Hall Coefficient and Magnetoresistivity of Soft Carbons and Polycrystalline Graphite: Doping with Acceptors*

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Using the experimental arrangement developed by Inagaki, Komatsu and Zanchetta[1] for studies of galvanomagnetic properties of carbons in the temperature range 1.5° - 300°K, the temperature dependence of the resistance, magnetoresistivity and the Hall constant was investigated for samples of soft carbon heat treated from 1800° - 3000°C after introduction of acceptors.

Boronations were performed by heating the samples in a container with boric acid powder to a temperature of 1700°C. As observed by Mrozowski[2,3] such a procedure does not give reproducible results, the boronation being in some runs more and in others less effective. A few successful runs were obtained however in which a large concentration of acceptors was introduced. Introduction of sulfuric ions was performed by dipping the samples for 15-30 min. in sulfuric acid to which a few drops of nitric acid were added and by subsequent thorough washing them in water, thus producing a residual bisulfate compound of carbon.

It has been found that introduction of acceptors to a great extent has a similar effect on galvanomagnetic properties as a corresponding decrease in heat treatment temperature. Although the total temperature change in relative resistivity decreases with introduction of acceptors, the resistivity curves retain some curvature of the type proper for the higher heat treatment and absent for the nondoped original material of correspondingly lower HTT. There are some differences to be noticed also in the Hall coefficient curves. In general, however, one can say that the main factor controlling the type of temperature dependence observed is the position of the Fermi level, the carrier scattering (mobility) either being little temperature dependent, or having about the same temperature dependence for a wide range of crystallite sizes.

A few of the curves obtained for the Hall constants and for the magnetoresistivity are presented in two graphs. The two types of acceptors differ radically in their effect on the absolute value of the resistivity. While introduction of boron causes some decrease in resistivity at low heat treatments, it causes an increase for higher heat treatments (in some cases of repeated boronation this being quite large). Bisulfate doping brings always a decrease in resistance, which is believed to be due partly to the increase in the conductivity across the planes (in c-direction).

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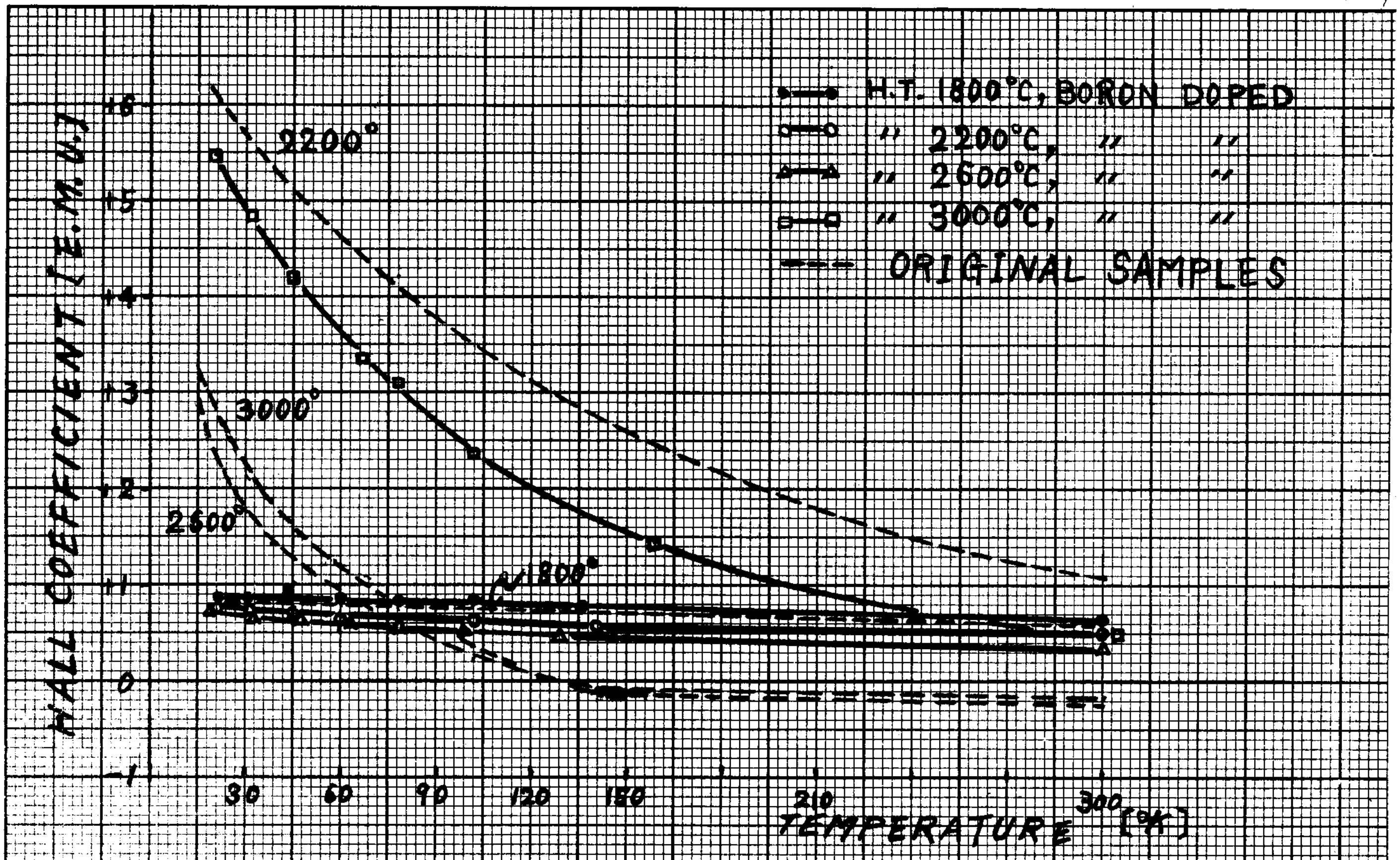
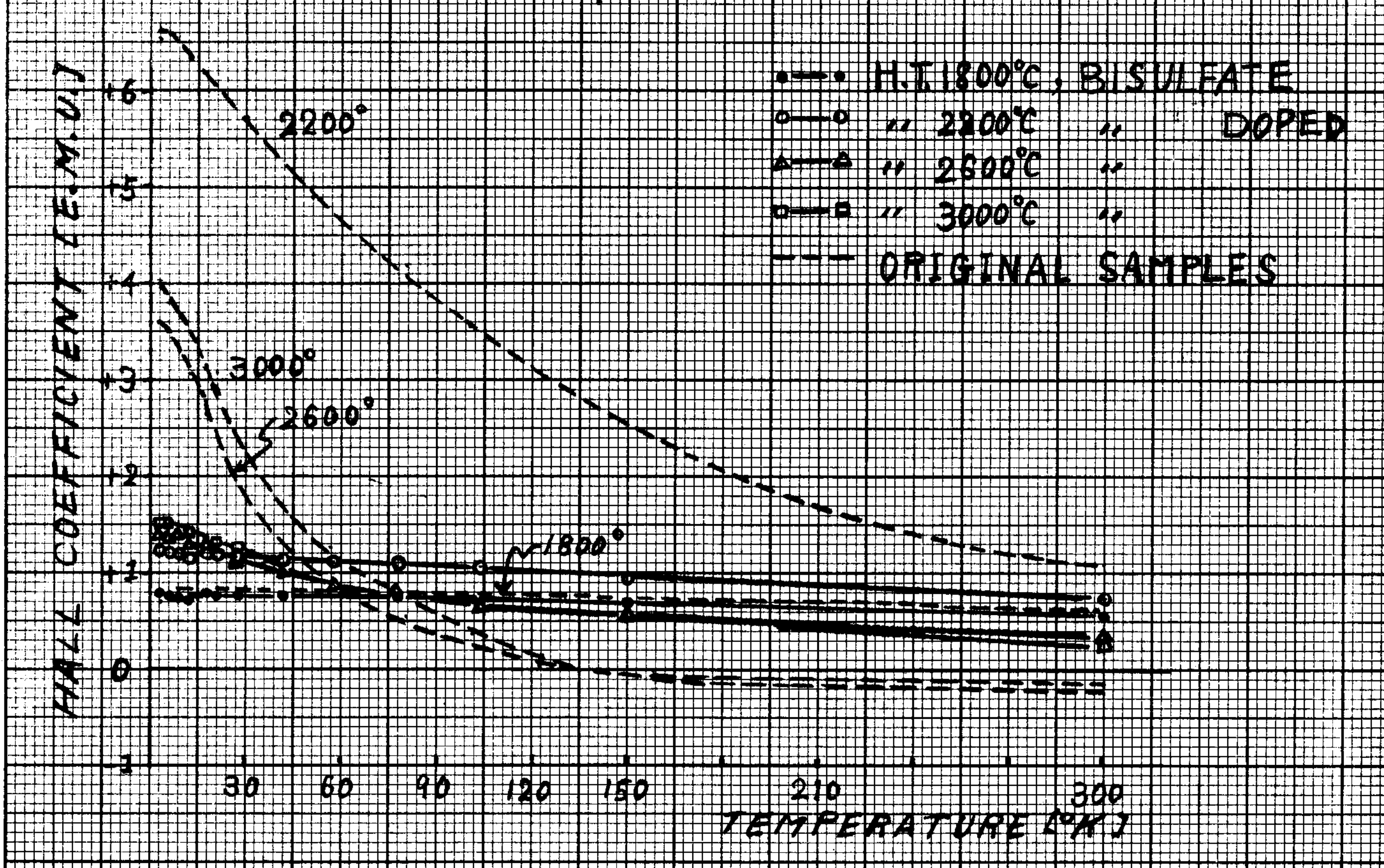
1. Previous papers at this Conference
2. S. Mrozowski, Carbon 3, 305 (1965)
3. S. Mrozowski, previous paper at this Conference



(Fig. 1) Dependence of Hall coefficient of Boron-doped carbon on temperature.



(Fig. 2) Dependence of Hall coefficient of Bisulfate-doped carbon on temperature.