Annealing Studies of Pile-Irradiated Graphite (II). Electronic Properties

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Study of the isothermal annealing effects on heavily-irradiated graphite (5.8×10^{20} nvt in total dose) has been extended to the electronic properties.

In Fig. 1, the electric resistivity (ρ), Hall coefficient (R_H) and magnetoresistance ($\Delta\rho/\rho$) at room and liquid oxigen temperatures are shown as functions of annealing temperature. Recovery of ρ is found to take place by two steps; the first one between 400°-600°C on the ordinate and the second starting from 1400°C. Confronting this with Hove's data which is based on the comparatively light irradiation, one can conclude that the heavier the damage the higher the recovery temperature. The galvanomagnetic properties, R_H and $\Delta\rho/\rho$, exhibit fashions quite similar to those often found in the graphitization process of soft carbons, though the maximum of R_H and the negative portion of magnetoresistance come out pretty earlier.

Fig. 2 reproduces the annealing temperature dependency of diamagnetic (χ_D) and paramagnetic (χ_P) components of the room temperature susceptibility. The latter has been calculated from the absorption intensity of ESR which abruptly fell down for the annealing between 600°-950°C and gave no signal for that between 1000°-1200°C. In Fig. 3 χ_P is plotted against the reciprocal temperature (1/T) for various annealing stages. The linear relationship displayed there implies that the spins are mostly Curie type, which is consistent with the fact that the g-factor stayed constantly around the free electron value with the line width of a few gauss.

An analysis in the framework of the STB model is being pushed forward and seems to win some success.

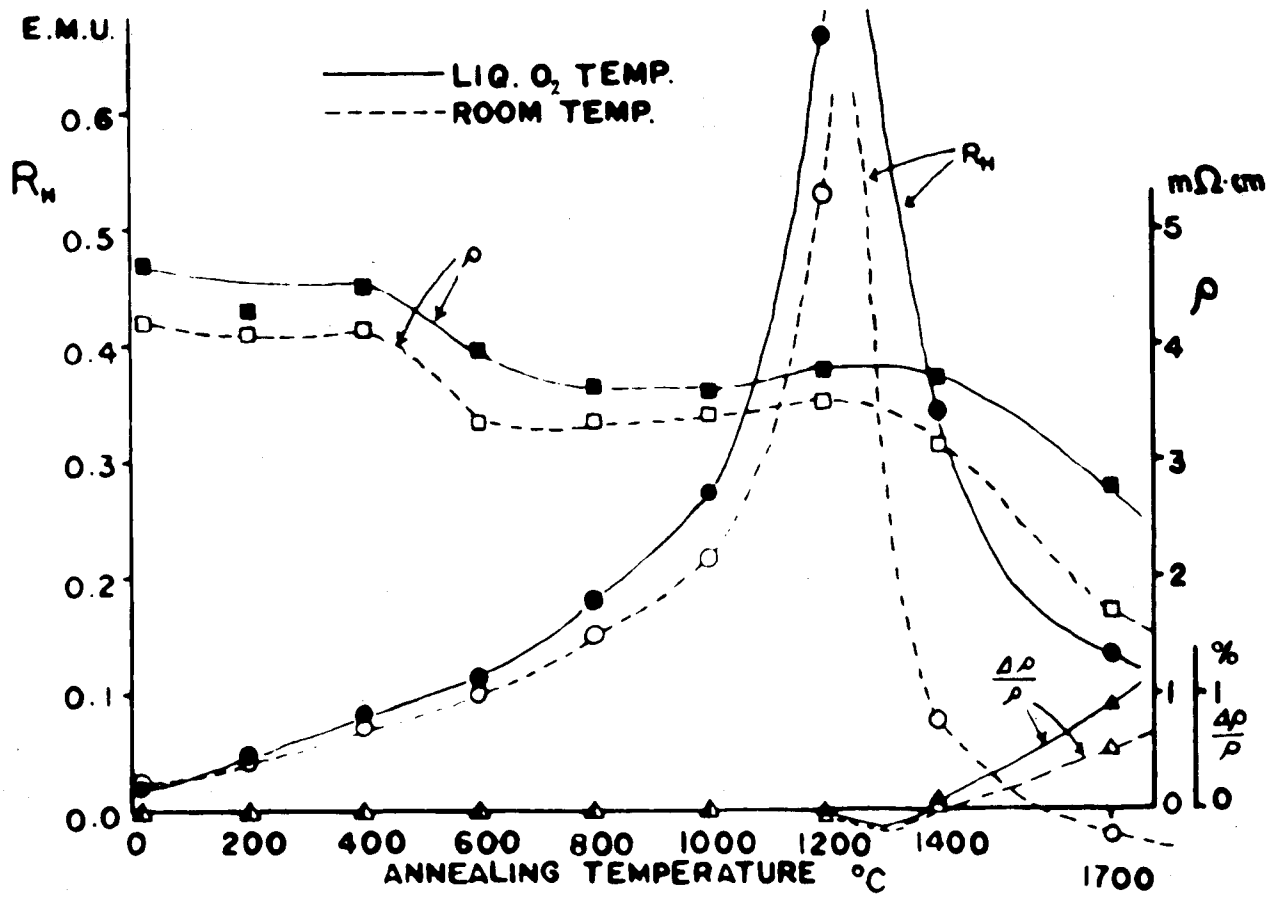

FIG. 1

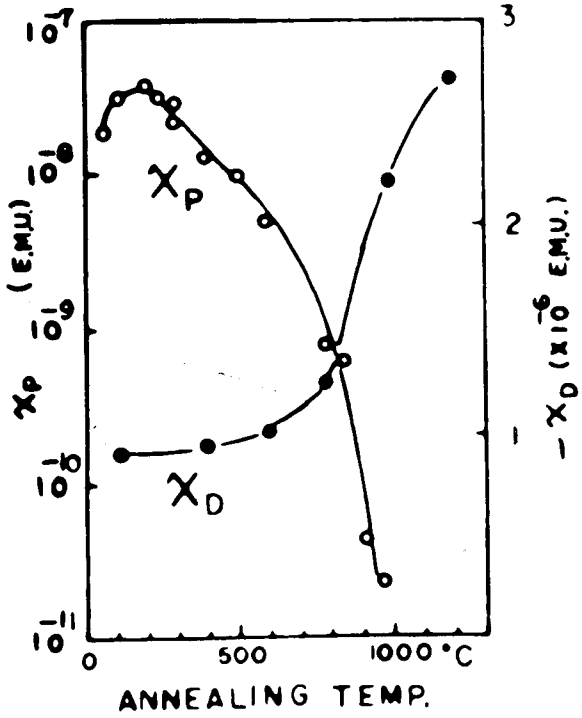

FIG. 2

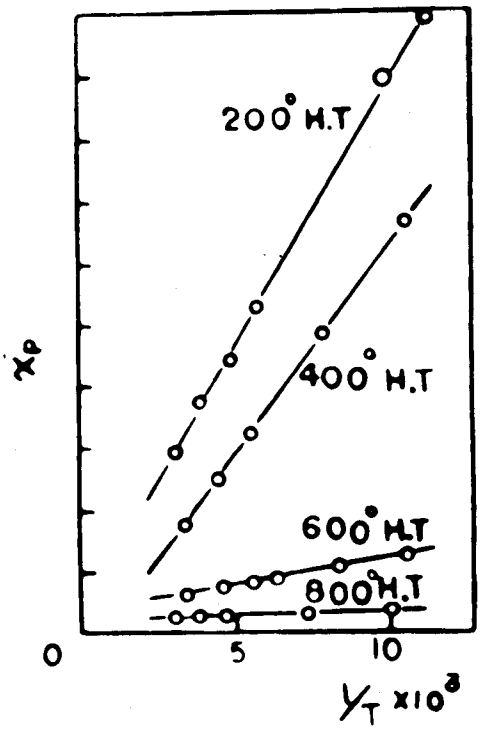

FIG. 3