

Annealing Studies of Pile-Irradiated Graphite (I).Internal Friction

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A reactor grade graphite irradiated with fast neutrons to total dose of 5.8×10^{20} nvt was isothermally annealed in a step-wise manner at temperatures from 100°C up to 2150°C, while the internal friction (Q^{-1}) in the amplitude independent range was measured each time as a function of ambient temperature (T) between 80° - 280°K.

Fig. 1 shows three basic forms of the Q^{-1} vs. T relationship obtained in this annealing process: (1) Monotonous rise-up found for those annealed between 100° - 1150°C. (2) A S-type character indicating levelling-off at temperatures above 240°K, representative of those annealed between 1250° - 1600°C. (3) Another S-type with a broad peak standing around 230°K, which corresponds to the annealing between 1800° - 2150°C. Comparing with past observations, (2) and (3) seem to be in close relation to the dislocation damping in the graphitic structure, for which an analysis in the framework of the Granato-Lücke theory is applicable.

In Fig. 2 the resonant frequency (f_0) as well as the internal friction at 80°K and 280°K is plotted against annealing temperature. It is noticeable that the recovery between 100°C and 500°C is displayed only in f_0 (i.e. elastic modulus) but not in Q^{-1} . On the other hand, the second recovery taking place between 1200°C and 1600°C is remarkable rather in Q^{-1} than f_0 . These facts can be accounted for by considering the structural meaning of dislocation loop length (L_c) and damping constant (B) in relation to the migration of interstitials and vacancies.

