

Electron-Impact Ionization Cross-
Sections and Ionization Rate
Coefficients for Atoms and Ions
from Scandium to Zinc

W. Lotz

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Using the empirical formula recently proposed, electron-impact ionization cross-sections for single ionization from the ground state are given for five atoms and for nearly all ionization stages from scandium ($Z = 21$) to zinc ($Z = 30$). For these species ionization rate coefficients are given under the assumption of a Maxwellian distribution of the impacting electrons. Multiple ionization, lowering of ionization potential, or collision limit are not taken into account.

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Abstract

Using the empirical formula recently proposed, electron-impact ionization cross-sections for single ionization from the ground state are given for free atoms and for nearly all ionization stages from scandium ($Z = 21$) to zinc ($Z = 30$). For these species ionization rate coefficients are given under the assumption of a Maxwellian distribution of the impacting electrons. Multiple ionization, lowering of ionization potential, or collision limit are not taken into account.

E is the energy of the impacting electron; P_i is the ionization potential, P_{i-1} is the binding energy of electrons in the i -th subshell; q_i is the number of equivalent electrons in this subshell; a_i , b_i , and c_i are individual constants, which have to be determined by a reasonable guess. For the species under consideration, $N = 3$ is a good approximation. If the subshell $i = 3$ is populated by 1s electrons (K shell), N is set equal to 2, because the contribution of the K shell is negligible in these cases.

No distinction is made between the L_{II} and L_{III} shells: it is assumed that all 2p electrons are equivalent and thus form one subshell. This assumption is justified, because the difference in binding energies of these subshells is always relatively small. The same statement holds for 3p electrons in the M_{II} and M_{III} shells and for 3d electrons in the M_{IV} and M_V shells.

Introduction

In a recent paper¹ the author attempted to predict ionization cross-sections hitherto unknown for atoms and ions from lithium to calcium after an empirical formula had been found² and certain regularities been discovered.

Up to calcium only s and p electrons had to be considered, for which a sufficient number of experimental measurements were available. From scandium onward 3d electrons have to be taken into account, but there are almost no measurements to be found in the literature. The problem therefore was to make a reasonable guess for the free constants of the formula used.

The Formula Used

The same formula is used as in reference 1:

$$\sigma = \sum_{i=1}^N a_i q_i \frac{\ln(E/P_i)}{E P_i} \left\{ 1 - b_i \exp \left[-c_i (E/P_i - 1) \right] \right\}, \quad E \geq P_i.$$

E is the energy of the impacting electron; P_1 is the ionization potential, P_i is the binding energy of electrons in the i-th subshell; q_i is the number of equivalent electrons in this subshell; a_i , b_i and c_i are individual constants, which have to be determined by a reasonable guess. For the species under consideration, $N = 3$ is a good approximation. If the subshell $i = 3$ is populated by 1s electrons (K shell), N is set equal to 2, because the contribution of the K shell is negligible in these cases.

No distinction is made between the L_{II} and L_{III} shells: it is assumed that all 2p electrons are equivalent and thus form one subshell. This assumption is justified, because the difference in binding energies of these subshells is always relatively small. The same statement holds for 3p electrons in the M_{II} and M_{III} shells and for 3d electrons in the M_{IV} and M_V shells.

Furthermore the use of the above formula is based on the assumption that the cross-section of electrons in the i -th subshell is independent of the electron configuration as a whole. This assumption is to be considered as a working hypothesis and is used here because nothing is known of the influence of configuration interactions on the actual magnitude of the cross-sections.

In Tables 1 and 2 all quantities (except binding energies) needed for the above formula are tabulated for the first few ionization stages of the elements under consideration. From scandium to zinc no cross-section curve is known experimentally, only a few isolated points have been measured with more or less accuracy for electron energies of 60 or 75 eV³. The cross-section curve of mercury² gives a hint for the constants a_i , b_i , and c_i to be used for d electrons. In order to get concrete figures, I assumed that these constants for 3d electrons are the same as those for 2p electrons (in the same ionization stage) as far as the same number of electrons is present in the subshell. Only six 2p electrons are possible, but there are up to ten 3d electrons; therefore an extrapolation had to be made for configurations with seven to ten 3d electrons.

For the species not mentioned in Tables 1 or 2 (four times and higher ionized ions), I assumed $a_i = 4.5 \times 10^{-14} \text{ cm}^2 (\text{eV})^2$ and $b_i = 0$. This assumption agrees within a few percent with the theoretical calculations of Rudge and Schwartz⁴ for a hydrogen-like ion with high Z-number in the Born-exchange approximation, and within 20 % for Fe XV and Fe XVI in the same approximation⁵. The validity of this assumption especially for neon-like ions or for 3d electrons is questionable, but no better approximation is known.

In Table 3 the binding energy of electrons in the outermost subshell is given⁶, which generally is equivalent to the ionization potential. In Table 4 the binding energy of electrons in the next

inner subshell⁷ is to be found and in Table 5 the binding energy of electrons in the second next inner subshell⁸, as far as this subshell is not populated by 1s electrons in the K shell.

For atoms and singly charged ions (net charge $\zeta = 1$ or 2) the following definitions have been made: outermost subshell = 4s electrons (Table 3), the next inner subshell = 3d electrons (Table 4), second next inner subshell = 3p electrons (Table 5). According to this definition, some singly charged ions have no "outermost" subshell and no value is given for these in Table 3, the ionization potential of these species is found in Table 4 instead.

The above formula implies that only one electron is hit by the impacting electron and that the rest of the configuration is left unchanged. Therefore, in Table 3 for V I, Co I, and Ni I not the ionization potential is used but the energy necessary to remove one 4s electron without changing the second 4s electron into a 3d electron, which would be mandatory in order to reach the ground state of the respective singly charged ion (see Table 1!). Impacting electrons with a kinetic energy larger than the ionization potential (= energy difference between ground states) but smaller than the energy necessary to remove one 4s electron without changing the state of the second 4s electron, will have a finite cross-section against ionization, but this cross-section should be relatively small and is neglected here.

Cross-Sections and Rate Coefficients

With the data of Table 1 cross-section curves for free atoms and for singly charged ions have been drawn (Figs. 1 through 20). As has been pointed out in the previous section, numerous uncertainties had to be replaced by reasonable guesses. Nevertheless I estimate the probable error of these cross-sections to be not higher than $\begin{matrix} +40 \\ -30 \end{matrix} \%$. The (relative) probable error is highest near threshold and is decreasing for values near maximum cross-section. All of the experimental points listed by Stafford³ are within this error limit.

As has been described in reference 1 the above formula can be folded with a Maxwellian electron distribution of temperature T in order to get a rate coefficient. The rate coefficients have been computed with the data of Tables 1 through 5 for a number of discrete electron temperatures between 1 and 10^4 eV, the results are given in Table 6 numerically and in Figs. 21 to 30 graphically. As far as an estimate of the error is concerned, the implications discussed in reference 1 are valid here as well. For single ionization of atoms and ions from the ground state in a rarefied plasma the rates given should not be in error by more than $\begin{matrix} +40 \\ -30 \end{matrix} \%$ (probable error). The error is larger for low electron temperatures, low compared to the ionization potential. For dense plasmas the ionization rates might be higher by an order of magnitude.

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Config	1	2	3	4	5	6	7	8	9	10	11	12
4s	1	10	6	Ca II	4.4	2.9	1.4	0	0.9	0.3	-	0.2
4s ²	2	10	6	Ca II	4.4	2.9	1.4	0.2	0.9	0.3	0.6	0.2
4s	1	10	6	Sc II	4.0	2.7	1.0	0	0.9	0.6	-	0.2
4s ²	2	10	6	Sc II	4.0	2.7	1.0	0.4	0.9	0.6	0.6	0.2
4s	1	10	6	Ti II	4.0	2.7	1.0	0	0.92	0.6	0.6	0.19
4s ²	2	10	6	Ti II	4.0	2.7	1.0	0.4	0.92	0.6	0.6	0.19
4s	1	10	6	V II	4.0	2.7	1.0	0	0.93	0.6	0.6	0.18
4s ²	2	10	6	V II	4.0	2.7	1.0	0.4	0.93	0.6	0.6	0.18
4s	1	10	6	Cr II	4.0	2.7	1.0	0	0.94	0.6	0.6	0.17
4s ²	2	10	6	Cr II	4.0	2.7	1.0	0.4	0.94	0.6	0.6	0.17
4s	1	10	6	Mn II	4.0	2.7	1.0	0	0.95	0.6	-	0.16
4s ²	2	10	6	Mn II	4.0	2.7	1.0	0.4	0.95	0.6	0.6	0.16
4s	1	10	6	Fe II	4.0	2.7	1.0	0	0.95	0.6	-	0.16
4s ²	2	10	6	Fe II	4.0	2.7	1.0	0.4	0.95	0.6	0.6	0.16
4s	1	10	6	Co II	4.4	2.9	1.4	0	0.9	0.3	-	0.2
4s ²	2	10	6	Co II	4.4	2.9	1.4	0.2	0.9	0.3	0.6	0.2
4s	1	10	6	Ni II	4.4	2.9	1.4	0	0.4	0.3	-	0.6
4s ²	2	10	6	Ni II	4.4	2.9	1.4	0.4	0.3	-	0.6	0.6
4s	1	10	6	Cu II	4.4	2.9	1.4	0	0.5	0.3	-	0.6
4s ²	2	10	6	Cu II	4.4	2.9	1.4	0.5	0.3	-	0.6	0.6
4s	1	10	6	Zn II	4.4	2.9	1.4	0	0.7	0.3	-	0.5
4s ²	2	10	6	Zn II	4.4	2.9	1.4	0.7	0.3	-	0.5	0.6
4s	1	10	6	Ga II	4.4	2.9	1.4	0	0.8	0.3	-	0.5
4s ²	2	10	6	Ga II	4.4	2.9	1.4	0.8	0.3	-	0.5	0.6
4s	1	10	6	Pb II	4.4	2.9	1.4	0	0.8	0.3	-	0.5
4s ²	2	10	6	Pb II	4.4	2.9	1.4	0.8	0.3	-	0.5	0.6
4s	1	10	6	Tl II	4.4	2.9	1.4	0	0.85	0.3	-	0.4
4s ²	2	10	6	Tl II	4.4	2.9	1.4	0.85	0.3	-	0.4	0.6
4s	1	10	6	Hg II	4.4	2.9	1.4	0	0.9	0.3	-	0.3
4s ²	2	10	6	Hg II	4.4	2.9	1.4	0.9	0.3	-	0.3	0.6
4s	1	10	6	Xe II	4.4	2.9	1.4	0	0.9	0.3	-	0.2
4s ²	2	10	6	Xe II	4.4	2.9	1.4	0.9	0.3	-	0.2	0.6
4s	1	10	6	Ce II	4.4	2.9	1.4	0	0.9	0.3	-	0.2
4s ²	2	10	6	Ce II	4.4	2.9	1.4	0.9	0.3	-	0.2	0.6
4s	1	10	6	Eu II	4.4	2.9	1.4	0	0.9	0.3	-	0.2
4s ²	2	10	6	Eu II	4.4	2.9	1.4	0.9	0.3	-	0.2	0.6
4s	1	10	6	Zn II	4.4	2.9	1.4	0	0.9	0.3	-	0.2
4s ²	2	10	6	Zn II	4.4	2.9	1.4	0.9	0.3	-	0.2	0.6
4s	1	10	6	Ga II	4.4	2.9	1.4	0	0.9	0.3	-	0.2
4s ²	2	10	6	Ga II	4.4	2.9	1.4	0.9	0.3	-	0.2	0.6

Table 1: Relevant data for the first and the second ionization stage of the elements under consideration. a_i is given in $10^{-14} \text{ cm}^2 (\text{eV})^2$.

Config-uration	q_1	q_2	q_3	Spe-cies	a_1	a_2	a_3	b_1	b_2	b_3	c_1	c_2	c_3
4s 3p ⁶	1	6	2	K I	4.0	4.0	4.0	0	0.6	0.4	-	0.4	0.6
4s ² 3p ⁶	2	6	2	Ca I	4.0	4.0	4.0	0.4	0.6	0.4	0.6	0.4	0.6
4s ² 3d	2	1	6	Sc I	4.0	3.8	4.0	0.4	0.7	0.6	0.6	0.4	0.4
4s ² 3d ²	2	2	6	Ti I	4.0	3.5	4.0	0.4	0.7	0.6	0.6	0.4	0.4
4s ² 3d ³	2	3	6	V I	4.0	3.2	4.0	0.4	0.8	0.6	0.6	0.25	0.4
4s 3d ⁵	1	5	6	Cr I	4.0	2.7	4.0	0	0.9	0.6	-	0.2	0.4
4s ² 3d ⁵	2	5	6	Mn I	4.0	2.7	4.0	0.4	0.9	0.6	0.6	0.2	0.4
4s ² 3d ⁶	2	6	6	Fe I	4.0	2.6	4.0	0.4	0.92	0.6	0.6	0.19	0.4
4s ² 3d ⁷	2	7	6	Co I	4.0	2.5	4.0	0.4	0.93	0.6	0.6	0.18	0.4
4s ² 3d ⁸	2	8	6	Ni I	4.0	2.4	4.0	0.4	0.94	0.6	0.6	0.17	0.4
4s 3d ¹⁰	1	10	6	Cu I	4.0	2.2	4.0	0	0.95	0.6	-	0.16	0.4
4s ² 3d ¹⁰	2	10	6	Zn I	4.0	2.2	4.0	0.4	0.95	0.6	0.6	0.16	0.4
4s 3p ⁶	1	6	2	Ca II	4.4	4.4	4.4	0	0.3	0.2	-	0.6	0.6
4s 3d	1	1	6	Sc II	4.4	4.2	4.4	0	0.4	0.3	-	0.6	0.6
4s 3d ²	1	2	6	Ti II	4.4	3.9	4.4	0	0.5	0.3	-	0.6	0.6
3d ⁴	0	4	6	V II	-	3.5	4.4	-	0.7	0.3	-	0.5	0.6
3d ⁵	0	5	6	Cr II	-	3.4	4.4	-	0.8	0.3	-	0.5	0.6
4s 3d ⁵	1	5	6	Mn II	4.4	3.4	4.4	0	0.8	0.3	-	0.5	0.6
4s 3d ⁶	1	6	6	Fe II	4.4	3.3	4.4	0	0.85	0.3	-	0.4	0.6
3d ⁸	0	8	6	Co II	-	3.1	4.4	-	0.9	0.3	-	0.3	0.6
3d ⁹	0	9	6	Ni II	-	3.0	4.4	-	0.9	0.3	-	0.25	0.6
3d ¹⁰	0	10	6	Cu II	-	2.9	4.4	-	0.9	0.3	-	0.2	0.6
4s 3d ¹⁰	1	10	6	Zn II	4.4	2.9	4.4	0	0.9	0.3	-	0.2	0.6
4s ² 3d ¹⁰	2	10	6	Ga II	4.4	2.9	4.4	0.2	0.9	0.3	0.6	0.2	0.6

Table 2: Relevant data for the third and the fourth ionization stage of the elements under consideration. a_i is given in $10^{-14} \text{ cm}^2 (\text{eV})^2$.

Configuration	q_1	q_2	q_3	Species	a_1	a_2	a_3	b_1	b_2	b_3	c_1	c_2	c_3
3d	1	6	2	Sc III	4.5	4.5	4.5	0.2	0.2	0	0.6	0.6	-
3d ²	2	6	2	Ti III	4.5	4.5	4.5	0.3	0.2	0	0.6	0.6	-
3d ³	3	6	2	V III	4.4	4.5	4.5	0.4	0.2	0	0.6	0.6	-
3d ⁴	4	6	2	Cr III	4.2	4.5	4.5	0.5	0.2	0	0.6	0.6	-
3d ⁵	5	6	2	Mn III	4.1	4.5	4.5	0.6	0.2	0	0.5	0.6	-
3d ⁶	6	6	2	Fe III	4.0	4.5	4.5	0.6	0.2	0	0.5	0.6	-
3d ⁷	7	6	2	Co III	3.9	4.5	4.5	0.7	0.2	0	0.5	0.6	-
3d ⁸	8	6	2	Ni III	3.8	4.5	4.5	0.7	0.2	0	0.5	0.6	-
3d ⁹	9	6	2	Cu III	3.7	4.5	4.5	0.8	0.2	0	0.4	0.6	-
3d ¹⁰	10	6	2	Zn III	3.6	4.5	4.5	0.8	0.2	0	0.4	0.6	-
3d	1	6	2	Ti IV	4.5	4.5	4.5	0	0	0	-	-	-
3d ²	2	6	2	V IV	4.5	4.5	4.5	0	0	0	-	-	-
3d ³	3	6	2	Cr IV	4.5	4.5	4.5	0.2	0	0	0.6	-	-
3d ⁴	4	6	2	Mn IV	4.5	4.5	4.5	0.2	0	0	0.6	-	-
3d ⁵	5	6	2	Fe IV	4.5	4.5	4.5	0.3	0	0	0.6	-	-
3d ⁶	6	6	2	Co IV	4.5	4.5	4.5	0.3	0	0	0.6	-	-
3d ⁷	7	6	2	Ni IV	4.4	4.5	4.5	0.4	0	0	0.6	-	-
3d ⁸	8	6	2	Cu IV	4.3	4.5	4.5	0.4	0	0	0.6	-	-
3d ⁹	9	6	2	Zn IV	4.2	4.5	4.5	0.5	0	0	0.6	-	-
3d ¹⁰	10	6	2	Ga IV	4.1	4.5	4.5	0.5	0	0	0.6	-	-

Table 3: Binding energy P_1 of electrons in the outermost subshell, generally equal to the ionization potential (in eV).

For atoms and singly charged ions ($\zeta = 1$ and $l = 2$) the binding energy of 4s electrons is given.

* = Energy necessary to remove one 4s electron while the second 4s electron remains a 4s electron and is not changed into a 3d electron; in these cases this energy is different from the respective ionization potential (IP = energy difference between ground states).

Z	ζ	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	
21	Sc	6.54	12.8	24.8	73.9	91.9	111	138	159	180	226	250	687	757	831	928	1009	1094	1213	1288	5675	6034						
22	Ti	6.82	13.6	27.5	43.2	99.9	120	141	170	193	217	266	292	789	863	942	1044	1131	1221	1346	1425	6249	6626					
23	V	*7.06	-	29.3	46.6	65.2	129	151	173	206	230	256	309	336	897	976	1060	1168	1260	1355	1486	1569	6851	7246				
24	Cr	6.77	-	31.0	49.1	69.3	91	161	185	209	244	271	298	355	384	1013	1097	1185	1299	1396	1496	1634	1721	7482	7895			
25	Mn	7.43	15.6	33.7	51.2	72.4	95	119	196	222	248	286	314	344	404	436	1136	1224	1317	1437	1539	1644	1788	1880	8141	8572		
26	Fe	7.87	16.2	30.7	54.8	75.0	99	125	151	235	262	290	331	361	392	457	490	1265	1358	1456	1582	1689	1799	1950	2045	8828	9278	
27	Co	*8.28	-	33.5	51.3	79.5	102	129	157	186	276	305	336	379	411	444	512	547	1402	1500	1603	1735	1846	1962	2119	2218	9544	
28	Ni	*8.68	-	35.2	54.9	75.5	108	133	162	193	225	321	352	384	430	464	499	571	608	1546	1648	1756	1894	2011	2131	2295	2399	
29	Cu	7.73	-	36.8	57.1	79.9	103	139	166	199	232	266	369	401	435	484	520	557	633	672	1697	1804	1916	2060	2182	2308	2478	
30	Zn	9.39	18.0	39.7	59.4	82.6	108	134	174	203	238	274	311	420	454	490	542	579	*619	698	739	1854	1966	2084	2234	2361	2493	

Table 4: Binding energy P_2 of electrons in the next inner subshell (in eV).
 For atoms and singly charged ions ($\zeta = 1$ and $\zeta = 2$) the binding energy of 3d electrons is given.
 The values for V II, Cr II, Co II, Ni II, and Cu II are identical with the ionization potential.

Z	ζ	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	
21	Sc	8	14	59	96	114	133	154	177	200	625	653	781	839	899	958	1042	1128	5399	5477								
22	Ti	8	15	68	83	124	144	165	188	213	238	723	753	890	951	1015	1077	1165	1256	5959	6041							
23	V	8	14.7	77	94	111	156	178	200	225	252	279	828	860	1006	1070	1137	1203	1296	1392	6547	6633						
24	Cr	8.25	16.5	86	104	123	142	191	214	238	266	294	323	940	974	1129	1197	1267	1336	1434	1535	7164	7254					
25	Mn	9	17	94	115	135	155	176	229	254	280	309	339	370	1059	1095	1259	1330	1404	1476	1579	1685	7809	7903				
26	Fe	9	17.5	103	125	147	169	190	213	271	297	324	356	388	421	1185	1223	1397	1471	1548	1622	1731	1842	8482	8580			
27	Co	9	17.1	112	135	159	182	206	229	253	315	343	372	406	439	474	1318	1358	1541	1619	1699	1776	1890	2007	9184	9286		
28	Ni	10	18.2	122	146	171	196	221	246	271	296	363	393	423	458	494	531	1458	1500	1694	1775	1858	1938	2056	2178	9914	10020	
29	Cu	10.4	20.3	132	158	184	210	236	263	289	316	342	414	446	477	514	552	591	1605	1649	1853	1938	2023	2106	2229	2357	10672	
30	Zn	11.2	24	142	170	197	225	252	280	308	336	364	391	469	502	535	574	613	654	1759	1805	2020	2108	2196	2281	2410	2543	

Table 5: Binding energy P_3 of electrons in the second next inner subshell (in eV).

For atoms and singly charged ions ($\zeta = 1$ and $\zeta = 2$) the binding energy of $3p$ electrons is given.

Z	$\zeta \rightarrow$	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
21	Sc	33	46	82	465	490	516	543	570	597	717	744									
22	Ti	38	53	93	109	551	578	606	635	664	693	821	850								
23	V	43	60	106	122	139	644	673	703	734	765	796	932	963							
24	Cr	48	67	117	136	154	172	744	775	807	840	873	906	1050	1083						
25	Mn	53	74	129	149	169	189	209	851	884	918	953	988	1023	1175	1210					
26	Fe	59	81	141	162	184	205	227	249	965	1000	1036	1073	1110	1147	1307	1344				
27	Co	66	89	153	176	199	222	245	268	292	1086	1123	1161	1200	1239	1278	1446	1485			
28	Ni	73	97	166	190	215	239	264	288	313	338	1214	1253	1293	1334	1375	1416	1592	1633		
29	Cu	80	106	179	205	231	257	283	309	335	361	387	1349	1390	1432	1475	1518	1561	1745	1788	
30	Zn	91	115	192	220	247	275	303	330	357	385	412	439	1491	1534	1578	1623	1668	1713	1905	1950

Table 6. Ionization rate coefficients for single ionization from the ground state by electron-impact in a rarefied plasma (Maxwellian distribution, no lowering of ionization potential, no collision limit).

E-08 = 10^{-8} etc.; T = T_e in eV; S = $\langle GV \rangle$ in cm^3/s ; error approx. $\pm 40\%$ to -30% . Scandium and Titanium.

T	SC I	SC II	SC III	SC IV	SC V	SC VI	SC VII	SC VIII	SC IX	SC X
1.0	1.10E-10	5.34E-14	6.48E-20	0.	0.	0.	0.	0.	0.	0.
1.5	1.20E-09	4.83E-12	3.05E-16	1.60E-30	5.31E-36	0.	0.	0.	0.	0.
2.0	4.15E-09	4.79E-11	2.17E-14	4.09E-25	2.74E-29	1.07E-33	0.	0.	0.	0.
3.0	1.51E-08	4.99E-10	1.62E-12	1.11E-19	1.49E-22	1.41E-25	8.50E-30	3.90E-33	1.39E-36	0.
4.0	2.97E-08	1.66E-09	1.45E-11	5.97E-17	3.61E-19	1.68E-21	9.70E-25	2.56E-27	5.27E-30	6.73E-35
5.0	4.53E-08	3.46E-09	5.49E-11	2.66E-15	3.96E-17	4.81E-19	1.08E-21	8.18E-24	4.84E-26	6.06E-30
7.0	7.52E-08	8.21E-09	2.61E-10	2.11E-13	8.86E-15	3.22E-16	3.47E-18	8.78E-20	1.75E-21	2.89E-24
10	1.12E-07	1.61E-08	8.90E-10	5.89E-12	5.39E-13	4.49E-14	1.58E-15	1.00E-16	5.19E-18	5.48E-20
15	1.57E-07	2.83E-08	2.55E-09	8.28E-11	1.40E-11	2.23E-12	2.00E-13	2.64E-14	2.94E-15	1.23E-16
20	1.86E-07	3.83E-08	4.64E-09	3.20E-10	7.39E-11	1.64E-11	2.36E-12	4.50E-13	7.46E-14	6.04E-15
30	2.23E-07	5.31E-08	9.16E-09	1.28E-09	4.07E-10	1.27E-10	2.91E-11	8.11E-12	2.03E-12	3.09E-13
40	2.43E-07	6.34E-08	1.34E-08	2.62E-09	9.78E-10	3.61E-10	1.05E-10	3.56E-11	1.10E-11	2.27E-12
50	2.55E-07	7.08E-08	1.71E-08	4.06E-09	1.67E-09	6.86E-10	2.30E-10	8.77E-11	3.07E-11	7.54E-12
70	2.68E-07	8.05E-08	2.29E-08	6.76E-09	3.13E-09	1.45E-09	5.73E-10	2.51E-10	1.02E-10	3.12E-11
100	2.74E-07	8.83E-08	2.88E-08	9.98E-09	5.06E-09	2.58E-09	1.16E-09	5.64E-10	2.57E-10	9.24E-11
150	2.73E-07	9.38E-08	3.44E-08	1.36E-08	7.40E-09	4.08E-09	2.03E-09	1.08E-09	5.43E-10	2.24E-10
200	2.68E-07	9.55E-08	3.73E-08	1.58E-08	8.98E-09	5.16E-09	2.72E-09	1.52E-09	8.04E-10	3.61E-10
300	2.56E-07	9.52E-08	3.99E-08	1.82E-08	1.09E-08	6.55E-09	3.67E-09	2.16E-09	1.22E-09	6.08E-10
400	2.45E-07	9.34E-08	4.08E-08	1.95E-08	1.19E-08	7.36E-09	4.27E-09	2.60E-09	1.52E-09	8.10E-10
500	2.35E-07	9.13E-08	4.09E-08	2.01E-08	1.25E-08	7.88E-09	4.67E-09	2.91E-09	1.74E-09	9.74E-10
700	2.19E-07	8.72E-08	4.04E-08	2.07E-08	1.31E-08	8.45E-09	5.16E-09	3.30E-09	2.04E-09	1.21E-09
1000	2.02E-07	8.19E-08	3.91E-08	2.07E-08	1.34E-08	8.79E-09	5.51E-09	3.61E-09	2.49E-09	1.64E-09
1500	1.82E-07	7.53E-08	3.70E-08	2.02E-08	1.33E-08	8.88E-09	5.59E-09	3.81E-09	2.69E-09	1.81E-09
2000	1.68E-07	7.04E-08	3.52E-08	1.96E-08	1.30E-08	8.78E-09	5.71E-09	3.87E-09	2.56E-09	1.73E-09
3000	1.49E-07	6.35E-08	3.23E-08	1.84E-08	1.24E-08	8.47E-09	5.59E-09	3.84E-09	2.59E-09	1.81E-09
4000	1.37E-07	5.87E-08	3.03E-08	1.75E-08	1.18E-08	8.15E-09	5.43E-09	3.76E-09	2.56E-09	1.82E-09
5000	1.27E-07	5.50E-08	2.86E-08	1.67E-08	1.13E-08	7.86E-09	5.27E-09	3.67E-09	2.52E-09	1.81E-09
7000	1.14E-07	4.98E-08	2.62E-08	1.55E-08	1.06E-08	7.38E-09	4.98E-09	3.50E-09	2.42E-09	1.77E-09
10000	1.01E-07	4.45E-08	2.37E-08	1.42E-08	9.75E-09	6.83E-09	4.65E-09	3.29E-09	2.29E-09	1.70E-09

T	SC XI	SC XII	SC XIII	SC XIV	SC XV	SC XVI	SC XVII	SC XVIII	SC XIX	SC XX
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	6.83E-38	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	2.04E-32	0.	0.	0.	0.	0.	0.	0.	0.	0.
7.0	3.83E-26	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	2.04E-21	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	1.02E-17	1.87E-30	1.21E-32	5.82E-35	5.88E-38	0.	0.	0.	0.	0.
20	7.48E-16	2.02E-25	4.21E-27	6.98E-29	3.70E-31	3.77E-33	2.61E-35	8.24E-38	0.	0.
30	5.73E-14	2.31E-20	1.56E-21	9.01E-23	2.53E-24	1.02E-25	3.14E-27	6.04E-29	2.20E-30	0.
40	5.16E-13	8.18E-18	9.97E-19	1.08E-19	6.94E-21	5.65E-22	3.68E-23	1.70E-24	1.15E-25	0.
50	1.96E-12	2.84E-16	4.95E-17	7.85E-18	8.26E-19	1.02E-19	1.05E-20	8.11E-22	8.05E-23	0.
70	9.23E-12	1.71E-14	4.49E-15	1.10E-15	2.02E-16	4.05E-17	7.00E-18	9.69E-19	1.48E-19	0.
100	3.06E-11	3.88E-13	1.39E-13	4.72E-14	1.31E-14	3.77E-15	9.65E-16	2.05E-16	4.32E-17	4.16E-37
150	8.35E-11	4.62E-12	2.11E-12	9.24E-13	3.50E-13	1.35E-13	4.68E-14	1.39E-14	3.75E-15	8.29E-29
200	1.46E-10	1.64E-11	8.43E-12	4.21E-12	1.86E-12	1.28E-13	3.35E-13	1.17E-13	3.61E-14	1.22E-24
300	2.77E-10	5.98E-11	3.48E-11	1.98E-11	1.02E-11	5.26E-12	2.49E-12	1.03E-12	3.59E-13	1.88E-20
400	3.99E-10	1.16E-10	7.19E-11	4.36E-11	2.44E-11	1.35E-11	6.92E-12	3.11E-12	1.16E-12	2.42E-18
500	5.05E-10	1.74E-10	1.12E-10	7.07E-11	4.15E-11	2.40E-11	1.29E-11	6.11E-12	2.36E-12	4.55E-17
700	6.74E-10	2.78E-10	1.87E-10	1.24E-10	7.70E-11	4.69E-11	2.66E-11	1.34E-11	5.41E-12	1.34E-15
1000	8.45E-10	3.98E-10	2.77E-10	1.90E-10	1.23E-10	7.83E-11	4.64E-11	2.44E-11	1.02E-11	1.76E-14
1500	1.01E-09	5.24E-10	3.77E-10	2.66E-10	1.79E-10	1.17E-10	7.20E-11	3.94E-11	1.71E-11	1.35E-13
2000	1.10E-09	5.99E-10	4.37E-10	3.14E-10	2.15E-10	1.43E-10	8.97E-11	5.03E-11	2.22E-11	3.82E-13
3000	1.18E-09	6.78E-10	5.03E-10	3.67E-10	2.56E-10	1.74E-10	1.11E-10	6.44E-11	2.93E-11	1.10E-12
4000	1.20E-09	7.13E-10	5.34E-10	3.93E-10	2.77E-10	1.91E-10	1.23E-10	7.28E-11	3.37E-11	1.90E-12
5000	1.21E-09	7.30E-10	5.49E-10	4.07E-10	2.89E-10	2.00E-10	1.30E-10	7.81E-11	3.67E-11	2.64E-12
7000	1.20E-09	7.38E-10	5.60E-10	4.18E-10	2.99E-10	2.09E-10	1.37E-10	8.41E-11	4.04E-11	3.87E-12
10000	1.16E-09	7.29E-10	5.56E-10	4.18E-10	3.01E-10	2.12E-10	1.40E-10	8.78E-11	4.30E-11	5.16E-12

T	SC XXI	TI I	TI II	TI III	TI IV	TI V	TI VI	TI VII	TI VIII	TI IX
1.0	0.	8.13E-11	2.21E-14	6.26E-21	2.74E-28	0.	0.	0.	0.	0.
1.5	0.	1.00E-09	2.70E-12	7.28E-17	5.95E-22	2.61E-38	0.	0.	0.	0.
2.0	0.	3.69E-09	3.14E-11	8.16E-15	9.10E-19	5.10E-31	1.28E-35	0.	0.	0.
3.0	0.	1.44E-08	3.87E-10	9.63E-13	1.46E-15	1.05E-23	7.52E-27	3.99E-30	1.31E-34	3.17E-38
4.0	0.	2.94E-08	1.41E-09	1.08E-11	6.07E-14	4.97E-20	1.90E-22	5.80E-25	2.15E-28	3.54E-31
5.0	0.	4.59E-08	3.12E-09	4.73E-11	5.78E-13	8.15E-18	8.52E-20	7.45E-22	1.18E-24	6.17E-27
7.0	0.	7.85E-08	7.93E-09	2.63E-10	7.85E-12	2.87E-15	9.50E-17	2.77E-18	2.35E-20	4.50E-22
10	0.	1.20E-07	1.65E-08	9.98E-10	5.86E-11	2.45E-13	1.94E-14	1.40E-15	4.23E-17	2.25E-18
15	0.	1.71E-07	3.02E-08	3.00E-09	3.10E-10	8.28E-12	1.29E-12	1.90E-13	1.56E-14	1.84E-15
20	0.	2.05E-07	4.16E-08	5.47E-09	7.75E-10	4.99E-11	1.10E-11	2.32E-12	3.15E-13	5.55E-14
30	0.	2.48E-07	5.87E-08	1.06E-08	2.15E-09	3.13E-10	9.78E-11	2.98E-11	6.69E-12	1.79E-12
40	0.	2.71E-07	7.04E-08	1.53E-08	3.80E-09	8.04E-10	3.00E-10	1.10E-10	3.18E-11	1.05E-11
50	0.	2.85E-07	7.88E-08	1.94E-08	5.47E-09	1.43E-09	5.95E-10	2.45E-10	8.23E-11	3.09E-11
70	0.	3.00E-07	8.97E-08	2.58E-08	8.49E-09	2.81E-09	1.32E-09	6.22E-10	2.49E-10	1.08E-10
100	5.08E-39	3.07E-07	9.85E-08	3.22E-08	1.20E-08	4.70E-09	2.45E-09	1.27E-09	5.83E-10	2.85E-10
150	3.35E-30	3.05E-07	1.04E-07	3.82E-08	1.58E-08	7.09E-09	4.00E-09	2.26E-09	1.15E-09	6.18E-10
200	8.96E-26	2.99E-07	1.06E-07	4.14E-08	1.82E-08	8.72E-09	5.14E-09	3.03E-09	1.64E-09	9.25E-10
300	2.52E-21	2.85E-07	1.06E-07	4.43E-08	2.07E-08	1.07E-08	6.61E-09	4.10E-09	2.36E-09	1.41E-09
400	4.38E-19	2.72E-07	1.04E-07	4.52E-08	2.18E-08	1.18E-08	7.48E-09	4.77E-09	2.85E-09	1.76E-09
500	9.87E-18	2.62E-07	1.01E-07	4.53E-08	2.24E-08	1.25E-08	8.04E-09	5.22E-09	3.19E-09	2.01E-09
700	3.58E-16	2.44E-07	9.67E-08	4.47E-08	2.27E-08	1.31E-08	8.66E-09	5.75E-09	3.62E-09	2.35E-09
1000	5.47E-15	2.24E-07	9.08E-08	4.32E-08	2.25E-08	1.35E-08	9.05E-09	6.13E-09	3.96E-09	2.63E-09
1500	4.74E-14	2.02E-07	8.34E-08	4.08E-08	2.18E-08	1.34E-08	9.17E-09	6.33E-09	4.18E-09	2.84E-09
2000	1.43E-13	1.86E-07	7.80E-08	3.88E-08	2.10E-08	1.32E-08	9.09E-09	6.33E-09	4.24E-09	2.92E-09
3000	4.39E-13	1.66E-07	7.03E-08	3.57E-08	1.96E-08	1.26E-08	8.78E-09	6.19E-09	4.21E-09	2.94E-09
4000	7.80E-13	1.52E-07	6.49E-08	3.33E-08	1.85E-08	1.20E-08	8.46E-09	6.01E-09	4.13E-09	2.91E-09
5000	1.11E-12	1.41E-07	6.09E-08	3.15E-08	1.76E-08	1.16E-08	8.17E-09	5.83E-09	4.03E-09	2.85E-09
7000	1.66E-12	1.27E-07	5.51E-08	2.89E-08	1.62E-08	1.08E-08	7.68E-09	5.51E-09	3.84E-09	2.74E-09
10000	2.25E-12	1.12E-07	4.93E-08	2.61E-08	1.48E-08	9.95E-09	7.12E-09	5.14E-09	3.60E-09	2.59E-09

Table 6. (Continued)

Titanium and Vanadium

T	TI X	TI XI	TI XII	TI XIII	TI XIV	TI XV	TI XVI	TI XVII	TI XVIII	TI XIX
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	4.51E-34	2.21E-39	0.	0.	0.	0.	0.	0.	0.	0.
5.0	2.50E-29	1.47E-33	3.37E-36	0.	0.	0.	0.	0.	0.	0.
7.0	7.05E-24	6.90E-27	6.99E-29	0.	0.	0.	0.	0.	0.	0.
10	9.63E-20	7.29E-22	2.25E-23	0.	0.	0.	0.	0.	0.	0.
15	1.81E-16	6.23E-18	4.59E-19	1.58E-33	7.96E-36	2.76E-38	0.	0.	0.	0.
20	8.43E-15	5.96E-16	6.78E-17	9.35E-28	1.62E-29	2.11E-31	8.72E-34	6.70E-36	3.62E-38	0.
30	4.23E-13	5.97E-14	1.05E-14	5.86E-22	3.51E-23	1.73E-24	4.12E-26	1.39E-27	3.63E-29	5.84E-31
40	3.12E-12	6.15E-13	1.35E-13	4.86E-19	5.42E-20	5.23E-21	2.98E-22	2.12E-23	1.23E-24	4.98E-26
50	1.05E-11	2.53E-12	6.32E-13	2.81E-17	4.58E-18	6.62E-19	6.35E-20	7.09E-21	6.62E-22	4.63E-23
70	4.34E-11	1.31E-11	3.80E-12	3.04E-15	7.62E-16	1.75E-16	3.03E-17	5.66E-18	9.16E-19	1.18E-19
100	1.29E-10	4.60E-11	1.51E-11	1.07E-13	3.72E-14	1.21E-14	3.24E-15	8.92E-15	2.18E-15	4.44E-17
150	3.11E-10	1.28E-10	4.69E-11	1.80E-12	8.08E-13	3.46E-13	1.29E-13	4.80E-14	1.63E-14	4.69E-15
200	4.91E-10	2.20E-10	8.75E-11	7.60E-12	3.88E-12	1.90E-12	8.34E-13	3.63E-13	1.44E-13	4.96E-14
300	7.98E-10	3.97E-10	1.78E-10	3.31E-11	1.93E-11	1.08E-11	5.59E-12	2.84E-12	1.33E-12	5.45E-13
400	1.03E-09	5.50E-10	2.66E-10	7.04E-11	4.37E-11	2.64E-11	1.48E-11	8.11E-12	4.13E-12	1.85E-12
500	1.21E-09	6.78E-10	3.47E-10	1.12E-10	7.21E-11	4.54E-11	2.67E-11	1.54E-11	8.24E-12	3.88E-12
700	1.47E-09	8.74E-10	4.80E-10	1.91E-10	1.29E-10	8.53E-11	5.32E-11	3.24E-11	1.84E-11	9.22E-12
1000	1.69E-09	1.07E-09	6.23E-10	2.86E-10	2.01E-10	1.38E-10	9.00E-11	5.72E-11	3.40E-11	1.79E-11
1500	1.88E-09	1.25E-09	7.67E-10	3.94E-10	2.85E-10	2.02E-10	1.36E-10	8.98E-11	5.53E-11	3.03E-11
2000	1.96E-09	1.34E-09	8.48E-10	4.61E-10	3.39E-10	2.44E-10	1.68E-10	1.13E-10	7.07E-11	3.97E-11
3000	2.01E-09	1.42E-09	9.28E-10	5.34E-10	3.99E-10	2.93E-10	2.06E-10	1.41E-10	9.01E-11	5.22E-11
4000	2.01E-09	1.44E-09	9.60E-10	5.69E-10	4.29E-10	3.18E-10	2.26E-10	1.56E-10	1.01E-10	5.99E-11
5000	1.98E-09	1.45E-09	9.71E-10	5.87E-10	4.46E-10	3.32E-10	2.38E-10	1.65E-10	1.08E-10	6.48E-11
7000	1.92E-09	1.42E-09	9.70E-10	6.00E-10	4.59E-10	3.45E-10	2.49E-10	1.74E-10	1.15E-10	7.06E-11
10000	1.83E-09	1.38E-09	9.48E-10	5.98E-10	4.60E-10	3.48E-10	2.53E-10	1.79E-10	1.18E-10	7.45E-11

T	TI XX	TI XXI	TI XXII	V I	V II	V III	V IV	V V	V VI	V VII
1.0	0.	0.	0.	6.13E-11	5.80E-15	1.16E-21	1.57E-29	3.38E-38	0.	0.
1.5	0.	0.	0.	8.20E-10	9.81E-13	2.46E-17	1.06E-22	1.13E-28	0.	0.
2.0	0.	0.	0.	3.14E-09	1.34E-11	3.74E-15	2.87E-19	6.77E-24	1.47E-37	0.
3.0	0.	0.	0.	1.27E-08	1.98E-10	6.01E-13	8.14E-16	4.28E-19	3.89E-28	1.55E-31
4.0	0.	0.	0.	2.66E-08	8.01E-10	7.93E-12	4.48E-14	1.12E-16	2.08E-23	5.20E-26
5.0	0.	0.	0.	4.22E-08	1.91E-09	3.81E-11	5.07E-13	3.21E-15	1.46E-20	1.10E-22
7.0	0.	0.	0.	7.35E-08	5.37E-09	2.37E-10	8.33E-12	1.54E-13	2.73E-17	7.22E-19
10	0.	0.	0.	1.15E-07	1.23E-08	9.78E-10	7.07E-11	2.97E-12	8.13E-15	5.55E-15
15	0.	0.	0.	1.67E-07	2.46E-08	3.12E-09	3.94E-10	3.29E-11	7.28E-13	1.04E-13
20	0.	0.	0.	2.04E-07	3.59E-08	5.80E-09	9.77E-10	1.20E-10	7.16E-12	1.49E-12
30	1.87E-32	0.	0.	2.52E-07	5.39E-08	1.14E-08	2.60E-09	5.02E-10	7.38E-11	2.25E-11
40	3.08E-27	0.	0.	2.79E-07	6.70E-08	1.65E-08	4.45E-09	1.10E-09	2.44E-10	9.02E-11
50	4.26E-24	0.	0.	2.97E-07	7.66E-08	2.09E-08	6.27E-09	1.82E-09	5.66E-10	2.11E-10
70	1.71E-20	0.	0.	3.16E-07	8.93E-08	2.78E-08	9.50E-09	3.34E-09	1.19E-09	5.66E-10
100	9.02E-18	0.	0.	3.26E-07	9.98E-08	3.48E-08	1.32E-08	5.39E-09	2.28E-09	1.21E-09
150	1.24E-15	1.49E-30	5.38E-32	3.27E-07	1.07E-07	4.14E-08	1.73E-08	7.94E-09	3.85E-09	2.22E-09
200	1.50E-14	5.71E-26	3.86E-27	3.22E-07	1.10E-07	4.49E-08	1.98E-08	9.56E-09	5.02E-09	3.03E-09
300	1.88E-13	2.30E-21	2.92E-22	3.08E-07	1.10E-07	4.79E-08	2.24E-08	1.17E-08	6.56E-09	4.16E-09
400	6.83E-13	4.78E-19	8.31E-20	2.94E-07	1.08E-07	4.89E-08	2.35E-08	1.28E-08	7.49E-09	4.88E-09
500	1.50E-12	1.20E-17	2.52E-18	2.83E-07	1.05E-07	4.91E-08	2.42E-08	1.34E-08	8.08E-09	5.36E-09
700	3.72E-12	4.92E-16	1.28E-16	2.64E-07	1.01E-07	4.84E-08	2.46E-08	1.40E-08	8.76E-09	5.94E-09
1000	7.50E-12	8.26E-15	2.54E-15	2.43E-07	9.46E-08	4.86E-08	2.44E-08	1.43E-08	9.19E-09	6.35E-09
1500	1.31E-11	7.71E-14	2.69E-14	2.19E-07	8.70E-08	4.42E-08	2.35E-08	1.41E-08	9.36E-09	6.58E-09
2000	1.76E-11	2.40E-13	8.95E-14	2.02E-07	8.13E-08	4.20E-08	2.27E-08	1.37E-08	9.29E-09	6.50E-09
3000	2.37E-11	7.68E-13	3.05E-13	1.79E-07	7.32E-08	3.86E-08	2.12E-08	1.30E-08	9.00E-09	6.47E-09
4000	2.77E-11	1.39E-12	5.72E-13	1.64E-07	6.77E-08	3.61E-08	2.00E-08	1.24E-08	8.68E-09	6.28E-09
5000	3.05E-11	2.00E-12	8.38E-13	1.53E-07	6.35E-08	3.41E-08	1.90E-08	1.18E-08	8.39E-09	6.10E-09
7000	3.39E-11	3.04E-12	1.31E-12	1.37E-07	5.47E-08	3.12E-08	1.75E-08	1.10E-08	7.90E-09	5.77E-09
10000	3.64E-11	4.17E-12	1.83E-12	1.22E-07	5.13E-08	2.82E-08	1.60E-08	1.01E-08	7.33E-09	5.39E-09

T	V VIII	V IX	V X	V XI	V XII	V XIII	V XIV	V XV	V XVI	V XVII
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	6.20E-35	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	1.30E-28	1.81E-32	2.40E-35	1.45E-38	0.	0.	0.	0.	0.	0.
5.0	8.26E-25	6.03E-28	2.66E-30	5.96E-33	2.01E-37	0.	0.	0.	0.	0.
7.0	1.91E-20	9.38E-23	1.63E-24	1.65E-26	1.10E-29	9.87E-32	0.	0.	0.	0.
10	3.80E-17	7.90E-19	3.88E-20	1.25E-21	7.37E-24	2.10E-25	0.	0.	0.	0.
15	1.50E-14	9.72E-16	1.09E-16	8.92E-18	2.64E-19	1.85E-20	9.16E-37	3.33E-39	0.	0.
20	3.14E-13	3.58E-14	6.11E-15	8.13E-16	5.19E-17	5.72E-18	3.28E-30	4.46E-32	4.57E-34	1.40E-36
30	6.92E-12	1.40E-12	3.67E-13	8.01E-14	1.07E-14	1.85E-15	1.24E-23	6.34E-25	2.67E-26	5.23E-28
40	3.36E-11	9.04E-12	2.96E-12	8.30E-13	1.58E-13	3.43E-14	2.53E-20	2.51E-21	2.16E-22	1.07E-23
50	8.83E-11	2.82E-11	1.05E-11	3.45E-12	8.09E-13	2.01E-13	2.51E-18	3.73E-19	4.93E-20	4.23E-21
70	2.72E-10	1.06E-10	4.61E-11	1.80E-11	5.36E-12	1.56E-12	5.04E-16	1.19E-16	2.57E-17	4.11E-18
100	6.46E-10	2.91E-10	1.43E-10	6.41E-11	2.28E-11	7.49E-12	2.83E-14	9.44E-15	2.96E-15	7.50E-16
150	1.29E-09	6.55E-10	3.56E-10	1.78E-10	7.30E-11	2.68E-11	6.85E-13	3.00E-13	1.26E-13	4.53E-14
200	1.84E-09	9.96E-10	5.70E-10	3.02E-10	1.35E-10	5.33E-11	3.48E-12	1.75E-12	8.45E-13	3.62E-13
300	2.66E-09	1.54E-09	9.31E-10	5.27E-10	2.62E-10	1.16E-10	1.83E-11	1.05E-11	5.89E-12	3.00E-12
400	3.20E-09	1.92E-09	1.20E-09	7.09E-10	3.77E-10	1.80E-10	4.27E-11	2.64E-11	1.59E-11	8.83E-12
500	3.58E-09	2.21E-09	1.41E-09	8.55E-10	4.77E-10	2.42E-10	7.18E-11	4.63E-11	2.91E-11	1.71E-11
700	4.06E-09	2.58E-09	1.70E-09	1.07E-09	6.36E-10	3.47E-10	1.31E-10	8.89E-11	5.88E-11	3.66E-11
1000	4.43E-09	2.89E-09	1.95E-09	1.26E-09	8.00E-10	4.65E-10	2.08E-10	1.46E-10	1.01E-10	6.58E-11
1500	4.67E-09	3.12E-09	2.16E-09	1.44E-09	9.59E-10	5.90E-10	2.99E-10	2.17E-10	1.54E-10	1.05E-10
2000	4.73E-09	3.21E-09	2.25E-09	1.52E-09	1.05E-09	6.64E-10	3.57E-10	2.64E-10	1.91E-10	1.32E-10
3000	4.69E-09	3.24E-09	2.30E-09	1.58E-09	1.13E-09	7.41E-10	4.25E-10	3.19E-10	2.35E-10	1.56E-10
4000	4.59E-09	3.20E-09	2.29E-09	1.59E-09	1.16E-09	7.75E-10	4.59E-10	3.48E-10	2.59E-10	1.85E-10
5000	4.48E-09	3.14E-09	2.26E-09	1.58E-09	1.17E-09	7.90E-10	4.78E-10	3.64E-10	2.73E-10	1.96E-10
7000	4.27E-09	3.01E-09	2.19E-09	1.55E-09	1.16E-09	7.96E-10	4.94E-10	3.80E-10	2.87E-10	2.08E-10
10000	4.00E-09	2.85E-09	2.08E-09	1.48E-09	1.13E-09	7.84E-10	4.97E-10	3.84E-10	2.92E-10	2.13E-10

Table 6. (Continued)

Vanadium, Chromium, and Manganese

T	V XVIII	V XIX	V XX	V XXI	V XXII	V XXIII	CR I	CR II	CR III	CR IV
1.0	0.	0.	0.	0.	0.	0.	6.44E-11	6.62E-16	2.40E-22	1.40E-30
1.5	0.	0.	0.	0.	0.	0.	7.57E-10	2.10E-13	9.02E-18	2.19E-23
2.0	0.	0.	0.	0.	0.	0.	2.71E-09	3.97E-12	1.82E-15	9.00E-20
3.0	0.	0.	0.	0.	0.	0.	1.03E-08	8.19E-11	3.88E-13	3.90E-16
4.0	0.	0.	0.	0.	0.	0.	2.08E-08	3.96E-10	5.90E-12	2.56E-14
5.0	0.	0.	0.	0.	0.	0.	3.25E-08	1.06E-09	3.09E-11	3.43E-13
7.0	0.	0.	0.	0.	0.	0.	5.60E-08	3.41E-09	2.12E-10	6.56E-12
10	0.	0.	0.	0.	0.	0.	8.75E-08	8.43E-09	9.39E-10	6.25E-11
15	0.	0.	0.	0.	0.	0.	1.29E-07	1.93E-08	3.15E-09	3.81E-10
20	7.29E-39	0.	0.	0.	0.	0.	1.61E-07	2.97E-08	5.97E-09	9.79E-10
30	1.50E-29	3.31E-31	4.51E-33	1.27E-34	0.	0.	2.04E-07	4.72E-08	1.19E-08	2.68E-09
40	6.74E-25	3.44E-26	1.24E-27	6.97E-29	0.	0.	2.31E-07	6.05E-08	1.73E-08	4.63E-09
50	4.30E-22	3.63E-23	2.32E-24	1.98E-25	0.	0.	2.50E-07	7.06E-08	2.19E-08	6.56E-09
70	7.20E-19	1.09E-19	1.32E-20	1.81E-21	0.	0.	2.72E-07	8.43E-08	2.91E-08	1.00E-08
100	1.98E-16	4.63E-17	9.04E-18	1.77E-18	0.	0.	2.87E-07	9.58E-08	3.64E-08	1.41E-08
150	1.65E-14	5.42E-15	1.53E-15	3.95E-16	2.25E-32	7.23E-34	2.94E-07	1.04E-07	4.33E-08	1.85E-08
200	1.55E-13	6.04E-14	2.04E-14	6.08E-15	2.35E-27	1.46E-28	2.92E-07	1.08E-07	4.70E-08	2.12E-08
300	1.51E-12	7.00E-13	2.84E-13	9.73E-14	2.58E-22	3.10E-23	2.82E-07	1.09E-07	5.03E-08	2.41E-08
400	4.82E-12	2.44E-12	1.09E-12	3.99E-13	8.87E-20	1.48E-20	2.72E-07	1.07E-07	5.14E-08	2.55E-08
500	9.79E-12	5.22E-12	2.45E-12	9.42E-13	3.01E-18	6.13E-19	2.62E-07	1.05E-07	5.15E-08	2.62E-08
700	2.23E-11	1.26E-11	6.34E-12	2.55E-12	1.75E-16	4.46E-17	2.45E-07	1.01E-07	5.09E-08	2.66E-08
1000	4.19E-11	2.49E-11	1.31E-11	5.49E-12	3.80E-15	1.15E-15	2.26E-07	9.50E-08	4.92E-08	2.64E-08
1500	6.90E-11	4.26E-11	2.34E-11	1.01E-11	4.35E-14	1.51E-14	2.04E-07	8.75E-08	4.65E-08	2.55E-08
2000	8.88E-11	5.59E-11	3.15E-11	1.39E-11	1.50E-13	5.57E-14	1.89E-07	8.19E-08	4.42E-08	2.46E-08
3000	1.14E-10	7.32E-11	4.25E-11	1.93E-11	5.34E-13	2.12E-13	1.68E-07	7.39E-08	4.06E-08	2.30E-08
4000	1.28E-10	8.34E-11	4.95E-11	2.29E-11	1.02E-12	4.19E-13	1.54E-07	6.83E-08	3.80E-08	2.17E-08
5000	1.37E-10	8.98E-11	5.41E-11	2.54E-11	1.51E-12	6.35E-13	1.43E-07	6.41E-08	3.59E-08	2.06E-08
7000	1.46E-10	9.68E-11	5.96E-11	2.86E-11	2.39E-12	1.03E-12	1.29E-07	5.80E-08	3.28E-08	1.90E-08
10000	1.51E-10	1.01E-10	6.35E-11	3.10E-11	3.38E-12	1.48E-12	1.14E-07	5.19E-08	2.97E-08	1.73E-08
T	CR V	CR VI	CR VII	CR VIII	CR IX	CR X	CR XI	CR XII	CR XIII	CR XIV
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	1.30E-29	2.60E-36	0.	0.	0.	0.	0.	0.	0.	0.
2.0	1.55E-24	1.08E-29	0.	0.	0.	0.	0.	0.	0.	0.
3.0	1.94E-19	4.72E-23	5.85E-33	1.24E-36	0.	0.	0.	0.	0.	0.
4.0	7.12E-17	1.03E-19	4.51E-27	7.08E-30	1.10E-32	9.65E-37	0.	0.	0.	0.
5.0	2.51E-15	1.05E-17	1.57E-23	8.20E-26	4.24E-28	2.15E-31	5.26E-34	9.87E-37	0.	0.
7.0	1.53E-13	2.17E-15	1.82E-19	3.76E-21	7.68E-23	2.91E-25	3.36E-27	2.99E-29	1.17E-32	7.97E-35
10	3.45E-12	1.24E-13	2.15E-16	1.24E-17	7.15E-19	1.24E-20	4.63E-22	1.35E-23	5.63E-26	1.33E-27
15	4.16E-11	3.21E-12	5.60E-14	7.29E-15	9.40E-16	5.42E-17	5.10E-18	3.91E-19	9.38E-21	5.82E-22
20	1.52E-10	1.80E-11	9.43E-13	1.84E-13	3.58E-14	3.77E-15	5.69E-16	7.19E-17	3.97E-18	4.00E-19
30	6.06E-10	1.17E-10	1.67E-11	4.94E-12	1.45E-12	2.79E-13	6.81E-14	1.44E-14	1.76E-15	2.88E-16
40	1.28E-09	3.26E-10	7.26E-11	2.64E-11	9.58E-12	2.50E-12	7.76E-13	2.14E-13	3.84E-14	7.99E-15
50	2.07E-09	6.25E-10	1.78E-10	7.35E-11	3.03E-11	9.46E-12	3.41E-12	1.10E-12	2.48E-13	5.98E-14
70	3.70E-09	1.37E-09	5.06E-10	2.42E-10	1.16E-10	4.45E-11	1.90E-11	7.39E-12	2.14E-12	6.12E-13
100	5.89E-09	2.55E-09	1.13E-09	6.05E-10	3.23E-10	1.46E-10	7.11E-11	3.18E-11	1.11E-11	3.52E-12
150	8.59E-09	4.22E-09	2.15E-09	1.26E-09	7.37E-10	3.77E-10	2.04E-10	1.02E-10	4.17E-11	1.51E-11
200	1.04E-08	5.46E-09	2.98E-09	1.83E-09	1.12E-09	6.14E-10	3.51E-10	1.87E-10	8.31E-11	3.24E-11
300	1.26E-08	7.07E-09	4.16E-09	2.69E-09	1.74E-09	1.02E-09	6.19E-10	3.53E-10	1.74E-10	7.55E-11
400	1.38E-08	8.01E-09	4.92E-09	3.27E-09	2.17E-09	1.32E-09	8.32E-10	4.94E-10	2.61E-10	1.23E-10
500	1.45E-08	8.60E-09	5.44E-09	3.68E-09	2.49E-09	1.56E-09	1.00E-09	6.10E-10	3.39E-10	1.69E-10
700	1.51E-08	9.24E-09	6.06E-09	4.20E-09	2.91E-09	1.88E-09	1.24E-09	7.86E-10	4.68E-10	2.52E-10
1000	1.53E-08	9.60E-09	6.51E-09	4.60E-09	3.25E-09	2.16E-09	1.47E-09	9.57E-10	6.06E-10	3.50E-10
1500	1.51E-08	9.67E-09	6.77E-09	4.86E-09	3.50E-09	2.38E-09	1.66E-09	1.11E-09	7.46E-10	4.57E-10
2000	1.48E-08	9.53E-09	6.80E-09	4.94E-09	3.59E-09	2.48E-09	1.75E-09	1.19E-09	8.27E-10	5.23E-10
3000	1.40E-08	9.15E-09	6.68E-09	4.91E-09	3.62E-09	2.54E-09	1.82E-09	1.26E-09	9.09E-10	5.96E-10
4000	1.33E-08	8.78E-09	6.50E-09	4.81E-09	3.57E-09	2.53E-09	1.83E-09	1.28E-09	9.43E-10	6.30E-10
5000	1.28E-08	8.45E-09	6.32E-09	4.69E-09	3.50E-09	2.49E-09	1.82E-09	1.29E-09	9.56E-10	6.47E-10
7000	1.19E-08	7.91E-09	5.99E-09	4.48E-09	3.36E-09	2.41E-09	1.77E-09	1.26E-09	9.58E-10	6.59E-10
10000	1.09E-08	7.31E-09	5.59E-09	4.20E-09	3.17E-09	2.30E-09	1.69E-09	1.22E-09	9.39E-10	6.54E-10
T	CR XV	CR XVI	CR XVII	CR XVIII	CR XIX	CR XX	CR XXI	CR XXII	MN I	MN II
1.0	0.	0.	0.	0.	0.	0.	0.	0.	3.54E-11	2.29E-15
1.5	0.	0.	0.	0.	0.	0.	0.	0.	5.29E-10	5.56E-13
2.0	0.	0.	0.	0.	0.	0.	0.	0.	2.15E-09	9.19E-12
3.0	0.	0.	0.	0.	0.	0.	0.	0.	9.32E-09	1.64E-10
4.0	0.	0.	0.	0.	0.	0.	0.	0.	2.02E-08	7.30E-10
5.0	0.	0.	0.	0.	0.	0.	0.	0.	3.30E-08	1.84E-09
7.0	0.	0.	0.	0.	0.	0.	0.	0.	5.97E-08	5.53E-09
10	0.	0.	0.	0.	0.	0.	0.	0.	9.66E-08	1.33E-08
15	0.	0.	0.	0.	0.	0.	0.	0.	1.46E-07	2.75E-08
20	7.79E-33	8.33E-35	7.05E-37	0.	0.	0.	0.	0.	1.82E-07	4.08E-08
30	2.04E-25	8.90E-27	3.31E-28	5.33E-30	1.30E-31	2.42E-33	2.69E-35	6.58E-37	2.31E-07	6.21E-08
40	1.09E-21	9.66E-23	7.57E-24	3.24E-25	1.81E-26	8.16E-28	2.53E-29	1.30E-30	2.62E-07	7.75E-08
50	1.94E-19	2.63E-20	3.23E-21	2.48E-22	2.29E-23	1.75E-24	9.95E-26	7.88E-27	2.82E-07	8.89E-08
70	7.56E-17	1.67E-17	3.44E-18	5.11E-19	8.36E-20	1.18E-20	1.32E-21	1.72E-22	3.06E-07	1.04E-07
100	6.99E-15	2.24E-15	6.78E-16	1.64E-16	4.14E-17	9.23E-18	1.71E-18	3.24E-19	3.22E-07	1.17E-07
150	2.50E-13	1.07E-13	4.39E-14	1.54E-14	5.44E-15	1.74E-15	4.74E-16	1.20E-16	3.28E-07	1.25E-07
200	1.55E-12	7.64E-13	3.65E-13	1.54E-13	6.44E-14	2.46E-14	8.14E-15	2.38E-15	3.25E-07	1.28E-07
300	9.93E-12	5.67E-12	3.15E-12	1.59E-12	7.92E-13	3.63E-13	1.45E-13	4.93E-14	3.14E-07	1.29E-07
400	2.57E-11	1.58E-11	9.48E-12	5.24E-12	2.84E-12	1.43E-12	6.29E-13	2.30E-13	3.02E-07	1.27E-07
500	4.59E-11	2.95E-11	1.85E-11	1.08E-11	6.19E-12	3.29E-12	1.54E-12	5.87E-13	2.91E-07	1.24E-07
700	9.02E-11	6.11E-11	4.05E-11	2.52E-11	1.53E-11	8.66E-12	4.33E-12	1.74E-12	2.72E-07	1.18E-07
1000	1.51E-10	1.07E-10	7.37E-11	4.82E-11	3.07E-11	1.82E-11	9.59E-12	4.02E-12	2.51E-07	1.11E-07
1500	2.27E-10	1.66E-10	1.18E-10	8.05E-11	5.32E-11	3.29E-11	1.81E-11	7.82E-12	2.27E-07	1.02E-07
2000	2.79E-10	2.06E-10	1.50E-10	1.04E-10	7.03E-11	4.43E-11	2.50E-11	1.10E-11	2.10E-07	9.55E-08
3000	3.40E-10	2.56E-10	1.90E-10	1.35E-10	9.27E-11	5.98E-11	3.47E-11	1.58E-11	1.86E-07	8.61E-08
4000	3.72E-10	2.84E-10	2.12E-10	1.52E-10	1.06E-10	6.92E-11	4.10E-11	1.71E-11	1.71E-07	7.95E-08
5000	3.91E-10	3.00E-10	2.26E-10	1.63E-10	1.14E-10	7.52E-11	4.53E-11	2.12E-11	1.59E-07	7.46E-08
7000	4.09E-10	3.16E-10	2.40E-10	1.75E-10	1.24E-10	8.21E-11	5.06E-11	2.42E-11	1.43E-07	6.74E-08
10000	4.15E-10	3.23E-10	2.47E-10	1.81E-10	1.29E-10	8.63E-11	5.44E-11	2.66E-11	1.27E-07	6.83E-08

Table 6. (Continued)

Manganese and Iron

T	MN III	MN IV	MN V	MN VI	MN VII	MN VIII	MN IX	MN X	MN XI	MN XII
1.0	1.13E-23	2.11E-31	0.	0.	0.	0.	0.	0.	0.	0.
1.5	1.06E-18	6.63E-24	2.26E-30	2.52E-37	0.	0.	0.	0.	0.	0.
2.0	3.37E-16	3.87E-20	4.51E-25	2.18E-30	4.28E-36	0.	0.	0.	0.	0.
3.0	1.15E-13	2.38E-16	9.50E-20	1.98E-23	2.13E-27	3.40E-38	0.	0.	0.	0.
4.0	2.21E-12	1.93E-14	4.52E-17	6.23E-20	4.95E-23	4.84E-31	4.74E-34	4.57E-37	0.	0.
5.0	1.34E-11	2.77E-13	1.86E-15	7.97E-18	2.11E-20	9.72E-27	3.49E-29	1.24E-31	3.52E-35	7.17E-38
7.0	1.10E-10	5.98E-12	1.35E-13	2.11E-15	2.21E-17	8.35E-22	1.33E-23	2.08E-25	5.26E-28	5.36E-30
10	5.65E-10	6.23E-11	3.49E-12	1.45E-13	4.28E-15	4.41E-18	2.14E-19	1.03E-20	1.36E-22	4.63E-24
15	2.15E-09	4.04E-10	4.59E-11	4.12E-12	2.83E-13	3.70E-15	4.31E-16	4.96E-17	2.40E-18	2.13E-19
20	4.39E-09	1.06E-09	1.73E-10	2.32E-11	2.53E-12	1.12E-13	2.03E-14	3.63E-15	3.38E-16	4.89E-17
30	9.49E-09	2.95E-09	6.92E-10	1.44E-10	2.67E-11	3.57E-12	1.01E-12	2.83E-13	5.07E-14	1.20E-14
40	1.45E-08	5.08E-09	1.45E-09	3.84E-10	9.60E-11	2.09E-11	7.40E-12	2.60E-12	6.46E-13	1.98E-13
50	1.90E-08	7.18E-09	2.31E-09	7.17E-10	2.16E-10	6.14E-11	2.49E-11	1.00E-11	3.03E-12	1.08E-12
70	2.63E-08	1.09E-08	4.08E-09	1.52E-09	5.72E-10	2.15E-10	1.02E-10	4.81E-11	1.82E-11	7.78E-12
100	3.41E-08	1.52E-08	6.41E-09	2.78E-09	1.24E-09	5.64E-10	3.02E-10	1.61E-10	7.21E-11	3.52E-11
150	4.17E-08	2.00E-08	9.30E-09	4.56E-09	2.31E-09	1.22E-09	7.18E-10	4.21E-10	2.16E-10	1.18E-10
200	4.60E-08	2.29E-08	1.12E-08	5.88E-09	3.20E-09	1.81E-09	1.12E-09	6.91E-10	3.80E-10	2.19E-10
300	5.00E-08	2.60E-08	1.36E-08	7.60E-09	4.43E-09	2.70E-09	1.77E-09	1.15E-09	6.80E-10	4.17E-10
400	5.15E-08	2.75E-08	1.48E-08	8.61E-09	5.21E-09	3.32E-09	2.23E-09	1.50E-09	9.21E-10	5.84E-10
500	5.19E-08	2.82E-08	1.56E-08	9.25E-09	5.73E-09	3.75E-09	2.57E-09	1.76E-09	1.11E-09	7.21E-10
700	5.15E-08	2.87E-08	1.63E-08	9.94E-09	6.33E-09	4.30E-09	3.02E-09	2.11E-09	1.38E-09	9.24E-10
1000	5.01E-08	2.85E-08	1.65E-08	1.03E-08	6.74E-09	4.73E-09	3.39E-09	2.42E-09	1.63E-09	1.12E-09
1500	4.74E-08	2.75E-08	1.63E-08	1.04E-08	6.93E-09	5.03E-09	3.67E-09	2.67E-09	1.84E-09	1.30E-09
2000	4.51E-08	2.65E-08	1.59E-08	1.03E-08	6.91E-09	5.12E-09	3.77E-09	2.78E-09	1.94E-09	1.39E-09
3000	4.16E-08	2.47E-08	1.51E-08	9.87E-09	6.73E-09	5.10E-09	3.80E-09	2.83E-09	2.02E-09	1.46E-09
4000	3.89E-08	2.33E-08	1.43E-08	9.47E-09	6.50E-09	5.00E-09	3.75E-09	2.82E-09	2.03E-09	1.48E-09
5000	3.68E-08	2.22E-08	1.37E-08	9.12E-09	6.29E-09	4.88E-09	3.69E-09	2.78E-09	2.01E-09	1.48E-09
7000	3.37E-08	2.05E-08	1.28E-08	8.54E-09	5.93E-09	4.66E-09	3.54E-09	2.69E-09	1.96E-09	1.45E-09
10000	3.05E-08	1.87E-08	1.17E-08	7.89E-09	5.51E-09	4.38E-09	3.35E-09	2.56E-09	1.88E-09	1.40E-09

T	MN XIII	MN XIV	MN XV	MN XVI	MN XVII	MN XVIII	MN XIX	MN XX	MN XXI	MN XXII
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7.0	3.13E-32	8.28E-36	3.68E-38	0.	0.	0.	0.	0.	0.	0.
10	1.02E-25	3.25E-28	5.69E-30	0.	0.	0.	0.	0.	0.	0.
15	1.36E-20	2.78E-22	1.41E-23	0.	0.	0.	0.	0.	0.	0.
20	5.39E-18	2.66E-19	2.31E-20	1.32E-25	1.17E-27	0.	0.	0.	0.	0.
30	2.34E-15	2.68E-16	3.98E-17	2.70E-27	1.04E-28	3.28E-30	4.34E-32	8.99E-34	1.42E-35	1.33E-37
40	5.12E-14	8.80E-15	1.71E-15	4.02E-23	3.24E-24	2.25E-25	8.35E-27	4.14E-28	1.64E-29	4.51E-31
50	3.34E-13	7.27E-14	1.66E-14	1.32E-20	1.66E-21	1.86E-22	1.28E-23	1.07E-24	7.40E-26	3.83E-27
70	2.93E-12	8.36E-13	2.29E-13	1.04E-17	2.19E-18	4.21E-19	5.80E-20	8.88E-21	1.17E-21	1.23E-22
100	1.55E-11	5.38E-12	1.70E-12	1.63E-15	5.05E-16	1.47E-16	3.37E-17	8.14E-18	1.73E-18	3.08E-19
150	5.83E-11	2.37E-11	8.42E-12	8.84E-14	3.70E-14	1.48E-14	5.03E-15	1.73E-15	5.37E-16	1.43E-16
200	1.16E-10	5.13E-11	1.96E-11	6.73E-13	3.28E-13	1.54E-13	6.35E-14	2.61E-14	9.77E-15	3.17E-15
300	2.37E-10	1.16E-10	4.94E-11	5.33E-12	3.03E-12	1.67E-12	8.32E-13	4.09E-13	1.85E-13	7.34E-14
400	3.46E-10	1.82E-10	8.36E-11	1.53E-11	9.41E-12	5.61E-12	3.08E-12	1.66E-12	8.27E-13	3.62E-13
500	4.39E-10	2.43E-10	1.19E-10	2.92E-11	1.88E-11	1.18E-11	6.85E-12	3.90E-12	2.06E-12	9.57E-13
700	5.84E-10	3.47E-10	1.84E-10	6.20E-11	4.20E-11	2.78E-11	1.73E-11	1.05E-11	5.92E-12	2.96E-12
1000	7.31E-10	4.63E-10	2.64E-10	1.10E-10	7.79E-11	5.39E-11	3.53E-11	2.24E-11	1.33E-11	7.02E-12
1500	8.72E-10	5.86E-10	3.56E-10	1.74E-10	1.27E-10	9.10E-11	6.20E-11	4.11E-11	2.54E-11	1.40E-11
2000	9.49E-10	6.60E-10	4.15E-10	2.19E-10	1.63E-10	1.19E-10	8.26E-11	5.58E-11	3.53E-11	1.99E-11
3000	1.02E-09	7.38E-10	4.82E-10	2.74E-10	2.08E-10	1.54E-10	1.10E-10	7.58E-11	4.90E-11	2.85E-11
4000	1.05E-09	7.73E-10	5.16E-10	3.04E-10	2.33E-10	1.75E-10	1.26E-10	8.81E-11	5.75E-11	3.42E-11
5000	1.05E-09	7.89E-10	5.34E-10	3.22E-10	2.49E-10	1.88E-10	1.36E-10	9.60E-11	6.33E-11	3.82E-11
7000	1.04E-09	7.97E-10	5.49E-10	3.41E-10	2.65E-10	2.02E-10	1.48E-10	1.05E-10	6.99E-11	4.31E-11
10000	1.02E-09	7.87E-10	5.50E-10	3.49E-10	2.73E-10	2.10E-10	1.55E-10	1.11E-10	7.43E-11	4.68E-11

T	MN XXIII	FE I	FE II	FE III	FE IV	FE V	FE VI	FE VII	FE VIII	FE IX
1.0	0.	2.10E-11	1.17E-15	3.22E-22	5.53E-33	0.	0.	0.	0.	0.
1.5	0.	3.68E-10	3.44E-13	1.10E-17	5.78E-25	4.97E-31	2.42E-38	0.	0.	0.
2.0	0.	1.62E-09	6.27E-12	2.14E-15	6.16E-21	1.53E-25	4.07E-31	3.86E-37	0.	0.
3.0	0.	7.59E-09	1.23E-10	4.41E-13	6.92E-17	4.97E-20	7.23E-24	5.24E-28	3.10E-32	0.
4.0	0.	1.72E-08	5.77E-10	6.63E-12	7.63E-15	2.94E-17	3.17E-20	2.01E-23	1.04E-26	1.97E-35
5.0	0.	2.88E-08	1.50E-09	3.47E-11	1.31E-13	1.38E-15	4.96E-18	1.15E-20	2.19E-23	2.78E-30
7.0	0.	5.39E-08	4.69E-09	2.40E-10	3.51E-12	1.16E-13	1.65E-15	1.70E-17	1.43E-19	2.22E-24
10	0.	8.97E-08	1.16E-08	1.08E-09	4.30E-11	3.35E-12	1.34E-13	4.24E-15	1.10E-16	6.24E-20
15	0.	1.39E-07	2.50E-08	3.69E-09	3.18E-10	4.78E-11	4.31E-12	3.30E-13	2.09E-14	1.92E-16
20	0.	1.76E-07	3.78E-08	7.09E-09	8.95E-10	1.86E-10	2.54E-11	3.08E-12	3.18E-13	1.12E-14
30	2.80E-39	2.28E-07	5.92E-08	1.43E-08	2.65E-09	7.62E-10	1.61E-10	3.18E-11	5.74E-12	6.86E-13
40	2.05E-32	2.62E-07	7.54E-08	2.09E-08	4.72E-09	1.60E-09	4.25E-10	1.10E-10	2.73E-11	5.58E-12
50	2.75E-28	2.84E-07	8.76E-08	2.66E-08	6.81E-09	2.55E-09	7.86E-10	2.42E-10	7.31E-11	2.00E-11
70	1.49E-23	3.11E-07	1.04E-07	3.56E-08	1.06E-08	4.45E-09	1.65E-09	6.26E-10	2.38E-10	8.83E-11
100	5.56E-20	3.29E-07	1.18E-07	4.47E-08	1.51E-08	6.96E-09	2.98E-09	1.33E-09	6.05E-10	2.76E-10
150	3.50E-17	3.37E-07	1.29E-07	5.33E-08	2.01E-08	1.00E-08	4.86E-09	2.47E-09	1.29E-09	6.86E-10
200	9.09E-16	3.36E-07	1.33E-07	5.78E-08	2.33E-08	1.21E-08	6.26E-09	3.41E-09	1.91E-09	1.09E-09
300	2.46E-14	3.25E-07	1.34E-07	6.19E-08	2.67E-08	1.46E-08	8.09E-09	4.73E-09	2.85E-09	1.77E-09
400	1.31E-13	3.13E-07	1.32E-07	6.31E-08	2.84E-08	1.59E-08	9.17E-09	5.57E-09	3.48E-09	2.25E-09
500	3.63E-13	3.02E-07	1.30E-07	6.32E-08	2.92E-08	1.67E-08	9.85E-09	6.13E-09	3.92E-09	2.61E-09
700	1.18E-12	2.83E-07	1.24E-07	6.23E-08	2.98E-08	1.74E-08	1.06E-08	6.78E-09	4.47E-09	3.09E-09
1000	2.93E-12	2.61E-07	1.17E-07	6.02E-08	2.96E-08	1.77E-08	1.10E-08	7.23E-09	4.78E-09	3.49E-09
1500	6.05E-12	2.36E-07	1.08E-07	5.67E-08	2.87E-08	1.75E-08	1.11E-08	7.44E-09	5.11E-09	3.79E-09
2000	8.78E-12	2.18E-07	1.01E-07	5.38E-08	2.77E-08	1.70E-08	1.10E-08	7.43E-09	5.16E-09	3.91E-09
3000	1.29E-11	1.94E-07	9.07E-08	4.93E-08	2.59E-08	1.62E-08	1.06E-08	7.24E-09	5.09E-09	3.95E-09
4000	1.58E-11	1.78E-07	8.38E-08	4.61E-08	2.44E-08	1.54E-08	1.01E-08	7.00E-09	4.96E-09	3.90E-09
5000	1.78E-11	1.66E-07	7.86E-08	4.35E-08	2.33E-08	1.47E-08	9.76E-09	6.78E-09	4.83E-09	3.84E-09
7000	2.06E-11	1.49E-07	7.11E-08	3.98E-08	2.15E-08	1.37E-08	9.14E-09	6.39E-09	4.58E-09	3.69E-09
10000	2.28E-11	1.32E-07	6.36E-08	3.59E-08	1.96E-08	1.26E-08	8.45E-09	5.94E-09	4.28E-09	3.49E-09

Table 6. (Continued)
Iron and Cobalt

T	FE X	FE XI	FE XII	FE XIII	FE XIV	FE XV	FE XVI	FE XVII	FE XVIII	FE XIX
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	1.55E-38	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	8.44E-33	2.04E-35	3.23E-39	0.	0.	0.	0.	0.	0.	0.
7.0	3.15E-26	3.79E-28	6.33E-31	4.90E-33	2.51E-35	3.34E-39	0.	0.	0.	0.
10	2.83E-21	1.13E-22	1.12E-24	3.16E-26	6.27E-28	1.27E-30	2.04E-32	0.	0.	0.
15	2.16E-17	2.21E-18	8.87E-20	6.96E-21	4.10E-22	6.36E-24	3.07E-25	0.	0.	0.
20	1.98E-15	3.26E-16	2.64E-17	3.49E-18	3.62E-19	1.48E-20	1.24E-21	1.69E-38	0.	0.
30	1.93E-13	5.14E-14	8.43E-15	1.89E-15	3.52E-16	3.61E-17	5.24E-18	2.96E-29	9.68E-31	2.61E-32
40	1.98E-12	6.72E-13	1.57E-13	4.62E-14	1.16E-14	1.84E-15	3.53E-16	1.29E-24	9.24E-26	5.69E-27
50	8.16E-12	3.21E-12	9.28E-13	3.21E-13	9.68E-14	1.99E-14	4.50E-15	8.08E-22	9.26E-23	9.40E-24
70	4.24E-11	1.98E-11	7.27E-12	3.04E-12	1.13E-12	3.11E-13	8.49E-14	1.33E-18	2.61E-19	4.72E-20
100	1.50E-10	7.96E-11	3.51E-11	1.70E-11	7.41E-12	2.52E-12	7.95E-13	3.63E-16	1.07E-16	2.99E-17
150	4.12E-10	2.42E-10	1.23E-10	6.68E-11	3.31E-11	1.33E-11	4.73E-12	3.03E-14	1.24E-14	4.81E-15
200	6.91E-10	4.28E-10	2.35E-10	1.35E-10	7.15E-11	3.14E-11	1.20E-11	2.87E-13	1.37E-13	6.32E-14
300	1.18E-09	7.71E-10	4.56E-10	2.80E-10	1.59E-10	7.78E-11	3.27E-11	2.83E-12	1.59E-12	8.67E-13
400	1.55E-09	1.84E-09	6.44E-10	4.10E-10	2.43E-10	1.27E-10	5.77E-11	9.12E-12	5.56E-12	3.29E-12
500	1.83E-09	1.26E-09	7.98E-10	5.20E-10	3.18E-10	1.74E-10	8.40E-11	1.86E-11	1.19E-11	7.42E-12
700	2.21E-09	1.56E-09	1.03E-09	6.89E-10	4.37E-10	2.58E-10	1.35E-10	4.27E-11	2.89E-11	1.91E-11
1000	2.55E-09	1.84E-09	1.24E-09	8.58E-10	5.63E-10	3.55E-10	2.01E-10	8.06E-11	5.70E-11	3.95E-11
1500	2.81E-09	2.07E-09	1.44E-09	1.02E-09	6.89E-10	4.62E-10	2.80E-10	1.34E-10	9.79E-11	7.02E-11
2000	2.93E-09	2.18E-09	1.54E-09	1.10E-09	7.60E-10	5.29E-10	3.32E-10	1.72E-10	1.29E-10	9.40E-11
3000	3.00E-09	2.26E-09	1.62E-09	1.18E-09	8.32E-10	6.02E-10	3.94E-10	2.22E-10	1.69E-10	1.26E-10
4000	2.98E-09	2.27E-09	1.64E-09	1.21E-09	8.61E-10	6.38E-10	4.27E-10	2.50E-10	1.92E-10	1.45E-10
5000	2.95E-09	2.25E-09	1.64E-09	1.22E-09	8.72E-10	6.56E-10	4.45E-10	2.68E-10	2.07E-10	1.57E-10
7000	2.85E-09	2.19E-09	1.61E-09	1.20E-09	8.71E-10	6.68E-10	4.62E-10	2.87E-10	2.23E-10	1.71E-10
10000	2.71E-09	2.09E-09	1.55E-09	1.17E-09	8.53E-10	6.65E-10	4.66E-10	2.97E-10	2.33E-10	1.79E-10

T	FE XX	FE XXI	FE XXII	FE XXIII	FE XXIV	FE XXV	FE XXVI	CO I	CO II	CO III
1.0	0.	0.	0.	0.	0.	0.	0.	1.33E-11	2.62E-16	1.43E-23
1.5	0.	0.	0.	0.	0.	0.	0.	2.68E-10	1.04E-13	1.26E-18
2.0	0.	0.	0.	0.	0.	0.	0.	1.26E-09	2.21E-12	3.93E-16
3.0	0.	0.	0.	0.	0.	0.	0.	6.38E-09	5.22E-11	1.31E-13
4.0	0.	0.	0.	0.	0.	0.	0.	1.50E-08	2.72E-10	2.53E-12
5.0	0.	0.	0.	0.	0.	0.	0.	2.57E-08	7.65E-10	1.54E-11
7.0	0.	0.	0.	0.	0.	0.	0.	4.95E-08	2.66E-09	1.28E-10
10	0.	0.	0.	0.	0.	0.	0.	8.46E-08	7.30E-09	6.64E-10
15	0.	0.	0.	0.	0.	0.	0.	1.34E-07	1.74E-08	2.57E-09
20	0.	0.	0.	0.	0.	0.	0.	1.72E-07	2.80E-08	5.30E-09
30	2.84E-34	4.98E-36	6.61E-38	0.	0.	0.	0.	2.27E-07	4.74E-08	1.15E-08
40	1.83E-28	8.00E-30	2.79E-31	6.62E-33	2.80E-34	0.	0.	2.62E-07	6.31E-08	1.76E-08
50	5.78E-25	4.38E-26	2.74E-27	1.26E-28	8.60E-30	0.	0.	2.86E-07	7.57E-08	2.30E-08
70	6.03E-21	8.60E-22	1.05E-22	1.02E-23	1.20E-24	0.	0.	3.16E-07	9.40E-08	3.18E-08
100	6.55E-18	1.50E-18	3.05E-19	5.14E-20	9.05E-21	0.	0.	3.36E-07	1.10E-07	4.10E-08
150	1.59E-15	5.30E-16	1.59E-16	4.09E-17	9.91E-18	2.57E-38	0.	3.46E-07	1.24E-07	5.00E-08
200	2.56E-14	1.03E-14	3.77E-15	1.19E-15	3.39E-16	7.24E-32	3.46E-33	3.46E-07	1.30E-07	5.50E-08
300	4.29E-13	2.08E-13	9.29E-14	3.63E-14	1.21E-14	2.15E-25	2.18E-26	3.36E-07	1.33E-07	5.96E-08
400	1.80E-12	9.60E-13	4.74E-13	2.06E-13	7.42E-14	3.86E-22	5.68E-23	3.24E-07	1.32E-07	6.12E-08
500	4.31E-12	2.43E-12	1.28E-12	5.90E-13	2.23E-13	3.53E-20	6.51E-21	3.12E-07	1.30E-07	6.16E-08
700	1.19E-11	7.17E-12	4.03E-12	2.01E-12	8.04E-13	6.35E-18	1.52E-18	2.93E-07	1.25E-07	6.11E-08
1000	2.58E-11	1.64E-11	9.75E-12	5.13E-12	2.14E-12	3.25E-16	9.42E-17	2.71E-07	1.18E-07	5.92E-08
1500	4.80E-11	3.18E-11	1.97E-11	1.08E-11	4.69E-12	7.24E-15	2.44E-15	2.45E-07	1.09E-07	5.60E-08
2000	6.57E-11	4.44E-11	2.81E-11	1.59E-11	7.01E-12	3.51E-14	1.28E-14	2.26E-07	1.07E-07	5.32E-08
3000	8.99E-11	6.22E-11	4.03E-11	2.34E-11	1.06E-11	1.75E-13	6.88E-14	2.01E-07	9.19E-08	4.89E-08
4000	1.05E-10	7.35E-11	4.82E-11	2.86E-11	1.32E-11	3.98E-13	1.63E-13	1.84E-07	8.50E-08	4.57E-08
5000	1.15E-10	8.09E-11	5.35E-11	3.22E-11	1.51E-11	6.56E-13	2.75E-13	1.72E-07	7.97E-08	4.32E-08
7000	1.26E-10	8.96E-11	5.98E-11	3.68E-11	1.76E-11	1.17E-12	5.06E-13	1.54E-07	7.21E-08	3.95E-08
10000	1.33E-10	9.54E-11	6.42E-11	4.05E-11	1.97E-11	1.83E-12	8.06E-13	1.37E-07	6.45E-08	3.57E-08

T	CO IV	CO V	CO VI	CO VII	CO VIII	CO IX	CO X	CO XI	CO XII	CO XIII
1.0	2.51E-31	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	8.16E-24	2.75E-32	4.11E-39	0.	0.	0.	0.	0.	0.	0.
2.0	4.85E-20	1.80E-26	1.14E-31	7.36E-38	0.	0.	0.	0.	0.	0.
3.0	3.04E-16	1.24E-20	3.35E-24	1.95E-28	7.78E-33	1.76E-37	0.	0.	0.	0.
4.0	2.50E-14	1.06E-17	1.88E-20	1.04E-23	4.29E-27	1.09E-30	0.	0.	0.	0.
5.0	3.61E-13	6.26E-16	3.42E-18	7.31E-21	1.22E-23	1.33E-26	5.55E-34	1.15E-36	1.54E-39	0.
7.0	7.89E-12	6.82E-14	1.35E-15	1.36E-17	1.13E-19	6.42E-22	4.62E-27	5.02E-29	3.96E-31	5.07E-34
10	8.32E-11	2.39E-12	1.25E-13	4.00E-15	1.11E-16	2.20E-18	7.52E-22	2.84E-23	8.49E-25	7.00E-27
15	5.45E-10	3.97E-11	4.43E-12	3.52E-13	2.51E-14	1.34E-15	9.10E-18	9.08E-19	7.69E-20	2.74E-21
20	1.44E-09	1.66E-10	2.73E-11	3.44E-12	3.98E-13	3.63E-14	1.05E-15	1.70E-16	2.44E-17	1.87E-18
30	3.96E-09	7.26E-10	1.77E-10	3.60E-11	7.00E-12	1.17E-12	1.28E-13	3.41E-14	8.30E-15	1.30E-15
40	6.75E-09	1.57E-09	4.69E-10	1.23E-10	3.19E-11	7.52E-12	1.47E-12	5.03E-13	1.60E-13	3.62E-14
50	9.44E-09	2.53E-09	8.65E-10	2.68E-10	8.28E-11	2.43E-11	6.50E-12	2.58E-12	9.66E-13	2.72E-13
70	1.41E-08	4.50E-09	1.80E-09	6.78E-10	2.61E-10	9.86E-11	3.65E-11	1.72E-11	7.77E-12	2.82E-12
100	1.95E-08	7.09E-09	3.23E-09	1.43E-09	6.51E-10	2.97E-10	1.37E-10	7.39E-11	3.84E-11	1.69E-11
150	2.53E-08	1.03E-08	5.24E-09	2.63E-09	1.38E-09	7.30E-10	3.94E-10	2.36E-10	1.37E-10	7.00E-11
200	2.88E-08	1.25E-08	6.73E-09	3.62E-09	2.04E-09	1.16E-09	6.77E-10	4.28E-10	2.64E-10	1.45E-10
300	3.25E-08	1.51E-08	8.68E-09	5.02E-09	3.04E-09	1.87E-09	1.18E-09	7.90E-10	5.16E-10	3.08E-10
400	3.42E-08	1.65E-08	9.83E-09	5.91E-09	3.72E-09	2.38E-09	1.57E-09	1.08E-09	7.31E-10	4.55E-10
500	3.50E-08	1.73E-08	1.06E-08	6.51E-09	4.19E-09	2.75E-09	1.86E-09	1.31E-09	9.04E-10	5.79E-10
700	3.55E-08	1.81E-08	1.14E-08	7.21E-09	4.78E-09	3.22E-09	2.27E-09	1.64E-09	1.16E-09	7.70E-10
1000	3.51E-08	1.85E-08	1.18E-08	7.69E-09	5.22E-09	3.60E-09	2.63E-09	1.94E-09	1.40E-09	9.58E-10
1500	3.38E-08	1.82E-08	1.19E-08	7.93E-09	5.49E-09	3.87E-09	2.92E-09	2.19E-09	1.62E-09	1.14E-09
2000	3.25E-08	1.78E-08	1.18E-08	7.92E-09	5.55E-09	3.95E-09	3.05E-09	2.31E-09	1.73E-09	1.23E-09
3000	3.03E-08	1.69E-08	1.13E-08	7.72E-09	5.48E-09	3.95E-09	3.13E-09	2.40E-09	1.82E-09	1.32E-09
4000	2.85E-08	1.61E-08	1.09E-08	7.48E-09	5.34E-09	3.88E-09	3.12E-09	2.41E-09	1.84E-09	1.35E-09
5000	2.72E-08	1.54E-08	1.05E-08	7.24E-09	5.20E-09	3.79E-09	3.08E-09	2.39E-09	1.83E-09	1.35E-09
7000	2.50E-08	1.43E-08	9.80E-09	6.83E-09	4.94E-09	3.62E-09	2.98E-09	2.33E-09	1.80E-09	1.34E-09
10000	2.28E-08	1.32E-08	9.06E-09	6.35E-09	4.62E-09	3.41E-09	2.84E-09	2.23E-09	1.73E-09	1.30E-09

Table 6. (Continued)

Cobalt and Nickel

T	CO XIV	CO XV	CO XVI	CO XVII	CO XVIII	CO XIX	CO XX	CO XXI	CO XXII	CO XXIII
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7.0	2.99E-36	1.13E-38	0.	0.	0.	0.	0.	0.	0.	0.
10	1.64E-28	2.68E-30	4.15E-33	5.49E-35	0.	0.	0.	0.	0.	0.
15	1.91E-22	9.91E-24	1.30E-25	5.53E-27	0.	0.	0.	0.	0.	0.
20	2.21E-19	2.09E-20	7.56E-22	5.76E-23	0.	0.	0.	0.	0.	0.
30	2.76E-16	4.85E-17	4.62E-18	6.33E-19	2.50E-31	6.99E-33	1.60E-34	1.44E-36	2.20E-38	0.
40	1.03E-14	2.47E-15	3.74E-16	6.86E-17	3.43E-26	2.18E-27	1.19E-28	3.32E-30	1.31E-31	3.93E-33
50	9.20E-14	2.69E-14	5.33E-15	1.16E-15	4.25E-23	4.43E-24	4.09E-25	2.25E-26	1.57E-27	8.73E-29
70	1.17E-12	4.25E-13	1.14E-13	3.05E-14	1.53E-19	2.82E-20	4.76E-21	5.64E-22	7.60E-23	8.54E-24
100	8.10E-12	3.50E-12	1.18E-12	3.66E-13	7.52E-17	2.13E-17	5.67E-18	1.18E-18	2.61E-19	5.00E-20
150	3.79E-11	1.87E-11	7.48E-12	2.63E-12	9.94E-15	3.94E-15	1.49E-15	4.79E-16	1.56E-16	4.52E-17
200	8.37E-11	4.42E-11	1.94E-11	7.30E-12	1.19E-13	5.57E-14	2.52E-14	9.98E-15	3.94E-15	1.41E-15
300	1.90E-10	1.08E-10	5.25E-11	2.18E-11	1.48E-12	8.22E-13	4.43E-13	2.16E-13	1.04E-13	4.57E-14
400	2.90E-10	1.73E-10	8.97E-11	4.00E-11	5.35E-12	3.24E-12	1.91E-12	1.03E-12	5.49E-13	2.68E-13
500	3.79E-10	2.32E-10	1.27E-10	6.00E-11	1.17E-11	7.47E-12	4.64E-12	2.68E-12	1.51E-12	7.84E-13
700	5.19E-10	3.30E-10	1.94E-10	1.00E-10	2.92E-11	1.98E-11	1.30E-11	8.09E-12	4.88E-12	2.73E-12
1000	6.65E-10	4.37E-10	2.75E-10	1.54E-10	5.89E-11	4.17E-11	2.88E-11	1.89E-11	1.20E-11	7.11E-12
1500	8.08E-10	5.49E-10	3.68E-10	2.21E-10	1.03E-10	7.54E-11	5.42E-11	3.71E-11	2.46E-11	1.52E-11
2000	8.89E-10	6.15E-10	4.28E-10	2.67E-10	1.36E-10	1.02E-10	7.47E-11	5.23E-11	3.54E-11	2.24E-11
3000	9.67E-10	6.84E-10	4.96E-10	3.24E-10	1.81E-10	1.38E-10	1.03E-10	7.38E-11	5.12E-11	3.32E-11
4000	9.99E-10	7.14E-10	5.31E-10	3.55E-10	2.07E-10	1.59E-10	1.21E-10	8.75E-11	6.15E-11	4.04E-11
5000	1.01E-09	7.28E-10	5.50E-10	3.73E-10	2.24E-10	1.73E-10	1.32E-10	9.66E-11	6.84E-11	4.53E-11
7000	1.01E-09	7.33E-10	5.65E-10	3.91E-10	2.42E-10	1.89E-10	1.45E-10	1.07E-10	7.67E-11	5.13E-11
10000	9.84E-10	7.23E-10	5.67E-10	3.98E-10	2.53E-10	1.99E-10	1.54E-10	1.15E-10	8.26E-11	5.57E-11
T	CO XXIV	CO XXV	NI I	NI II	NI III	NI IV	NI V	NI VI	NI VII	NI VIII
1.0	0.	0.	7.57E-12	8.00E-17	2.64E-24	5.88E-33	0.	0.	0.	0.
1.5	0.	0.	1.73E-10	4.50E-14	4.09E-19	6.37E-25	5.27E-31	0.	0.	0.
2.0	0.	0.	8.74E-10	1.14E-12	1.69E-16	6.91E-21	1.76E-25	6.34E-33	1.25E-38	0.
3.0	0.	0.	4.72E-09	3.18E-11	7.50E-14	7.94E-17	6.22E-20	5.06E-25	6.44E-29	2.07E-33
4.0	0.	0.	1.15E-08	1.80E-10	1.66E-12	8.87E-15	3.84E-17	4.69E-21	4.81E-24	1.73E-27
5.0	0.	0.	2.02E-08	5.31E-10	1.10E-11	1.54E-13	1.85E-15	1.15E-18	4.12E-21	6.35E-24
7.0	0.	0.	4.00E-08	1.95E-09	1.01E-10	4.16E-12	1.60E-13	6.42E-16	9.82E-18	7.79E-20
10	0.	0.	6.98E-08	5.59E-09	5.62E-10	5.17E-11	4.72E-12	7.68E-14	3.37E-15	9.49E-17
15	0.	0.	1.13E-07	1.38E-08	2.31E-09	3.88E-10	6.83E-11	3.33E-12	3.38E-13	2.52E-14
20	0.	0.	1.47E-07	2.29E-08	4.89E-09	1.10E-09	2.67E-10	2.26E-11	3.50E-12	4.27E-13
30	0.	0.	1.97E-07	3.99E-08	1.09E-08	3.26E-09	1.08E-09	1.60E-10	3.84E-11	7.77E-12
40	8.21E-35	3.16E-36	2.30E-07	5.44E-08	1.69E-08	5.79E-09	2.22E-09	4.44E-10	1.33E-10	3.52E-11
50	3.65E-30	2.30E-31	2.54E-07	6.64E-08	2.23E-08	8.32E-09	3.46E-09	8.35E-10	2.88E-10	9.06E-11
70	7.77E-25	8.63E-26	2.84E-07	8.43E-08	3.11E-08	1.29E-08	5.90E-09	1.78E-09	7.27E-10	2.81E-10
100	8.06E-21	1.37E-21	3.06E-07	1.01E-07	4.05E-08	1.82E-08	8.97E-09	3.23E-09	1.52E-09	6.93E-10
150	1.13E-17	2.67E-18	3.19E-07	1.16E-07	4.98E-08	2.41E-08	1.26E-08	5.29E-09	2.79E-09	1.46E-09
200	4.37E-16	1.22E-16	3.21E-07	1.23E-07	5.50E-08	2.78E-08	1.51E-08	6.84E-09	3.84E-09	2.15E-09
300	1.77E-14	5.82E-15	3.14E-07	1.28E-07	5.99E-08	3.18E-08	1.79E-08	8.88E-09	5.33E-09	3.21E-09
400	1.15E-13	4.13E-14	3.04E-07	1.28E-07	6.16E-08	3.38E-08	1.94E-08	1.01E-08	6.28E-09	3.94E-09
500	3.61E-13	1.36E-13	2.94E-07	1.27E-07	6.21E-08	3.47E-08	2.03E-08	1.09E-08	6.91E-09	4.44E-09
700	1.36E-12	5.42E-13	2.77E-07	1.23E-07	6.17E-08	3.53E-08	2.11E-08	1.17E-08	7.66E-09	5.07E-09
1000	3.74E-12	1.56E-12	2.57E-07	1.16E-07	5.99E-08	3.51E-08	2.13E-08	1.22E-08	8.18E-09	5.55E-09
1500	8.38E-12	3.63E-12	2.32E-07	1.08E-07	5.67E-08	3.39E-08	2.10E-08	1.24E-08	8.44E-09	5.84E-09
2000	1.27E-11	5.60E-12	2.15E-07	1.01E-07	5.39E-08	3.27E-08	2.04E-08	1.22E-08	8.43E-09	5.91E-09
3000	1.93E-11	8.75E-12	1.92E-07	9.13E-08	4.96E-08	3.05E-08	1.93E-08	1.18E-08	8.23E-09	5.84E-09
4000	2.40E-11	1.10E-11	1.76E-07	8.45E-08	4.64E-08	2.88E-08	1.84E-08	1.13E-08	7.97E-09	5.70E-09
5000	2.73E-11	1.27E-11	1.64E-07	7.93E-08	4.39E-08	2.74E-08	1.76E-08	1.09E-08	7.72E-09	5.55E-09
7000	3.16E-11	1.51E-11	1.47E-07	7.18E-08	4.02E-08	2.53E-08	1.63E-08	1.02E-08	7.28E-09	5.27E-09
10000	3.51E-11	1.71E-11	1.31E-07	6.43E-08	3.63E-08	2.30E-08	1.50E-08	9.45E-09	6.78E-09	4.93E-09
T	NI IX	NI X	NI XI	NI XII	NI XIII	NI XIV	NI XV	NI XVI	NI XVII	NI XVIII
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	3.17E-38	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	3.52E-31	4.36E-35	0.	0.	0.	0.	0.	0.	0.	0.
5.0	6.08E-27	3.73E-30	5.08E-38	0.	0.	0.	0.	0.	0.	0.
7.0	4.39E-22	1.68E-24	5.53E-30	4.58E-32	3.19E-34	2.70E-37	0.	0.	0.	0.
10	2.03E-18	3.06E-20	6.20E-24	1.94E-25	5.35E-27	3.31E-29	6.39E-31	8.58E-33	9.15E-36	9.99E-38
15	1.52E-15	6.85E-17	3.36E-19	2.97E-20	2.40E-21	7.10E-23	4.33E-24	1.97E-25	2.05E-27	7.69E-29
20	4.40E-14	3.53E-15	8.19E-17	1.22E-17	1.69E-18	1.10E-19	1.21E-20	1.03E-21	3.19E-23	2.22E-24
30	1.41E-12	2.18E-13	2.12E-14	5.36E-15	1.28E-15	1.85E-16	3.68E-17	6.03E-18	5.23E-19	6.73E-20
40	8.68E-12	1.95E-12	3.57E-13	1.17E-13	3.70E-14	7.90E-15	2.13E-15	4.89E-16	6.93E-17	1.22E-17
50	2.72E-11	7.72E-12	1.98E-12	7.64E-13	2.85E-13	7.70E-14	2.50E-14	7.03E-15	1.33E-15	2.80E-16
70	1.07E-10	3.99E-11	1.44E-11	6.71E-12	3.03E-12	1.07E-12	4.31E-13	1.53E-13	3.99E-14	1.04E-14
100	3.16E-10	1.45E-10	6.63E-11	3.54E-11	1.85E-11	8.02E-12	3.79E-12	1.61E-12	5.31E-13	1.63E-13
150	7.70E-10	4.13E-10	2.23E-10	1.33E-10	7.82E-11	3.97E-11	2.13E-11	1.04E-11	4.13E-12	1.44E-12
200	1.23E-09	7.10E-10	4.16E-10	2.63E-10	1.64E-10	9.00E-11	5.16E-11	2.71E-11	1.18E-11	4.41E-12
300	1.98E-09	1.24E-09	7.88E-10	5.29E-10	3.50E-10	2.09E-10	1.28E-10	7.29E-11	3.53E-11	1.44E-11
400	2.52E-09	1.64E-09	1.09E-09	7.58E-10	5.17E-10	3.23E-10	2.06E-10	1.22E-10	6.32E-11	2.78E-11
500	2.91E-09	1.95E-09	1.34E-09	9.45E-10	6.59E-10	4.24E-10	2.77E-10	1.69E-10	9.19E-11	4.28E-11
700	3.43E-09	2.36E-09	1.68E-09	1.22E-09	8.74E-10	5.83E-10	3.93E-10	2.50E-10	1.46E-10	7.42E-11
1000	3.84E-09	2.71E-09	2.00E-09	1.48E-09	1.09E-09	7.46E-10	5.18E-10	3.41E-10	2.13E-10	1.18E-10
1500	4.13E-09	2.97E-09	2.28E-09	1.72E-09	1.28E-09	9.07E-10	6.46E-10	4.40E-10	2.94E-10	1.75E-10
2000	4.23E-09	3.08E-09	2.41E-09	1.84E-09	1.39E-09	9.96E-10	7.21E-10	5.00E-10	3.47E-10	2.16E-10
3000	4.23E-09	3.12E-09	2.50E-09	1.93E-09	1.48E-09	1.08E-09	7.97E-10	5.65E-10	4.11E-10	2.67E-10
4000	4.16E-09	3.09E-09	2.52E-09	1.96E-09	1.51E-09	1.12E-09	8.30E-10	5.96E-10	4.44E-10	2.96E-10
5000	4.07E-09	3.03E-09	2.50E-09	1.96E-09	1.52E-09	1.13E-09	8.45E-10	6.11E-10	4.63E-10	3.14E-10
7000	3.89E-09	2.92E-09	2.44E-09	1.92E-09	1.50E-09	1.12E-09	8.49E-10	6.21E-10	4.81E-10	3.32E-10
10000	3.66E-09	2.76E-09	2.34E-09	1.85E-09	1.45E-09	1.10E-09	8.35E-10	6.16E-10	4.86E-10	3.41E-10

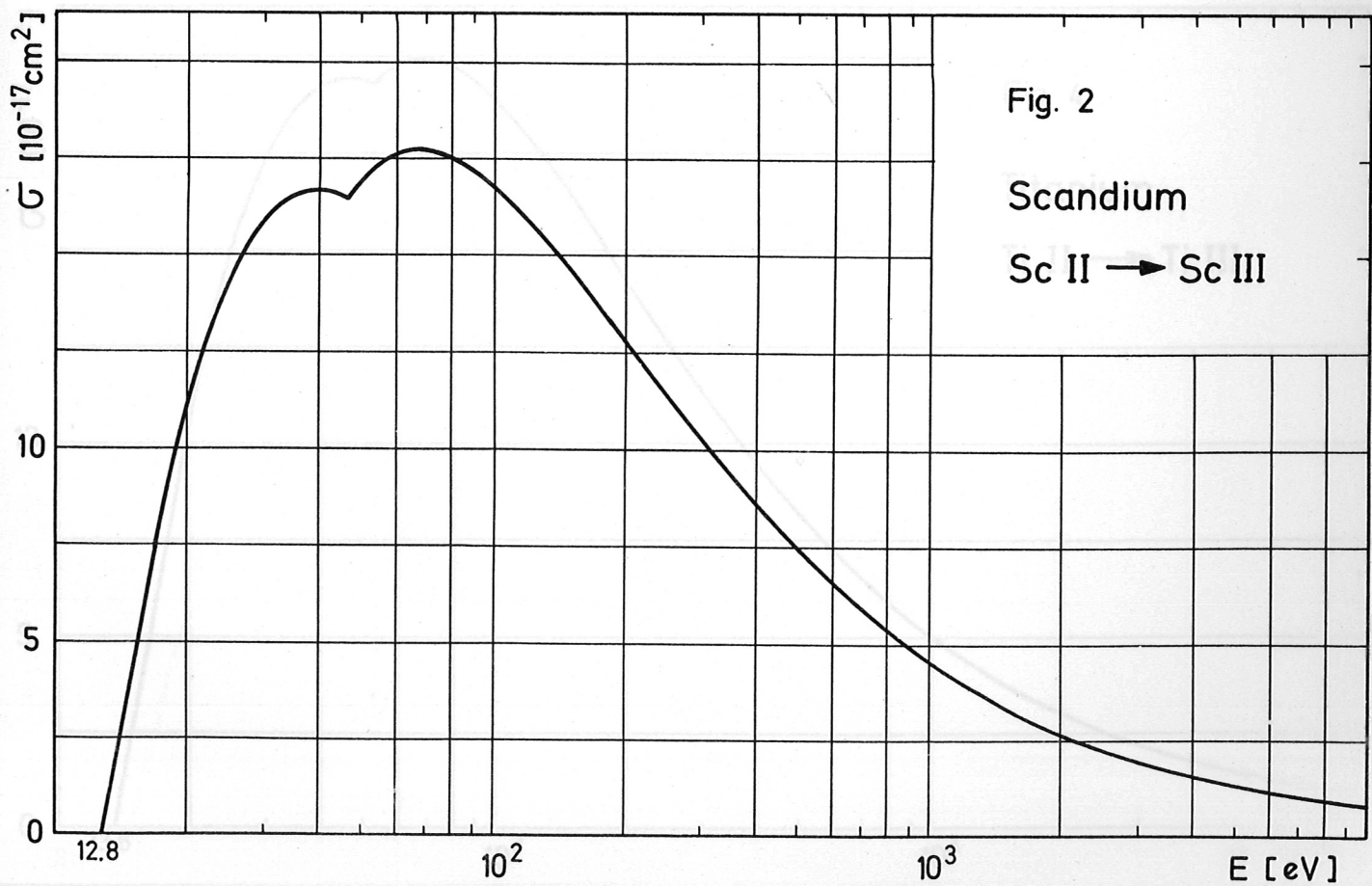
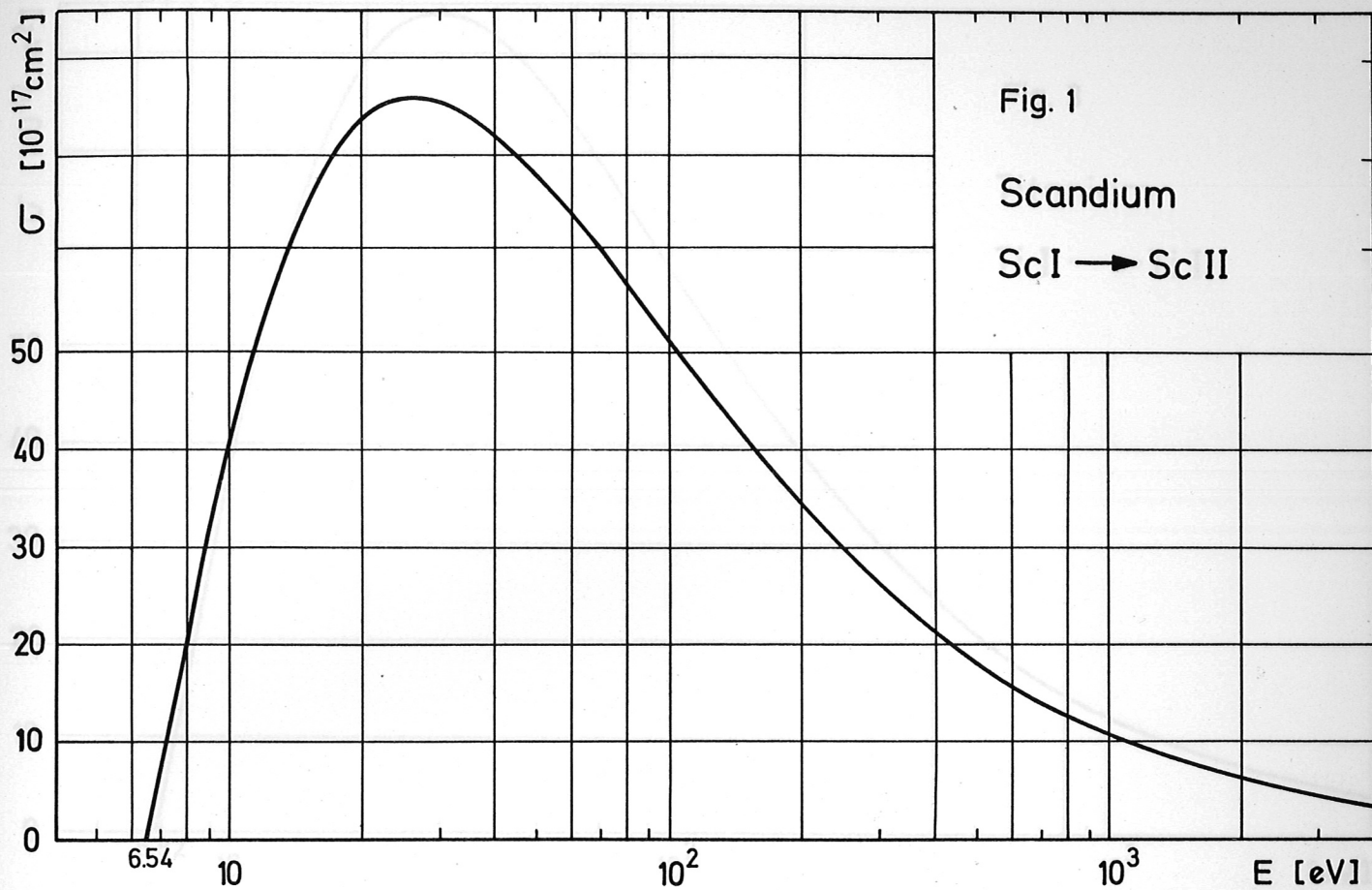
Table 6. (Continued)

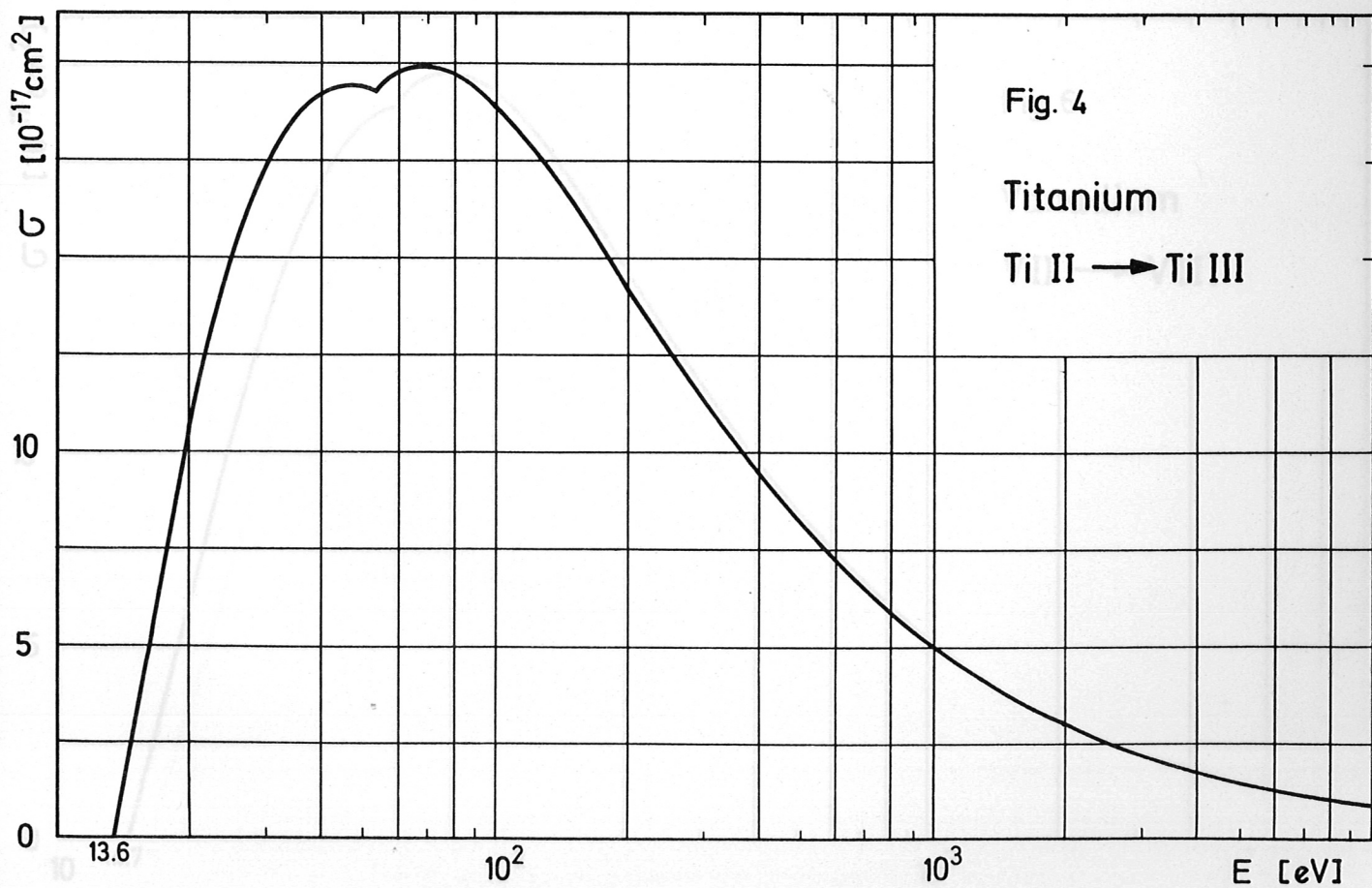
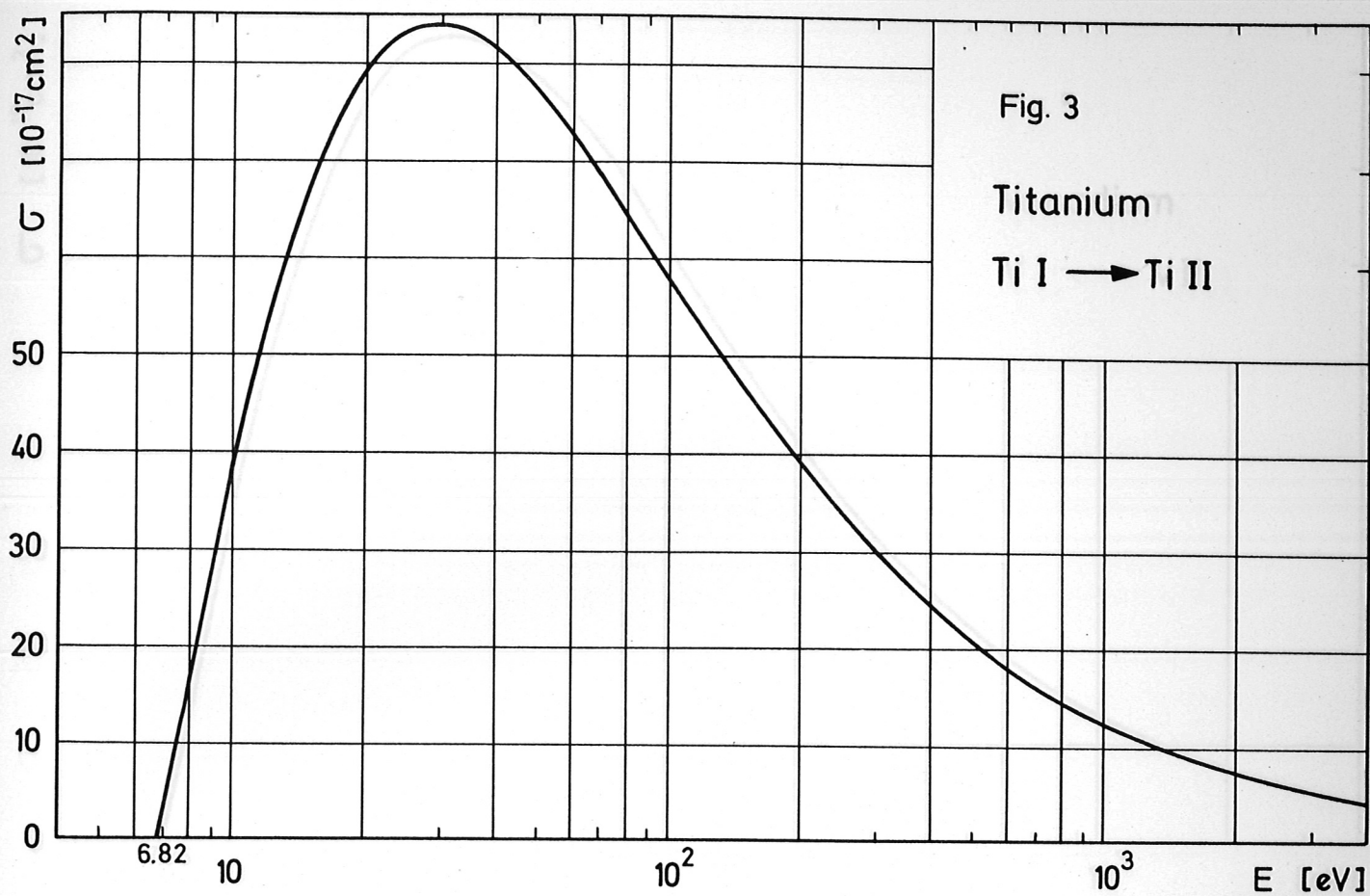
Nickel and Copper

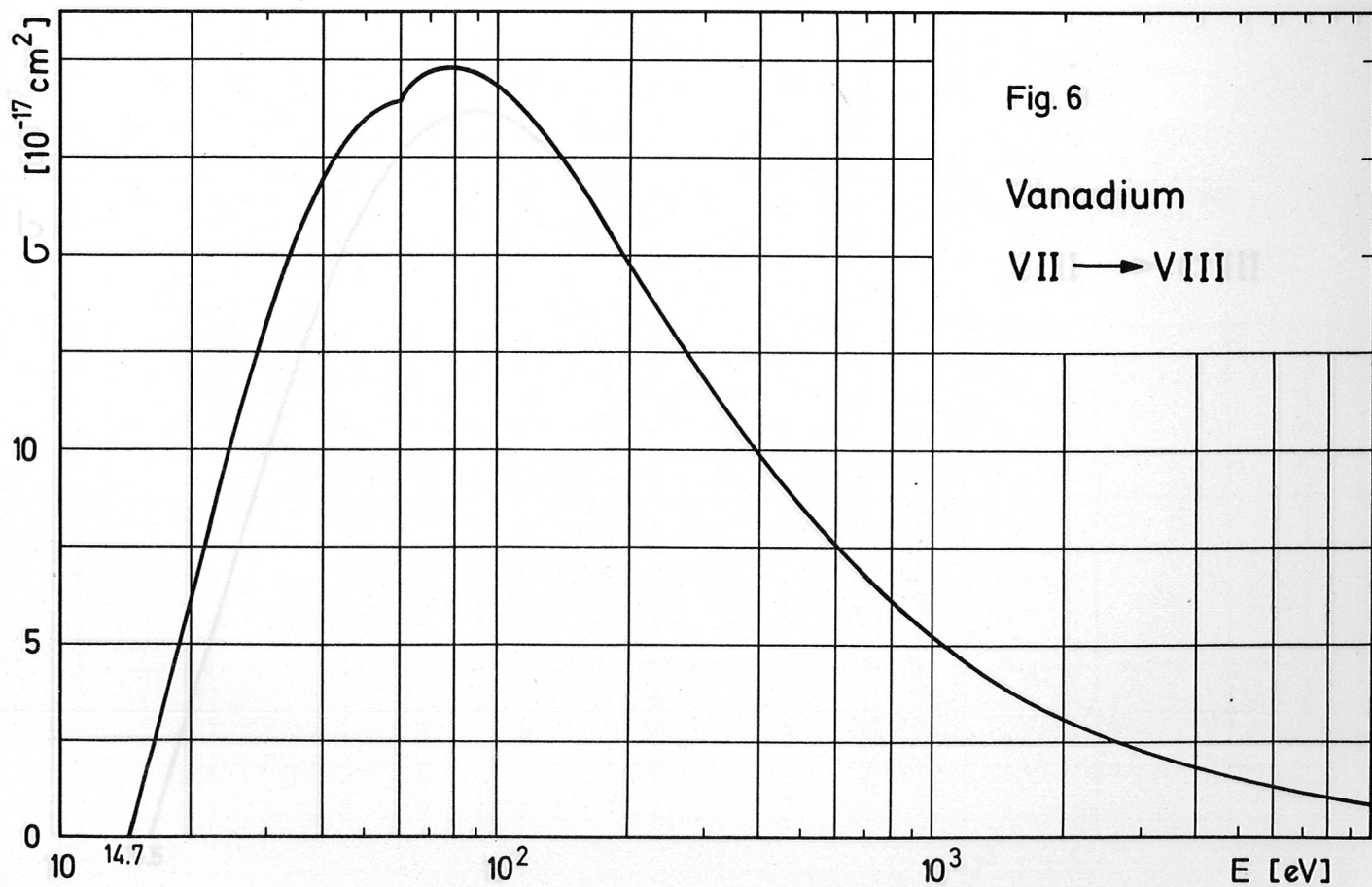
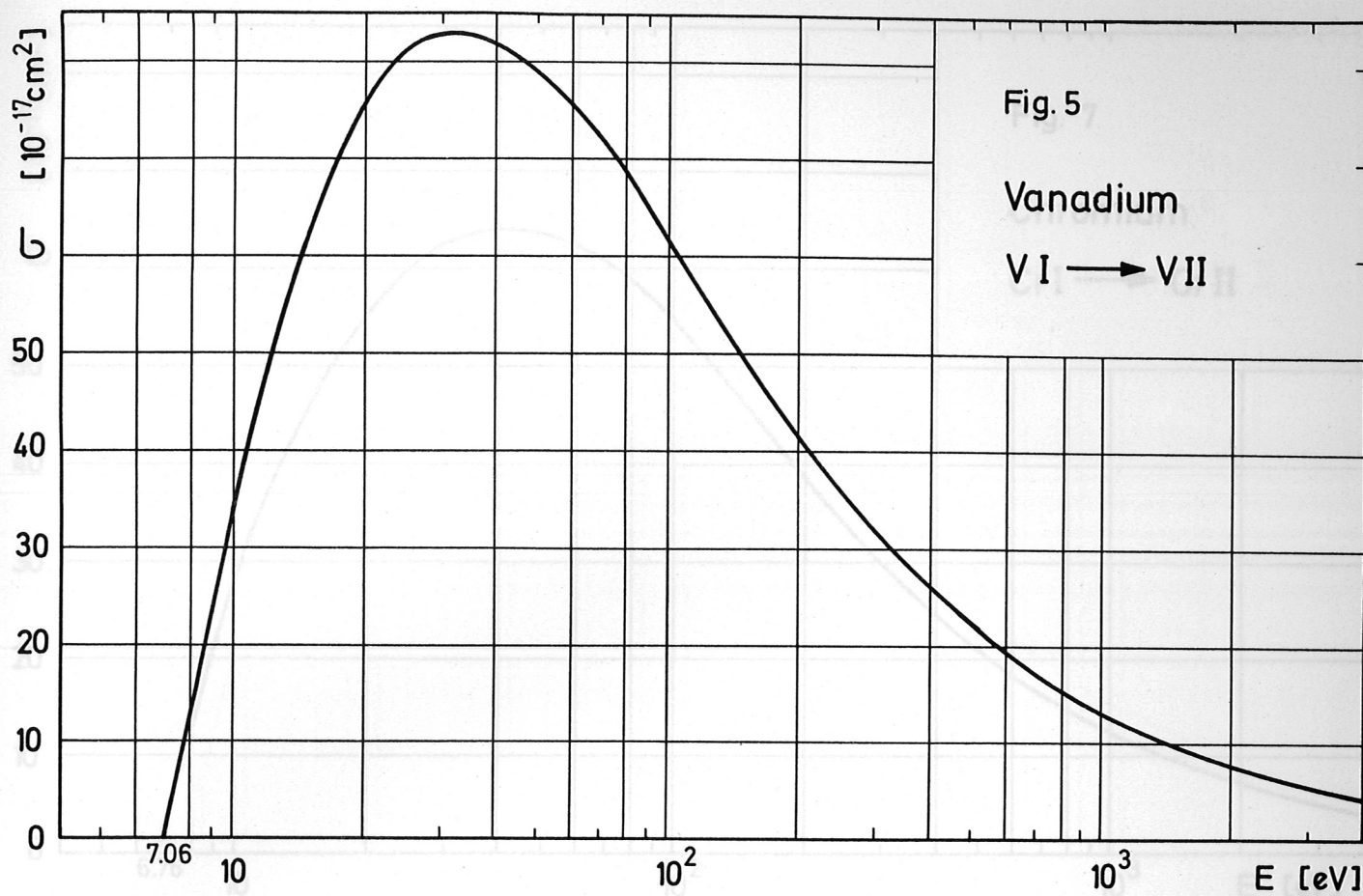
T	NI XIX	NI XX	NI XXI	NI XXII	NI XXIII	NI XXIV	NI XXV	NI XXVI	CU I	CU II
1.0	0.	0.	0.	0.	0.	0.	0.	0.	1.79E-11	8.05E-18
1.5	0.	0.	0.	0.	0.	0.	0.	0.	2.85E-10	8.97E-15
2.0	0.	0.	0.	0.	0.	0.	0.	0.	1.18E-09	3.18E-13
3.0	0.	0.	0.	0.	0.	0.	0.	0.	5.25E-09	1.23E-11
4.0	0.	0.	0.	0.	0.	0.	0.	0.	1.16E-08	8.19E-11
5.0	0.	0.	0.	0.	0.	0.	0.	0.	1.91E-08	2.66E-10
7.0	0.	0.	0.	0.	0.	0.	0.	0.	3.54E-08	1.09E-09
10	0.	0.	0.	0.	0.	0.	0.	0.	5.92E-08	3.38E-09
15	0.	0.	0.	0.	0.	0.	0.	0.	9.34E-08	8.96E-09
20	0.	0.	0.	0.	0.	0.	0.	0.	1.21E-07	1.54E-08
30	1.70E-33	4.17E-35	8.12E-37	5.19E-39	0.	0.	0.	0.	1.63E-07	2.83E-08
40	7.70E-28	4.45E-29	2.15E-30	5.17E-32	1.78E-33	4.79E-35	8.61E-37	2.93E-38	1.93E-07	3.98E-08
50	1.96E-24	1.90E-25	1.59E-26	7.78E-28	4.88E-29	2.48E-30	9.22E-32	5.28E-33	2.15E-07	4.98E-08
70	1.61E-20	2.81E-21	4.44E-22	4.84E-23	6.05E-24	6.40E-25	5.37E-26	5.57E-27	2.44E-07	6.55E-08
100	1.46E-17	4.01E-18	1.02E-18	2.01E-19	4.23E-20	7.77E-21	1.19E-21	1.92E-22	2.67E-07	8.18E-08
150	3.14E-15	1.22E-15	4.49E-16	1.39E-16	4.39E-17	1.24E-17	2.99E-18	6.86E-19	2.82E-07	9.73E-08
200	4.77E-14	2.21E-14	9.78E-15	3.79E-15	1.47E-15	5.13E-16	1.56E-16	4.24E-17	2.86E-07	1.06E-07
300	7.59E-13	4.19E-13	2.23E-13	1.08E-13	5.10E-14	2.22E-14	8.44E-15	2.74E-15	2.83E-07	1.13E-07
400	3.11E-12	1.87E-12	1.10E-12	5.89E-13	3.10E-13	1.50E-13	6.40E-14	2.27E-14	2.75E-07	1.14E-07
500	7.35E-12	4.67E-12	2.88E-12	1.66E-12	9.26E-13	4.79E-13	2.19E-13	8.19E-14	2.67E-07	1.14E-07
700	2.00E-11	1.35E-11	8.89E-12	5.50E-12	3.31E-12	1.85E-12	9.12E-13	3.62E-13	2.52E-07	1.12E-07
1000	4.30E-11	3.05E-11	2.11E-11	1.38E-11	8.76E-12	5.18E-12	2.72E-12	1.13E-12	2.34E-07	1.07E-07
1500	7.93E-11	5.83E-11	4.19E-11	2.87E-11	1.91E-11	1.18E-11	6.49E-12	2.81E-12	2.13E-07	9.95E-08
2000	1.08E-10	8.10E-11	5.95E-11	4.17E-11	2.83E-11	1.79E-11	1.01E-11	4.47E-12	1.97E-07	9.37E-08
3000	1.47E-10	1.13E-10	8.46E-11	6.08E-11	4.22E-11	2.75E-11	1.60E-11	7.22E-12	1.76E-07	8.51E-08
4000	1.72E-10	1.33E-10	1.01E-10	7.33E-11	5.16E-11	3.40E-11	2.02E-11	9.27E-12	1.62E-07	7.89E-08
5000	1.87E-10	1.46E-10	1.11E-10	8.18E-11	5.80E-11	3.85E-11	2.32E-11	1.08E-11	1.51E-07	7.42E-08
7000	2.05E-10	1.61E-10	1.24E-10	9.20E-11	6.59E-11	4.42E-11	2.72E-11	1.30E-11	1.35E-07	6.73E-08
10000	2.17E-10	1.71E-10	1.33E-10	9.94E-11	7.17E-11	4.85E-11	3.06E-11	1.48E-11	1.20E-07	6.03E-08
T	CU III	CU IV	CU V	CU VI	CU VII	CU VIII	CU IX	CU X	CU XI	CU XII
1.0	3.63E-25	6.73E-34	0.	0.	0.	0.	0.	0.	0.	0.
1.5	9.67E-20	1.52E-25	2.92E-32	3.11E-39	0.	0.	0.	0.	0.	0.
2.0	5.27E-17	2.38E-21	2.04E-26	1.02E-31	0.	0.	0.	0.	0.	0.
3.0	3.10E-14	3.94E-17	1.50E-20	3.53E-24	9.99E-30	6.94E-34	6.06E-39	0.	0.	0.
4.0	7.95E-13	5.28E-15	1.33E-17	2.16E-20	1.23E-24	8.11E-28	1.11E-31	1.43E-35	0.	0.
5.0	5.78E-12	1.02E-13	8.01E-16	4.12E-18	1.42E-21	3.63E-24	2.59E-27	1.73E-30	7.36E-34	0.
7.0	5.90E-11	3.14E-12	8.93E-14	1.73E-15	4.68E-18	5.59E-20	2.63E-22	1.16E-24	3.45E-27	4.41E-33
10	3.62E-10	4.29E-11	3.18E-12	1.66E-13	2.12E-15	8.09E-17	1.57E-18	2.86E-20	3.65E-22	3.87E-26
15	1.62E-09	3.46E-10	5.35E-11	6.09E-12	2.60E-13	2.45E-14	1.43E-15	7.89E-17	3.19E-18	1.04E-20
20	3.61E-09	1.02E-09	2.25E-10	3.79E-11	2.97E-12	4.41E-13	4.51E-14	4.36E-15	3.23E-16	5.64E-18
30	8.60E-09	3.13E-09	9.76E-10	2.45E-10	3.57E-11	8.39E-12	1.53E-12	2.66E-13	3.91E-14	3.26E-15
40	1.38E-08	5.65E-09	2.08E-09	6.39E-10	1.29E-10	3.84E-11	9.46E-12	2.28E-12	4.93E-13	8.19E-14
50	1.87E-08	8.19E-09	3.32E-09	1.16E-09	2.84E-10	9.86E-11	2.94E-11	8.69E-12	2.41E-12	5.79E-13
70	2.72E-08	1.28E-08	5.77E-09	2.34E-09	7.31E-10	3.04E-10	1.14E-10	4.31E-11	1.60E-11	5.59E-12
100	3.66E-08	1.82E-08	8.90E-09	4.09E-09	1.54E-09	7.42E-10	3.34E-10	1.53E-10	7.05E-11	3.17E-11
150	4.66E-08	2.43E-08	1.27E-08	6.46E-09	2.86E-09	1.55E-09	8.11E-10	4.34E-10	2.35E-10	1.26E-10
200	5.23E-08	2.81E-08	1.52E-08	8.19E-09	3.95E-09	2.28E-09	1.29E-09	7.46E-10	4.38E-10	2.56E-10
300	5.81E-08	3.23E-08	1.82E-08	1.04E-08	5.50E-09	3.41E-09	2.08E-09	1.30E-09	8.30E-10	5.30E-10
400	6.05E-08	3.43E-08	1.98E-08	1.17E-08	6.50E-09	4.18E-09	2.66E-09	1.74E-09	1.15E-09	7.70E-10
500	6.14E-08	3.53E-08	2.07E-08	1.26E-08	7.17E-09	4.71E-09	3.08E-09	2.06E-09	1.40E-09	9.67E-10
700	6.14E-08	3.60E-08	2.16E-08	1.35E-08	7.97E-09	5.39E-09	3.64E-09	2.51E-09	1.76E-09	1.26E-09
1000	5.99E-08	3.58E-08	2.19E-08	1.40E-08	8.53E-09	5.90E-09	4.08E-09	2.89E-09	2.07E-09	1.54E-09
1500	5.70E-08	3.47E-08	2.16E-08	1.40E-08	8.81E-09	6.22E-09	4.40E-09	3.17E-09	2.32E-09	1.79E-09
2000	5.43E-08	3.34E-08	2.10E-08	1.38E-08	8.82E-09	6.29E-09	4.50E-09	3.29E-09	2.43E-09	1.92E-09
3000	5.01E-08	3.12E-08	1.99E-08	1.33E-08	8.62E-09	6.23E-09	4.51E-09	3.34E-09	2.50E-09	2.03E-09
4000	4.69E-08	2.95E-08	1.89E-08	1.28E-08	8.35E-09	6.08E-09	4.44E-09	3.31E-09	2.49E-09	2.06E-09
5000	4.44E-08	2.81E-08	1.81E-08	1.23E-08	8.10E-09	5.92E-09	4.35E-09	3.25E-09	2.46E-09	2.05E-09
7000	4.07E-08	2.59E-08	1.69E-08	1.15E-08	7.65E-09	5.63E-09	4.16E-09	3.13E-09	2.39E-09	2.02E-09
10000	3.68E-08	2.36E-08	1.55E-08	1.06E-08	7.12E-09	5.27E-09	3.92E-09	2.96E-09	2.27E-09	1.95E-09
T	CU XIII	CU XIV	CU XV	CU XVI	CU XVII	CU XVIII	CU XIX	CU XX	CU XXI	CU XXII
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7.0	3.22E-35	1.71E-37	0.	0.	0.	0.	0.	0.	0.	0.
10	1.12E-27	2.54E-29	1.18E-31	1.87E-33	2.06E-35	1.51E-38	0.	0.	0.	0.
15	8.75E-22	6.23E-23	1.52E-24	8.17E-26	3.24E-27	2.68E-29	8.85E-31	0.	0.	0.
20	8.13E-19	1.03E-19	5.81E-21	5.79E-22	4.47E-23	1.17E-24	7.42E-26	0.	0.	0.
30	8.08E-16	1.82E-16	2.40E-17	4.49E-18	6.88E-19	5.41E-20	6.56E-21	9.19E-26	1.91E-37	3.25E-39
40	2.67E-14	8.06E-15	1.61E-15	4.16E-16	9.09E-17	1.20E-17	2.02E-18	1.47E-29	7.52E-31	3.31E-32
50	2.22E-13	8.02E-14	2.07E-14	6.48E-15	1.75E-15	3.15E-16	6.42E-17	7.96E-26	6.99E-27	5.44E-28
70	2.60E-12	1.15E-12	3.94E-13	1.55E-13	5.36E-14	1.35E-14	3.45E-15	1.54E-21	2.52E-22	3.78E-23
100	1.70E-11	8.78E-12	3.73E-12	1.74E-12	7.27E-13	2.35E-13	7.11E-14	2.69E-18	7.02E-19	1.72E-19
150	7.60E-11	4.43E-11	2.23E-11	1.19E-11	5.76E-12	2.26E-12	7.79E-13	9.54E-16	3.60E-16	1.30E-16
200	1.64E-10	1.01E-10	5.55E-11	3.17E-11	1.66E-11	7.17E-12	2.66E-12	1.87E-14	8.48E-15	3.70E-15
300	3.59E-10	2.38E-10	1.42E-10	8.69E-11	4.93E-11	2.37E-11	9.61E-12	3.84E-13	2.09E-13	1.11E-13
400	5.39E-10	3.68E-10	2.30E-10	1.47E-10	8.70E-11	4.47E-11	1.94E-11	1.79E-12	1.07E-12	6.23E-13
500	6.91E-10	4.83E-10	3.11E-10	2.03E-10	1.24E-10	6.70E-11	3.08E-11	4.58E-12	2.89E-12	1.78E-12
700	9.24E-10	6.63E-10	4.43E-10	3.00E-10	1.90E-10	1.10E-10	5.53E-11	1.36E-11	9.18E-12	6.04E-12
1000	1.15E-09	8.47E-10	5.84E-10	4.06E-10	2.68E-10	1.66E-10	9.08E-11	3.15E-11	2.22E-11	1.54E-11
1500	1.37E-09	1.03E-09	7.28E-10	5.20E-10	3.54E-10	2.36E-10	1.39E-10	6.12E-11	4.51E-11	3.25E-11
2000	1.48E-09	1.12E-09	8.11E-10	5.89E-10	4.09E-10	2.84E-10	1.75E-10	8.60E-11	6.45E-11	4.75E-11
3000	1.58E-09	1.22E-09	8.95E-10	6.62E-10	4.70E-10	3.42E-10	2.22E-10	1.21E-10	9.27E-11	6.97E-11
4000	1.62E-09	1.25E-09	9.32E-10	6.96E-10	5.01E-10	3.74E-10	2.49E-10	1.43E-10	1.11E-10	8.44E-11
5000	1.62E-09	1.27E-09	9.47E-10	7.12E-10	5.17E-10	3.93E-10	2.66E-10	1.58E-10	1.23E-10	9.44E-11
7000	1.61E-09	1.26E-09	9.51E-10	7.22E-10	5.30E-10	4.11E-10	2.84E-10	1.75E-10	1.38E-10	1.07E-10
10000	1.56E-09	1.23E-09	9.35E-10	7.14E-10	5.29E-10	4.19E-10	2.94E-10	1.87E-10	1.48E-10	1.15E-10

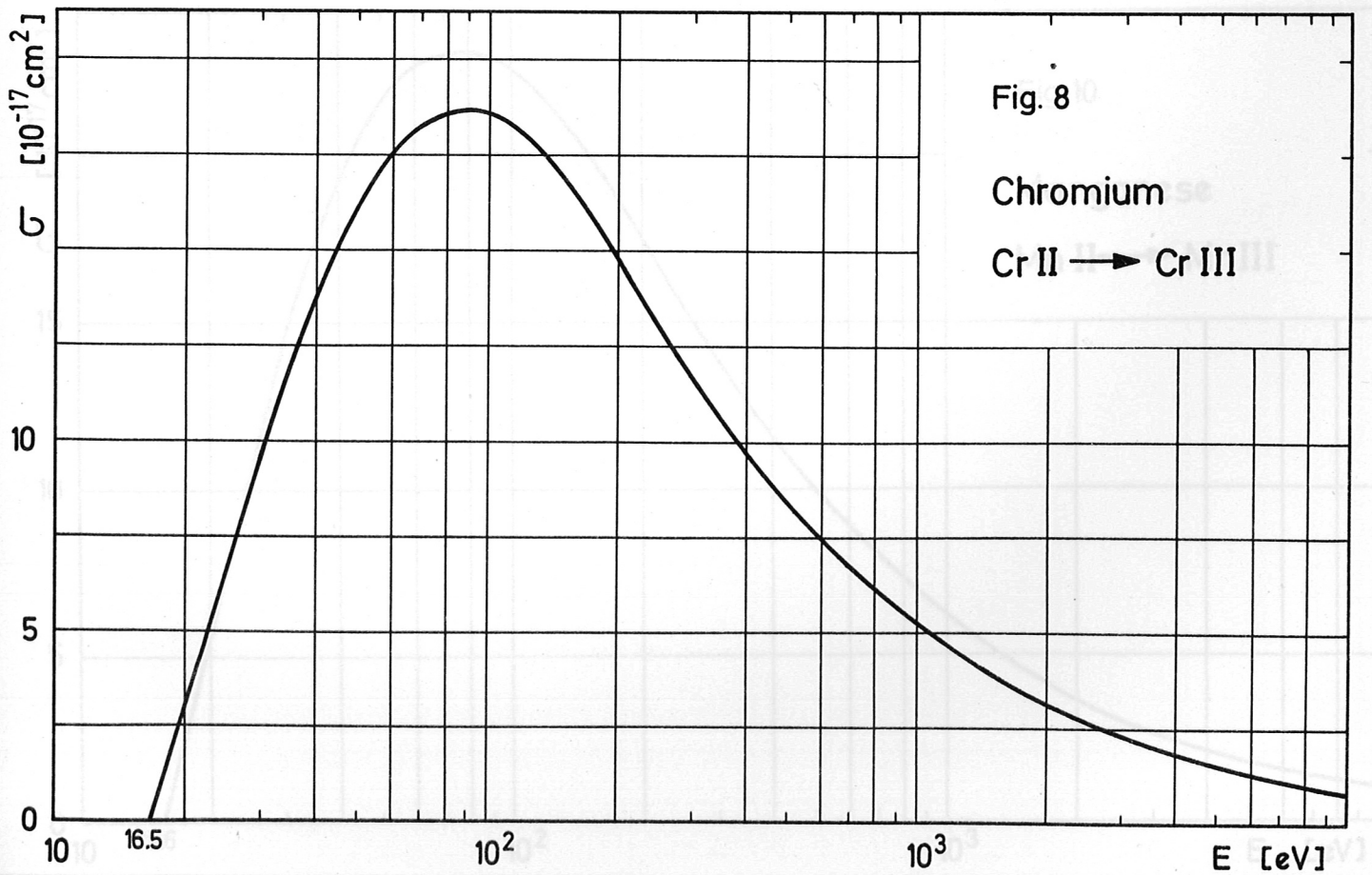
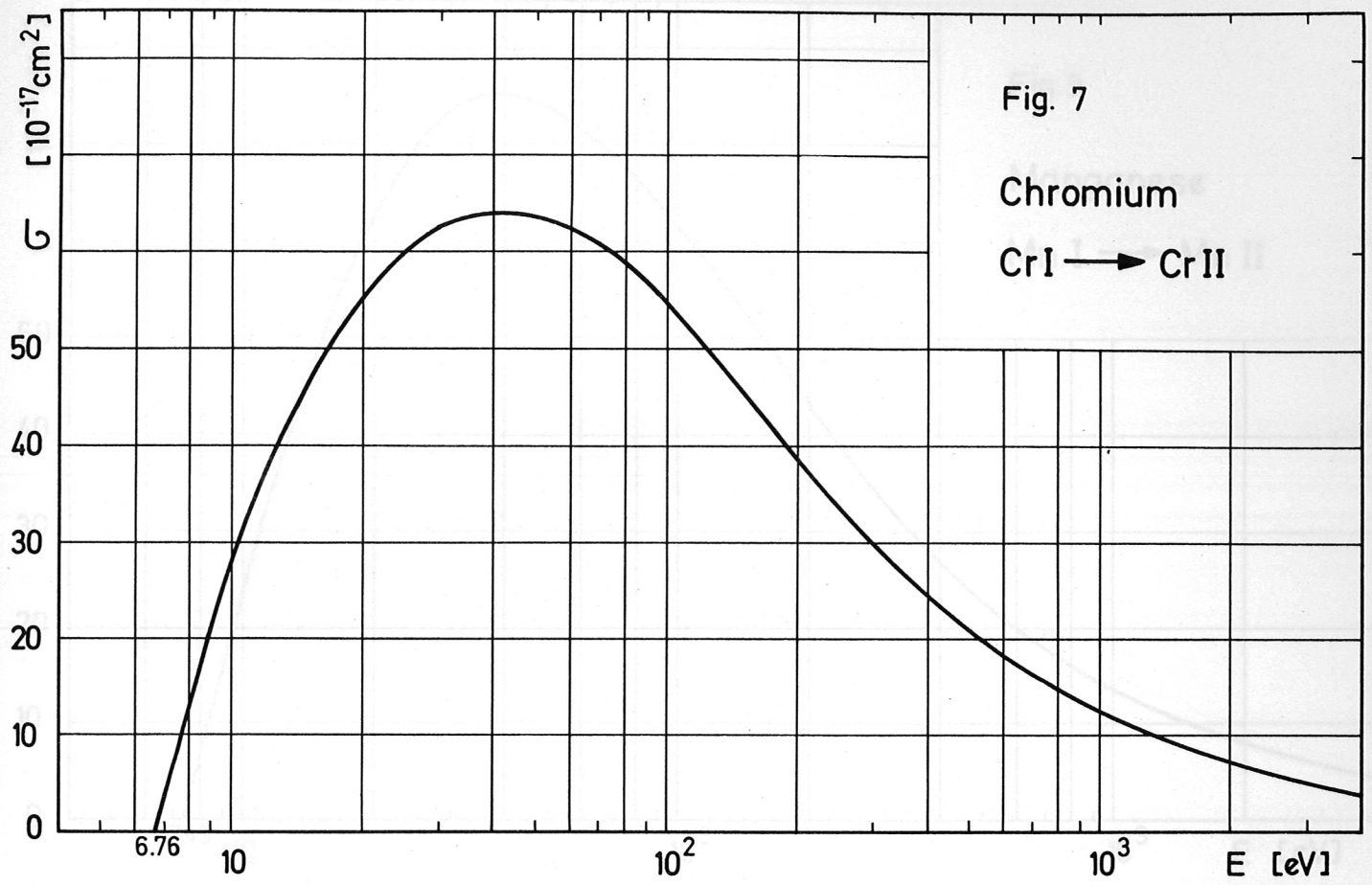
Table 6. (Continued)
Copper and Zinc

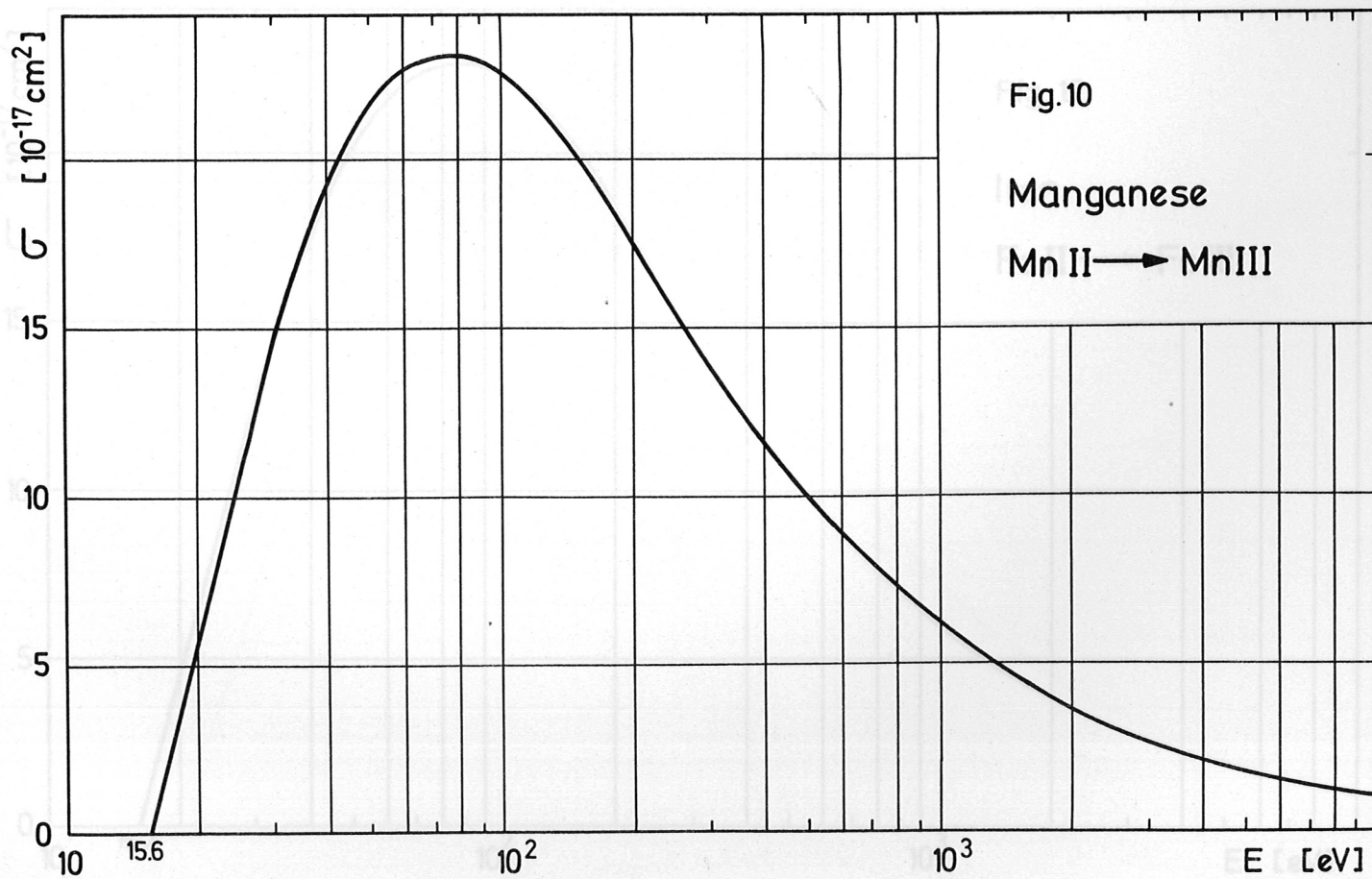
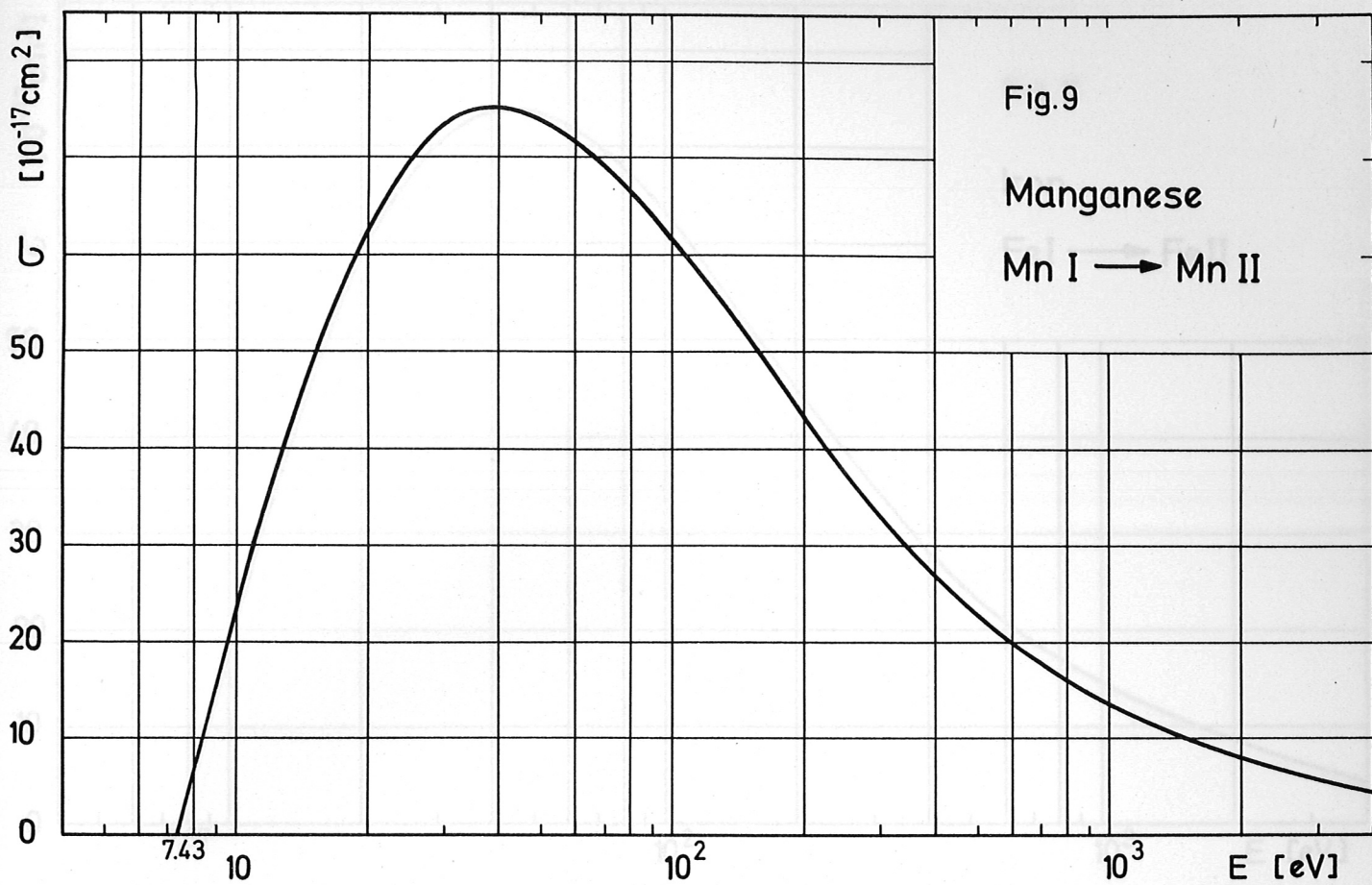
T	CU XXIII	CU XXIV	CU XXV	CU XXVI	ZN I	ZN II	ZN III	ZN IV	ZN V	ZN VI
1.0	0.	0.	0.	0.	3.10E-12	1.32E-16	1.85E-26	5.74E-35	0.	0.
1.5	0.	0.	0.	0.	8.91E-11	6.41E-14	1.29E-20	2.80E-26	5.17E-33	0.
2.0	0.	0.	0.	0.	5.04E-10	1.48E-12	1.14E-17	6.45E-22	5.65E-27	8.88E-33
3.0	0.	0.	0.	0.	3.07E-09	3.65E-11	1.08E-14	1.58E-17	6.52E-21	7.08E-25
4.0	0.	0.	0.	0.	7.96E-09	1.92E-10	3.54E-13	2.58E-15	7.27E-18	6.57E-21
5.0	0.	0.	0.	0.	1.45E-08	5.39E-10	2.97E-12	5.62E-14	5.00E-16	1.61E-18
7.0	0.	0.	0.	0.	3.01E-08	1.84E-09	3.58E-11	1.99E-12	6.51E-14	8.99E-16
10	0.	0.	0.	0.	5.45E-08	4.96E-09	2.49E-10	3.03E-11	2.61E-12	1.08E-13
15	0.	0.	0.	0.	9.14E-08	1.15E-08	1.23E-09	2.69E-10	4.80E-11	4.65E-12
20	0.	0.	0.	0.	1.22E-07	1.84E-08	2.87E-09	8.31E-10	2.11E-10	3.15E-11
30	0.	0.	0.	0.	1.67E-07	3.11E-08	7.19E-09	2.70E-09	9.58E-10	2.21E-10
40	6.84E-34	2.08E-35	4.81E-37	7.62E-39	1.99E-07	4.19E-08	1.19E-08	5.04E-09	2.08E-09	6.00E-10
50	2.36E-29	1.34E-30	6.05E-32	2.04E-33	2.22E-07	5.10E-08	1.64E-08	7.46E-09	3.36E-09	1.11E-09
70	3.81E-24	4.44E-25	4.31E-26	3.38E-27	2.52E-07	6.52E-08	2.43E-08	1.20E-08	5.91E-09	2.30E-09
100	3.23E-20	6.48E-21	1.12E-21	1.64E-22	2.76E-07	7.98E-08	3.33E-08	1.74E-08	9.19E-09	4.07E-09
150	3.90E-17	1.19E-17	3.24E-18	7.61E-19	2.92E-07	9.40E-08	4.30E-08	2.37E-08	1.31E-08	6.51E-09
200	1.40E-15	5.31E-16	1.80E-16	5.37E-17	2.96E-07	1.02E-07	4.89E-08	2.76E-08	1.58E-08	8.31E-09
300	5.27E-14	2.47E-14	1.05E-14	3.96E-15	2.93E-07	1.08E-07	5.49E-08	3.21E-08	1.89E-08	1.06E-08
400	3.32E-13	1.73E-13	8.28E-14	3.50E-14	2.85E-07	1.10E-07	5.75E-08	3.43E-08	2.06E-08	1.20E-08
500	1.02E-12	5.65E-13	2.90E-13	1.32E-13	2.77E-07	1.10E-07	5.85E-08	3.54E-08	2.16E-08	1.29E-08
700	3.73E-12	2.23E-12	1.24E-12	6.10E-13	2.62E-07	1.08E-07	5.88E-08	3.63E-08	2.25E-08	1.38E-08
1000	1.01E-11	6.39E-12	3.76E-12	1.97E-12	2.44E-07	1.04E-07	5.77E-08	3.62E-08	2.28E-08	1.44E-08
1500	2.23E-11	1.48E-11	9.13E-12	5.03E-12	2.21E-07	9.72E-08	5.50E-08	3.51E-08	2.25E-08	1.45E-08
2000	3.33E-11	2.27E-11	1.44E-11	8.12E-12	2.05E-07	9.16E-08	5.26E-08	3.39E-08	2.20E-08	1.43E-08
3000	5.02E-11	3.49E-11	2.27E-11	1.32E-11	1.83E-07	8.34E-08	4.86E-08	3.17E-08	2.08E-08	1.38E-08
4000	6.16E-11	4.34E-11	2.86E-11	1.70E-11	1.68E-07	7.75E-08	4.55E-08	3.00E-08	1.98E-08	1.32E-08
5000	6.94E-11	4.94E-11	3.28E-11	1.98E-11	1.57E-07	7.29E-08	4.32E-08	2.85E-08	1.90E-08	1.27E-08
7000	7.92E-11	5.69E-11	3.82E-11	2.35E-11	1.41E-07	6.62E-08	3.96E-08	2.64E-08	1.77E-08	1.19E-08
10000	8.64E-11	6.25E-11	4.24E-11	2.67E-11	1.26E-07	5.95E-08	3.58E-08	2.40E-08	1.62E-08	1.10E-08
T	ZN VII	ZN VIII	ZN IX	ZN X	ZN XI	ZN XII	ZN XIII	ZN XIV	ZN XV	ZN XVI
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	1.12E-38	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	6.82E-29	5.49E-35	2.05E-39	0.	0.	0.	0.	0.	0.	0.
4.0	5.53E-24	1.25E-28	5.23E-32	4.54E-36	0.	0.	0.	0.	0.	0.
5.0	4.99E-21	8.34E-25	1.49E-27	7.44E-31	2.80E-34	6.66E-38	0.	0.	0.	0.
7.0	1.23E-17	2.03E-20	1.91E-22	7.04E-25	2.08E-27	4.09E-30	2.34E-36	1.30E-38	0.	0.
10	4.51E-15	4.14E-17	1.35E-18	2.24E-20	3.09E-22	2.98E-24	1.83E-28	4.36E-30	8.20E-32	2.83E-34
15	4.67E-13	1.64E-14	1.41E-15	7.52E-17	3.46E-18	1.16E-19	2.68E-22	2.00E-23	1.25E-24	2.52E-26
20	4.90E-12	3.37E-13	4.71E-14	4.53E-15	3.85E-16	2.49E-17	3.40E-19	4.48E-20	5.17E-21	2.53E-22
30	5.35E-11	7.27E-12	1.67E-12	2.93E-13	4.71E-14	6.33E-15	4.61E-16	1.08E-16	2.29E-17	2.75E-18
40	1.82E-10	3.52E-11	1.04E-11	2.51E-12	5.71E-13	1.16E-13	1.77E-14	5.55E-15	1.61E-15	3.01E-16
50	3.88E-10	9.32E-11	3.23E-11	9.51E-12	2.69E-12	7.16E-13	1.62E-13	6.04E-14	2.11E-14	5.17E-15
70	9.48E-10	2.96E-10	1.24E-10	4.64E-11	1.71E-11	6.21E-12	2.10E-12	9.60E-13	4.15E-13	1.38E-13
100	1.92E-09	7.36E-10	3.59E-10	1.63E-10	7.40E-11	3.38E-11	1.49E-11	7.93E-12	4.04E-12	1.68E-12
150	3.43E-09	1.56E-09	8.63E-10	4.57E-10	2.45E-10	1.33E-10	7.09E-11	4.26E-11	2.46E-11	1.23E-11
200	4.65E-09	2.31E-09	1.37E-09	7.85E-10	4.57E-10	2.70E-10	1.58E-10	1.01E-10	6.21E-11	3.38E-11
300	6.36E-09	3.48E-09	2.21E-09	1.38E-09	8.70E-10	5.59E-10	3.57E-10	2.43E-10	1.61E-10	9.57E-11
400	7.44E-09	4.28E-09	2.82E-09	1.83E-09	1.21E-09	8.12E-10	5.44E-10	3.82E-10	2.62E-10	1.64E-10
500	8.16E-09	4.85E-09	3.27E-09	2.18E-09	1.48E-09	1.02E-09	7.04E-10	5.05E-10	3.54E-10	2.28E-10
700	9.01E-09	5.56E-09	3.86E-09	2.66E-09	1.86E-09	1.32E-09	9.51E-10	7.00E-10	5.04E-10	3.38E-10
1000	9.59E-09	6.11E-09	4.34E-09	3.06E-09	2.20E-09	1.60E-09	1.20E-09	8.99E-10	6.63E-10	4.59E-10
1500	9.87E-09	6.45E-09	4.68E-09	3.38E-09	2.47E-09	1.84E-09	1.42E-09	1.09E-09	8.23E-10	5.86E-10
2000	9.86E-09	6.54E-09	4.79E-09	3.50E-09	2.60E-09	1.95E-09	1.55E-09	1.20E-09	9.15E-10	6.63E-10
3000	9.60E-09	6.48E-09	4.81E-09	3.56E-09	2.67E-09	2.03E-09	1.66E-09	1.30E-09	1.01E-09	7.44E-10
4000	9.30E-09	6.34E-09	4.73E-09	3.53E-09	2.67E-09	2.04E-09	1.70E-09	1.34E-09	1.05E-09	7.81E-10
5000	9.00E-09	6.18E-09	4.64E-09	3.48E-09	2.64E-09	2.03E-09	1.71E-09	1.36E-09	1.06E-09	7.99E-10
7000	8.49E-09	5.88E-09	4.44E-09	3.35E-09	2.56E-09	1.98E-09	1.69E-09	1.35E-09	1.07E-09	8.09E-10
10000	7.89E-09	5.50E-09	4.18E-09	3.17E-09	2.44E-09	1.89E-09	1.64E-09	1.32E-09	1.05E-09	8.00E-10
T	ZN XVII	ZN XVIII	ZN XIX	ZN XX	ZN XXI	ZN XXII	ZN XXIII	ZN XXIV	ZN XXV	ZN XXVI
1.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	4.12E-36	3.38E-38	0.	0.	0.	0.	0.	0.	0.	0.
15	1.28E-27	4.18E-29	2.90E-31	8.42E-33	0.	0.	0.	0.	0.	0.
20	2.42E-23	1.62E-24	3.75E-26	2.16E-27	0.	0.	0.	0.	0.	0.
30	5.02E-19	7.03E-20	5.12E-21	5.83E-22	4.11E-38	0.	0.	0.	0.	0.
40	7.64E-17	1.56E-17	1.96E-18	3.14E-19	2.43E-31	1.10E-32	4.18E-34	7.49E-36	2.00E-37	2.59E-39
50	1.60E-15	4.11E-16	7.10E-17	1.40E-17	2.89E-27	2.30E-28	1.59E-29	6.18E-31	3.17E-32	1.27E-33
70	5.38E-14	1.80E-14	4.43E-15	1.10E-15	1.37E-22	2.09E-23	2.89E-24	2.69E-25	2.92E-26	2.62E-27
100	7.83E-13	3.20E-13	1.02E-13	3.04E-14	4.68E-19	1.17E-19	2.71E-20	4.83E-21	9.21E-22	1.51E-22
150	6.54E-12	3.14E-12	1.22E-12	4.17E-13	2.81E-16	1.03E-16	3.58E-17	1.04E-17	3.09E-18	8.09E-19
200	1.94E-11	1.00E-11	4.32E-12	1.59E-12	7.17E-15	3.18E-15	1.35E-15	5.02E-16	1.86E-16	6.16E-17
300	5.89E-11	3.33E-11	1.59E-11	6.40E-12	1.92E-13	1.03E-13	5.37E-14	2.53E-14	1.17E-14	4.90E-15
400	1.05E-10	6.19E-11	3.17E-11	1.36E-11	1.02E-12	6.06E-13	3.49E-13	1.85E-13	9.52E-14	4.51E-14
500	1.50E-10	9.13E-11	4.90E-11	2.22E-11	2.83E-12	1.78E-12	1.09E-12	6.18E-13	3.41E-13	1.73E-13
700	2.29E-10	1.45E-10	8.37E-11	4.14E-11	9.27E-12	6.22E-12	4.08E-12	2.51E-12	1.50E-12	8.26E-13
1000	3.21E-10	2.11E-10	1.30E-10	7.03E-11	2.30E-11	1.62E-11	1.12E-11	7.34E-12	4.64E-12	2.73E-12
1500	4.21E-10	2.87E-10	1.90E-10	1.12E-10	4.74E-11	3.49E-11	2.51E-11	1.72E-11	1.14E-11	7.06E-12
2000	4.84E-10	3.36E-10	2.33E-10	1.43E-10	6.86E-11	5.15E-11	3.79E-11	2.67E-11	1.81E-11	1.15E-11
3000	5.53E-10	3.93E-10	2.86E-10	1.85E-10	9.95E-11	7.64E-11	5.75E-11	4.15E-11	2.89E-11	1.88E-11
4000	5.87E-10	4.23E-10	3.16E-10	2.10E-10	1.20E-10	9.30E-11	7.09E-11	5.18E-11	3.66E-11	2.42E-11
5000	6.04E-10	4.40E-10	3.34E-10	2.26E-10	1.33E-10	1.04E-10	8.01E-11	5.91E-11	4.21E-11	2.80E-11
7000	6.17E-10	4.54E-10	3.53E-10	2.44E-10	1.50E-10	1.18E-10	9.17E-11	6.83E-11	4.91E-11	3.31E-11
10000	6.15E-10	4.57E-10	3.63E-10	2.55E-10	1.62E-10	1.29E-10	1.00E-10	7.54E-11	5.47E-11	3.71E-11

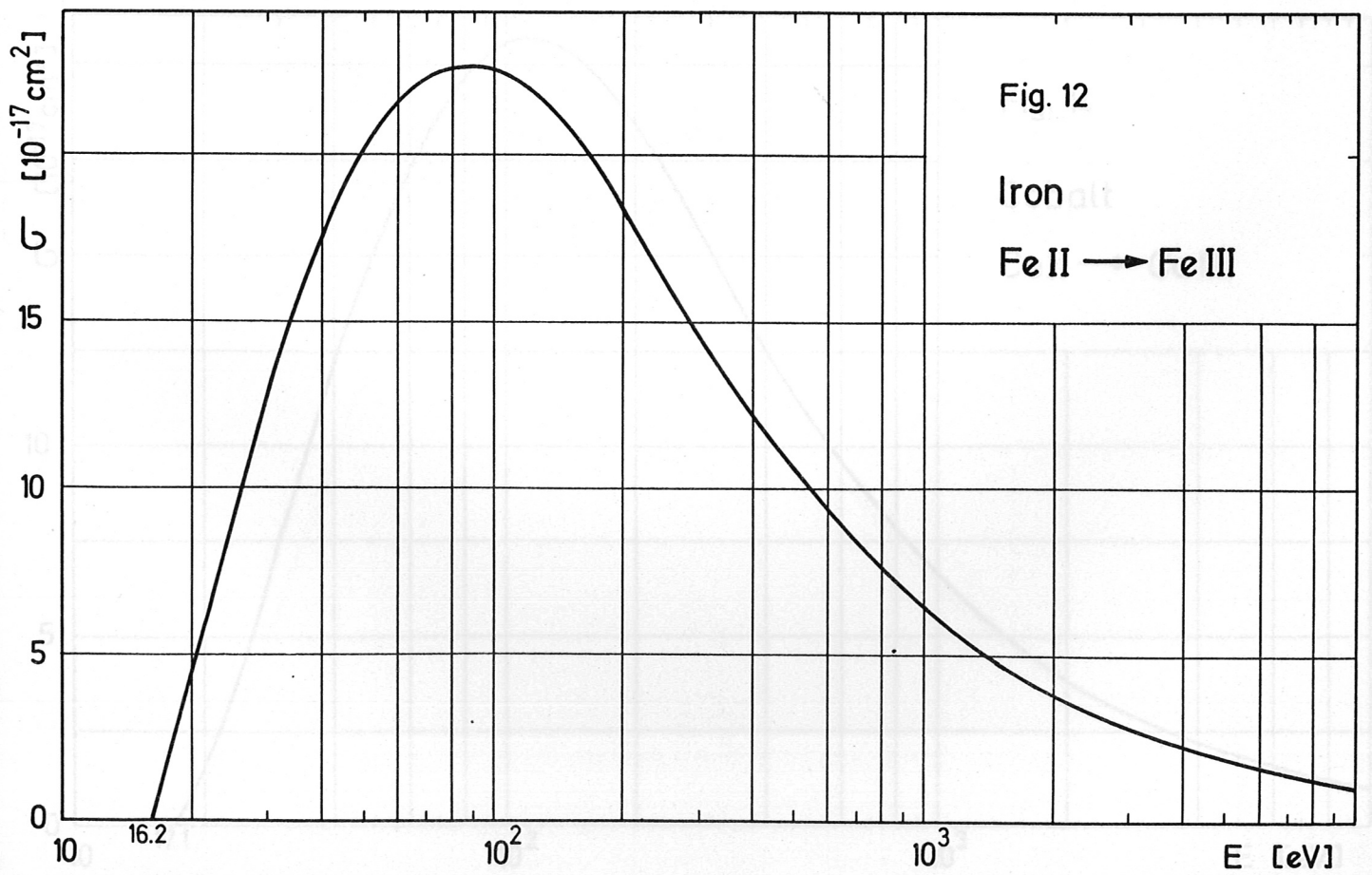
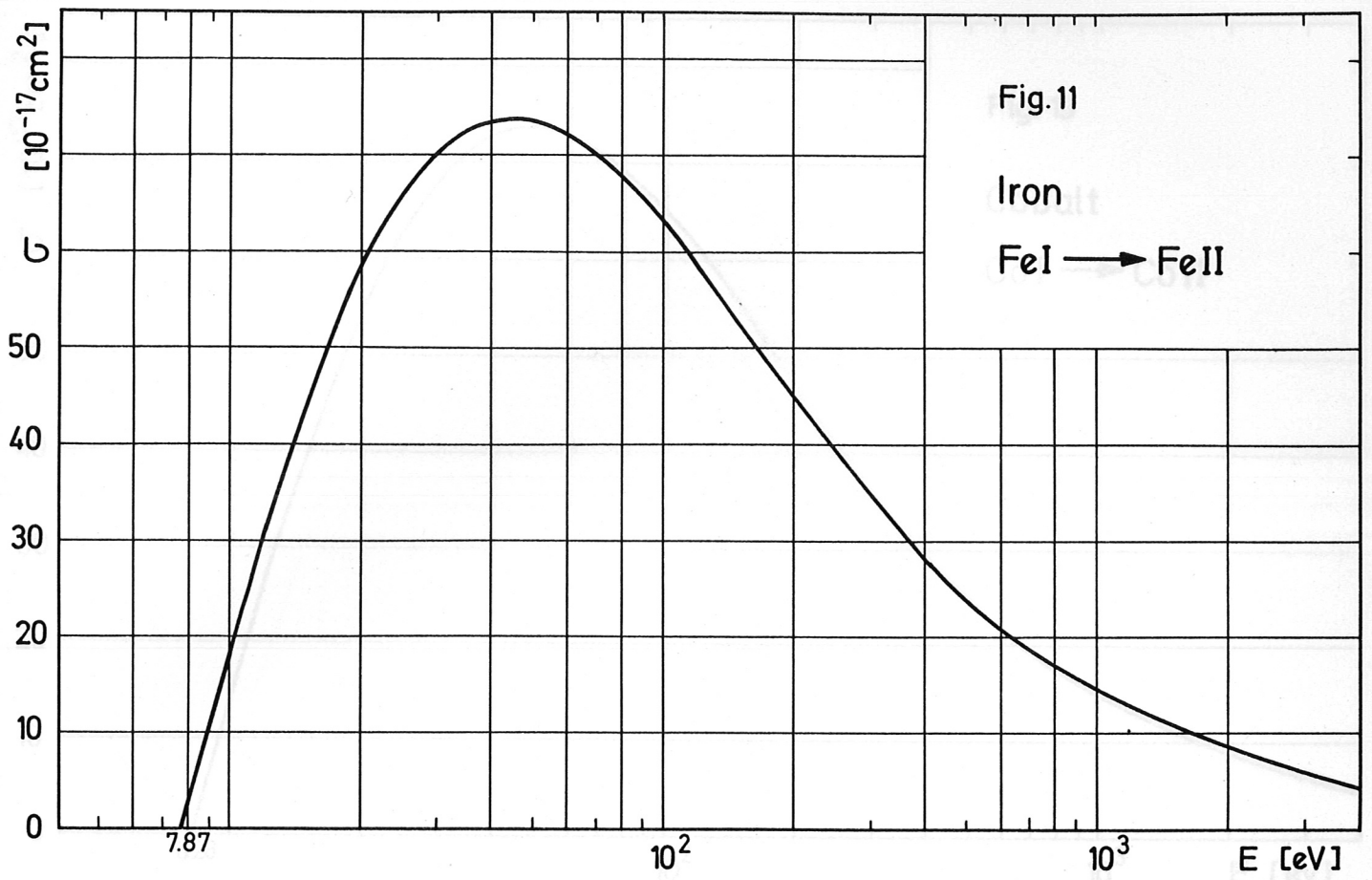


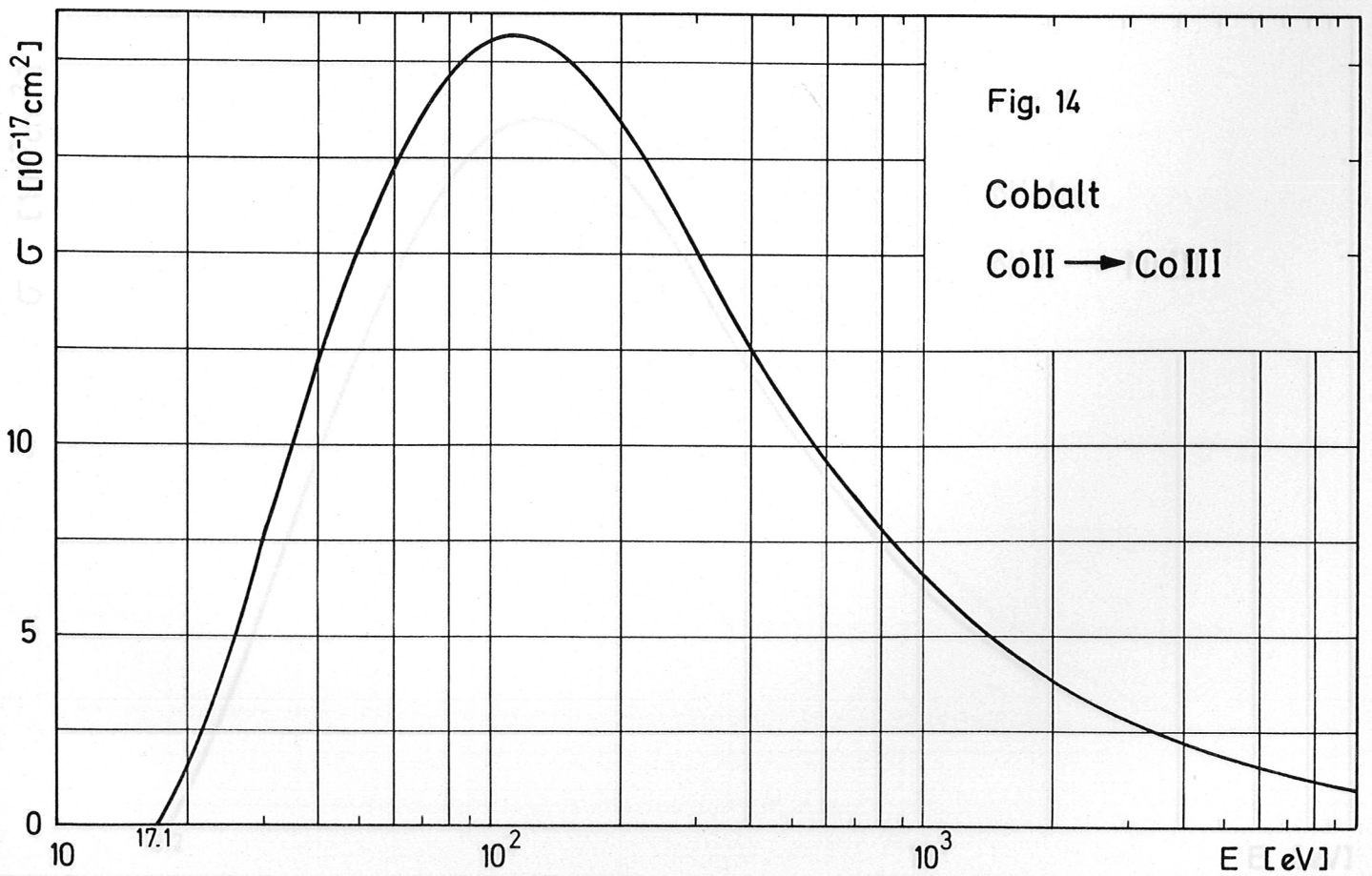
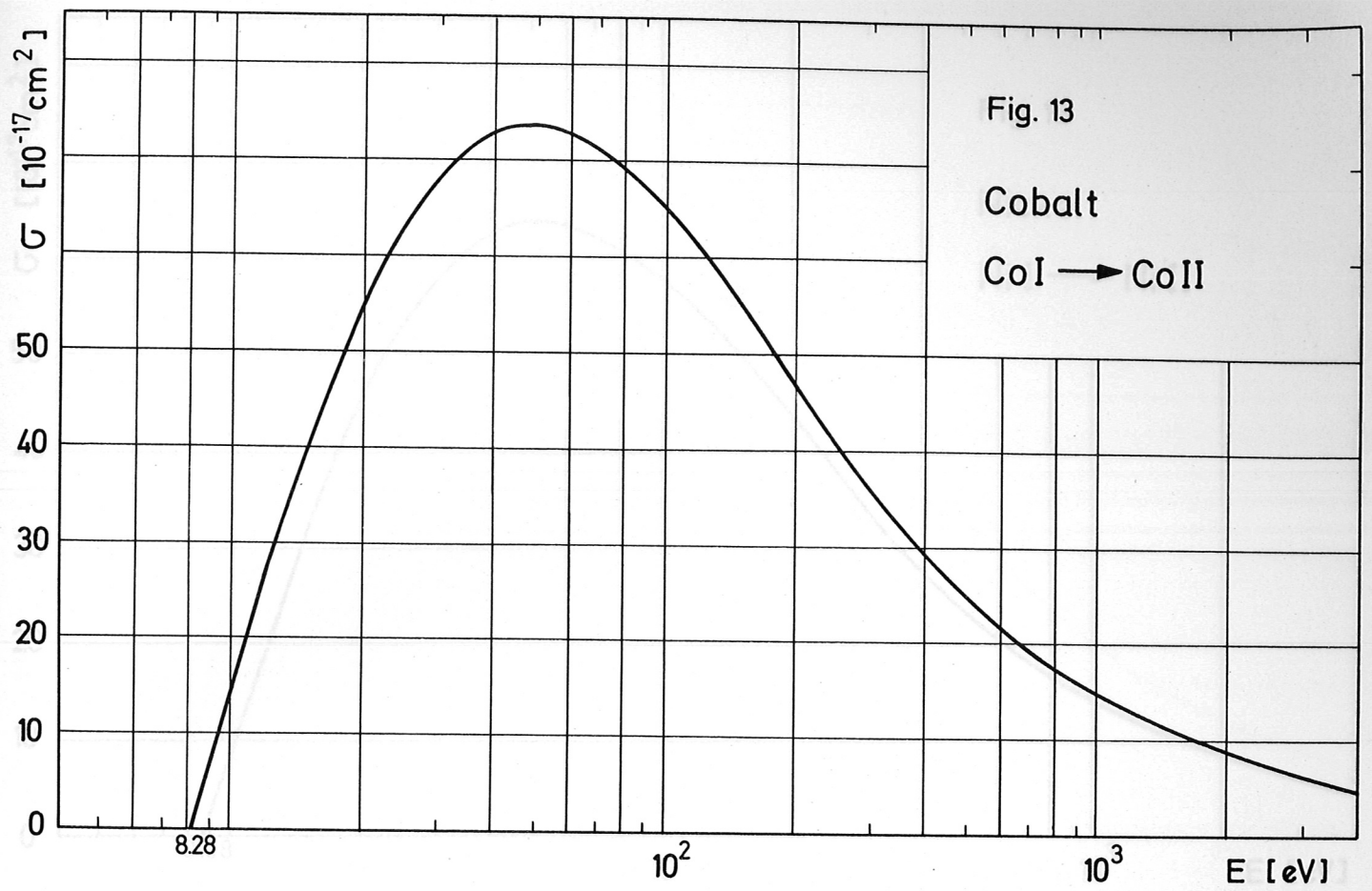


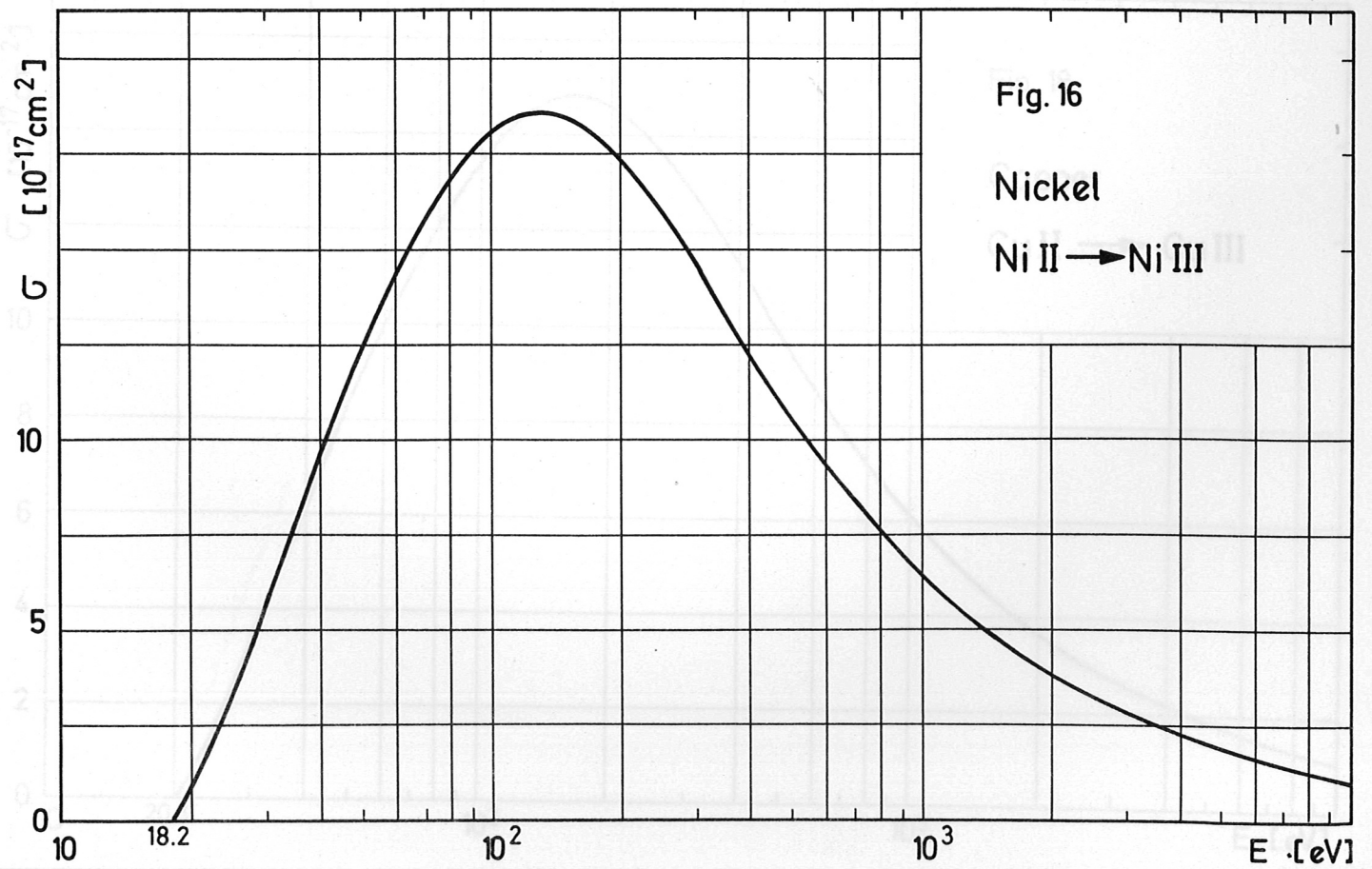
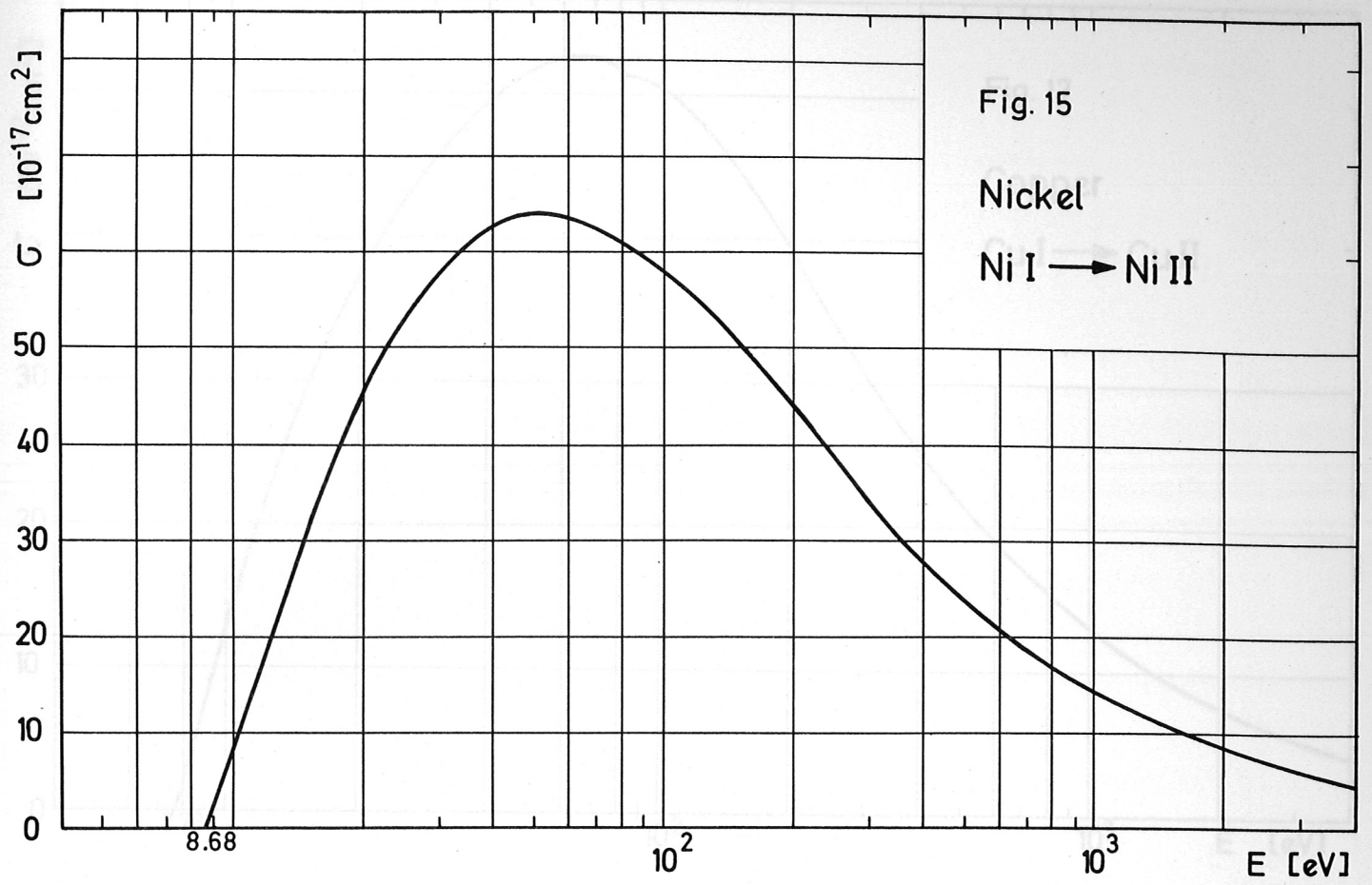


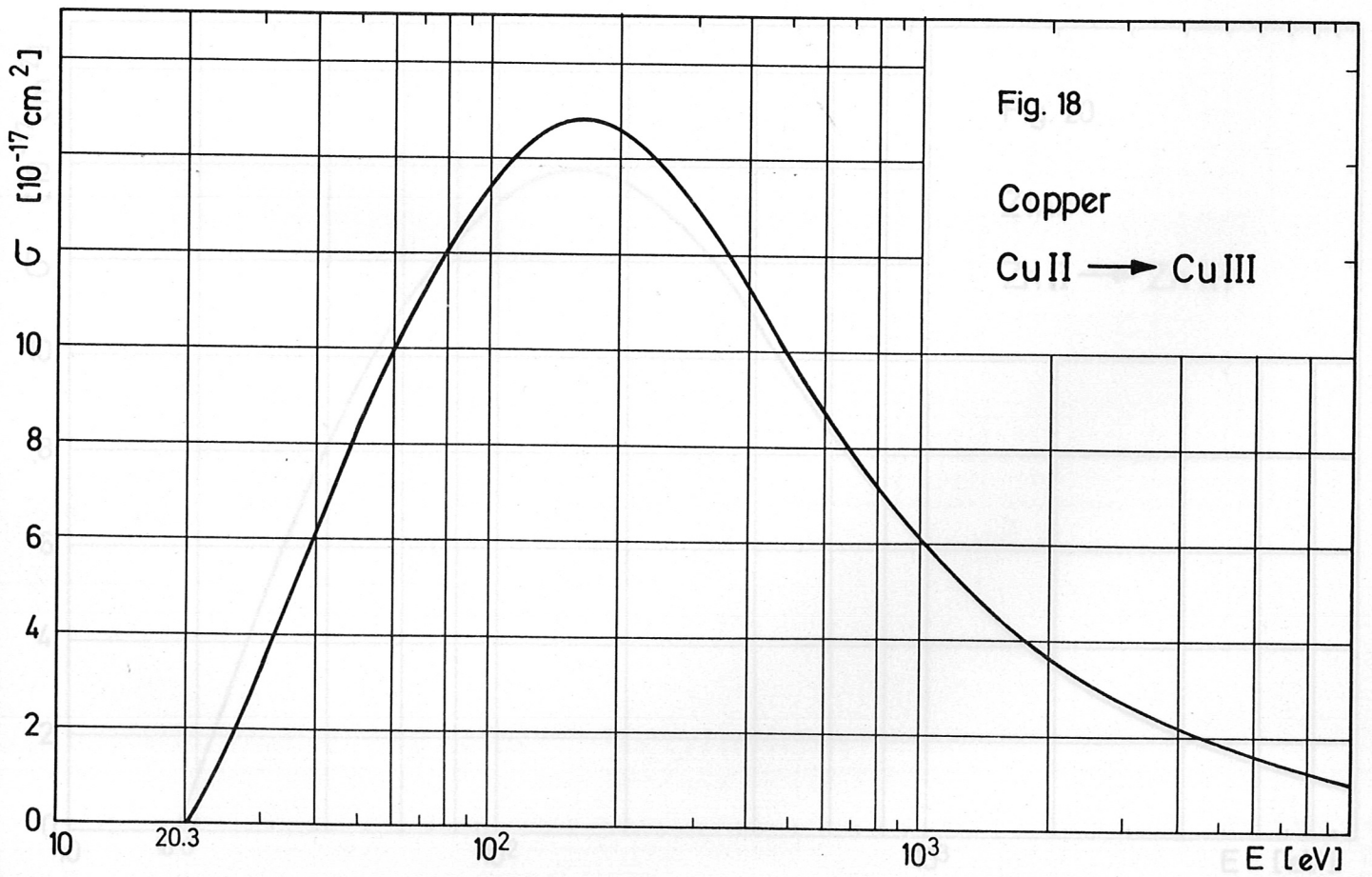
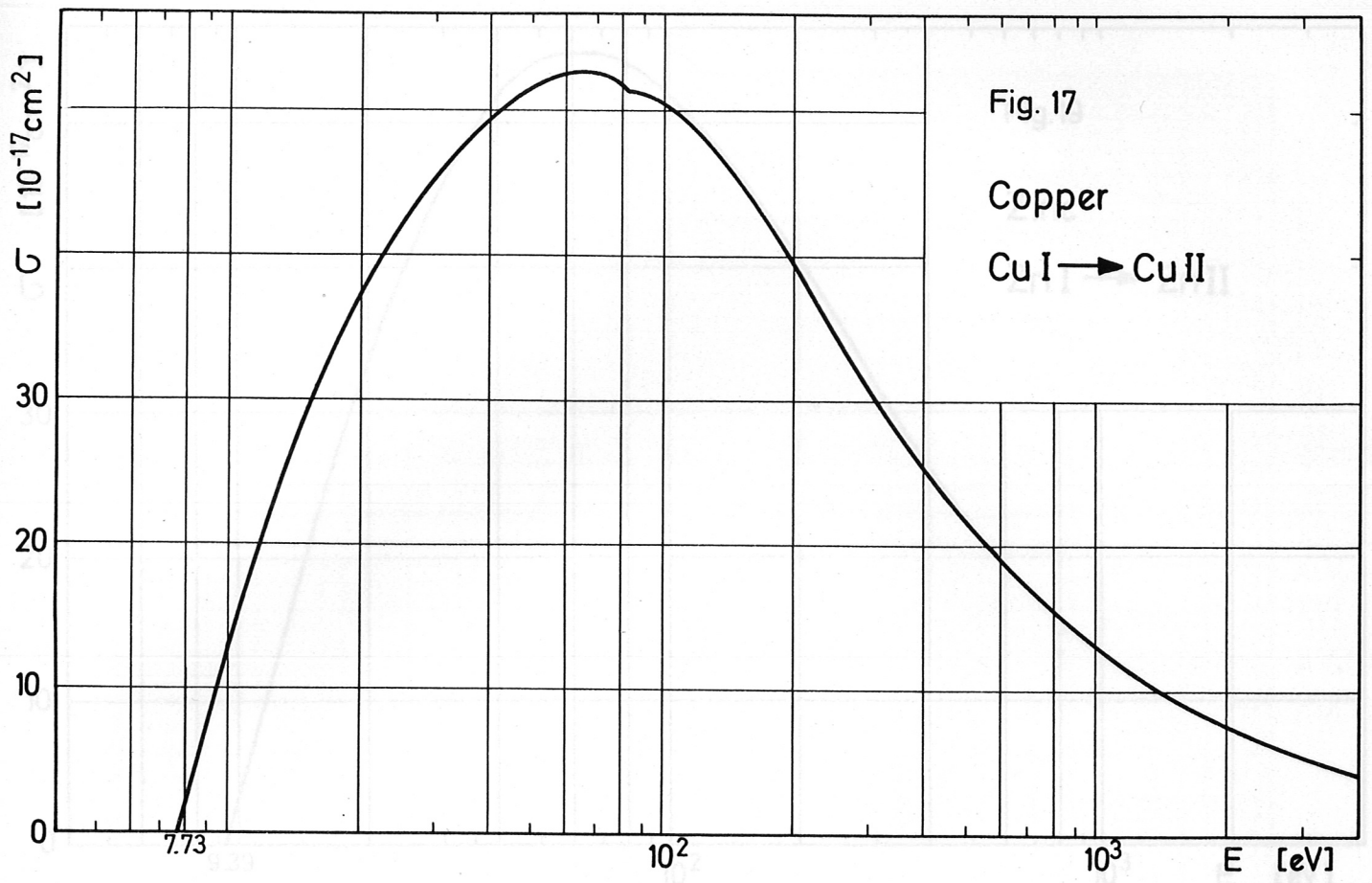


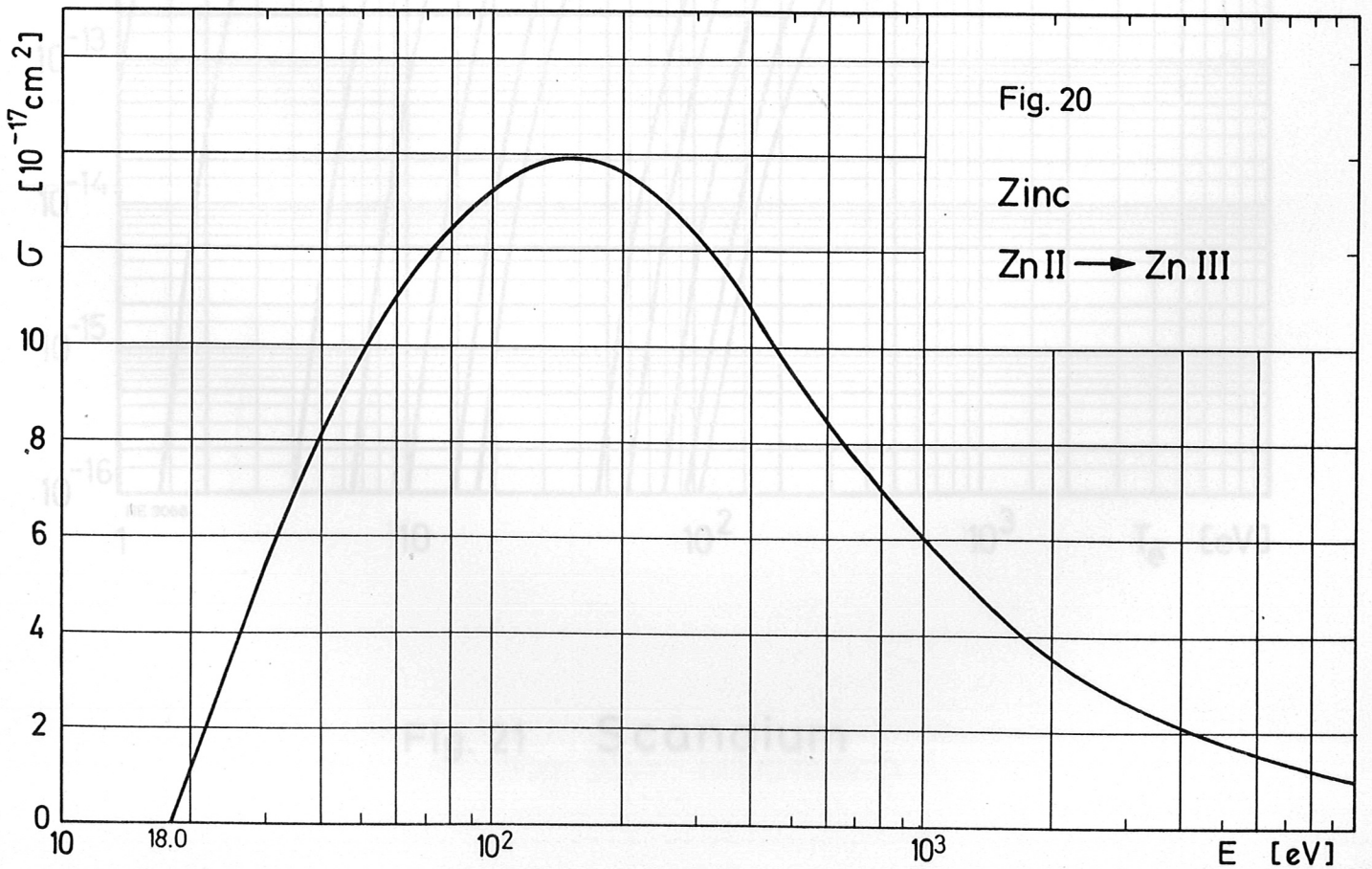
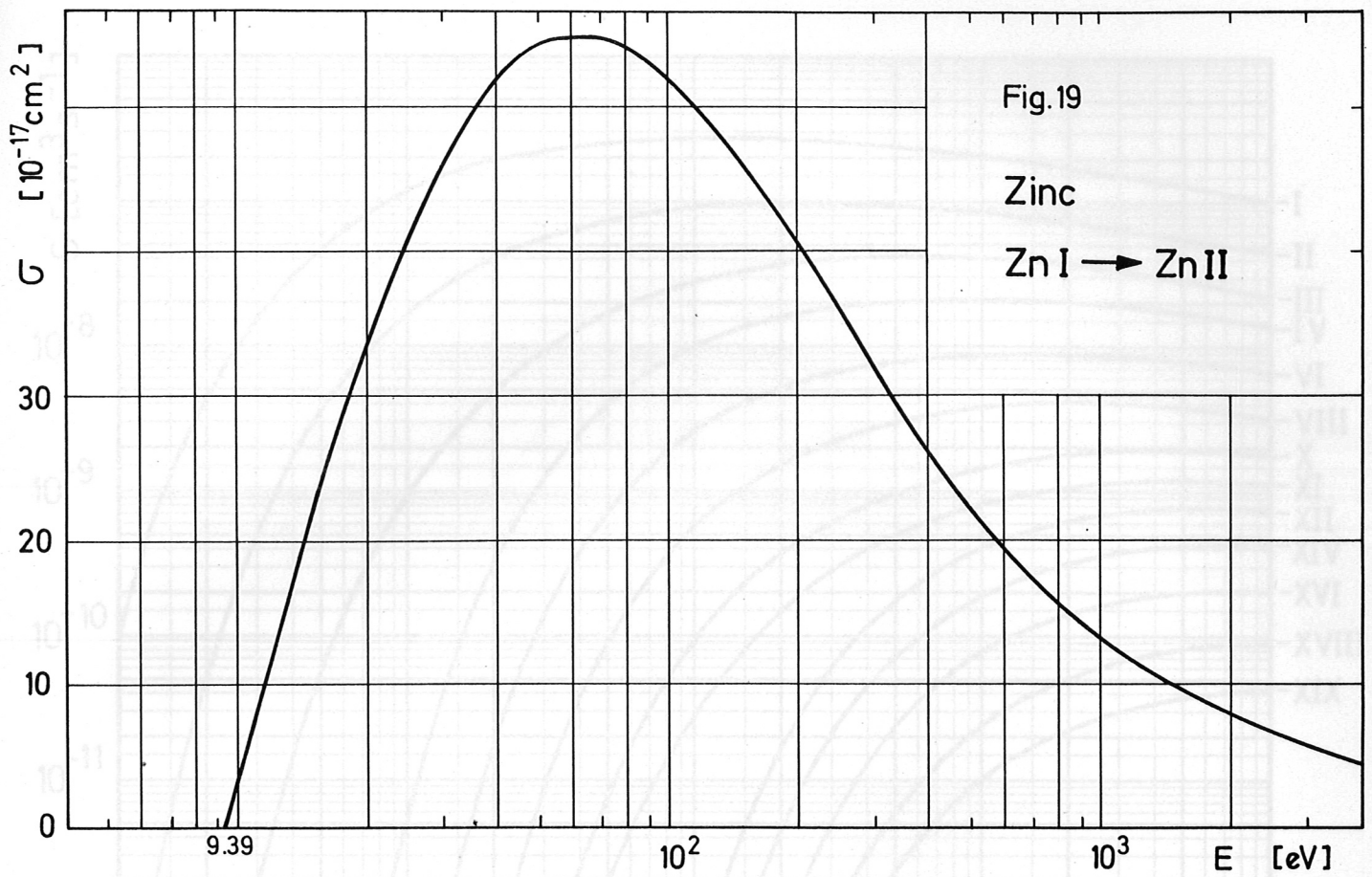












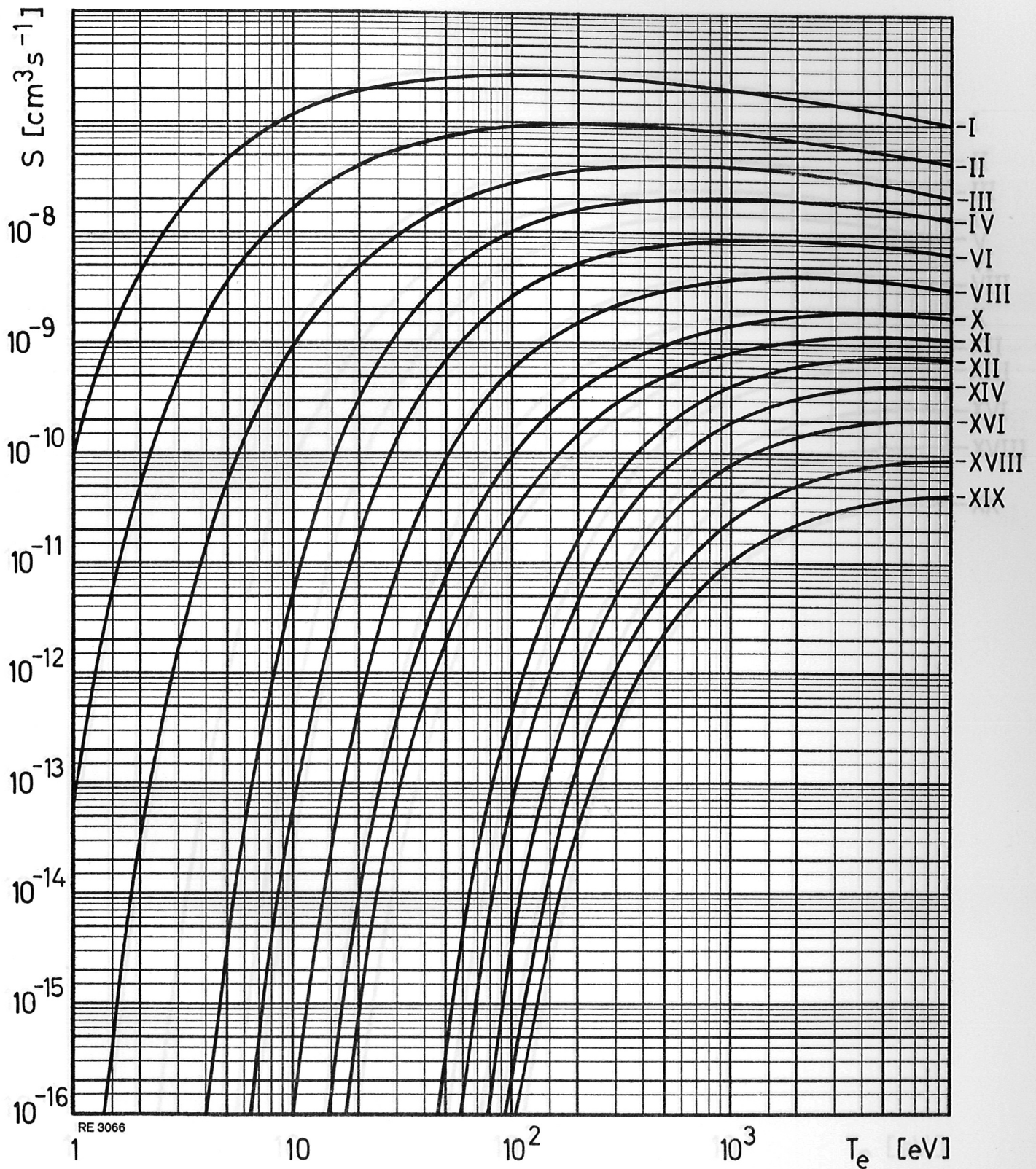


Fig. 21 Scandium

Fig. 22 Titanium

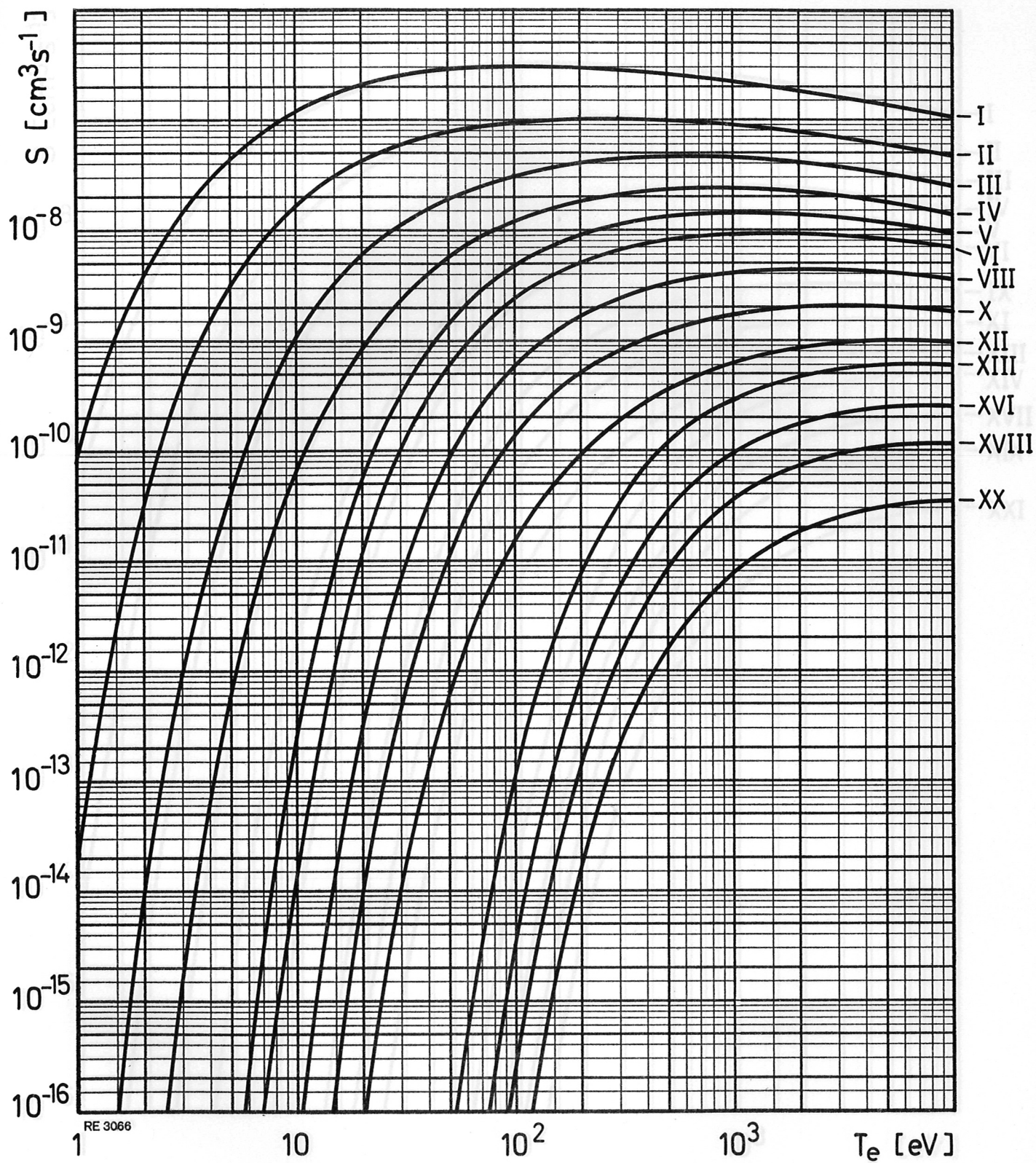


Fig. 22 Va Titanium

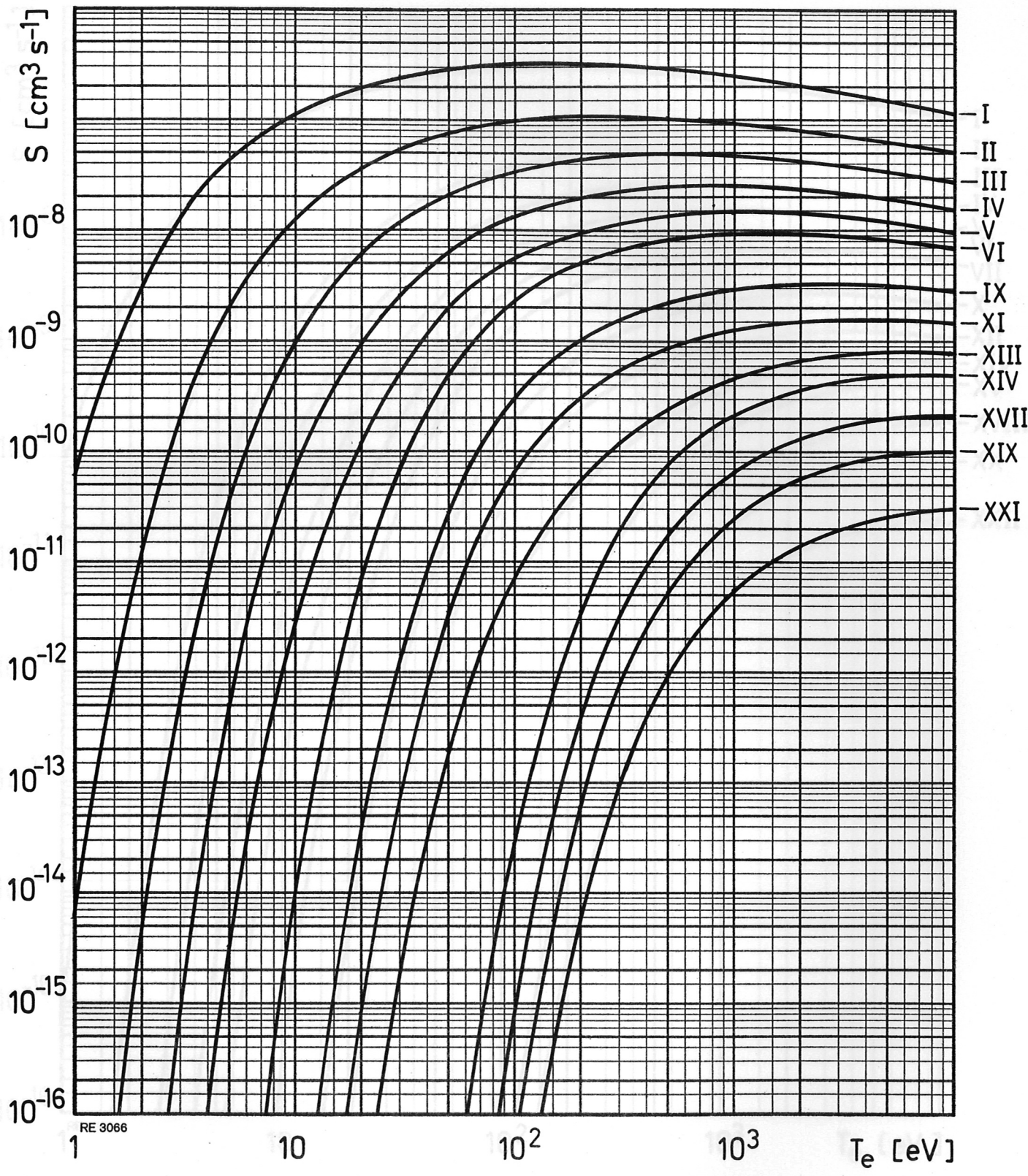


Fig. 23 Vanadium

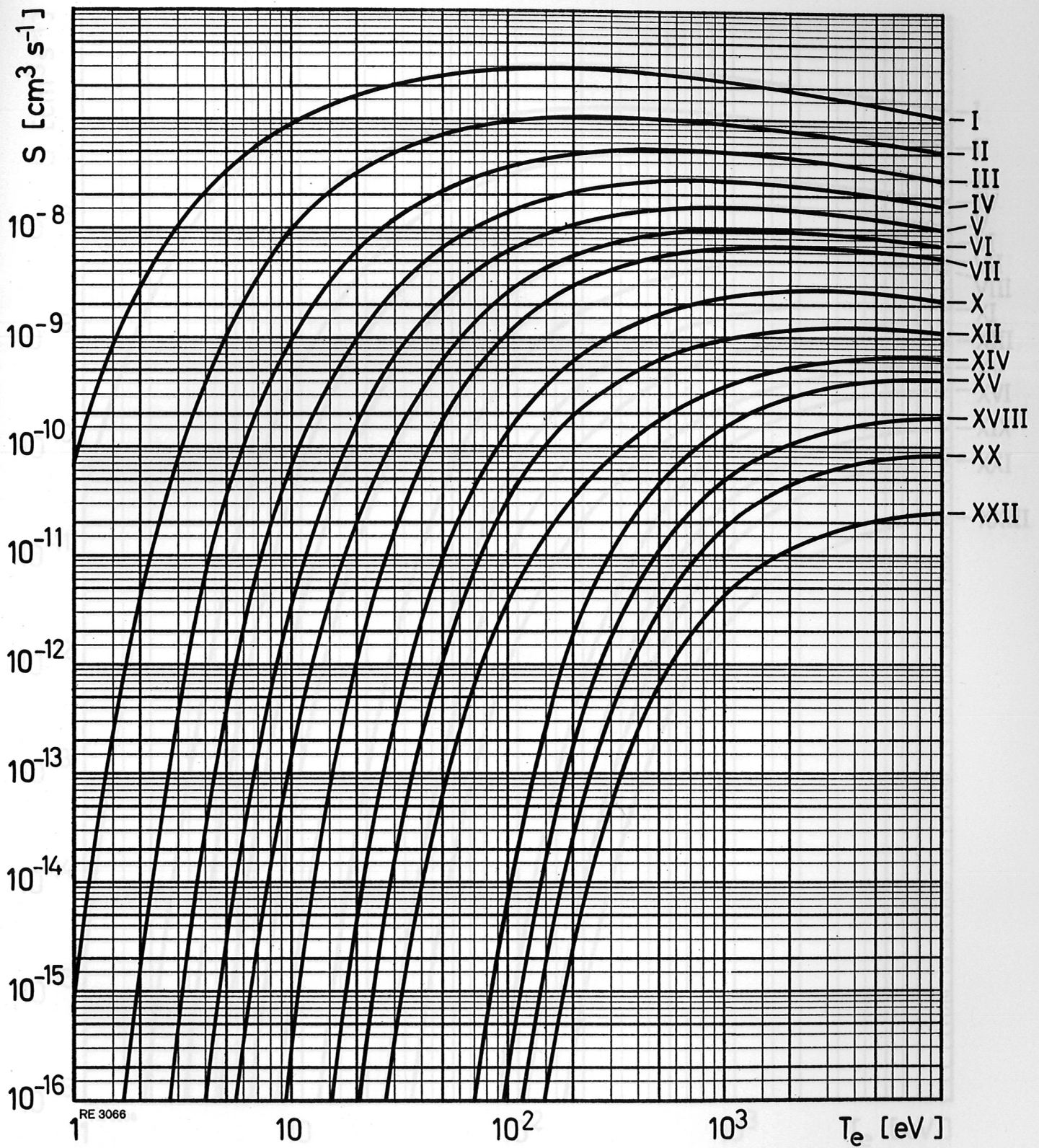


Fig. 24 Chromium

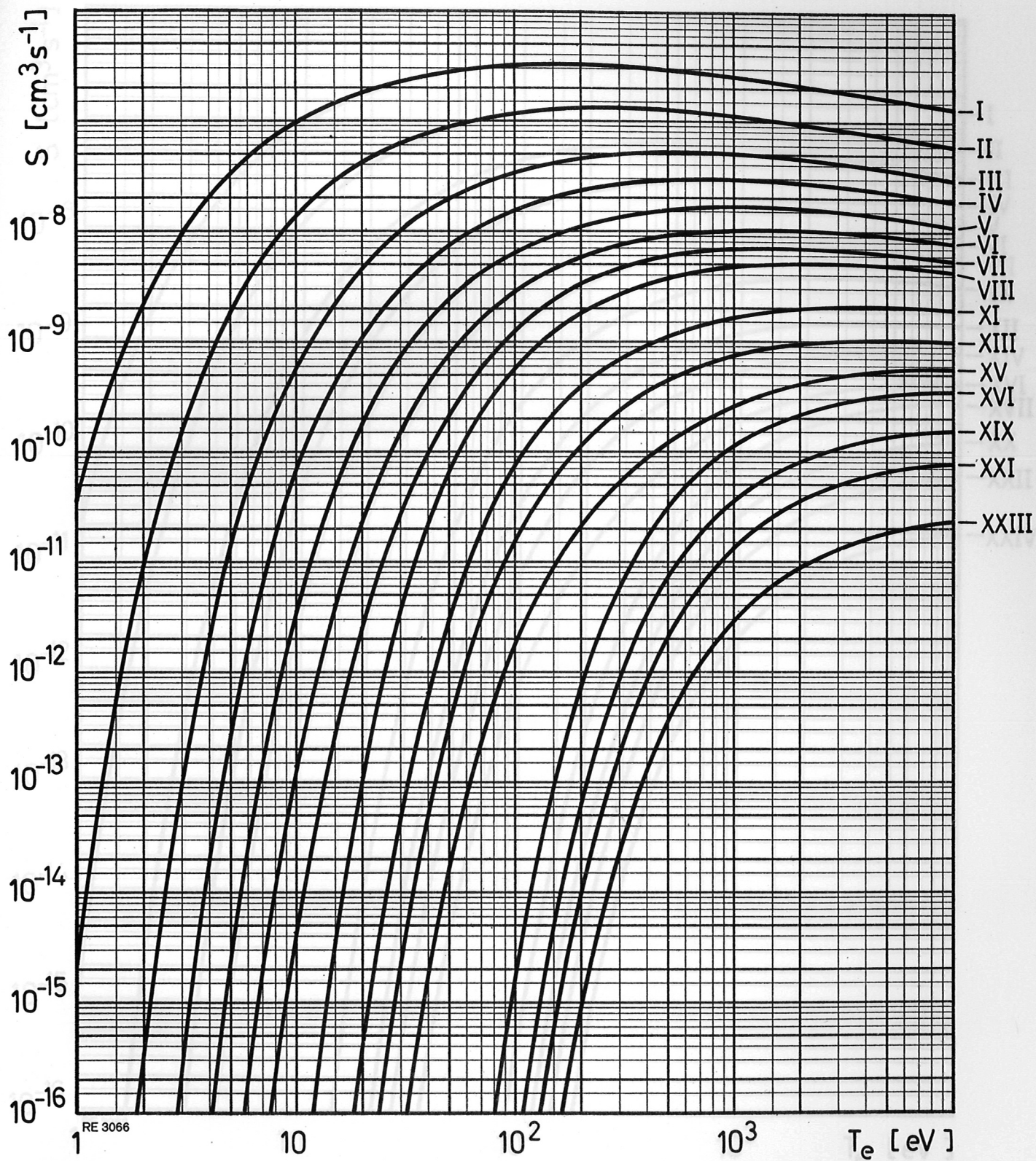


Fig. 25 ²⁶Manganese

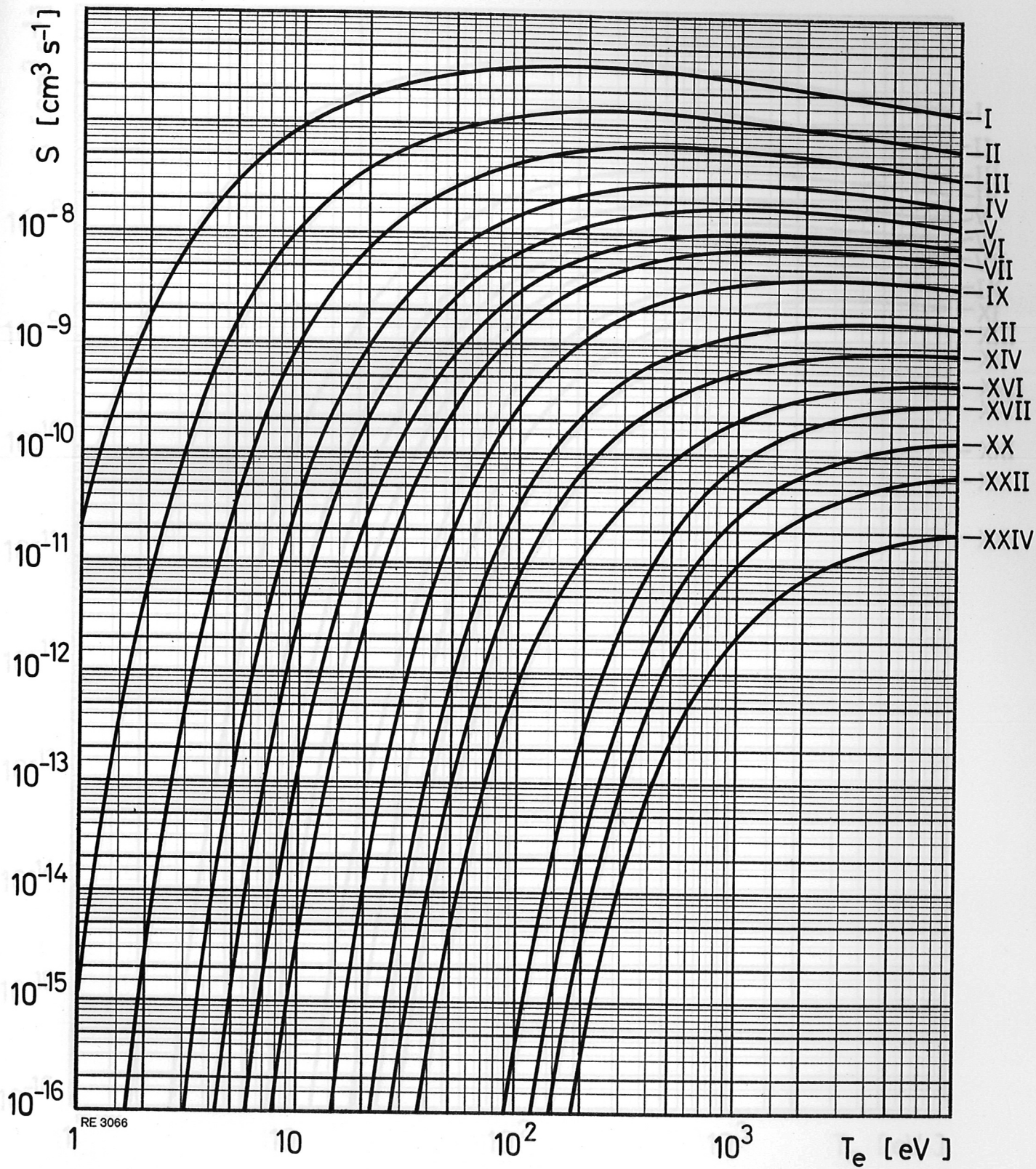


Fig. 26 Iron

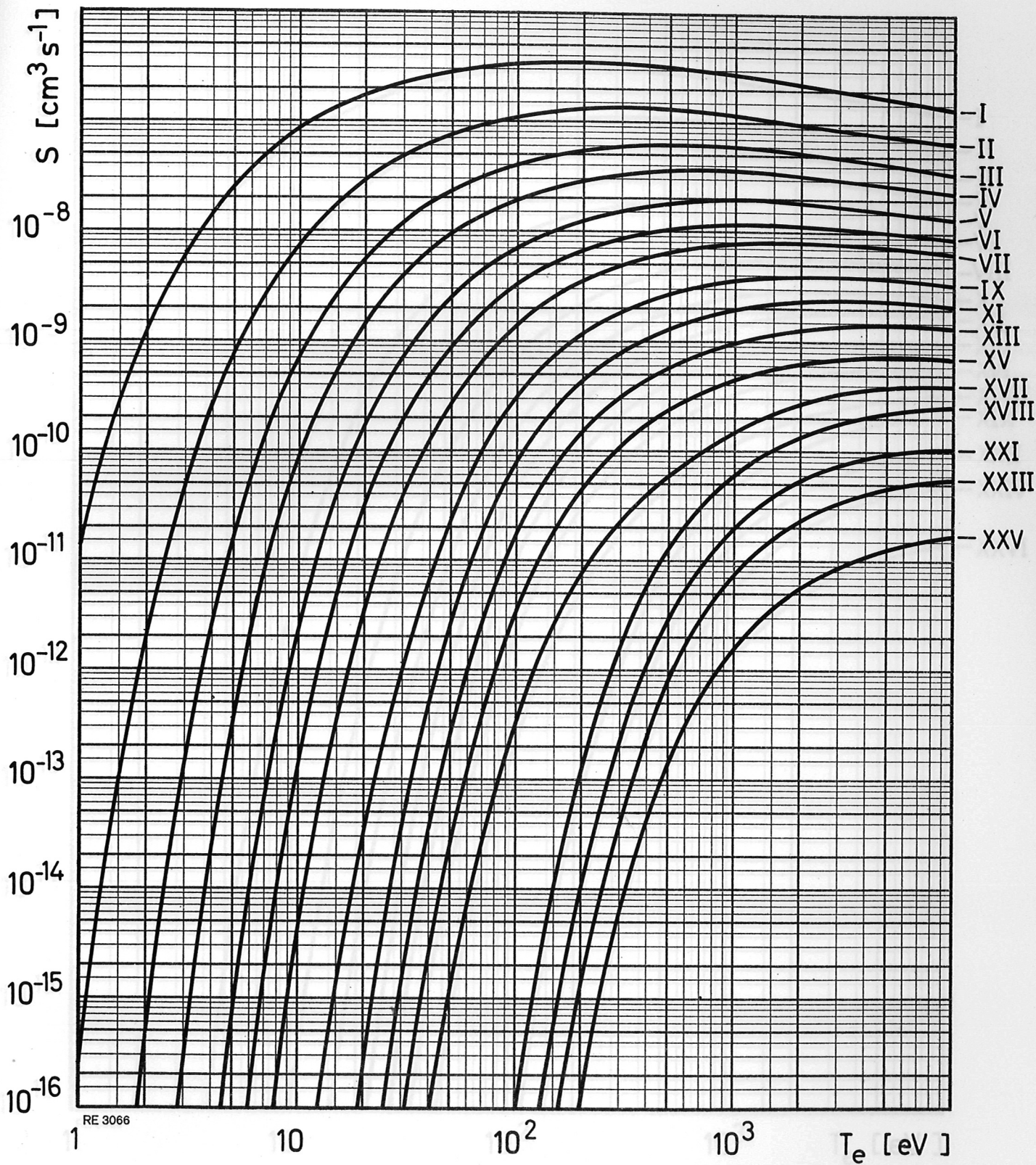


Fig. 27 Cobalt

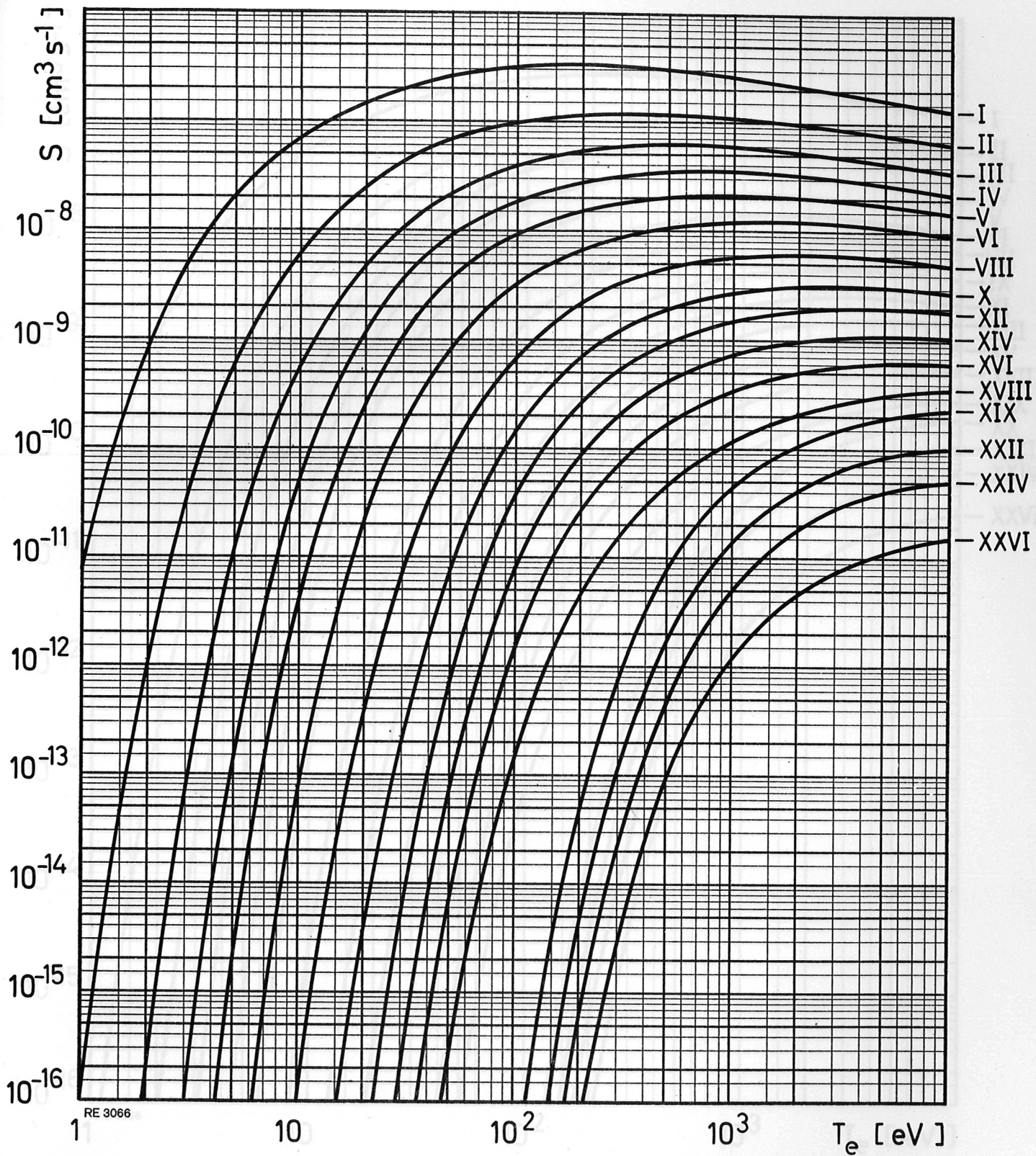


Fig. 28 Nickel

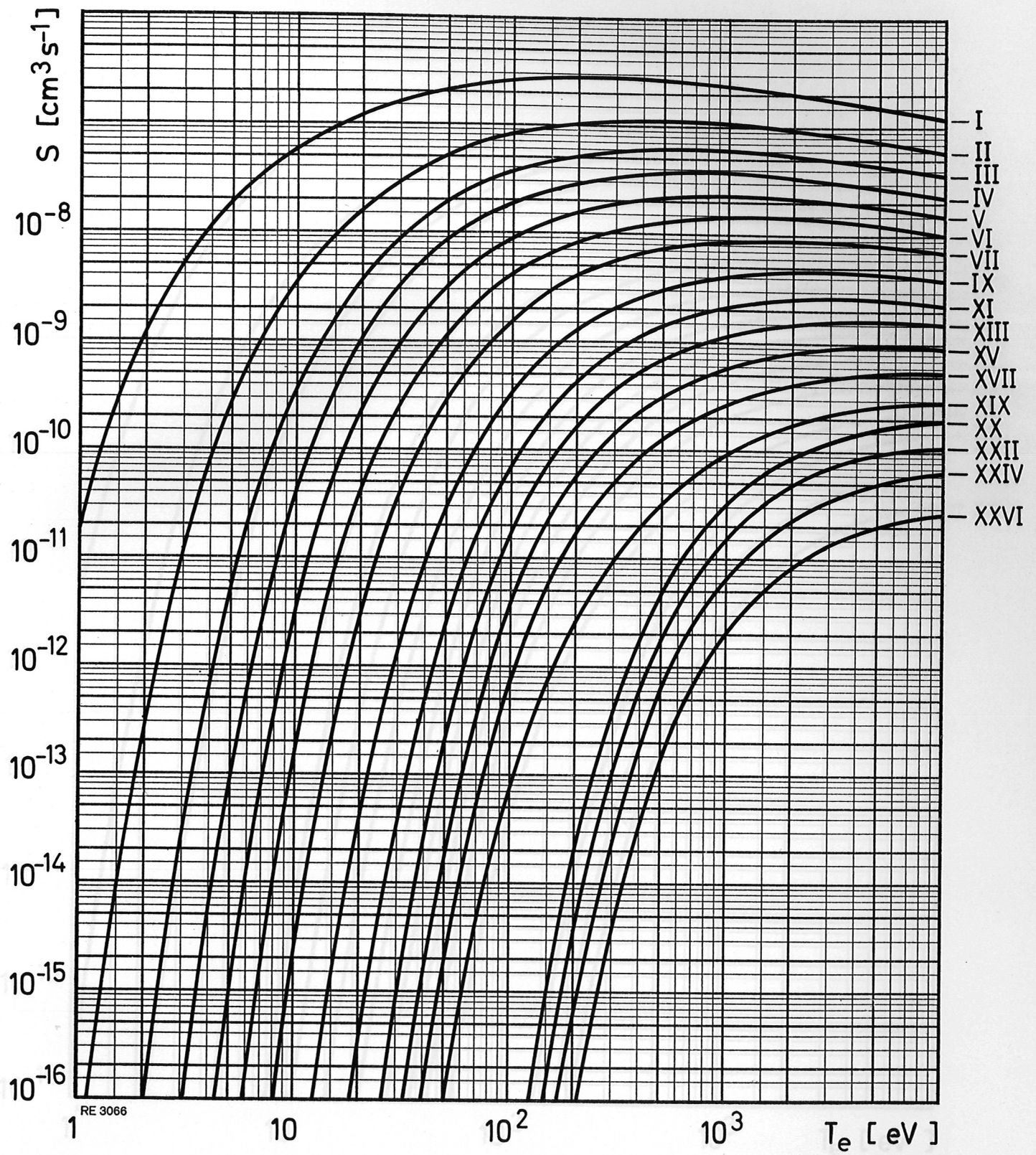


Fig. 29 Copper

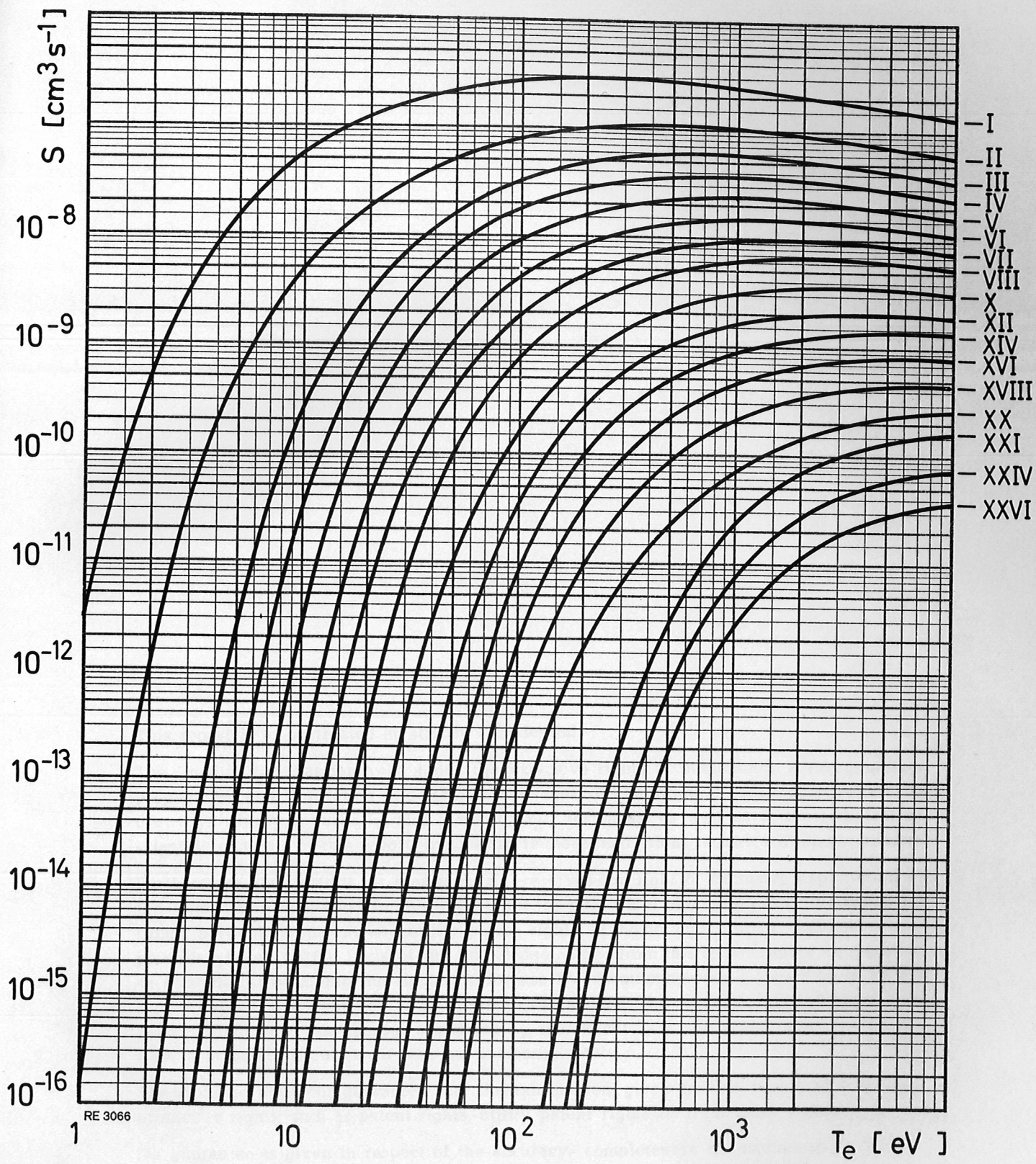


Fig. 30 Zinc