Effect of Bragg Cutoff on the Diffusion of Thermal Neutrons in a Finite Solid Medium

In an earlier paper (1) having the above title some numerical errors in the values of average energy transfer cross section g^{12} and g^{21} for beryllium at 100°K have been detected, which affect considerably the parameters B_1^2, B_2^2, A'/A, C'/C, and the general results obtained. Therefore a recalculation of the problem with corrected constants was necessary. This was done for a beryllium slab of thickness 198.72 cm at a temperature of 100°K. An improvement in the formula for the average diffusion constant was also introduced. Instead of $D^i = \frac{1}{3}\lambda_{tr}^i$ ($i = 1, 2$) used previously, the more accurate expression

$$D^i = \frac{\lambda_{tr}^i}{3(1 + \Sigma_a{}^i\lambda_{tr}^i)}$$

was now introduced. The changes in the average values of the nuclear constants and parameters are given in Tables I and II. The ratio of the neutron fluxes in the two groups and the mean energy of neutrons as a function of x are given in Fig. 1. Both these quantities are now quite different from what was published before. In fact both $\phi^1(x)/\phi^2(x)$ and $\bar{E}(x)$ tend to attain a nearly constant value for the lower temperature (100°K) of the medium before showing a slight rise for ϕ^1/ϕ^2 and consequently a small decrease for $\bar{E}(x)$ near the boundary, which is the effect of the finite size of the slab.

TABLE I

Constants	Values used in ref. 1	Revised values
D^1 (cm)	46.08	30.07
D^2 (cm)	0.4072	0.4064
g^{12} (cm^{-1})	6.6671×10^{-7}	3.9770×10^{-4}
g^{21} (cm^{-1})	4.8024×10^{-6}	2.8621×10^{-3}

TABLE II

Parameters depending on constants in Table I	Values used in ref. 1	Revised values
B_1^2 (cm^{-2})	4.0051×10^{-5}	5.0090×10^{-3}
B_2^2 (cm^{-2})	8.3691×10^{-5}	2.0381×10^{-4}
A'/A	-2.7103×10^5	-361.84
C'/C	3.0076×10^{-3}	1.4716

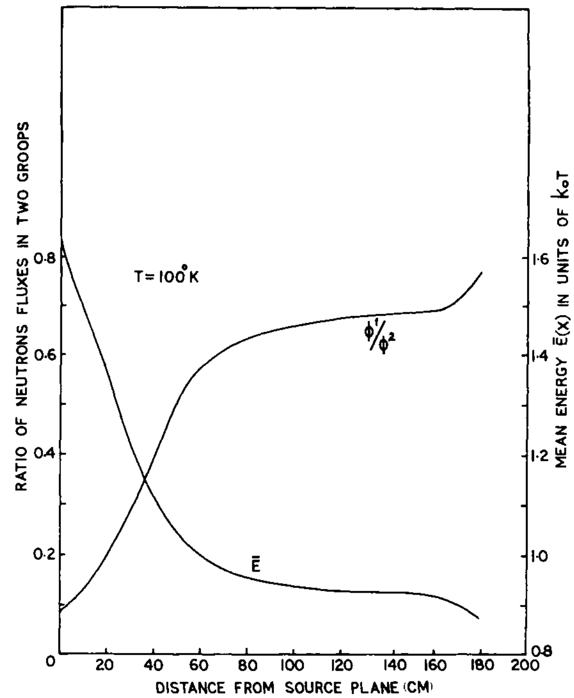

FIG. 1. The ratio of neutron fluxes in the two groups and the mean neutron energy in a 198.72 cm thick beryllium slab at temperature T = 100°K plotted as a function of distance from the source.

When the corrected values of g^{12} and g^{21} are used for calculating the equilibrium flux distribution in a semi-infinite slab, as done by Jain and Lawande (2), their results for beryllium at 100°K are also completely changed. For the asymptotic value of the ratio of cold to thermal neutron flux, one now obtains

$$\left.\frac{\phi_{\text{cold}}}{\phi_{\text{thermal}}}\right|_{\text{asym.}} = 0.68 = \frac{C'}{C}$$

instead of 333 quoted by them. Results for beryllium at 300°K are unaltered.

REFERENCES

1. S. SANATANI AND L. S. KOTHARI, *Nuclear Sci. and Eng.* **11**, 211–217 (1961).
2. R. D. JAIN AND S. V. LAWANDE, *Nuclear Sci. and Eng.* **11**, 228–9 (1961).

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Received June 8, 1962