of germanium films. In particular, the fraction of carriers, scattered by surface diffusively, decreases in the longitudinal strong magnetic field.

The general analysis of the influence of size effects and distribution of electrophysical parameters along the thickness on integral kinetic characteristics of germanium films is carried out.