A Library of Multigroup Kerma Factors and Partial Cross Sections for Fusion Neutronics and Photonics

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In the nuclear design of a fusion reactor blanket, magnet shield, and magnet, the neutronic and photonic analysis should provide a wide variety of results[1,2] for other disciplines. The energy deposition by the neutrons and secondary gammas provide the basic input for heat removal studies. The helium and hydrogen production rates are quite important in evaluating radiation damage problems. Various reaction rates are required for decay heating calculation and emergency cooling design.

A library of energy group neutron and gamma energy release parameters (fluence-to-kerma factors) and neutron group cross sections by reaction has been generated for several elements proposed for use in CTR's. The library was generated with the MACK[3] code from ENDF/B for the 100-group GAM-II neutron energy group structure. The gamma kerma factors were calculated for 43 energy groups by the MUG[4] code. The weighting functions used are spectra representative of a CTR blanket. The radioactive decay contributions to neutron kerm factors were added with an arbitrary half life cut-off of 50 days.

A retrieval routine is available to prepare kerma factors and cross sections in ANISN[5] format for any desired composition. The retrieval routine can also perform simple group collapsing using an arbitrary input weighting function.

A list of the materials in the library is given in Table I with

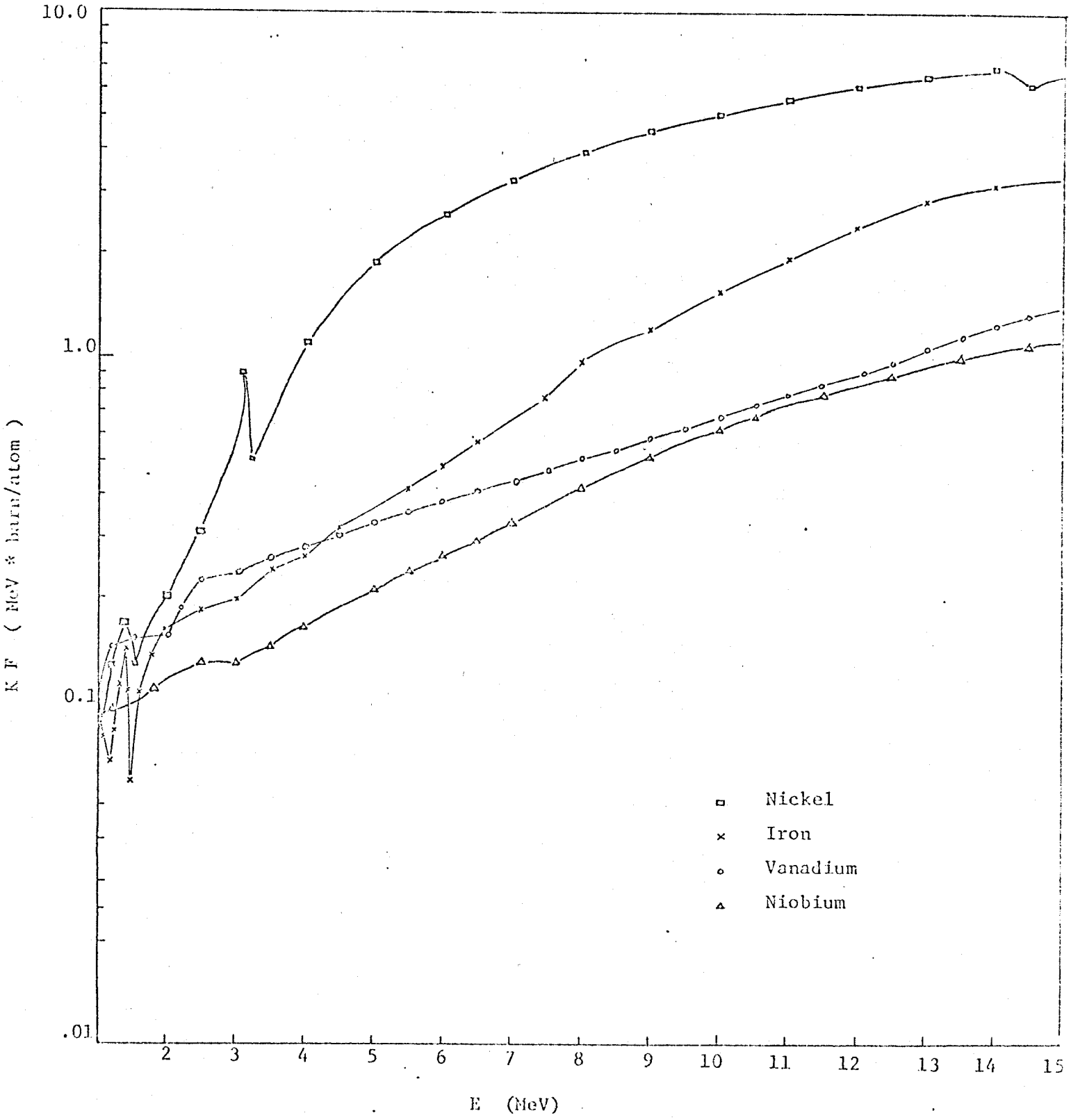
the corresponding ENDF/B MAT numbers which are used as the identification numbers in the library. The ENDF/B 3 evaluations were used except for materials with MAT numbers 3023, 3111, and 3000. Flourine was generated from the UK library data. MAT 3023 is a recent ORNL evaluation[7] for vanadium which includes (n,n´) charged particles reactions. The present ENDF/B evaluation for Molybdenum (MAT1111) is not adequate for kerma calculations since the (n, charged particles) reactions are not provided. These cross sections were estimated by the authors and included in MAT 3111. The results indicate that about 50% of local neutron heat generation for neutrons of energies between 10 and 15 MeV is from the (n, charged particles) reactions. About 90% of the neutron heating in the blanket first wall is generated by neutrons of this range. Hence, the inclusion of the (n,α), (n,p),....,etc., contribution to kerma factors is necessary.

The pointwise kerma factors generated by MACK[3] were saved for future use with different energy group structures. A sample of the results is shown in Figure 1 for some materials of interest.

Table 1

Library of 100-group neutron kerma factors and partial cross sections and 43-group gamma kerma factors

Material	ENDF/B MAT	Material	ENDF/B MAT
He	1088	Cu-63	1085
Li-6	1115	Cu-65	1086
Li-7	1116	Cr	1121
N-14	1120	Ni	1123
O-16	1134	Fe	1180
H-1	1148	W-182	1060
Be-9	1154	W-183	1061
B-10	1155	W-184	1062
B-11	1160	W-186	1063
C-12	1165	Mo	1111
Al-27	1135	Mo	3111
Na-23	1156	Ta-181	1126
V	1017	T2-182	1127
V	3023	Pb	1136
K	1150	Nb	1164
		F	3000



Neutron, Kerma Factors for some materials of interest for CTR

Figure 1

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