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

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Study of the isothermal annealing effects on heavily-irradiated graphite ($5.3 \times 10^{20}$ nvt in total dose) has been extended to the electronic properties.

In Fig. 1, the electric resistivity ($\rho$), Hall coefficient ($R_H$) and magnetoresistance ($\Delta \rho / \rho$) at room and liquid oxygen temperatures are shown as functions of annealing temperature. Recovery of $\rho$ is found to take place by two steps; the first one between $400^\circ$-$500^\circ C$ on the ordinate and the second starting from $1400^\circ C$. 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 ($\chi_D$) and paramagnetic ($\chi_P$) 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 $600^\circ$-$350^\circ C$ and gave no signal for that between $1000^\circ$-$1200^\circ C$. In Fig. 3 $\chi_P$ 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.