Electronic Properties of Graphite-Nitrate Residue Compounds

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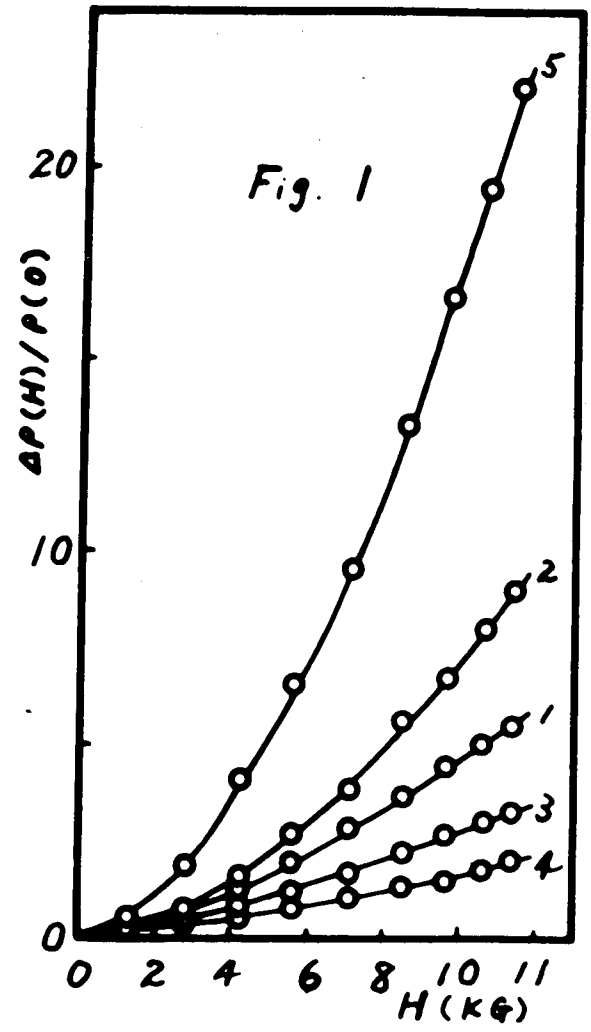
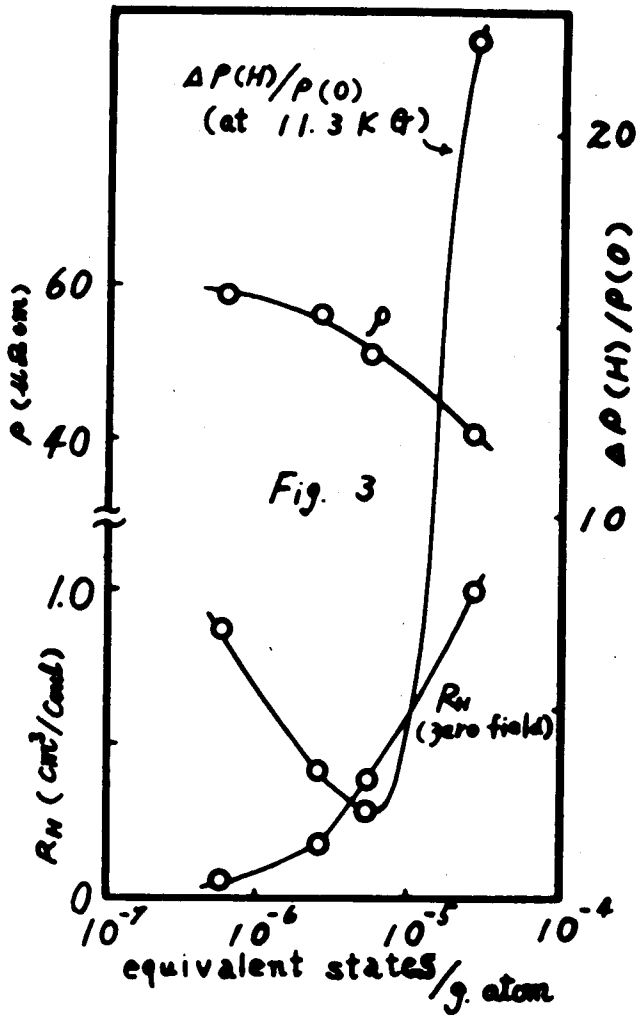
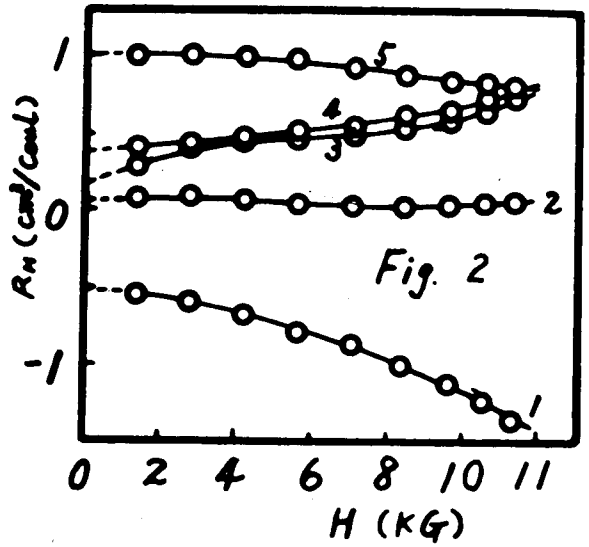
By means of the so-called electrolytic oxidation technique, a number of graphite-nitrate residue compounds was prepared for the purpose of controlling the Fermi level depth in the lower π -band of graphite. Specimens were taken from a pyrolytic graphite heat treated at 3600°C for the structral improvement and were examined by turns for such nitrate doping.

In Figs. 1 and 2, the Hall coefficient (R_H) and the magnetoresistance ($\Delta\rho(H)/\rho(0)$) at liquid nitrogen temperature for those specimens oxidized to 10^{-5}-10^{-7} equivalents per gram atom of carbon are plotted against intensity of the magnetic field perpendicular to the deposit surface. Also in Fig. 3, the magnetoresistance under the field of 11.3 kG as well as the zero-field values of Hall coefficient and of basal-plane resistivity (ρ) are shown as functions of the electron deficit per atom (e/a, which is equal to the oxidation state equivalents). It may be noted that the resistivity indicates a monotonous decrease with the increase of oxidation states, while the Hall coefficient changes its sign from - to + at the oxidation as low as 10^{-7} e/a and rises up thenceforth.

On the other hand, such heavily-doped specimens containing 0.7 - 4 x 10^{-2} NO_3^- ions per C-atom were prepared throgh the decomposition of lamellar compounds derived from another pyrolytic graphite. Their interlayer spacing has been found to be 3.30-3.35 A (less than the ideal graphite value), and in addition the X-ray diffraction diagram gives some extra peaks in the lower angle side, suggesting the presence of super-lattice. The basal plane resistivity is lower than that of single crystals, and the Hall coefficient stays in the negative range throughout.







1 : PG (H.T. 3600°C)
2 : 0.04×10^{-5} e/a
3 : 0.16×10^{-5} e/a
4 : 0.40×10^{-5} e/a
5 : 2.0×10^{-5} e/a