PERPENDICULAR ELECTRIC FIELD EFFECT ON THE ELECTRIC RESISTIVITY OF THIN GRAPHITE CRYSTALS

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From the analysis of the magnetic field dependence of the Hall coefficient and the transverse magnetoresistance of thin graphite crystals using McClure's method(1), it was found that thin crystals of graphite have larger number densities of holes and electrons as well as smaller mobilities than bulk crystals(2). This size effect of graphite crystals seems to arise from the surface layer.

In this study, the electric resistivity of thin graphite crystals was measured with application of electric field perpendicular to the basal planes of the crystal surface up to 7.0×10^5V/cm at liquid helium temperature.

The method to prepare specimens was the same as that described in the previous paper(3). Current flow through the specimen was kept at around 10^3A/cm^2.

The resistivity of graphite crystals of various thickness less than 1μm was found to change with the electric field E applied perpendicularly to the surface, examples of which are illustrated in Fig.1. Here, E>0 means that the sample is charged negative.

The resistivity of crystals of any thickness monotonically decreases with increasing electric field (E>0), while for E<0 it increases with increasing field, except for the specimen of 460A thickness. The magnitude of this effect is of the order of several per cent at the highest field in this study. This tendency becomes conspicuous for thinner crystals, and for the thinnest crystal $\Delta\rho/\rho$ at first increases, reaches a maximum, and then monotonically decreases. The oscillations in the curves of $\Delta\rho/\rho$ vs. E did not appear unlike in the case of bismuth films studied by Yu.F.Ogrin et al.(4), which was explained by the quantum size effect(5).

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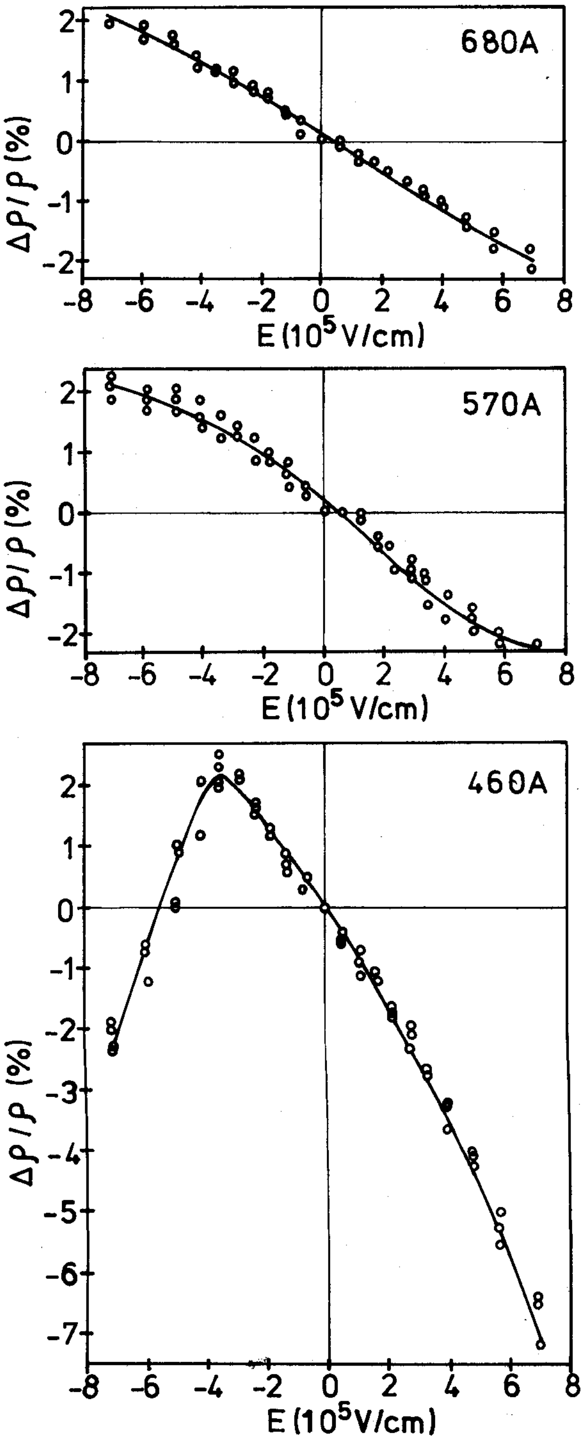

Fig.1. Resistivity as a function of electric field applied perpendicularly to the surface for various crystal thickness at 4.2K.

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