100 Group Displacement Cross sections from RECOIL Data Base

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Displacement cross sections in 100 nutron energy groups were calculated from the RECOIL data base[1] using the RECOIL program [1], for use in DPA (Displacements Per Atom) calculations for FBTR and PFBR materials.

DPA, which denotes the number of Displacements Per Atom of the target material due to neutron irradiation, is given in multigroup from, by

$$D = t \sum_{g_n} \sum_{g_R} \sigma(g_n, g_R)\, \upsilon(g_R)\, \phi(g_n)$$

where

$\sigma(g_n, g_R)$ is the cross section for a neutron energy group g_n to produce a primary knock on atom (pkA) in a (recoil) energy group g_R,

$\phi(g_n)$ is the neutron flux density,

$\upsilon(g_R)$ is the number of displacements the pkA could produce in the material in the subsequent cascade of interactions within the material,

and t is the irradiation time.

It can be rewritten as

$$D = t \sum_{g_n} \sigma_{dis}(g_n)\, \phi(g_n)$$

where

$$\sigma_{dis}(g_n) = \sum_{g_R} \sigma(g_n, g_R)\, \upsilon(g_R)$$

is known as the displacement cross section, in multigroup form.

RECOIL Data base gives multigroup kernels $\sigma(g_n, g_R)$, known also as the pkA spectrum in 105 neutron groups and 104 recoil groups. Program RECOIL calculates the displacement cross sections in the desired group structure.

100 group displacement cross sections were calculated/2/ using RECOIL-Data Base and RECOIL Program. Modifications were made in the data base to reduce space requirement, and in the the program for easy handling on a PC.

1. T. A. Gabriel et al., Radiation Damage Calculation: PrimaryRecoil Spectra, Displacement Rates, and Gas-Production Rates, Report ORNL/TM-5160(1979).

2. V. Gopalakrishnan, 100 Group Displacement Cross sections from RECOIL Data Base, Internal Note RPD/NDS/54 (1994).