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CROSS SECTIONS FOR *K*-SHELL IONIZATION BY ELECTRON IMPACT*

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Cross sections for *K*-shell ionization by electron impact derived from experimental measurements are tabulated according to target atomic number and incident electron energy. Data are presented for elements C through U. © 1990 Academic Press, Inc.

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CONTENTS

INTRODUCTION

The behavior and values of the cross section for K-shell ionization by electron impact have been and are the subject of numerous investigations. There is wide interest in this parameter for reasons of both basic knowledge and technological progress.[1] The determination of these cross sections is of basic importance in the attempt to better understand the inelastic electron–atom interaction. Cross sections of this type are used in two common methods of elemental analysis, electron-probe microanalysis (EPMA) and Auger-electron spectroscopy (AES); in addition, these cross sections are needed for elemental analysis by measurement of the K-shell energy-loss spectra of electrons transmitted through samples in electron microscopes.[2] At present there is a large number of measurements of K-shell ionization cross sections by electron impact over a very wide energy range, from just above the energy threshold to several GeV. It is useful to have available an up-to-date compilation of experimental measurements of this quantity. For this purpose, we have conducted a review of all available cross-section data for K-shell ionization by electron impact. We present here a tabulation of these experimental cross sections.

Experimentally, three techniques have been used to make K-shell ionization cross-section measurements. The creation of K-shell vacancies in atoms or molecules can be detected through the observation of x-ray or Auger electrons which are emitted in the subsequent deexcitation process. A third method of determining K-shell ionization cross sections is measurement of energy-loss spectra of electrons transmitted through thin target films. A detailed review of the methods used, results obtained, and theories developed in studies of inner-shell ionization by electron impact has been given by Powell.[1]

In the Table presented here, we have indicated which cross sections have been derived from measurements of x-ray yields, which have been derived from measurements of Auger-electron yields, and which have been derived from transmission electron energy-loss experiments.

The experimentally measured x-ray production cross sections σ_x or Auger-electron production cross sections σ_A are related to ionization cross sections σ_I through the fluorescence yield f (which is the number of x-rays emitted per vacancy produced)

$$\sigma_I = \sigma_x/f$$
$$= \sigma_A/(1-f).$$

It seems appropriate that all the tabulated values be associated with one consistent set of fluorescence yields. Therefore, the K-shell ionization cross sections presented here have been reevaluated, where necessary, using the K-shell fluorescence yields given by Tawara et al.[3] (for $Z \leq 10$) and Bambynek et al.[4] (for $Z > 10$). In addition, it seems useful to give these f values along with the element at the beginning of each data block.

The K-shell ionization cross sections tabulated here were obtained from a search of the literature up to May 1989. Data in the present Table are extracted mostly from tabular listings in the original published papers. For papers in which only graphs of K-shell ionization cross sections are presented, the references are indicated in the footnotes of each block, but in general no effort has been made to extract the numerical values from the figures. Exceptions to the latter are made in the cases where the numerical values can be read off with little uncertainty, and in the cases where the authors of the original papers kindly provided the numerical values upon our request. Data not included because of neglect of target-thickness effects or lack of absolute cross section value are:

1.6- to 40-keV electrons on Al target by Butz and Wagner[5]

2- to 15-keV electrons on Al, Ti, Ni, Zr, Nb, Mo, Pd, Ta, and Pt targets by Reuter et al.[6]

11.7- to 36-keV electrons on Cu target by Hink[7]

13.5- to 49.4-keV electrons on Al, Cu, and Ag targets by Green and Cosslet[8]

30- to 180-keV electrons on Ag target by Webster et al.[9]

100- to 400-keV electrons on Ag target by Ito et al.[10]

300-keV electrons on C, Cu, Ag, and Au targets by Komma and Nakel[11]

500-keV electrons on Ag target by Schule and Nakel[12]

Acknowledgments

A number of people contributed to this compilation of the *K*-shell ionization cross-section data. In particular, the authors thank Professors W. Mehlhorn and W. Scholz for kindly providing their experimental data in tabular form.

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EXPLANATION OF TABLE

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

The data are arranged first by increasing target atomic number and then by increasing incident electron energy.

Z	Target atomic number
f	*K*-shell fluorescence yield
ENERGY	Incident electron energy in units of keV 3.51 1 means 3.51×10^1 keV
CROSS SECTION	*K*-shell ionization cross section and error in units of barns derived from experimental data 4.76 0.44 3 means $(4.76 \pm 0.44) \times 10^3$ barns
TYPE	Type of measurement
A	Auger-electron yield measurement
X	x-ray yield measurement
El	Transmission electron energy-loss measurement
G	Gas target
Tn	Thin solid target
REF.	Key for locating the reference in the list at the end of the Table

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS	SECTION		TYPE	REF.
** Z=6		C		f=2.69E-3 **		
2.90	-1	6.91	0.76	4	X,G	Ta73
3.00	-1	9.44	1.04	4	X,G	Ta73
3.50	-1	1.46	0.16	5	X,G	Ta73
4.00	-1	1.94	0.21	5	X,G	Ta73
5.00	-1	2.50	0.28	5	X,G	Ta73
6.00	-1	2.93	0.32	5	X,G	Ta73
7.00	-1	3.03	0.33	5	X,G	Ta73
8.00	-1	3.27	0.36	5	X,G	Ta73
9.00	-1	3.26	0.36	5	X,G	Ta73
1.00	0	3.28	0.35	5	X,G	Ta73
1.25	0	3.26	0.36	5	X,G	Ta73
1.50	0	3.21	0.35	5	X,G	Ta73
1.75	0	3.05	0.34	5	X,G	Ta73
2.00	0	2.89	0.32	5	X,G	Ta73
2.00	0	4.53	0.68	5	X,Tn	Hi71
3.00	0	2.42	0.27	5	X,G	Ta73
3.00	0	3.38	0.34	5	X,Tn	Hi71
4.00	0	2.11	0.23	5	X,G	Ta73
4.00	0	2.78	0.19	5	X,Tn	Hi71
5.00	0	1.83	0.20	5	X,G	Ta73
5.00	0	2.26	0.11	5	X,Tn	Hi71
6.00	0	1.65	0.18	5	X,G	Ta73
7.00	0	1.77	0.09	5	X,Tn	Hi71
8.50	0	1.33	0.15	5	X,G	Ta73
1.00	1	1.29	0.06	5	X,Tn	Hi71
1.06	1	1.17	0.13	5	X,G	Ta73
1.26	1	1.02	0.11	5	X,G	Ta73
1.47	1	9.18	1.01	4	X,G	Ta73
1.50	1	9.07	0.45	4	X,Tn	Hi71
1.68	1	8.55	0.94	4	X,G	Ta73
2.00	1	7.21	0.36	4	X,Tn	Hi71
2.50	1	5.99	0.30	4	X,Tn	Hi71
2.50	1	7.50	1.50	4	El,Tn	Is72
3.00	1	5.24	0.26	4	X,Tn	Hi71
7.50	1	6.00		?	El,Tn	Co72
8.00	1	3.70	0.60	4	El,Tn	Eg75

Graph is presented in Ref. Ro79 for K-shell ionization cross section of C by 80 keV electron impact

** Z=7		N		f=4.73E-3 **		
4.50	-1	5.62	0.62	4	X,G	Ta73
5.00	-1	7.57	0.83	4	X,G	Ta73
6.00	-1	8.83	0.44	4	A,G	G171
6.00	-1	1.09	0.12	5	X,G	Ta73
6.50	-1	1.06	0.05	5	A,G	G171
7.00	-1	1.36	0.15	5	X,G	Ta73
8.00	-1	1.53	0.17	5	X,G	Ta73
9.00	-1	1.42	0.07	5	A,G	G171
9.00	-1	1.59	0.17	5	X,G	Ta73
1.00	0	1.56	0.08	5	A,G	G171
1.00	0	1.72	0.19	5	X,G	Ta73
1.10	0	1.65	0.08	5	A,G	G171
1.21	0	1.72	0.09	5	A,G	G171
1.25	0	1.78	0.20	5	X,G	Ta73

ENERGY		CROSS	SECTION		TYPE	REF.
** Z=7		N		f=4.73E-3 **		
1.41	0	1.76	0.09	5	A,G	G171
1.50	0	1.76	0.19	5	X,G	Ta73
1.51	0	1.76	0.09	5	A,G	G171
1.61	0	1.76	0.09	5	A,G	G171
1.71	0	1.75	0.09	5	A,G	G171
1.75	0	1.79	0.20	5	X,G	Ta73
1.81	0	1.76	0.09	5	A,G	G171
2.00	0	1.69	0.19	5	X,G	Ta73
2.01	0	1.72	0.09	5	A,G	G171
2.41	0	1.66	0.08	5	A,G	G171
2.81	0	1.60	0.08	5	A,G	G171
3.00	0	1.48	0.16	5	X,G	Ta73
3.22	0	1.53	0.08	5	A,G	G171
3.62	0	1.47	0.07	5	A,G	G171
4.00	0	1.35	0.15	5	X,G	Ta73
4.02	0	1.39	0.07	5	A,G	G171
4.82	0	1.28	0.06	5	A,G	G171
5.63	0	1.20	0.06	5	A,G	G171
6.00	0	1.04	0.11	5	X,G	Ta73
6.43	0	1.10	0.06	5	A,G	G171
7.24	0	1.03	0.05	5	A,G	G171
8.04	0	9.69	0.48	4	A,G	G171
8.50	0	8.75	0.96	4	X,G	Ta73
8.84	0	9.11	0.46	4	A,G	G171
9.65	0	8.58	0.43	4	A,G	G171
1.05	1	8.11	0.41	4	A,G	G171
1.06	1	7.65	0.84	4	X,G	Ta73
1.26	1	6.60	0.73	4	X,G	Ta73
1.47	1	5.75	0.63	4	X,G	Ta73
1.68	1	5.52	0.61	4	X,G	Ta73
2.50	1	5.30	1.50	4	El,Tn	Is72

Graph is presented in Ref. Ro79 for K-shell ionization cross section of N by 80 keV electron impact

** Z=8		O		f=6.45E-3 **		
1.00	0	6.43	0.32	4	A,G	G171
1.00	0	7.58	0.99	4	X,G	Ta73
1.20	0	7.65	0.38	4	A,G	G171
1.24	0	8.90	0.89	4	A,G	P185
1.40	0	8.53	0.42	4	A,G	G171
1.60	0	9.05	0.45	4	A,G	G171
1.80	0	9.32	0.46	4	A,G	G171
2.00	0	9.42	0.47	4	A,G	G171
2.00	0	9.41	1.22	4	X,G	Ta73
2.08	0	9.40	0.94	4	A,G	P185
2.20	0	9.52	0.47	4	A,G	G171
2.40	0	9.52	0.47	4	A,G	G171
2.60	0	9.40	0.47	4	A,G	G171
2.90	0	9.28	0.46	4	A,G	G171
3.00	0	9.08	0.45	4	A,G	G171
3.00	0	9.36	1.22	4	X,G	Ta73
3.11	0	9.10	0.91	4	A,G	P185
3.20	0	9.01	0.45	4	A,G	G171
3.50	0	8.76	0.48	4	A,G	G171

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS	SECTION	TYPE	REF
** Z=8		O		f=6.45E-3 **	
3.80	0	8.57	0.43	4 A,G	G17
4.00	0	8.96	1.16	4 X,G	Ta7
4.10	0	8.36	0.42	4 A,G	G17
4.40	0	8.13	0.41	4 A,G	G17
4.50	0	8.07	0.40	4 A,G	G17
4.70	0	7.93	0.39	4 A,G	G17
5.00	0	7.61	0.38	4 A,G	G171
5.00	0	7.81	1.02	4 X,G	Ta7
5.50	0	7.32	0.36	4 A,G	G171
6.00	0	7.02	0.35	4 A,G	G171
6.00	0	6.82	0.87	4 X,G	Ta73
7.00	0	6.53	0.33	4 A,G	G171
8.00	0	6.12	0.30	4 A,G	G171
8.50	0	5.60	0.57	4 X,G	Ta73
9.00	0	5.72	0.28	4 A,G	G171
1.00	1	5.39	0.27	4 A,G	G171
1.06	1	4.68	0.61	4 X,G	Ta73
1.10	1	5.09	0.26	4 A,G	G171
1.20	1	4.83	0.24	4 A,G	G171
1.26	1	4.19	0.54	4 X,G	Ta73
1.30	1	4.55	0.23	4 A,G	G171
1.68	1	3.43	0.45	4 X,G	Ta73
2.50	1	4.00	1.50	4 El,Tn	Is72
** Z=10		Ne		f=1.55E-2 **	
9.50	-1	6.00	0.66	3 X,G	Ta73
1.00	0	9.16	1.01	3 X,G	Ta73
1.25	0	2.07	0.23	4 X,G	Ta73
1.26	0	1.56	0.27	4 A,G	P185
1.31	0	1.98	0.10	4 A,G	G171
1.50	0	2.88	0.32	4 X,G	Ta73
1.54	0	2.95	0.50	4 A,G	P185
1.74	0	2.83	0.14	4 A,G	G171
1.75	0	3.35	0.37	4 X,G	Ta73
2.00	0	3.74	0.41	4 X,G	Ta73
2.04	0	4.05	0.45	4 A,G	P185
2.18	0	3.26	0.16	4 A,G	G171
2.50	0	3.68	0.40	4 X,G	Ta73
2.61	0	3.52	0.18	4 A,G	G171
3.00	0	3.82	0.42	4 X,G	Ta73
3.05	0	3.62	0.18	4 A,G	G171
3.26	0	3.62	0.18	4 A,G	G171
3.32	0	4.11	0.70	4 A,G	P185
3.48	0	3.62	0.18	4 A,G	G171
3.50	0	3.94	0.43	4 X,G	Ta73
3.70	0	3.62	0.18	4 A,G	G171
3.92	0	3.60	0.18	4 A,G	G171
4.00	0	4.01	0.44	4 X,G	Ta73
4.08	0	3.54	0.60	4 A,G	P185
4.13	0	3.57	0.18	4 A,G	G171
4.35	0	3.55	0.18	4 A,G	G171
5.04	0	3.25	0.55	4 A,G	P185
5.22	0	3.41	0.17	4 A,G	G171
6.00	0	3.50	0.38	4 X,G	Ta73
6.09	0	3.25	0.16	4 A,G	G171
6.96	0	3.11	0.16	4 A,G	G171

ENERGY		CROSS	SECTION	TYPE	REF.
** Z=10		Ne		f=1.55E-2 **	
7.83	0	2.94	0.15	4 A,G	G171
8.50	0	3.14	0.35	4 X,G	Ta73
8.70	0	2.82	0.14	4 A,G	G171
1.00	1	2.61	0.14	4 A,G	G171
1.04	1	2.54	0.13	4 A,G	G171
1.06	1	2.68	0.30	4 X,G	Ta73
1.26	1	2.35	0.26	4 X,G	Ta73
1.46	1	2.23	0.24	4 X,G	Ta73

Graph is presented in Ref. Hi81 for K-shell ionization cross section of Ne by 0.871 to 5.37 keV electron impact

** Z=11		Na		f=2.40E-2 **	
7.00	4	3.50	0.56	3 X,Tn	Ka80
2.30	5	3.50	0.56	3 X,Tn	Ka80
** Z=12		Mg		f=2.72E-2 **	
1.00	4	8.74	1.40	2 X,Tn	Mc88
2.00	4	1.19	0.19	3 X,Tn	Mc88
5.00	4	2.04	0.55	3 X,Tn	Ho79
7.00	4	2.64	0.42	3 X,Tn	Ka80
2.30	5	2.80	0.45	3 X,Tn	Ka80
** Z=13		Al		f=3.57E-2 **	
2.58	0	1.18	0.13	4 X,Tn	Hi69
3.68	0	1.46	0.16	4 X,Tn	Hi69
5.06	0	1.53	0.17	4 X,Tn	Hi69
6.54	0	1.46	0.16	4 X,Tn	Hi69
8.79	0	1.34	0.15	4 X,Tn	Hi69
1.10	1	1.28	0.14	4 X,Tn	Hi69
1.38	1	1.14	0.13	4 X,Tn	Hi69
1.72	1	1.00	0.11	4 X,Tn	Hi69
2.18	1	8.88	0.98	3 X,Tn	Hi69
2.58	1	8.00	0.88	3 X,Tn	Hi69
2.97	1	7.28	0.80	3 X,Tn	Hi69
1.00	4	8.85	1.42	2 X,Tn	Mc88
2.00	4	1.26	0.20	3 X,Tn	Mc88
5.00	4	2.18	0.30	3 X,Tn	Ho79
7.00	4	2.38	0.38	3 X,Tn	Ka80
1.50	5	2.84	1.14	3 X,Tn	Is77
2.30	5	2.55	0.41	3 X,Tn	Ka80

Graph is presented in Ref. Ro79 for K-shell ionization cross section of Al by 80 keV electron impact

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS	SECTION	TYPE	REF.
** Z=14		Si	f=4.70E-2 **		
2.99	0	8.80	0.88	3 A,G	P185
5.13	0	8.50	0.85	3 A,G	P185
5.69	0	8.60	0.86	3 A,G	P185
6.62	0	9.50	0.95	3 A,G	P185
7.95	0	9.60	0.96	3 A,G	P185
5.00	4	1.59	0.23	3 X,Tn	Ho79
1.50	5	2.25	0.90	3 X,Tn	Is77
** Z=17		Cl	f=9.42E-2 **		
7.00	4	1.22	0.20	3 X,Tn	Ka80
2.30	5	1.30	0.21	3 X,Tn	Ka80
2.70	5	1.27	0.51	3 X,Tn	Is77
** Z=18		Ar	f=1.15E-1 **		
3.37	0	3.28	0.40	2 X,G	Hi82
3.59	0	7.80	0.95	2 X,G	Hi82
3.64	0	8.20	1.64	2 A,G	P185
3.85	0	1.09	0.13	3 X,G	Hi82
3.99	0	1.35	0.27	3 A,G	P185
4.00	0	1.37	0.18	3 X,G	Ta73
4.03	0	1.27	0.16	3 X,G	Hi82
4.19	0	1.44	0.15	3 X,G	Qu82
4.32	0	1.49	0.18	3 X,G	Hi82
4.54	0	1.66	0.33	3 A,G	P185
4.56	0	1.67	0.20	3 X,G	Hi82
5.00	0	1.90	0.25	3 X,G	Ta73
5.05	0	2.26	0.45	3 A,G	P185
5.11	0	1.79	0.18	3 X,G	Qu82
5.46	0	2.17	0.26	3 X,G	Hi82
5.97	0	2.76	0.55	3 A,G	P185
6.00	0	2.38	0.31	3 X,G	Ta73
6.10	0	2.27	0.23	3 X,G	Qu82
6.42	0	2.68	0.33	3 X,G	Hi82
6.99	0	2.76	0.55	3 A,G	P185
7.27	0	2.71	0.33	3 X,G	Hi82
7.68	0	2.67	0.27	3 X,G	Qu82
8.00	0	3.37	0.67	3 A,G	P185
8.11	0	2.92	0.36	3 X,G	Hi82
8.20	0	3.12	0.32	3 X,G	Qu82
8.50	0	2.91	0.38	3 X,G	Ta73
8.90	0	3.46	0.69	3 A,G	P185
9.18	0	2.98	0.36	3 X,G	Hi82
9.74	0	2.96	0.59	3 A,G	P185
1.00	1	2.87	0.35	3 X,G	Hi82
1.03	1	3.08	0.31	3 X,G	Qu82
1.06	1	2.91	0.38	3 X,G	Ta73
1.10	1	2.90	0.35	3 X,G	Hi82
1.20	1	2.87	0.35	3 X,G	Hi82
1.26	1	2.95	0.38	3 X,G	Ta73
1.47	1	2.89	0.38	3 X,G	Ta73
1.68	1	2.78	0.36	3 X,G	Ta73
1.89	1	2.73	0.35	3 X,G	Ta73
2.00	4	8.09	0.97	2 X,G	Ho79
3.00	4	8.35	1.00	2 X,G	Ho79
4.00	4	8.68	1.04	2 X,G	Ho79
5.00	4	8.66	1.04	2 X,G	Ho79
6.00	4	9.20	1.10	2 X,G	Ho79
Graph is presented in Ref. Hi83 for K-shell ionization cross section of Ar by 3.21 to 4.20 keV electron impact					
** Z=20		Ca	f=1.63E-1 **		
2.00	4	6.09	0.79	2 X,G	Ho79
3.50	4	6.52	0.85	2 X,G	Ho79
5.00	4	6.95	0.90	2 X,G	Ho79
6.00	4	7.12	0.93	2 X,G	Ho79
7.00	4	8.89	3.56	2 X,Tn	Is77
1.50	5	9.08	3.63	2 X,Tn	Is77
2.70	5	1.05	0.42	3 X,Tn	Is77
** Z=22		Ti	f=2.19E-1 **		
5.91	0	4.99		2 X,Tn	Je75
6.46	0	6.58		2 X,Tn	Je75
7.45	0	9.09		2 X,Tn	Je75
8.44	0	1.07		3 X,Tn	Je75
9.44	0	1.20		3 X,Tn	Je75
9.98	0	1.26		3 X,Tn	Je75
1.04	1	1.30		3 X,Tn	Je75
1.15	1	1.35		3 X,Tn	Je75
1.25	1	1.38		3 X,Tn	Je75
1.34	1	1.40		3 X,Tn	Je75
1.49	1	1.42		3 X,Tn	Je75
1.80	1	1.42		3 X,Tn	Je75
2.30	1	1.36		3 X,Tn	Je75
2.80	1	1.29		3 X,Tn	Je75
3.30	1	1.22		3 X,Tn	Je75
3.80	1	1.15		3 X,Tn	Je75
4.30	1	1.09		3 X,Tn	Je75
4.70	1	1.05		3 X,Tn	Je75
5.00	1	1.03		3 X,Tn	Je75
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Ti by 300 MeV electron impact					
** Z=23		V	f=2.50E-1 **		
2.00	3	3.53	0.35	2 X,Tn	Sc72

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS	SECTION	TYPE	REF.
** Z=24		Cr	f=2.82E-1 **		
2.00	3	2.71	0.27	2 X,Tn	Sc72
2.00	4	4.50	0.45	2 X,Tn	Ho79
3.50	4	5.01	0.50	2 X,Tn	Ho79
5.00	4	5.02	0.50	2 X,Tn	Ho79
6.00	4	5.28	0.53	2 X,Tn	Ho79

Graph is presented in Ref. Wa87 for K-shell ionization cross section of Cr by 300 MeV electron impact

** Z=25		Mn	f=3.14E-1 **		
6.71	0	0.26	0.06	2 X,Tn	Sh80
6.90	0	0.68	0.13	2 X,Tn	Sh80
7.40	0	1.49	0.30	2 X,Tn	Sh80
8.00	0	2.40	0.31	2 X,Tn	Sh80
9.00	0	3.52	0.39	2 X,Tn	Sh80
1.10	1	5.18	0.55	2 X,Tn	Sh80
1.50	1	6.54	0.70	2 X,Tn	Sh80
2.00	1	6.77	0.71	2 X,Tn	Sh80
2.00	3	2.70	0.32	2 X,Tn	Sc72
5.00	4	4.34	0.39	2 X,Tn	Ho79

Graph is presented in Ref. Fi67 for K-shell ionization cross section of Mn by 50 keV electron impact
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Mn by 350 MeV electron impact

** Z=26		Fe	f=3.47E-1 **		
2.00	3	2.55	0.25	2 X,Tn	Sc72

** Z=27		Co	f=3.81E-1 **		
2.00	3	2.41	0.30	2 X,Tn	Sc72

** Z=28		Ni	f=4.14E-1 **		
8.91	0	1.05		2 X,Tn	Je75
9.83	0	1.93		2 X,Tn	Je75
1.23	1	3.51		2 X,Tn	Je75
1.47	1	4.46		2 X,Tn	Je75
1.48	1	3.16		2 X,Tn	Po47
1.97	1	5.28		2 X,Tn	Je75
2.47	1	5.52		2 X,Tn	Je75
2.48	1	3.89		2 X,Tn	Po47
2.98	1	5.53		2 X,Tn	Je75
3.48	1	5.40		2 X,Tn	Je75
3.57	1	3.82		2 X,Tn	Po47
3.97	1	5.26		2 X,Tn	Je75
4.47	1	5.12		2 X,Tn	Je75
4.62	1	3.63		2 X,Tn	Po47
4.97	1	4.98		2 X,Tn	Je75
5.56	1	3.37		2 X,Tn	Po47
7.00	1	3.14	0.20	2 X,Tn	Sm45
7.53	1	2.98		2 X,Tn	Po47
9.51	1	2.75		2 X,Tn	Po47
1.25	2	2.44		2 X,Tn	Po47
1.53	2	2.23		2 X,Tn	Po47
1.83	2	2.06		2 X,Tn	Po47
4.90	2	3.37	0.84	2 X,Tn	Se74
6.70	2	3.45	0.86	2 X,Tn	Se74
2.00	3	2.34	0.27	2 X,Tn	Sc72
2.00	4	2.78	0.22	2 X,Tn	Ho79
5.00	4	3.30	0.26	2 X,Tn	Ho79
6.00	4	3.67	0.29	2 X,Tn	Ho79
9.00	5	4.92	0.39	2 X,Tn	Ge82
1.50	6	5.96	0.48	2 X,Tn	Ge82
2.00	6	6.20	0.50	2 X,Tn	Ge82

Graph is presented in Ref. Da75 for K-shell ionization cross section of Ni by 3.0 to 21 MeV electron impact
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Ni by 300 MeV electron impact

** Z=29		Cu	f=4.45E-1 **		
9.12	0	1.59	0.36	1 X,Tn	Sh81
9.27	0	1.08	0.20	1 X,Tn	Sh80
9.50	0	3.26	0.60	1 X,Tn	Sh80
1.00	1	8.60	1.70	1 X,Tn	Sh81
1.00	1	6.72	1.10	1 X,Tn	Sh80
1.10	1	1.20	0.18	2 X,Tn	Sh80
1.20	1	1.86	0.21	2 X,Tn	Sh80
1.50	1	2.94	0.36	2 X,Tn	Sh81
1.50	1	2.94	0.31	2 X,Tn	Sh80
2.00	1	3.80	0.41	2 X,Tn	Sh81
2.00	1	4.02	0.40	2 X,Tn	Sh80
2.50	1	3.97	0.45	2 X,Tn	Sh81
2.50	1	4.15	0.40	2 X,Tn	Sh80
2.50	1	5.51	0.09	2 X,Tn	Da72
3.00	1	5.84	0.07	2 X,Tn	Da72
4.00	1	5.45	0.05	2 X,Tn	Da72
6.00	1	5.24	0.16	2 X,Tn	Da72
8.00	1	4.79	0.04	2 X,Tn	Da72
8.10	1	2.69	0.27	2 X,Tn	Hu72
1.00	2	3.98	0.05	2 X,Tn	Da72
1.14	2	2.49	0.25	2 X,Tn	Hu72
1.35	2	3.66	0.02	2 X,Tn	Da72
1.52	2	2.19	0.18	2 X,Tn	Hu72
3.00	2	2.21	0.20	2 X,Tn	Be78
4.00	2	2.03	0.18	2 X,Tn	Be78
5.00	2	1.96	0.18	2 X,Tn	Be78
6.00	2	1.91	0.17	2 X,Tn	Be78
2.00	3	1.98	0.19	2 X,Tn	Sc72
4.00	4	2.64	0.18	2 X,Tn	Ho79
1.50	5	4.30	0.68	2 X,Tn	Is77

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS SECTION			TYPE	REF.
** Z=29		Cu	f=4.45E-1 **			
1.50	5	3.93	0.05	2	X,Tn	Mi70
3.00	5	4.44	0.05	2	X,Tn	Mi70
5.00	5	4.72	0.06	2	X,Tn	Mi70
7.00	5	4.72	0.07	2	X,Tn	Mi70
9.00	5	4.74	0.07	2	X,Tn	Mi70
9.00	5	4.61	0.30	2	X,Tn	Ge82
1.50	6	5.93	0.41	2	X,Tn	Ge82
2.00	6	6.29	0.41	2	X,Tn	Ge82
Graph is presented in Ref. Fi67 for K-shell ionization cross section of Cu by 50 keV electron impact						
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Cu by 350 MeV electron impact						
** Z=30		Zn	f=4.79E-1 **			
2.00	3	1.83	0.21	2	X,Tn	Sc72
1.50	5	3.96	0.59	2	X,Tn	Is77
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Zn by 350 MeV electron impact						
** Z=32		Ge	f=5.40E-1 **			
1.12	1	4.76	0.98	0	X,Tn	Sh81
1.20	1	3.73	0.59	1	X,Tn	Sh81
1.50	1	1.36	0.14	2	X,Tn	Sh81
2.00	1	2.10	0.22	2	X,Tn	Sh81
2.50	1	2.37	0.24	2	X,Tn	Sh81
2.00	4	1.94	0.16	2	X,Tn	Ho79
3.50	4	2.10	0.17	2	X,Tn	Ho79
5.00	4	2.18	0.17	2	X,Tn	Ho79
6.00	4	2.24	0.18	2	X,Tn	Ho79
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Ge by 350 MeV electron impact						
** Z=33		As	f=5.67E-1 **			
2.00	3	1.34	0.15	2	X,Tn	Sc72
** Z=34		Se	f=5.96E-1 **			
6.00	1	2.06	0.19	2	X,Tn	Ki81
1.00	2	1.80	0.17	2	X,Tn	Ki81
2.00	2	1.45	0.13	2	X,Tn	Ki81
3.00	2	1.29	0.12	2	X,Tn	Ki81
3.00	2	1.48	0.13	2	X,Tn	Be78
4.00	2	1.24	0.11	2	X,Tn	Ki81
4.00	2	1.38	0.12	2	X,Tn	Be78

ENERGY		CROSS SECTION			TYPE	REF.
** Z=34		Se	f=5.96E-1 **			
5.00	2	1.20	0.11	2	X,Tn	Ki81
5.00	2	1.33	0.12	2	X,Tn	Be78
6.00	2	1.17	0.11	2	X,Tn	Ki81
6.00	2	1.30	0.12	2	X,Tn	Be78
2.00	3	1.12	0.12	2	X,Tn	Sc72
7.00	4	2.69	0.40	2	X,Tn	Is77
1.50	5	2.74	0.41	2	X,Tn	Is77
Graph is presented in Ref. Fi67 for K-shell ionization cross section of Se by 50 keV electron impact						
** Z=35		Br	f=6.22E-1 **			
2.00	3	1.12	0.12	2	X,Tn	Sc72
** Z=36		Kr	f=6.46E-1 **			
2.00	4	1.47	0.06	2	X,G	Ho79
3.00	4	1.54	0.06	2	X,G	Ho79
4.00	4	1.60	0.06	2	X,G	Ho79
5.00	4	1.68	0.07	2	X,G	Ho79
6.00	4	1.73	0.07	2	X,G	Ho79
** Z=37		Rb	f=6.69E-1 **			
2.00	3	1.02	0.10	2	X,Tn	Sc72
** Z=38		Sr	f=6.91E-1 **			
2.00	3	8.96	0.91	1	X,Tn	Sc72
1.50	5	2.07	0.04	2	X,Tn	Mi70
3.00	5	2.15	0.03	2	X,Tn	Mi70
5.00	5	2.35	0.04	2	X,Tn	Mi70
7.00	5	2.52	0.04	2	X,Tn	Mi70
9.00	5	2.55	0.04	2	X,Tn	Mi70
** Z=39		Y	f=7.11E-1 **			
4.90	2	0.73	0.18	2	X,Tn	Se74
6.70	2	0.76	0.19	2	X,Tn	Se74
5.00	4	1.38	0.14	2	X,Tn	Ho79
7.00	4	1.89	0.28	2	X,Tn	Is77
1.50	5	1.87	0.28	2	X,Tn	Is77
2.70	5	2.05	0.31	2	X,Tn	Is77
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Y by 300 to 380 MeV electron impact						
** Z=40		Zr	f=7.30E-1 **			
2.40	2	0.90	0.05	2	X,Tn	Ha64

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS SECTION		TYPE	REF.
** Z=40		Zr	f=7.30E-1 **		
5.30	2	1.15	0.08	2 X,Tn	Ha64
8.20	2	1.25	0.09	2 X,Tn	Ha64
1.13	3	1.15	0.09	2 X,Tn	Ha64
1.44	3	0.99	0.10	2 X,Tn	Ha64
** Z=42		Mo	f=7.64E-1 **		
9.00	4	1.48	0.22	2 X,Tn	Is77
1.50	5	1.41	0.02	2 X,Tn	Mi70
3.00	5	1.51	0.02	2 X,Tn	Mi70
5.00	5	1.63	0.02	2 X,Tn	Mi70
7.00	5	1.66	0.03	2 X,Tn	Mi70
9.00	5	1.74	0.02	2 X,Tn	Mi70
** Z=46		Pd	f=8.19E-1 **		
3.00	2	6.73	0.60	1 X,Tn	Ri77
4.00	2	6.45	0.60	1 X,Tn	Ri77
5.00	2	6.45	0.60	1 X,Tn	Ri77
6.00	2	6.43	0.60	1 X,Tn	Ri77
2.50	3	7.10	0.71	1 X,Tn	Be70
7.10	3	7.80	0.78	1 X,Tn	Be70
9.00	4	1.16	0.17	2 X,Tn	Is77
2.50	5	1.23	0.18	2 X,Tn	Is77
** Z=47		Ag	f=8.30E-1 **		
2.60	1	1.90	0.30	0 X,Tn	Sh81
2.70	1	6.21	0.90	0 X,Tn	Sh81
2.80	1	9.11	1.10	0 X,Tn	Sh81
2.90	1	1.25	0.16	1 X,Tn	Sh81
3.00	1	1.64	0.19	1 X,Tn	Sh81
3.00	1	2.57	0.06	1 X,Tn	Da72
3.05	1	1.47	0.13	1 X,Tn	Cl35
3.85	1	2.86	0.26	1 X,Tn	Cl35
4.00	1	4.99	0.09	1 X,Tn	Da72
5.00	1	6.32	0.10	1 X,Tn	Da72
5.10	1	3.73	0.34	1 X,Tn	Cl35
6.00	1	6.80	0.11	1 X,Tn	Da72
6.00	1	5.51	0.66	1 X,Tn	Ki81
6.38	1	4.08	0.36	1 X,Tn	Cl35
7.65	1	4.25	0.38	1 X,Tn	Cl35
8.00	1	6.79	0.07	1 X,Tn	Da72
8.93	1	4.34	0.39	1 X,Tn	Cl35
1.00	2	6.79	0.06	1 X,Tn	Da72
1.00	2	5.91	0.71	1 X,Tn	Ki81
1.00	2	5.69	0.58	1 X,Tn	Re66
1.02	2	4.25	0.38	1 X,Tn	Cl35
1.14	2	4.94	0.45	1 X,Tn	Hu72
1.20	2	6.77	0.07	1 X,Tn	Da72
1.28	2	4.16	0.37	1 X,Tn	Cl35
1.40	2	6.54	0.10	1 X,Tn	Da72
1.50	2	5.69	0.58	1 X,Tn	Re66
1.53	2	4.08	0.36	1 X,Tn	Cl35
1.79	2	3.90	0.36	1 X,Tn	Cl35
2.00	2	5.61	0.67	1 X,Tn	Ki81
2.00	2	5.10	0.48	1 X,Tn	Re66
2.50	2	5.10	0.48	1 X,Tn	Re66
3.00	2	5.41	0.65	1 X,Tn	Ki81
3.00	2	4.72	0.48	1 X,Tn	Re66
3.00	2	5.99	0.54	1 X,Tn	Ri77
3.00	2	5.59	0.56	1 X,Tn	Sc76
4.00	2	5.21	0.62	1 X,Tn	Ki81
4.00	2	5.78	0.52	1 X,Tn	Ri77
4.00	2	5.30	0.53	1 X,Tn	Sc76
4.90	2	3.68	0.90	1 X,Tn	Se74
5.00	2	5.21	0.62	1 X,Tn	Ki81
5.00	2	5.61	0.51	1 X,Tn	Ri77
5.00	2	5.02	0.50	1 X,Tn	Sc76
6.00	2	5.21	0.62	1 X,Tn	Ki81
6.00	2	5.46	0.50	1 X,Tn	Ri77
6.00	2	5.21	0.52	1 X,Tn	Sc76
6.70	2	3.97	1.00	1 X,Tn	Se74
1.00	3	4.53	0.48	1 X,Tn	Re66
2.00	3	5.66	0.51	1 X,Tn	Sc72
2.00	4	7.70	0.50	1 X,Tn	Ho79
3.50	4	8.60	0.50	1 X,Tn	Ho79
5.00	4	8.70	0.50	1 X,Tn	Ho79
6.00	4	9.50	0.60	1 X,Tn	Ho79
9.00	5	1.47	0.11	2 X,Tn	Ge82
1.50	6	1.44	0.11	2 X,Tn	Ge82
2.00	6	1.55	0.11	2 X,Tn	Ge82

Graph is presented in Ref. Fi67 for K-shell ionization cross section of Ag by 50 keV electron impact
Graph is presented in Ref. Ha66 for K-shell ionization cross section of Ag by 100 to 400 keV electron impact
Graph is presented in Ref. Da75 for K-shell ionization cross section of Ag by 3.0 to 30 MeV electron impact
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Ag by 300 to 380 MeV electron impact

** Z=48	Cd	f=8.40E-1 **			
2.00	3	4.57	0.41	1 X,Tn	Sc72
** Z=49	In	f=8.50E-1 **			
3.00	2	5.72	0.52	1 X,Tn	Ri77
4.00	2	5.57	0.50	1 X,Tn	Ri77
5.00	2	5.63	0.51	1 X,Tn	Ri77
6.00	2	5.66	0.51	1 X,Tn	Ri77
2.00	3	4.33	0.39	1 X,Tn	Sc72
1.50	5	1.28	0.19	2 X,Tn	Is77
1.50	5	9.61	0.13	1 X,Tn	Mi70
3.00	5	1.18	0.02	2 X,Tn	Mi70
5.00	5	1.23	0.02	2 X,Tn	Mi70

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS	SECTION		TYPE	REF.
** Z=49		In	f=8.50E-1 **			
7.00	5	1.25	0.02	2	X,Tn	Mi70
9.00	5	1.30	0.02	2	X,Tn	Mi70
** Z=50		Sn	f=8.59E-1 **			
2.00	2	4.60	0.49	1	X,Tn	Re66
2.40	2	5.80	0.30	1	X,Tn	Ha64
3.00	2	5.10	0.46	1	X,Tn	Ri77
4.00	2	4.89	0.44	1	X,Tn	Ri77
5.00	2	4.88	0.44	1	X,Tn	Ri77
5.30	2	6.10	0.30	1	X,Tn	Ha64
6.00	2	3.91	0.39	1	X,Tn	Re66
6.00	2	4.85	0.44	1	X,Tn	Ri77
8.00	2	3.81	0.39	1	X,Tn	Re66
8.20	2	6.80	0.40	1	X,Tn	Ha64
1.00	3	3.81	0.39	1	X,Tn	Re66
1.13	3	7.20	0.40	1	X,Tn	Ha64
1.20	3	3.91	0.39	1	X,Tn	Re66
1.40	3	4.11	0.39	1	X,Tn	Re66
1.44	3	7.20	0.40	1	X,Tn	Ha64
1.70	3	4.20	0.39	1	X,Tn	Re66
2.00	3	4.30	0.39	1	X,Tn	Re66
2.00	3	4.30	0.39	1	X,Tn	Sc72
2.00	4	7.10	0.50	1	X,Tn	Ho79
5.00	4	8.30	0.60	1	X,Tn	Ho79
1.50	5	1.11	0.17	2	X,Tn	Is77

Graph is presented in Ref. Fi67 for K-shell ionization cross section of Sn by 50 keV electron impact
Graph is presented in Ref. Mo64 for K-shell ionization cross section of Sn by 50 to 500 keV electron impact
Graph is presented in Ref. Ha66 for K-shell ionization cross section of Sn by 100 to 400 keV electron impact
Graph is presented in Ref. Wa87 for K-shell ionization cross section of Sn by 300 to 380 MeV electron impact

ENERGY		CROSS	SECTION		TYPE	REF.
** Z=51		Sb	f=8.67E-1 **			
6.00	1	3.40	0.41	1	X,Tn	Ki81
1.00	2	4.01	0.48	1	X,Tn	Ki81
2.00	2	4.11	0.49	1	X,Tn	Ki81
3.00	2	3.81	0.46	1	X,Tn	Ki81
4.00	2	3.71	0.44	1	X,Tn	Ki81
5.00	2	3.71	0.44	1	X,Tn	Ki81
6.00	2	3.81	0.46	1	X,Tn	Ki81
2.00	3	4.11	0.37	1	X,Tn	Sc72
** Z=52		Te	f=8.75E-1 **			
2.00	3	3.79	0.34	1	X,Tn	Sc72

Graph is presented in Ref. Wa87 for K-shell ionization cross section of Te by 300 to 380 MeV electron impact

** Z=54		Xe	f=8.89E-1 **			
2.00	4	5.00	0.50	1	X,G	Ho79
3.00	4	5.50	0.50	1	X,G	Ho79
4.00	4	5.70	0.50	1	X,G	Ho79
5.00	4	5.80	0.50	1	X,G	Ho79
6.00	4	6.00	0.50	1	X,G	Ho79
** Z=56		Ba	f=9.01E-1 **			
2.00	3	3.01	0.27	1	X,Tn	Sc72
7.00	4	7.64	1.15	1	X,Tn	Is77
9.00	4	6.86	1.03	1	X,Tn	Is77
1.50	5	7.76	1.16	1	X,Tn	Is77
2.70	5	8.95	1.34	1	X,Tn	Is77
** Z=57		La	f=9.06E-1 **			
2.00	3	1.90	0.17	1	X,Tn	Sc72
** Z=58		Ce	f=9.11E-1 **			
2.00	3	2.34	0.21	1	X,Tn	Sc72
** Z=59		Pr	f=9.15E-1 **			
2.00	3	2.38	0.21	1	X,Tn	Sc72
** Z=60		Nd	f=9.20E-1 **			
2.00	3	2.14	0.19	1	X,Tn	Sc72
** Z=62		Sm	f=9.28E-1 **			
2.00	3	2.19	0.19	1	X,Tn	Sc72
9.00	4	5.36	0.80	1	X,Tn	Is77
** Z=63		Eu	f=9.31E-1 **			
2.00	3	2.11	0.19	1	X,Tn	Sc72

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS SECTION		TYPE	REF.
** Z=64		Gd	f=9.34E-1 **		
2.00	3	2.09	0.19	1 X,Tn	Sc72
** Z=67		Ho	f=9.43E-1 **		
2.00	4	3.40	0.30	1 X,Tn	Ho79
5.00	4	4.20	0.40	1 X,Tn	Ho79
9.00	4	3.79	0.57	1 X,Tn	Is77
** Z=68		Er	f=9.45E-1 **		
2.00	3	1.70	0.15	1 X,Tn	Sc72
** Z=69		Tm	f=9.48E-1 **		
3.00	5	4.74	0.09	1 X,Tn	Mi70
5.00	5	4.63	0.06	1 X,Tn	Mi70
7.00	5	4.74	0.06	1 X,Tn	Mi70
9.00	5	4.94	0.06	1 X,Tn	Mi70
** Z=70		Yb	f=9.50E-1 **		
4.90	2	1.32	0.33	1 X,Tn	Se74
6.70	2	1.66	0.41	1 X,Tn	Se74
2.00	3	1.54	0.14	1 X,Tn	Sc72
** Z=73		Ta	f=9.56E-1 **		
4.90	2	1.13	0.28	1 X,Tn	Se74
6.70	2	1.50	0.30	1 X,Tn	Se74
3.00	5	3.83	0.05	1 X,Tn	Mi70
5.00	5	4.36	0.16	1 X,Tn	Mi70
** Z=74		W	f=9.57E-1 **		
2.40	2	1.96	0.16	1 X,Tn	Ha64
5.30	2	2.38	0.25	1 X,Tn	Ha64
8.20	2	3.45	0.35	1 X,Tn	Ha64
1.13	2	3.40	0.35	1 X,Tn	Ha64
1.44	2	2.49	0.38	1 X,Tn	Ha64

Graph is presented in Ref. Ha66 for K-shell ionization cross section of W by 200 to 550 keV electron impact

ENERGY		CROSS SECTION		TYPE	REF.
** Z=78		Pt	f=9.63E-1 **		
2.00	3	1.21	0.11	1 X,Tn	Sc72
** Z=79		Au	f=9.64E-1 **		
9.00	1	2.46	0.30	0 X,Tn	Da72
1.00	2	4.43	0.10	0 X,Tn	Da72
1.20	2	5.91	0.10	0 X,Tn	Da72
1.40	2	6.50	0.10	0 X,Tn	Da72
2.00	2	8.57	0.10	0 X,Tn	Re66
4.90	2	1.06	0.26	1 X,Tn	Se74
6.00	2	0.99	0.10	1 X,Tn	Re66
6.70	2	1.47	0.36	1 X,Tn	Se74
8.00	2	0.99	0.10	1 X,Tn	Re66
1.00	3	0.99	0.10	1 X,Tn	Re66
1.20	3	0.99	0.10	1 X,Tn	Re66
1.40	3	0.99	0.10	1 X,Tn	Re66
1.70	3	1.08	0.10	1 X,Tn	Re66
2.00	3	1.08	0.10	1 X,Tn	Re66
2.00	3	1.21	0.11	1 X,Tn	Sc72
2.50	3	1.10	0.11	1 X,Tn	Be70
7.10	3	1.40	0.14	1 X,Tn	Be70
2.00	4	2.26	0.10	1 X,Tn	Ho79
3.50	4	2.42	0.10	1 X,Tn	Ho79
5.00	4	2.50	0.10	1 X,Tn	Ho79
6.00	4	2.66	0.10	1 X,Tn	Ho79
9.00	4	2.85	0.29	1 X,Tn	Is77
3.00	5	3.03	0.04	1 X,Tn	Mi70
5.00	5	3.16	0.05	1 X,Tn	Mi70
7.00	5	3.35	0.05	1 X,Tn	Mi70
9.00	5	3.43	0.05	1 X,Tn	Mi70

Graph is presented in Ref. Mo64 for K-shell ionization cross section of Au by 100 to 500 keV electron impact
Graph is presented in Ref. Ha66 for K-shell ionization cross section of Au by 240 to 550 keV electron impact
Graph is presented in Ref. Da75 for K-shell ionization cross section of Au by 3.0 to 21 MeV electron impact

ENERGY		CROSS SECTION		TYPE	REF.
** Z=82		Pb	f=9.68E-1 **		
2.40	2	1.71	0.20	1 X,Tn	Ha64
4.90	2	6.50	3.20	0 X,Tn	Se74
5.30	2	1.87	0.28	1 X,Tn	Ha64
6.70	2	9.70	4.80	0 X,Tn	Se74
8.20	2	2.55	0.35	1 X,Tn	Ha64
1.13	3	2.60	0.35	1 X,Tn	Ha64
1.44	3	2.48	0.50	1 X,Tn	Ha64
2.00	3	1.03	0.09	1 X,Tn	Sc72
5.00	4	2.40	0.20	1 X,Tn	Ho79
9.00	4	2.26	0.23	1 X,Tn	Is77

Graph is presented in Ref. Ha66 for K-shell ionization cross section of Pb by 250 to 550 keV electron impact

TABLE. Cross Sections for *K*-Shell Ionization by Electron Impact

See page 356 for Explanation of Table

ENERGY		CROSS SECTION		TYPE	REF.
** Z=83		Bi		f=9.70E-1 **	
2.00	3	9.87	0.89	0 X,Tn	Sc72
3.50	4	2.10	0.10	1 X,Tn	Ho79
5.00	4	2.10	0.10	1 X,Tn	Ho79
6.00	4	2.21	0.10	1 X,Tn	Ho79
9.00	4	2.14	0.21	1 X,Tn	Is77
3.00	5	2.98	0.05	1 X,Tn	Mi70
5.00	5	3.22	0.05	1 X,Tn	Mi70
** Z=92		U		f=9.76E-1 **	
9.00	4	1.80	0.18	1 X,Tn	Is77

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