Scattering of Thermal Neutrons in Graphite

In a recent paper (*1*) L. S. Kothari and the present author reported the calculations of the total cross section of thermal neutrons in graphite. However the calculated value of the elastic plus one phonon inelastic cross section was found to be 10 % higher than the experimental value (Fig. 1). The model adopted for the lattice vibrations was as suggested by Krumhansl and Brooks (*2*). In calculating the elastic part of the cross section we summed over all the reciprocal lattice vectors with nonzero form factor.

coincide with the experimental points within 2 %. This fit is satisfactory upto 0.06 ev, but after this the calculated results are lower than those obtained experimentally. This is exactly what is to be expected. In the x-ray pattern the last line corresponds to a d spacing of 0.61 A and this just starts reflecting neutrons of 0.055 ev. Since we have no information about the actual planes taking part in diffraction, above this energy we could not possibly calculate the correct cross section. Two and higher phonon processes may also start contributing at higher energies.

It is remarked that when we take into account only those

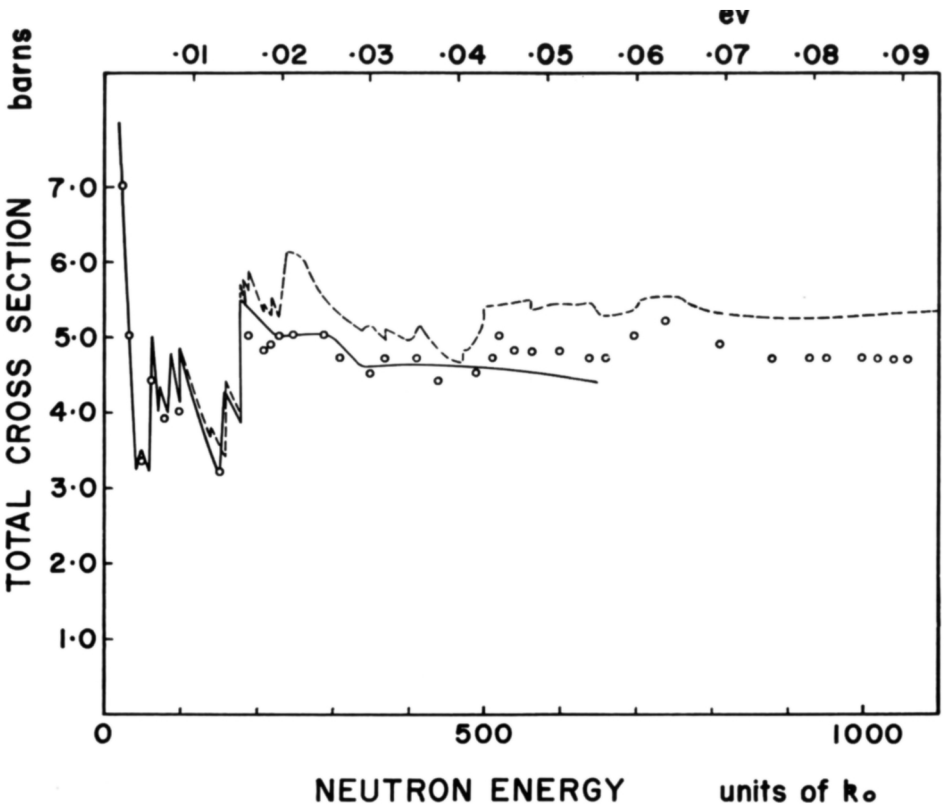

FIG. 1. Total cross section is plotted as a function of neutron energy for graphite at room temperature. The solid curve indicates the present calculations, whereas the dashed curve represents the earlier results of Kothari and Khubchandani. The circles denote the experimental points (BNL325).

We have indexed the x-ray data of graphite (*3*), for which molybdenum radiation has been used. We find that only 18 reflections upto $\tau = 1.6393\ A^{-1}$ of the expected forty reflections have been reported. For example reflections like 105, 202, 204 are not obtained. (A very faint 105 reflection has been observed in this laboratory, by V. M. Padmanabhan in the powder pattern of Ceylon graphite. In the present calculations we have used the card data.)

We have modified our calculations so as to calculate the elastic scattering cross section taking into account contributions to neutron scattering only from the planes which give x-ray reflections (limited by the condition $\tau \leqq k_1/\pi$). As the inelastic scattering cross section was calculated by the method of incoherent approximation no attempt was made to correct this. We find that the calculated results planes which diffract x-rays, we are able to explain the scattering of thermal neutrons on the basis of the KB model.

REFERENCES

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