Compilation of Energy Band Gaps in Elemental and Binary Compound Semiconductors and Insulators

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Energy band gaps are tabulated for elemental and binary compound semiconductors and insulators reported in 723 references. The method of measurement, transition, type of sample, and other pertinent information are included for each entry. The determinations believed to be the most reliable are indicated.

Key words: Band gaps; binary compounds; electronic properties; insulators; semiconductors.

1. Introduction

This compilation of energy band gaps in elemental and binary compound semiconductors and insulators is intended for scientists who are concerned with energy states and electronic properties of solids and for materials engineers who are concerned with the application of solid state science to semiconductor device technology. Binary compounds included in this compilation are those involving elements in Groups IIIA, IVA, VA, VIA, and VIIA of the Periodic Table with elements of atomic numbers 3 (lithium) through 92 (uranium). In addition to the band gap, the compilation gives the method of measurement, the form of the sample, and the temperature at which the measurement was made for each material listed. When available, temperature coefficients of band gaps and indications of whether the material exhibits cathodoluminescence, electroluminescence, laser emission, mechanical luminescence, photoluminescence, or thermoluminescence are also given.

The data tabulated in this report were obtained from the files of the Electronic Properties Information Center (EPIC), Hughes Aircraft Company, Culver City, California, and from the Research Materials Information Center (RMIC), Oak Ridge National Laboratory, Oak Ridge, Tennessee. Additional data were extracted from Chemical Abstracts, published by the American Chemical Society, and from the open literature. An effort has been made to cover the literature through 1971.

2. Energy Band Gaps

According to the band theory of solids [1, 2, 3],[1] when atoms are brought together to form a crystal, the discrete electronic energy states of the isolated atoms merge into energy bands which represent the allowed energies for electrons in the crystal. These bands may be separated by forbidden regions or gaps. The conductivity of a solid, and hence its classification as a metal, semiconductor, or insulator, depends upon the distribution of electrons in the allowed energy bands. Electrons contained in a filled band make no contribution to the electrical conductivity. Thus, if the valence electrons exactly fill one or more bands leaving others empty, the crystal will be an insulator; if the valence electrons partially fill one or more bands the crystal will be a conductor. In an insulator at temperatures above 0 K, some electrons from the highest valence band are thermally excited into the lowest empty band and conduction becomes possible (intrinsic semiconduction). The number of electrons excited into the conduction band is a function of both the temperature and the magnitude of the energy band gap E_g, which is defined as the separation between the maximum energy in the valence band and the minimum energy in the conduction band. If E_g is small (0–3 or 4 eV) a material is considered to be a semiconductor and if E_g is large (4–12 eV) a material is considered to be an insulator. As the electrical and optical properties of a semiconductor are dependent upon the energy gap, these data are important in semiconductor device design.

Attempts have been made to correlate band gaps with other properties of the solids or with properties of the constituent elements in the solid. Correlations have been proposed between band gaps and heats of formation [4, 5], heats of atomization [6], reciprocal bond length [7], the ratio of bond length to cation radius [8], single bond energies [9], average bond energies [10], electronegativities [11], and atomic numbers [12, 13, 14]. None of these correlations yields empirical relations which are sufficiently general to be of practical use. This may be attributed in part to the number of compounds for which energy band gaps were known at the time the correlations were proposed. Winkler [15], lists only about 90 inorganic compounds which, in 1955, were known to exhibit semiconductor properties.

3. Measurement of Energy Band Gaps

Band gaps have been measured by both spectroscopic and conductivity methods. They have been determined from absorption and reflectance spectra [16], from photoconductivity measurements [17], and from the thermal activation energies in electrical conductivity measurements [18]. Absorption edge measurements account for a majority of the band gaps listed in this compilation.

In determining a band gap by absorption spectroscopy, the absorption coefficient, α, is measured as a function of energy from below to above the absorption edge. At

[1] Numbers in brackets indicate references in section 6.

the absorption edge α rises steeply above background and may change by a factor of 10^7 in an energy range of 0.3–0.6 eV. The threshold energy, E_g, is determined by extrapolating the linear portion of the α vs energy curve to a value of α which is estimated or assumed to represent background. Some workers take the absorption edge to be the energy value which corresponds to a preselected value of α (usually between 1 and 100 cm^{-1}) while other workers attempt to correct for actual background. Often, the original reference does not specify the experimental procedures with sufficient detail to permit a precise comparison of results obtained by other workers. Consequently, when two or more values for a particular band gap are available, whether they have been measured by the same method or by different methods, an attempt has been made to classify the degree of reliability of the values. This classification takes into consideration the material, the method of measurement, the reported sample purity, and the experimental conditions. A review of the band gap data compiled shows that the actual experimental uncertainties are frequently greater than 5 percent and seldom less than 1 percent.

4. Arrangement of Table

The energy band gap table consists of 1504 entries. Entry numbers are given at the left hand side of the table; they are cited in the author cross index. Tabulated data and comments are arranged in columns and the numbers assigned at the top of the columns denote the following:

Column
1 Chemical symbol of the first elements
2 Stoichiometry of the first element
3 Chemical symbol of the second element
4 Stoichiometry of the second element
5 Band gap
6 Temperature at which the quoted band gap was measured
7 Temperature dependence of the band gap e denotes 10 raised to the indicated power
8 Reliability rating:
  "1" selected as the most reliable measurement for the band gap listed
  "2" denotes other citations for the same compound
9 Method of determination:
  0 Not specified
  1 Reflection
  2 Absorption
  3 Photoconduction
  4 Thermal activation
  5 Electroreflection
  6 Magnetoabsorption
  7 Magnetoreflection
  8 Others
  9 Estimated
10 Type of sample the band gap was determined on:
  0 Not specified
  1 Thin film, single crystalline
  2 This film, polycrystalline
  3 Single crystalline
  4 Polycrystalline
  5 Amorphous
  6 Other
11 Transition involved:
  First entry denotes:
    U = Unspecified transition
    E = Excitonic transition
    D = Direct transition
    I = Indirect transition
  If applicable, second entry denotes:
    A = Allowed transition
    F = Forbidden transition
  If applicable, third entry denotes:
    D = Direct transition is the lowest transition
    I = Indirect transition is the lowest transition
12 Selected effects reported in the citation:
    C = Cathodoluminescence
    E = Electroluminescence
    L = Laser emission
    M = Mechanical luminescence
    P = Photoluminescence
    T = Thermoluminescence
13 Color
14 Bibliographic reference number
15 Comments

5. Acknowledgements

The compilation of energy band gaps was made possible through the enthusiastic cooperation we received from Mrs. Meta S. Neuberger and Mr. Walter Veazie of EPIC, and Mr. T. F. Connolly of RMIC. A special acknowledgement is extended to Mr. Stanley E. Kohn, University of California, Berkeley, who searched the files of the two data centers.

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Note

This material was originally compiled by Minnesota Mining and Manufacturing Company, St. Paul, Minnesota.

Energy band gaps in elemental and binary compound semiconductors and insulators

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
1	Li	1	F	1	13.6	300.0		1	1	3	D D			532	
2	Li	1	F	1	12.61	300.0		1	1	3	E			532	
3	Li	1	F	1	12.6	.0		2	9	3	E			384	
4	Li	1	F	1	12.1	77.0		2	2	3	U			313	ABSORPTION EDGE.
5	Li	1	F	1	12.	200.0		2	2	3	U			313	ABSORPTION EDGE.
6	Li	1	F	1	11.7	300.0		2	2	3	U			313	ABSORPTION EDGE.
7	Li	1	Cl	1	9.33	55.0		1	1	3	U			55	G EDGE.
8	Li	1	Br	1	7.95	80.0		1	2	2	D D			501	TRANSITION G15 -> G1.
9	Li	1	Br	1	7.5	55.0		2	1	3	U			55	G EDGE.
10	Li	3	Sb	1	1.	300.0		1	4	2	U			246	
11	Li	1	I	1	6.	55.0		1	1	3	U			55	L EDGE.
12	Li	1	I	1	6.	.0		2	9	0	I I			45	
13	Li	1	I	1	5.62	4.7		2	2	2	E			45	
14	Li	1	I	1	5.9	80.0		2	2	3	E			607	
15	Li	1	I	1	6.3	.0		2	9	0	D I			45	
16	Li	3	Bi	1	.7	300.0		1	4	2	U			245	ACTIVATION ENERGY.
17	Be	1	O	1	10.39	300.0	−3.00e−04	1	1	3	E			531	
18	Be	1	O	1	10.57	300.0	−3.00e−04	1	1	3	D D			531	
19	Be	1	O	1	11.2	300.0		2	1	3	U			405	
20	Be	1	O	1	11.6	300.0		2	0	0	U	EPT	WHITE	146	
21	Be	1	O	1	14.5	300.0		2	0	0	U			569	
22	Be	1	O	1	5.2	300.0		2	4	0	U			513	
23	Be	1	S	1	4.17	.0		1			I I			598	CALCULATED, SCOPW METHOD.
24	Be	1	Se	1	3.61	.0		1			I I			598	CALCULATED, SCOPW METHOD.
25	Be	3	Sb	2	.67	300.0		1	4	2	U			637	
26	Be	1	Te	1	2.89	.0		1			I I			598	CALCULATED, SCOPW METHOD.
27	B				.93	300.0		1	2	3	IAI			193	
28	B				1.47	300.0		2	2	3	DAI			193	
29	B				1.53	300.0		2	2	3	D I			95	
30	B				.74	300.0		2	2	5	I I			454	
31	B				1.16	300.0		2	3	3	U			10	
32	B				1.27	300.0		2	4	3	U			116	
33	B				1.38	300.0		2	2	5	D I			454	
34	B				1.41	300.0		2	3	3	U			116	
35	B				1.42	300.0		2	4	3	U			95	
36	B				1.44	300.0		2	3	3	U			116	
37	B				1.55	300.0		2	4	3	U			560	
38	B	1	N	1	8.	300.0		1	0	3	I I		WHITE	677	CUBIC, CALCULATED, APW METHOD.
39	B	1	N	1	3.4	.0		2	9	0	U			16	
40	B	1	N	1	3.8	300.0		2	2	2	U	T		517	
41	B	2	O	3	7.	300.0		1						328	
42	B	2	O	3	4.9	300.0		2	8	2	U			417	
43	B	1	P	1	2.	300.0		1	2	3	I I		RED	33	
44	B	1	P	1	2.	300.0		2	8	0	U			223	
45	B	1	P	1	2.	300.0		2	2	3	I I			665	
46	B	1	P	1	5.9	.0		2	0	0	U			676	
47	B	1	P	1	4.5	300.0		2	0	0	U			543	
48	B	1	As	1	1.46	300.0		1	2	4	U		DK BROWN	383	CUBIC.
49	B	1	As	1	1.6	.0		2			I I			597	CALCULATED, SCOPW METHOD.
50	B	1	As	1	3.56	.0		2			D I			597	CALCULATED, SCOPW METHOD.
51	B	2	Se	3		.0		2					ORANGE	157	
52	B	1	Sb	1	2.6	300.0		1	0	0	U			126	
53	C				5.47	295.0	−5.40e−05	1	2	3	I I	EPT	COLORLESS	144	
54	C				7.02	295.0	−6.30e−04	1	1	3	D I	EPT	COLORLESS	144	
55	C				5.413	90.0		2	3	3	E			178	
56	C				5.493	90.0		2	3	3	E			178	
57	C				5.503	90.0		2	3	3	I I			178	
58	C				5.542	90.0		2	3	3	E			178	NATURAL DIAMOND.
59	C				5.41	100.0		2	2	3	E	P		154	
60	C				6.	.0		2	9	0	D I			500	TRANSITION G25 -> G15.
61	C	1	Br	4	3.7	300.0		1	2	4	U			601	
62	C	1	I	4	2.26	300.0		1	2	4	U			601	
63	Na		N			.0		2				T		356	
64	Na	1	F	1	10.5	300.0		1	0	0	U			198	
65	Na	2	S	1	2.4	300.0		1	9	0	U			602	
66	Na	1	Cl	1	8.97	300.0		1	2	3	D D			485	TRANSITION G15 -> G1.
67	Na	1	Cl	1	8.5	55.0		2	1	3	D D			54	G EDGE.
68	Na	1	Cl	1	8.6	55.0		2	1	3	U			55	G EDGE.
69	Na	1	Cl	1	8.97	77.0		2	1	3	D D			534	TRANSITION G15 -> G1.
70	Na	1	Cl	1	8.4	80.0		2	2	3	D D			501	TRANSITION G15 -> G1.
71	Na	1	Cl	1	8.6	80.0		2	2	3	U			198	
72	Na	2	Se	1	2.	300.0		1	9	0	U			602	
73	Na	1	Br	1	7.5	80.0		1	2	3	D D			501	TRANSITION G15 -> G1.
74	Na	1	Br	1	7.26	55.0		2	1	3	U			55	G EDGE.
75	Na	1	Br	1	7.025	77.0		2	1	3	E			433	
76	Na	1	Br	1	7.7	80.0		2	2	3	U			198	ABSORPTION EDGE.
77	Na	3	Sb	1	1.1	300.0		1	2	2	DFD			588	
78	Na	3	Sb	1	1.1	300.0		2	2	3	U	P		586	
79	Na	3	Sb	1	1.1	300.0		2	3	0	U			587	HEXAGONAL.

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
80	Na	3	Sb	1	1.17	250.0		2	4	3	U			722	
81	Na	3	Sb	1	1.	300.0		2	3	2	I I			321	
82	Na	3	Sb	1	2.2	300.0		2	2	2	D I			321	
83	Na	2	Te	1	2.3	355.0		1	4	4	U			477	
84	Na	2	Te	1	2.	300.0		2	9	0	U			602	
85	Na	1	I	1	5.890	77.0		1	1	3	U			433	
86	Na	1	I	1	6.	5.8		2	2	3	U			198	ABSORPTION EDGE.
87	Na	1	I	1	5.93	55.0		2	1	3	U			55	G EDGE.
88	Na	1	I	1	5.8	80.0		2	2	3	U			607	ABSORPTION EDGE.
89	Na	1	I	1	6.75	80.0		2	2	3	D D			501	TRANSITION G15 -> G1.
90	Mg	1	O	1	7.77	295.0		1	1	3	D D	CPT	COLORLESS	533	
91	Mg	1	O	1	7.69	295.0		2	1	3	E			533	
92	Mg	1	O	1	7.4	300.0		2	2	3	U	EPT		336	
93	Mg	1	F	2	11.8	300.0		1	1	3	E			678	
94	Mg	1	F	2	11.1	77.0		2	2	3	U			313	ABSORPTION EDGE.
95	Mg	1	F	2	10.8	300.0		2	2	3	U			313	ABSORPTION EDGE.
96	Mg	1	F	2	5.65	300.0		2	4	3	U			656	ACTIVATION ENERGY.
97	Mg	1	F	2		.0		2				PT		119	K(LO) = 4.84, K(HI) = .00.
98	Mg	1	F	2		.0		2						593	K(LO) = .00, K(HI) = .95.
99	Mg	1	F	2		.0		2						192	K(LO) = 5.26, K(HI) = .00.
100	Mg	2	Si	1	.6	300.0		1	9	4	I I			679	
101	Mg	2	Si	1	2.27	300.0		1	5	3	D I			36	
102	Mg	2	Si	1	.77	.0	−6.00e−04	2	4	4	I I			679	
103	Mg	2	Si	1	.78	.0		2	4	3	U			456	
104	Mg	2	Si	1	.655	15.0		2	3	3	I I			592	
105	Mg	2	Si	1	2.17	77.0		2	1	3	DAI			648	TRANSITION G15 -> G1.
106	Mg	2	Si	1	.66	90.0		2	2	3	I I			592	
107	Mg	2	Si	1	2.27	300.0		2	5	3	DAI			648	TRANSITION G15 -> G1.
108	Mg	3	P	2	1.4	300.0		1	9	0	U			602	
109	Mg	1	Cl	1		.0		2				P		474	
110	Mg	2	Ce	1	.532	300.0	−1.80e−04	1	2	3	I I			408	
111	Mg	2	Ge	1	1.64	300.0		1	5	3	DAI	P		648	TRANSITION G15 -> G1.
112	Mg	2	Ge	1	.69	.0		2	4	3	I I			522	
113	Mg	2	Ge	1	.57	4.2	−1.80e−04	2	2	3	I I			408	
114	Mg	2	Ge	1	1.804	10.0		2	8	3	D I			437	
115	Mg	2	Ce	1	.66	15.0		2	3	3	I I			592	
116	Mg	2	Ge	1	.567	77.0	−1.80e−04	2	2	3	I I			408	
117	Mg	2	Ge	1	.57	77.0		2	8	3	I I			437	
118	Mg	2	Ge	1	1.67	77.0		2	1	3	DAI	P		648	TRANSITION G15 -> G1.
119	Mg	2	Ge	1	1.78	77.0		2	8	3	D I			437	
120	Mg	2	Ge	1	.63	90.0		2	3	3	I I			592	
121	Mg	2	Ge	1	.54	195.0		2	8	3	I I			437	
122	Mg	2	Ge	1	1.737	195.0		2	8	3	D I			437	
123	Mg	2	Ge	1	.548	300.0		2	2	3	I I			437	
124	Mg	2	Ge	1	1.64	300.0		2	5	0	D I			36	
125	Mg	2	Ge	1	.74	.0	−8.00e−04	2	4	4	I I			679	
126	Mg	3	As	2	2.55	300.0		1	4	4	U		BROWN	509	VALUE VARIES: 2.2–2.9 EV.
127	Mg	3	As	2	1.	300.0		2	9	0	U			602	
128	Mg	1	Se	1	5.6	70.0		1	2	3	U			546	
129	Mg	1	Se	1	5.63	90.0		2	2	2	U			451	
130	Mg	1	Se	1	5.6	300.0		2	0	0	U			126	
131	Mg	2	Sn	1	.135	296.0	−1.70e−04	1	2	3	I I			404	
132	Mg	2	Sn	1	.18	296.0	−1.70e−04	1	1	3	DFI			404	
133	Mg	2	Sn	1	.185	.0		2	2	3	I I			404	
134	Mg	2	Sn	1	.23	.0		2	2	3	DFI			404	
135	Mg	2	Sn	1	.34	.0		2	4	4	U			690	
136	Mg	2	Sn	1	.36	.0	−3.00e−04	2	4	4	I I			679	
137	Mg	2	Sn	1	.33	5.0		2	2	3	I I			90	
138	Mg	2	Sn	1	.31	85.0	−3.50e−04	2	2	3	I I			90	
139	Mg	2	Sn	1	.22	300.0	−3.50e−04	2	2	3	I I		BLUISH	90	
140	Mg	3	Sb	2	.82	.0	−3.50e−04	1	4	4	U			123	
141	Mg	3	Sb	2	.8	.0		2	3	2	U			457	
142	Mg	1	Te	1	4.7	300.0		1	0	0	U			126	
143	Mg	1	Te	1	3.6	70.0		2	2	3	U			546	
144	Mg	2	Pb	1	.041	77.0	−5.00e−05	1	4	3	U			359	
145	Mg	2	Pb	1	.1	300.0		2	4	4	U			239	
146	Mg	2	Pb	1	.1	300.0		2	9	0	U			602	METALLIC.
147	Mg	3	Bi	2	.1	300.0		1	9	0	U			602	PROBABLY METALLIC.
148	Mg	3	Bi	2	.1	300.0		2	4	4	U			452	APPROXIMATE VALUE.
149	Al	1	B	1	.82	300.0		1	4	3	U		BLUE	135	ACTIVATION ENERGY.
150	Al	1	B	1	.5	300.0		2	4	3	U		BROWN	135	ACTIVATION ENERGY.
151	Al		B		.74	400.0		2	4	3	U		BROWN	136	ACTIVATION ENERGY.
152	Al	1	N	1	5.74	300.0		1	2	3	D I	EPT	WHITE	496	POLARIZED E $\parallel$ C.
153	Al	1	N	1	5.88	300.0		2	2	3	D I	EPT	WHITE	496	POLARIZED E $\perp$ C.
154	Al	1	N	1	5.9	300.0		2	2	3	U			150	
155	Al	1	N	1	5.9	300.0		2	2	3	U	EPT	WHITE	200	
156	Al	2	O	3	9.5	300.0		1	2	3	E			31	
157	Al	2	O	3	9.9	300.0		1	2	3	U			31	ABSORPTION EDGE.
158	Al	2	O	3	8.7	300.0		2	2	3	U			524	
159	Al	2	O	3	8.56	.0	−1.50e−03	2	0	3	U			284	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
160	Al	2	O	3	7.	300.0		2	3	3	U			295	SAPPHIRE.
161	Al	2	O	3	7.3	300.0		2	4	2	U			217	SAPPHIRE.
162	Al	1	P	1	2.45	300.0		1	2	3	I I			407	
163	Al	1	P	1	2.51	6.0		2	2	3	E			306	
164	Al	1	P	1	2.42	293.0	−4.00e−04	2	8	4	U	P		264	
165	Al	1	P	1	2.65	300.0		2	9	3	U	EP	YELLOW	439	
166	Al	2	S	3	4.1	300.0	−1.15e−03	1	2	0	U		WHITE	349	
167	Al	1	As	1	2.1	300.0		1	0	3	I I			436	
168	Al	1	As	1	2.9	300.0		1	0	3	D I		ORANGE	436	
169	Al	1	As	1	2.25	.0	−4.00e−04	2	8	3	U	E		364	
170	Al	1	As	1	2.228	2.0		2	2	4	E			407	TRANSITION G1 -> X1.
171	Al	1	As	1	2.223	77.0		2	2	4	E			407	TRANSITION G1 -> X1.
172	Al	1	As	1	2.205	145.0		2	2	4	E			407	TRANSITION G1 -> X1.
173	Al	1	As	1	2.13	300.0	−4.00e−04	2	8	3	U	E		364	
174	Al	1	As	1	2.16	300.0		2	2	3	I I			407	
175	Al	1	As	1	2.2	300.0		2	2	2	I I			444	
176	Al	1	As	1	3.5	300.0		2			D I			444	
177	Al	1	As	1	2.233	77.0		2	2	3	I I			407	
178	Al	1	As	1	2.215	145.0		2	2	3	I I			407	
179	Al	2	Se	3	3.1	300.0	−1.12e−03	1	2	0	U		WHITE	349	
180	Al	1	Sb	1	1.62	300.0		1	1	3	I I		DK GREY	131	
181	Al	1	Sb	1	2.218	300.0		1	1	3	D I		DK GREY	131	
182	Al	1	Sb	1	1.62	300.0	−3.50e−04	2	1	3	D D			221	
183	Al	1	Sb	1	1.6	.0		2	0	3	U	P	DK GREY	131	
184	Al	2	Te	3	2.5	300.0		1	2	0	U			349	
185	Al	2	Te	3	2.5	300.0		2	4	6	U		YELLOW	446	
186	Al	2	Te	3	2.2	800.0		2	4	6	U		YELLOW	446	
187	Al	1	Bi	1	.4	300.0		1	9	0	U			602	
188	Si	1	C	1	2.2	300.0		1	2	3	I I		YELLOW	499	CUBIC.
189	Si	1	C	1	2.86	300.0	−3.30e−04	1	2	3	I I			142	HEXAGONAL.
190	Si	1	C	1	2.39	4.2		2	2	3	E			141	CUBIC.
191	Si	1	C	1	2.6	300.0		2	2	3	I I		YELLOW	708	CUBIC.
192	Si	1	C	1	2.86	300.0		2	2	3	I I	EPT		499	HEXAGONAL.
193	Si	1	C	1	3.33	4.2		2	2	3	I I	EPT		497	HEXAGONAL.
194	Si	1	C	1	4.4	300.0		2	9	3	D I			339	HEXAGONAL.
195	Si	3	N	4	5.	300.0		1	8	0	U			703	
196	Si	3	N	4	5.1	300.0		2	2	1	U			251	
197	Si	3	N	4	4.5	300.0		2	2	5	U			109	
198	Si	1	O	2	11.	300.0		1	1	3	U	EMPT		405	
199	Si	1	O	2	10.4	300.0		2	1	3	E			405	
200	Si	1	O	2	8.	300.0		2	2	5	I I			313	FUSED QUARTZ, ABSORPTION EDGE.
201	Si	1	O	2	8.4	300.0		2	2	3	U			313	SYNTHETIC QUARTZ, ABSORPTION EDGE.
202	Si				1.12	291.0		1	2	3	I I			415	
203	Si				1.166	4.2		2	8	3	I I			207	
204	Si				1.17	4.2		2	2	3	I I			415	
205	Si				1.165	35.0		2	2	3	I I			57	
206	Si				1.16	77.0		2	2	3	I I			415	
207	Si				1.16	85.0		2	2	3	I I			57	
208	Si				1.12	300.0		2	2	3	I I			57	
209	Si	1	P	2	1.89	300.0		1	2	3	U			591	ORTHORHOMBIC.
210	Si	1	As	1	1.45	300.0		1	2	3	I I			443	POLARIZED E ⊥ B.
211	Si	1	As	1	1.48	300.0		2	2	3	DFD			443	POLARIZED E ∥ B.
212	Si	1	As	1	1.57	300.0		2	2	3	D I			443	
213	Si	1	As	1	2.2	300.0		2	2	3	U			322	
214	Si	1	Se	2	1.72	300.0		1	2	3	I I			286	POLARIZED E ∥ C.
215	Si	1	Se	2	1.74	300.0		2	2	3	I I			286	POLARIZED E ⊥ C.
216	Si	1	Sn	1	.59	300.0		1	0	0	U			126	
217	Si	2	Te	3	1.98	300.0	−6.50e−04	1	2	3	I I			649	
218	Si	1	Te	2	1.85	300.0		1	2	3	I I			520	
219	Si	1	Te	2	2.18	300.0		1	2	3	D I			520	
220	Si	2	Te	3	2.	300.0		2	2	3	U		RED	53	
221	P				.33	300.0	2.80e−04	1	1	3	U	P	BLACK	571	
222	P				1.6	300.0		1	1	3	U	P	RED	571	
223	P				1.4	300.0		2	2	3	U		RED	274	
224	P				.35	300.0	2.80e−04	2	4	3	U			667	
225	P		As		.23	300.0		1	4	5	U			103	36 TO 50 % PHOSPHORUS.
226	S				3.82	300.0		1	3	3	U			438	A-PHASE, ORTHORHOMBIC.
227	S				4.2	300.0		2	1	3	D D	P		584	A-PHASE, ORTHORHOMBIC, VALUE VARIES: 4.2–4.3 EV.
228	S				3.82	300.0		2	3	3	U			619	A-PHASE, ORTHORHOMBIC.
229	K	1	F	1	10.9	300.0		1	1	3	D D			530	TRANSITION G15 -> G1.
230	K	1	F	1	10.9	80.0		2	2	3	U			198	ABSORPTION EDGE.
231	K	1	F	1	9.61	293.0		2	1	3	E			594	
232	K	1	F	1	10.3	293.0		2	1	3	D D			594	TRANSITION G15 -> G1.
233	K	2	S	1	2.1	300.0		1	9	0	U			602	
234	K	1	Cl	1	8.5	80.0		1	2	3	D D			501	TRANSITION G15 -> G1.
235	K	1	Cl	1	8.9	10.0		2	3	1	U			305	
236	K	1	Cl	1	7.8	55.0		2	1	3	E			54	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
237	K	1	Cl	1	8.69	77.0		2	1	3	D D	P		534	TRANSITION G15 -> G1.
238	K	1	Cl	1	7.68	300.0		2	1	3	E			86	
239	K	2	Se	1	1.8	300.0		1	9	0	U			602	
240	K	1	Br	1	7.6	300.0		1	2	3	D D			502	TRANSITION G15 -> G1.
241	K	1	Br	1	8.	10.0		2	3	2	U			305	
242	K	1	Br	1	7.3	20.0		2	2	3	DAD	P		227	TRANSITION G8- -> G6+.
243	K	1	Br	1	6.75	55.0		2	1	3	E			54	
244	K	1	Br	1	7.215	78.0		2	1	3	E			625	TRANSITION G8- -> G6+.
245	K	1	Br	1	7.76	80.0		2	2	3	D D			502	TRANSITION G15 -> G1.
246	K	1	Br	1	6.58	300.0		2	1	3	E			86	
247	K	1	Br	1	7.13	300.0		2	1	3	E			86	
248	K	3	Sb	1	1.8	300.0		1	2	2	D I			321	HEXAGONAL, VALUE VARIES: 1.7–1.9 EV.
249	K	3	Sb	1	1.	300.0		1	4	2	I I			321	
250	K	3	Sb	1	1.4	300.0		1	2	3	U			578	CUBIC.
251	K	3	Sb	1	1.1	300.0		2	3	2	U			587	HEXAGONAL.
252	K	3	Sb	1	1.1	300.0		2	2	2	DFD			588	
253	K	3	Sb	1	1.1	300.0		2	2	2	U			586	
254	K	2	Te	1	1.9	300.0		1	9	0	U			602	
255	K	1	I	1	6.17	300.0		1	1	3	D D			625	TRANSITION G8- -> G6+.
256	K	1	I	1	6.31	10.0		2	2	3	D D			514	
257	K	1	I	1	6.25	55.0		2	1	3	D D	P		54	G EDGE.
258	K	1	I	1	6.375	78.0		2	1	3	D D			625	
259	K	1	I	1	6.08	80.0		2	2	3	D D			502	TRANSITION G15 -> G1.
260	K	1	I	1	6.2	80.0		2	2	3	U			198	ABSORPTION EDGE.
261	K	1	I	1	6.2	80.0		2	2	3	U			607	ABSORPTION EDGE.
262	K	1	I	1	5.61	300.0		2	1	3	D D			86	TRANSITION G15 -> G1.
263	K	1	I	1	5.92	300.0		2	2	3	D D			502	TRANSITION G15 -> G1.
264	K	1	I	1	6.28	300.0		2	2	3	U			112	
265	Ca	1	B	6	4.5	300.0		1	1	3	U			361	
266	Ca	1	B	6	4.4	.0		2	9	0	U			406	
267	Ca	1	B	6	3.3	300.0		2	1	3	U			361	UNCERTAIN ABOUT TRANSITION INVOLVED.
268	Ca	1	O	1	7.7	300.0		1	9	3	U			238	
269	Ca	1	O	1	6.1	300.0		2	2	3	E	PT	WHITE	464	
270	Ca	1	O	1	7.	300.0		2	2	3	E			238	
271	Ca	1	O	1	7.03	300.0		2	1	3	E			673	
272	Ca	1	O	1	7.5	300.0		2	9	3	U	PT	WHITE	464	
273	Ca	1	F	2	10.	300.0		1	2	3	U			313	ABSORPTION EDGE, SEE ALSO SOV. PHYS.–SOLID STATE, 11, 1505 (1970).
274	Ca	2	Si	1	1.9	300.0		1	4	4	U			124	SEE ALSO ADVAN. PHYS., 5, 315 (1956).
275	Ca	1	S	1	5.8	300.0		1	2	2	U	EPT		399	ESTIMATED VALUE: 5.8–6.2 EV.
276	Ca	1	S	1	5.38	70.0		2	2	2	U	EPT	BROWN	546	
277	Ca	1	Se	1	4.87	77.0		1	2	2	U	E	YELLOW	546	
278	Ca	2	Sn	1	.9	300.0		1	4	4	U			145	SEE ALSO ADVAN. PHYS., 5, 315 (1956).
279	Ca	1	Te	1	4.07	70.0		1	2	2	U	P	WHITE	546	
280	Ca	1	I	2	5.98	77.0		1	2	2	E			627	
281	Ca	2	Pb	1	.46	300.0		1	4	4	U			124	ACTIVATION ENERGY.
282	Sc	1	N	1	2.6	.0		1	9	0	U			553	
283	Sc	2	O	3	6.	300.0	−9.60e−04	1	2	3	U	EP		622	
284	Sc	2	O	3	6.2	80.0	−9.60e−04	2	2	3	U	EP		622	
285	Sc	2	O	3	5.4	300.0		2	1	4	U			147	
286	Sc	2	O	3	1.7	873.0		2	4	4	U			473	ACTIVATION ENERGY.
287	Sc	2	S	3	2.	300.0		1	4	3	U			181	
288	Ti		C		.3	293.0		1	7	0	U			247	TI 1.0 – C 0.9.
289	Ti	2	O	3	.02	4.2		1	8	0	U			300	VALUE VARIES: 0.02–0.06 EV.
290	Ti	1	O	2	3.	296.0		1	5	3	I I			47	RUTILE.
291	Ti	1	O	2	3.3	296.0		1	5	3	D I			47	RUTILE.
292	Ti	2	O	3	.02	4.2		2	0	3	U			299	QUESTIONABLE VALUE.
293	Ti	2	O	3	.050	180.0		2	4	3				138	
294	Ti	1	O	2	3.05	300.0		2	3	3	U			153	
295	Ti	1	O	2	3.5	300.0		2	5	3	D D			228	
296	Ti	1	O	2	3.75	300.0		2	2	3	D D			664	RUTILE.
297	Ti	1	O	2	2.9	300.0		2	2	3	U			60	RUTILE, ABSORPTION EDGE.
298	Ti	1	S	2	1.24	300.0		1	9	3	U			261	FROM FIGURE 8.
299	Ti	2	S	3	.3	300.0		1	4	4	U			542	
300	Ti	1	S	3	.9	300.0		1	2	0	U			265	
301	Ti	1	S	2	1.95	300.0		2	1	3	U			261	E1 REFLECTION PEAK.
302	Ti	1	Cl	3		300.0		2	2	3	U			56	
303	Ti	1	Se	2	.69	300.0		1	9	3	U			261	FROM FIGURE 8.
304	Ti	1	Se	2	1.55	300.0		2	1	3	U			261	E1 REFLECTION PEAK.
305	Ti	1	Te	2	1.	300.0		1	1	3	U			261	E1 REFLECTION PEAK.
306	V	1	O	1	.3	.0		1	9	0	U			11	
307	V	2	O	3	.1	77.0		1	2	3	U			215	
308	V	2	O	5	2.34	300.0		1	2	3	DFD			357	POLARIZED ‖ C.
309	V	1	O	2	.65	300.0		1	2	3	U			74	VALUE VARIES: 0.6–0.7 EV.
310	V	2	O	4	.66	300.0		1	2	3	U			388	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
311	V	5	O	9	0.15	100.0		1	4	3	U			481	ACTIVATION ENERGY, VARIES: 0.1–0.2 EV.
312	V	4	O	7	.8	200.0		1	4	3	U			480	ACTIVATION ENERGY.
313	V	2	O	5	2.49	.0	−6.10e−04	2	2	3	DFD			92	POLARIZED E∥ C.
314	V	2	O	5	2.54	.0	−7.30e−04	2	2	3	DFD			92	POLARIZED E ⊥ C.
315	V	2	O	5	2.3	300.0	−6.10e−04	2	2	3	DFD			92	POLARIZED E∥ C.
316	V	2	O	5	2.36	300.0		2	2	3	DFD			357	POLARIZED E ⊥ C.
317	V	1	O	2	.4	300.0		2	2	3	U			448	
318	V	2	O	5	2.32	300.0	−7.30e−04	2	2	3	DFD			92	POLARIZED E⊥C.
319	V	1	O	2	.12	339.0		2						96	
320	V	2	O	5	1.95	273.0		2	4	4	U	P		710	
321	Cr	2	O	3	1.68	300.0		1	4	3	U			152	ACTIVATION ENERGY.
322	Cr	1	O	2	.23	300.0		1	2	4	U			186	
323	Cr	2	O	3	1.59	300.0		2	4	3	U			152	ACTIVATION ENERGY.
324	Cr	2	O	3	1.	300.0		2						59	
325	Cr	2	O	3	1.62	300.0		2	1	4	U	P		659	
326	Cr	1	O	2		300.0		2	4	0	U			143	
327	Cr	1	Si	2	.35	300.0		1	4	3	U			564	
328	Cr	2	S	3	.9	300.0		1	4	2	U			542	
329	Cr	3	Se	4	.015	300.0		1	4	0	U			326	ACTIVATION ENERGY.
330	Cr	2	Se	3	.025	300.0		1	4	0	U			326	ACTIVATION ENERGY.
331	Cr	3	Se	4	.015	300.0		2	4	0	U			325	ACTIVATION ENERGY.
332	Cr	2	Se	3	.15	300.0		2	4	0	U			325	ACTIVATION ENERGY.
333	Cr	1	Br	3		.0		2						338	K(LO) = 4.17, K(HI) = 6.20.
334	Cr	1	Sb	1	.2	300.0		1	4	4	U			643	ACTIVATION ENERGY.
335	Cr		Te		.02	300.0		1	4	4	U			643	ACTIVATION ENERGY.
336	Mn	1	O	2	.26	300.0		1	4	3	U			140	B-PHASE.
337	Mn	1	O	1	3.7	300.0		1	2	3	U			324	VALUE VARIES: 3.6–3.8 EV, SEE ALSO PHYS. REV., 116, 281 (1959).
338	Mn	1	O	1	1.84	300.0		2	4	4	U			475	
339	Mn	1	O	1	2.6	300.0		2	4	3	U			17	
340	Mn	1	O	2	.28	300.0		2	4	3	U			186	
341	Mn	1	O	2	.7	300.0		2	4	3	U			140	
342	Mn	1	O	1	2.2	300.0		2	4	4	U			475	HOPPING TYPE SEMICONDUCTOR OR BAND CONDUCTION OF ELECTRONS.
343	Mn	1	F	2	9.9	77.0		1	2	3	I I			429	
344	Mn	1	F	2	10.2	300.0		1	2	3	E			429	
345	Mn	1	F	2	10.24	77.0		2	2	3	E			429	
346	Mn	1	Al	3	.58	300.0		1	4	4	U			370	
347	Mn		Si		.6	600.0		1	4	0	U			373	MN 1.0–SI 1.67–1.73.
348	Mn		Si		.8	.0		2	4	3	U			470	MN 11–SI 19.
349	Mn	1	S	1	6.2	300.0		1	1	3	U			304	A-PHASE.
350	Mn	1	S	1	6.	300.0		2	1	3	E			304	A-PHASE.
351	Mn	1	Se	2	.2	300.0		1	4	4	U			308	ACTIVATION ENERGY.
352	Mn	1	Se	1	1.8	300.0		1	1	3	U		BRN–BLACK	675	
353	Mn	1	Te	1	1.25	300.0		1	1	3	U			695	
354	Mn	1	Te	2	.48	300.0		1	4	4	U			187	ACTIVATION ENERGY.
355	Mn	1	Te	1	1.35	80.0		2	1	3	U			695	
356	Mn	1	Te	2	.2	300.0		2	4	4	U			308	ACTIVATION ENERGY.
357	Mn	1	I	2	4.04	77.0		1	2	2	U			627	ABSORPTION EDGE.
358	Mn	1	I	2	4.4	77.0		2	2	2	E			627	
359	Fe	2	O	3	2.34	300.0		1	4	4	U			455	
360	Fe	2	O	3	1.06	600.0		2	4	4	U			79	ACTIVATION ENERGY.
361	Fe	2	O	3	2.2	300.0		2	1	4	U			659	
362	Fe	1	Si	2	.9	.0		1	4	4	U			81	VALUE SOMEWHAT SMALLER THAN 0.9 EV.
363	Fe	1	Si	1	.1	300.0		1	4	3	DAD			342	APPROXIMATE VALUE.
364	Fe	1	Si	2	.85	.0		2	4	6	U			82	
365	Fe	1	Si	2	.88	.0		2	4	0	U			666	
366	Fe	1	P	2	.4	300.0		1	4	4	U			308	ACTIVATION ENERGY.
367	Fe	1	S	2	1.2	300.0		1	4	3	U		YELLOW	424	
368	Fe	1	As	2	.2	300.0		1	4	4	U			308	ACTIVATION ENERGY.
369	Fe	1	As	2	.2	300.0		2	4	4	U			337	
370	Fe	1	Se	2	.6	300.0		1	4	4	U			187	ACTIVATION ENERGY, VALUE VARIES: 0.6–0.95 EV.
371	Fe	1	Se	2	.5	300.0		2	4	4	U			308	ACTIVATION ENERGY.
372	Fe	1	Sb	2	.17	300.0		1	4	4	U			187	ACTIVATION ENERGY.
373	Fe	1	Sb	2	.05	300.0		2	4	4	U			308	
374	Fe	2	Te	3	.6	300.0		1	2	4	U			422	
375	Fe	1	Te	2	.46	300.0		1	4	4	U			187	ACTIVATION ENERGY.
376	Fe	2	Te	3	0.34	0.0		2	4	4	U			32	
377	Fe	1	I	2	5.15	300.0		1	2	2	D I			627	
378	Co	1	O	1	0.47	250.0		1	4	3	U			40	ACTIVATION ENERGY.
379	Co	1	O	1	.73	373.0		2	4	3	U			518	ACTIVATION ENERGY.
380	Co	1	O	1	.125	500.0		2	4	0	U	P		115	
381	Co	1	F	2		300.0		2	2	2	D D	P		687	K(LO) = 4.80, K(HI) = 2.25.
382	Co	1	F	2		300.0		2	2	2	D D	P		687	K(LO) = 6.10, K(HI) = 2.25.
383	Co	1	Si	1	.045	300.0		1	8	3	U			341	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
384	Co	1	As	2	.15	300.0		1	4	4	U			308	ACTIVATION ENERGY.
385	Co	1	As	3	.25	300.0		1	4	4	U			308	ACTIVATION ENERGY.
386	Co		Te		.2	300.0		1	2	0	U			421	NONSTOICHIOMETRIC, CO 1.0 TE 1.88.
387	Ni	1	O	1	3.7	300.0		1	5	3	U		DK GREEN	435	
388	Ni	1	O	1	0.92	300.0		2	4	3	U			102	ACTIVATION ENERGY.
389	Ni	1	O	1	4.	300.0	−2.90e−04	2	1	2	U	P		536	
390	Ni	1	O	1	3.7	700.0		2	4	3	U			382	
391	Ni	1	P	2	.5	300.0		1	4	6	U			311	
392	Ni	1	S	1	0.12	264.0		1	4	3	U			583	ACTIVATION ENERGY.
393	Ni	1	S	2	.5	300.0		1	4	4	U			308	ACTIVATION ENERGY.
394	Ni	1	S	1	0.01	77.0		2	4	3	U			583	ACTIVATION ENERGY.
395	Ni	1	As	2	.05	.0		1	4	4	U			308	
396	Ni		Te		0.23	300.0		1	4	0	U			547	ACTIVATION ENERGY.
397	Cu	1	N	3	4.17	300.0		1	2	2	U			175	
398	Cu	1	N	3	4.96	300.0		2	2	2	D D		YELLOW	174	
399	Cu	2	O	1	2.023	77.0		1	5	4	I I			98	
400	Cu	2	O	1	2.17	.0		2	1	2	E			99	TRANSITION G25 -> G1.
401	Cu	2	O	1	2.58	.0		2	1	2	D I			99	TRANSITION G25 -> G12.
402	Cu	2	O	1	2.59	293.0		2	5	0	D I			563	
403	Cu	2	O	1	2.02	300.0		2	1	4	U			610	
404	Cu	2	O	1	2.02	300.0		2	1	4	U			611	
405	Cu	2	O	1	2.67	300.0		2	1	4	D I			610	TRANSITION G25 -> G12.
406	Cu	1	P	2	1.4	300.0		1	2	3	I I			255	
407	Cu	1	P	2	1.51	300.0		2	2	3	D I			255	
408	Cu	2	S	1	1.21	300.0		1	1	2	I I	E		425	
409	Cu	2	S	1	1.93	293.0		2	1	3	U			658	
410	Cu	2	S	1	1.7	300.0		2	2	2	D I			515	
411	Cu	2	S	1	1.8	300.0		2	4	4	U			581	
412	Cu	2	S	1	1.84	300.0		2	3	3	U			580	
413	Cu	2	S	1	1.93	300.0		2	1	3	D I			570	
414	Cu	2	S	1	1.26	80.0		2	1	2	I I	E		425	
415	Cu	2	S	1	1.05	300.0		2	2	2	I I			515	
416	Cu	1	Cl	1	3.306	80.0		1	2	2	E	EP		134	
417	Cu	2	Se	1	1.23	293.0		1	1	3	U			658	
418	Cu	2	Se	1	1.23	300.0		2	1	3	D I			570	
419	Cu	2	Se	1	1.29	300.0		2	3	3	U			580	
420	Cu	2	Se	1	1.3	300.0		2	2	3	U	EP		2	
421	Cu	1	Br	1	2.987	80.0		1	2	2	E	P		134	
422	Cu	1	Br	1	3.02	8.0		2	3	2	U			256	
423	Cu	2	Te	1	1.08	300.0	−3.00e−04	1	2	2	U			162	
424	Cu	2	Te	1	1.15	80.0	−3.00e−04	2	2	2	U			162	
425	Cu	2	Te	1	1.02	300.0		2	3	3	U			580	
426	Cu	2	Te	1	1.04	300.0		2	1	3	U			658	
427	Cu	2	Te	1	1.04	300.0		2	1	3	D D			570	
428	Cu	1	I	1	3.07	300.0	−1.00e−04	1	9	3	D D	P		352	
429	Cu	1	I	1	3.047	80.0		2	2	2	E			134	
430	Zn	1	O	1	3.35	300.0		1	1	3	U	EPT		296	
431	Zn	1	O	1	3.435	1.2		2	1	3	D D			494	
432	Zn	1	O	1	3.26	77.0		2	8	3	E	L		468	
433	Zn	1	O	1	3.31	300.0		2	5	3	U			297	
434	Zn	1	O	1	3.418	77.0		2	1	3	E			197	
435	Zn	1	P	2	1.65	293.0	−2.30e−04	1			I I			574	TETRAGONAL, POLARIZED E ⊥ C.
436	Zn	1	P	2	1.85	293.0	−2.30e−04	1			I I			574	TETRAGONAL, POLARIZED E ∥ C.
437	Zn	1	P	2	2.18	293.0	−5.50e−04	1			D I			574	TETRAGONAL.
438	Zn	3	P	2	1.15	300.0		1	1	3	U			573	
439	Zn	1	P	2	2.03	300.0	−4.00e−04	1	2	3	U	EP	RED	365	TETRAGONAL.
440	Zn	1	S	1	3.87	300.0		1	1	3	U	E		130	HEXAGONAL, POLARIZED E ⊥ C.
441	Zn	1	S	1	3.68	300.0	−4.86e−04	2	2	3	U			463	POLARIZED E ∥ C.
442	Zn	1	S	1	3.69	300.0		2	2	3	U		WHITE	78	HEXAGONAL, POLARIZED E ⊥ C.
443	Zn	1	S	1	3.704	300.0	−4.86e−04	2	2	3	U			463	POLARIZED E ⊥ C.
444	Zn	1	S	1	3.73	300.0		2	2	3	U		WHITE	78	HEXAGONAL, POLARIZED E ∥ C.
445	Zn	1	S	1	3.88	300.0		2	1	3	U	E		130	HEXAGONAL, POLARIZED E ∥ C.
446	Zn	1	S	1	3.82	.0		2	8	3	E	L		317	
447	Zn	1	As	2	.9	297.0		1	2	3	U			629	POLARIZED E ∥ C.
448	Zn	3	As	2	.93	297.0		1	2	3	U			629	
449	Zn	3	As	2	.86	.0	−5.40e−04	2	4	4	U			508	
450	Zn	1	As	2	.93	297.0		2	2	3	U			629	POLARIZED E ⊥ C.
451	Zn	3	As	2	.51	300.0		2	2	2	U			280	
452	Zn	1	As	2	1.3	.0	−7.50e−04	2	4	3	U			639	
453	Zn	1	Se	1	2.67	297.0		1	1	3	D D		YELLOW	42	
454	Zn	1	Se	1	2.874	15.0		2	2	3	DAD			401	HEXAGONAL.
455	Zn	1	Se	1	2.81	23.0		2	1	3	E		YELLOW	42	
456	Zn	1	Se	1	2.68	150.0		2	8	3	U	L		93	
457	Zn	1	Se	1	2.795	300.0		2	3	3	U			493	HEXAGONAL, POLARIZED E ⊥ C.
458	Zn	1	Se	1	2.76	290.0		2	8	3	D D			197	
459	Zn	1	Sb	1	.5	300.0		1	2	3	I I			372	
460	Zn	1	Sb	1	.99	300.0		1	2	3	D I			372	
461	Zn	3	Sb	2	.22	300.0		1	2	3	U			572	
462	Zn	4	Sb	3	1.2	300.0		1	2	3	U			572	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
463	Zn	1	Sb	1	.508	4.2		2	2	3	I I			428	POLARIZED E ‖C.
464	Zn	1	Sb	1	.603	4.2		2	2	3	I I			428	POLARIZED E ‖C.
465	Zn	1	Sb	1	.606	4.2		2	2	3	I I			428	POLARIZED E ‖B.
466	Zn	1	Sb	1	.61	4.2		2	2	3	I I			428	POLARIZED E ‖A.
467	Zn	1	Sb	1	.61	4.2		2	2	3	I I			372	
468	Zn	1	Sb	1	1.05	4.2		2	2	3	D I			372	POLARIZED E ‖C.
469	Zn	1	Sb	1	1.09	4.2		2	2	3	D I			372	POLARIZED E ‖B.
470	Zn	1	Sb	1	1.11	4.2		2	2	3	D I			372	POLARIZED E ‖A.
471	Zn	1	Sb	1	.59	77.0		2	2	3	I I			428	POLARIZED E ‖B.
472	Zn	1	Sb	1	.59	77.0		2	2	3	I I			372	
473	Zn	1	Sb	1	.53	297.0		2	2	3	U			629	
474	Zn	1	Sb	1	.48	300.0		2	2	3	I I			697	
475	Zn	1	Sb	1	.514	300.0		2	2	3	I I			428	POLARIZED E ‖A.
476	Zn	3	Sb	2	.2	300.0		2	4	4	U			636	
477	Zn	1	Sb	1	.5	300.0		2	2	3	U			572	
478	Zn	1	Te	1	2.25	300.0		1	2	3	DAD		RED	462	TRANSITION G15 -> G1.
479	Zn	1	Te	1	2.385	4.2		2	2	3	DAD		RED	462	TRANSITION G15 -> G1.
480	Zn	1	Te	1	2.29	77.0		2	1	3	I I			548	
481	Zn	1	Te	1	2.35	77.0		2	1	3	D I			548	
482	Zn	1	Te	1	2.372	77.0		2	8	2	U			526	
483	Zn	1	Te	1	2.37	80.0		2	2	3	DAD		RED	462	TRANSITION G15 -> G1.
484	Zn	1	Te	1	2.34	290.0		2	8	3	U			197	CUBIC.
485	Zn	1	Te	1	2.281	295.0		2	8	2	U			526	
486	Zn	1	Te	1	2.176	300.0		2	1	3	I I			548	
487	Zn	1	Te	1	2.23	300.0		2	2	3	D D			319	
488	Zn	1	Te	1	2.255	300.0		2	1	3	D I			548	
489	Zn	1	Te	1	2.35	300.0		2	1	3	D D	EPT		128	TRANSITION G15 -> G1.
490	Zn	1	Te	1	2.29	110.0		2	8	3	U	L		655	
491	Zn	1	I	2	4.53	77.0		1	2	2	E			615	
492	Ga	1	N	1	3.24	300.0		1	2	1	D D			489	
493	Ga	1	N	1	3.25	300.0	−3.90e−04	2	2	4	U			348	
494	Ga	1	N	1	3.39	300.0		2	2	3	D D		COLORLESS	427	
495	Ga	1	N	1	3.8	300.0		2	1	1	D D			376	
496	Ga	2	O	3	4.54	300.0		1	2	3	D D			623	B−PHASE.
497	Ga	2	O	3	4.4	300.0	−8.30e−04	2	2	3	U	EP	WHITE	349	
498	Ga	1	P	1	2.22	300.0	−5.20e−04	1	2	3	I I			692	TRANSITION G15 -> X1.
499	Ga	1	P	1	2.78	300.0	−4.60e−04	1	2	3	D I			692	TRANSITION G15 -> G1.
500	Ga	1	P	1	2.235	.0	−2.34e−06	2	2	3	I I			233	
501	Ga	1	P	1	2.895	.0	−2.34e−06	2	3	3	D I			465	
502	Ga	1	P	1	2.78	290.0		2	2	3	D I			1	
503	Ga	1	P	1	2.223	300.0	−2.34e−06	2	2	3	I I			233	
504	Ga	1	P	1	2.75	300.0		2	5	3	D I			618	
505	Ga	1	S	1	2.5	295.0		1	2	3	I I	EPT		104	
506	Ga	2	S	3	3.59	.0	−9.50e−04	1	8	3	U			590	
507	Ga	1	S	1	2.591	77.0		2	2	3	I I			39	
508	Ga	1	S	1	2.62	77.0		2	2	3	I I	EPT		104	
509	Ga	1	S	1	2.7	77.0		2	8	3	U	E		14	
510	Ga	1	S	1	2.58	150.0		2	2	3	I I	EPT		104	
511	Ga	1	S	1	2.38	300.0	−7.20e−04	2	3	3	U			13	
512	Ga	1	S	1	2.5	300.0		2	1	3	U			15	
513	Ga	1	S	1	2.52	300.0		2	2	3	U			105	
514	Ga	1	S	1	2.53	300.0	−7.20e−04	2	2	3	U			13	
515	Ga	1	S	1	2.84	.0		2	8	3	U	P	PALEYELLOW	590	
516	Ga	2	S	3	2.85	300.0		2	2	3	U		YELL−WHITE	349	
517	Ga	1	As	1	1.42	300.0		1	1	3	D D			561	
518	Ga	1	As	1	1.46	4.2		2	8	3	U	L		315	
519	Ga	1	As	1	1.521	21.0		2	2	3	D D			599	
520	Ga	1	As	1	1.518	55.0		2	2	3	D D			599	
521	Ga	1	As	1	1.507	77.0		2	8	3	U	P		49	
522	Ga	1	As	1	1.51	77.0		2	2	3	D D			600	
523	Ga	1	As	1	1.511	90.0		2	2	3	D D			599	
524	Ga	1	As	1	1.479	185.0		2	2	3	D D			599	
525	Ga	1	As	1	1.43	295.0		2	2	3	D D			600	
526	Ga	1	As	1	1.37	300.0		2	2	3	D D			589	
527	Ga	1	As	1	1.62	300.0		2	2	3	I D			589	
528	Ga	1	As	1	1.35	473.0		2	2	3	D D			488	TRANSITION G15 -> G1.
529	Ga	1	As	1	1.253	673.0		2	2	3	D D			488	TRANSITION G15 -> G1.
530	Ga	1	As	1	1.147	873.0		2	2	3	D D			488	TRANSITION G15 -> G1.
531	Ga	1	As	1	1.09	973.0		2	2	3	D D			488	TRANSITION G15 -> G1.
532	Ga	1	As	1	1.33	500.0		2	8	3	D D			195	TRANSITION G15 -> G1.
533	Ga	1	As	1	1.435	294.0		2	2	3	D D			599	
534	Ga	1	Se	1	1.98	300.0		1	2	3	I I	EPT		418	
535	Ga	1	Se	1	2.12	300.0		1	2	3	D I			418	
536	Ga	2	Se	3	2.05	300.0		1	2	3	U		RED	459	
537	Ga	1	Se	1	2.2	.0	−5.70e−04	2	8	3	U			590	
538	Ga	1	Se	1	2.132	4.2		2	6	3	U			27	
539	Ga	1	Se	1	2.065	77.0		2	2	3	I I			39	G− AND E− PHASES.
540	Ga	1	Se	1	2.07	77.0		2	8	3	E	L		61	
541	Ga	1	Se	1	2.109	77.0		2	5	3	U			346	
542	Ga	1	Se	1	2.117	77.0		2	2	3	I I			39	B−PHASE.

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Entry No.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	Ref	Comment
543	Ga	1	Se	1	2.12	77.0		2	2	3	D I			39	G- AND E- PHASES.
544	Ga	1	Se	1	2.169	77.0		2	2	3	D I			39	B-PHASE
545	Ga	1	Se	1	1.93	300.0	-8.00e-04	2	3	3	U			13	
546	Ga	1	Se	1	1.97	300.0	-4.00e-04	2	2	3	U			117	
547	Ga	1	Se	1	1.97	300.0	-8.00e-04	2	2	3	U			13	
548	Ga	1	Se	1	2.01	300.0		2	4	3	U			44	
549	Ga	1	Se	1	2.1	300.0		2	1	3	D I			15	
550	Ga	2	Se	3	2.3	.0	-4.75e-04	2	8	3	U			590	
551	Ga	2	Se	3	1.86	300.0		2	4	3	U		RED	201	
552	Ga	1	Sb	1	.725	300.0	-4.10e-04	1	2	3	U			624	
553	Ga	1	Sb	1	.773	.0		2	3	3	U			412	
554	Ga	1	Sb	1	.812	1.7		2	2	3	D D		LT GREY	335	
555	Ga	1	Sb	1	.813	4.2	-4.10e-04	2	2	3	D D			624	
556	Ga	1	Sb	1	.725	300.0		2	2	3	D D			64	
557	Ga	1	Sb	1	.81	4.0		2	8	3	U	L		69	
558	Ga	1	Te	1	1.42	293.0	-4.00e-04	1	2	1	U			257	
559	Ga	2	Te	3	1.13	300.0	-6.00e-04	1	1	3	I I			458	
560	Ga	2	Te	3	1.32	300.0	-6.00e-04	1	1	3	DAI			458	
561	Ga	2	Te	3	1.08	.0	-4.80e-04	2	2	3	I I			282	
562	Ga	1	Te	1	1.52	.0	-4.80e-04	2	2	1	U			258	
563	Ga	1	Te	1	1.74	.0		2	4	3	U			3	
564	Ga	1	Te	1	1.74	77.0		2	1	3	U			66	
565	Ga	2	Te	3	1.33	300.0	-4.00e-04	2	2	3	U			259	
566	Ga	2	Te	3	1.5	300.0		2	4	3	U		BLACK	459	
567	Ga	1	Te	1	1.5	300.0		2	3	3	U			13	
568	Ga	1	Te	1	1.63	300.0		2	1	3	U			66	
569	Ga	1	Te	1	1.67	300.0		2	2	3	U			13	
570	Ga	1	Te	1	1.7	300.0	-4.35e-04	2						612	
571	Ga	2	Te	3	1.45	933.0		2	4	3	U			538	
572	Ga	1	Bi	1	.1	300.0		1	9	0	U			602	
573	Ge	1	O	2	5.56	300.0		1	1	3	U			486	
574	Ge	1	O	2	5.54	300.0		2	2	3	U	PT	GREY	492	
575	Ge	1	O	2	5.63	300.0		2	1	5	U			486	
576	Ge	1	O	2	6.	300.0		2	2	5	U			127	
577	Ge		Si		1.042	300.0		2	5	4	DAD			366	6.45 % SILICON.
578	Ge		Si		1.042	300.0		2	5	2	U	P		410	7 % SILICON.
579	Ge		Si		1.126	300.0		2	5	4	DAD			366	10.9 % SILICON.
580	Ge		Si		1.319	300.0		2	5	4	DAD			366	16.2 % SILICON.
581	Ge		Si		1.503	300.0		2	5	4	DAD			366	22.6 % SILICON.
582	Ge		Si		1.914	300.0		2	5	4	DAD			366	34.7 % SILICON.
583	Ge		Si		2.238	300.0		2	5	4	DAD			366	45.8 % SILICON.
584	Ge	1	S	1	1.58	300.0		1	4	0	I I			159	
585	Ge	1	S	2	3.54	300.0		1	2	3	U		AMBER	402	
586	Ge	1	S	1	1.69	77.0	-4.30e-04	2	2	3	U			402	POLARIZED E ‖ A.
587	Ge	1	S	1	1.77	77.0	-4.30e-04	2	2	3	U			402	POLARIZED E ‖ C.
588	Ge	1	S	1	1.59	300.0	-4.30e-04	2	2	3	U			402	POLARIZED E ‖ A.
589	Ge	1	S	1	1.68	300.0	-4.30e-04	2	2	3	U			402	POLARIZED E ‖ C.
590	Ge	1	S	2	3.71	77.0		2	2	3	U		AMBER	402	
591	Ge				.665	291.0		1	2	3	I I			414	
592	Ge				.805	293.0	-3.90e-04	1	6	3	D I			716	
593	Ge				.744	1.5		2	6	3	I I			716	
594	Ge				.771	1.7		2	6	3	I I			279	
595	Ge				.735	77.0		2	2	3	I I			414	
596	Ge				.889	77.0	-3.90e-04	2	6	3	D I			716	
597	Ge				.880	89.0		2	2	3	D I			229	
598	Ge				.799	305.0		2	2	3	D I			229	
599	Ge				.882	77.0	-3.50e-04	2	2	1	D I	EP		483	
600	Ge				.88	300.0		2	2	5	I I			614	
601	Ge	1	As	1	.65	300.0		1	2	3	I I			519	VALUE VARIES: 0.6–0.7 EV.
602	Ge	1	As	2	1.	300.0		1	2	3	I I			519	VALUE VARIES: 0.9–1.1 EV.
603	Ge	1	As	2	1.45	300.0		1	2	3	D I			519	VALUE VARIES: 1.1–1.8 EV.
604	Ge	1	As	1	1.45	300.0		1	2	3	D I			519	VALUE VARIES: 1.0–1.9 EV.
605	Ge	1	Se	1	1.1	300.0		1	2	3	IFI			411	
606	Ge	1	Se	1	1.53	300.0		1	2	3	D I			344	
607	Ge	1	Se	2	2.38	300.0		1	2	3	I I			232	EXTRAPOLATED VALUE.
608	Ge	1	Se	2	2.485	300.0		1	2	3	D I		YELL–ORAN	232	
609	Ge	1	Se	2	2.69	.0		2	2	3	D I		YELL–ORAN	232	
610	Ge	1	Se	1	1.	100.0		2	4	3	U			35	
611	Ge	1	Se	1	1.17	300.0		2	3	3	U			344	
612	Ge	1	Sn	1	.8	300.0		1	0	0	U			126	
613	Ge	1	Te	1	.84	300.0		1	2	2	D D			51	VALUE VARIES: 0.73–0.95 EV.
614	Ge	1	Te	2	.3	293.0		1						720	
615	Ge	1	Te	1	.8	300.0		2	2	2	U			52	
616	Ge	1	Te	1	.33	.0		2	4	0	U			209	
617	Ge	1	Te	1	.77	77.0		2	2	5	U			303	
618	Ge	1	Te	1	.7	295.0		2	2	5	U			303	
619	Ge	1	I	2	1.5	300.0		1	9	0	U			602	
620	As	2	O	3	4.	300.0		1	2	2	U			184	
621	As	2	O	3	5.	300.0		2	1	4	U			609	ESTIMATED VALUE.

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
622	As	2	S	3	2.43	293.0		1	2	3	I I			252	POLARIZED E ⊥ C, PHONON ASSISTED TRANSITION.
623	As	4	S	4	2.4	300.0		1	3	3	U			596	
624	As	2	S	5	2.48	298.0	−6.70e−04	1	2	5	U			374	
625	As	2	S	3	2.2	.0	−6.80e−04	2	2	5	U			368	
626	As	2	S	3	3.	.0	−1.40e−03	2	2	3	U			368	
627	As	2	S	3	2.35	77.0	−6.70e−04	2	2	5	D I			236	
628	As	2	S	3	2.57	90.0		2	2	3	I I			252	POLARIZED E ⊥ C, PHONON ASSISTED TRANSITION.
629	As	2	S	3	2.64	90.0		2	2	3	I I			252	POLARIZED E ∥ C, PHONON ASSISTED TRANSITION.
630	As	2	S	3	2.45	293.0		2	2	3	I I			252	POLARIZED E ∥ C, PHONON ASSISTED TRANSITION.
631	As	2	S	3	2.	300.0	−6.80e−04	2	2	5	U			368	
632	As	2	S	3	2.062	300.0		2	2	5	I I			713	
633	As	2	S	3	2.21	300.0	−6.70e−04	2	2	5	D I			236	
634	As	2	S	3	2.23	300.0		2	2	5	D I			713	
635	As	2	S	3	2.48	300.0		2	1	4	U			611	
636	As	2	S	3	2.56	300.0	−1.40e−03	2	2	3	U			368	
637	As	2	S	3	2.355	403.0		2	2	3	I I			252	POLARIZED E ⊥ C, PHONON ASSISTED TRANSITION.
638	As	2	S	3	2.365	403.0		2	2	3	I I			252	POLARIZED E ∥ C, PHONON ASSISTED TRANSITION.
639	As	2	S	3	2.43	80.0	−5.10e−04	2	2	5	U			374	
640	As	2	S	5	2.62	80.0	−6.70e−04	2	2	5	U			374	
641	As	2	S	3	2.32	293.0	−5.10e−04	2	2	5	U			374	
642	As	2	S	3	1.89	300.0		2	2	5	I I			714	
643	As	2	S	5	2.01	300.0		2	2	5	I I			714	
644	As	2	S	3	2.1	300.0		2	2	5	D I			714	
645	As	2	S	5	2.21	300.0		2	2	5	D I			714	
646	As	2	S	3	2.32	300.0		2	2	5	U			218	
647	As	2	S	3	2.36	300.0		2	3	5	U			218	
648	As	2	S	3	2.74	300.0	−6.92e−04	2	2	3	U			374	POLARIZED E ∥ C.
649	As	2	S	3	2.8	300.0	−6.92e−04	2	2	3	U			374	POLARIZED E ⊥ C.
650	As				1.2	300.0		1	3	3	U		GREY	391	
651	As				.172	4.2		2	7	3	D D			420	
652	As				.346	4.2		2	7	3	D D			419	
653	As				1.07	300.0		2	1	2	U			280	
654	As	1	Se	1	1.01	300.0		1	2	5	I I			712	
655	As	1	Se	1	1.42	300.0		1	2	5	D I			712	
656	As	2	Se	3	1.77	300.0		1	1	3	I I			67	
657	As	2	Se	3	1.8	.0	−1.10e−03	2	2	5	U			368	
658	As	2	Se	3	1.81	.0		2	4	5	U			199	
659	As	2	Se	3	1.85	.0		2	2	5	U			199	
660	As	2	Se	3	2.	.0	−8.00e−04	2	2	3	U			368	
661	As	2	Se	3	1.63	297.0		2	2	5	U			199	
662	As	2	Se	3	1.5	300.0	−1.10e−03	2	2	5	U			368	
663	As	2	Se	3	1.7	300.0	−8.00e−04	2	2	3	U			368	
664	As	2	Se	3	1.7	300.0		2	8	2	U			417	
665	As	2	Se	3	1.73	300.0		2	2	2	U			203	
666	As	2	Se	3	1.1	300.0		2	8	5	U			380	
667	As	1	Br	3	2.6	300.0		1	2	4	U		ORANGE RED	25	
668	As	2	Te	3	.48	300.0	−3.00e−04	1	2	3	U			368	
669	As	1	Te	1	.74	293.0		1	8	5	U			490	
670	As	2	Te	3	.58	.0	−3.00e−04	2	2	3	U			368	
671	As	2	Te	3	1.1	.0	−1.60e−03	2	2	5	U			368	
672	As	2	Te	3	.62	300.0	−1.60e−03	2	2	5	U			368	
673	As	2	Te	3	.9	300.0		2	8	2	U			417	
674	As	2	Te	3	1.	300.0		2	2	4	U			85	
675	As	1	I	3	2.29	300.0	−8.20e−04	1	9	3	D D			631	
676	As	1	I	3	2.54	.0	−8.20e−04	2	2	3	D D			631	
677	Se		S		1.9	300.0		1	2	4	U			668	50 % SULFUR.
678	Se				1.71	300.0		1	2	3	D D			528	TRIGONAL, POLARIZED E ⊥ C.
679	Se				1.72	300.0		1	2	3	D I			528	TRIGONAL, POLARIZED E ∥ C.
680	Se				1.75	300.0		1	2	3	I I			244	HEXAGONAL, POLARIZED E ∥ C.
681	Se				1.81	.0		2	2	3	I I			528	TRIGONAL, POLARIZED E ∥ C.
682	Se				2.85	.0	−2.38e−03	2	3	3	U			369	HEXAGONAL.
683	Se				2.01	20.0		2	2	3	DAD			632	TRIGONAL.
684	Se				1.8	77.0		2	2	3	I I			528	TRIGONAL, POLARIZED E ∥ C.
685	Se				2.3	80.0		2	2	3	U			291	
686	Se				1.56	300.0		2	2	3	I I			528	TRIGONAL, POLARIZED E ∥ C.
687	Se				1.7	300.0		2	2	3	U			527	
688	Se				1.77	300.0		2	2	3	I I			244	HEXAGONAL, POLARIZED E ⊥ C.
689	Se				1.98	300.0		2	2	3	U			291	
690	Se				2.01	300.0		2	1	3	U			290	TRIGONAL, POLARIZED E ⊥ C.
691	Se				2.14	300.0	−2.38e−03	2	3	3	U			369	HEXAGONAL.
692	Se				2.2	300.0		2	1	3	D D			544	
693	Se				1.85	300.0		2	2	3	U			512	HEXAGONAL.
694	Se				2.4	300.0		2	2	3	U			512	HEXAGONAL.

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
695	Se	1	Te	1	.64	300.0		1	2	3	I I			605	
696	Se	3	Te	1	1.87	300.0		1	2	2	U			392	
697	Se		Te		.561	300.0		2	2	0	U			358	50 % TELLURIUM.
698	Se	1	Te	1	1.58	300.0		2	2	2	U			392	
699	Rb	1	F	1	10.4	80.0		1	2	3	U			198	ABSORPTION EDGE.
700	Rb	1	Cl	1	8.29	300.0		1	2	3	U			719	
701	Rb	1	Cl	1	8.5	10.0		2	2	3	D D			616	TRANSITION G8- -> G6+.
702	Rb	1	Cl	1	8.3	55.0		2	1	3	DAD			54	G EDGE.
703	Rb	1	Cl	1	8.1	80.0		2	2	3	D D			501	TRANSITION G15 -> G1.
704	Rb	1	Cl	1	8.2	80.0		2	2	3	U			198	
705	Rb	1	Br	1	7.2	80.0		1	2	3	DAD			227	TRANSITION G8- -> G6+.
706	Rb	1	Br	1	7.25	55.0		2	1	3	DAD			54	G EDGE.
707	Rb	1	Br	1	7.65	80.0		2	2	3	D D			501	TRANSITION G15 -> G1.
708	Rb	1	Br	1	7.7	80.0		2	2	3	U			198	
709	Rb	3	Sb	1	1.	300.0		1	2	2	D D			588	
710	Rb	3	Sb	1	.9	300.0		2	4	0	I I			321	
711	Rb	3	Sb	1	1.	300.0		2	2	2	U			586	
712	Rb	3	Sb	1	1.7	300.0		2	2	0	D I			321	VALUE VARIES: 1.6–1.8 EV.
713	Rb	2	Te	1	4.5	300.0		1	3	0	U			298	
714	Rb	1	I	1	5.83	300.0		1	2	3	D D			501	TRANSITION G15 -> G1.
715	Rb	1	I	1	6.26	10.0		2	2	3	D D			616	TRANSITION G8- ->G6+.
716	Rb	1	I	1	6.37	10.0		2	3	1	U			305	
717	Rb	1	I	1	6.25	55.0		2	1	3	DAD			54	G EDGE.
718	Rb	1	I	1	6.05	80.0		2	2	3	D D			501	TRANSITION G15 -> G1.
719	Rb	1	I	1	6.1	80.0		2	2	3	U			607	ABSORPTION EDGE.
720	Rb	1	I	1	6.1	80.0		2	2	3	U			198	ABSORPTION EDGE.
721	Rb	1	I	1	6.36	80.0		2	3	1	U			305	
722	Sr	1	O	1	5.77	70.0		1	2	2	U			546	
723	Sr	1	O	1	5.7	300.0		2	1	4	U			659	
724	Sr	1	O	1	1.16	873.0		2	4	0	U	EPT		473	ACTIVATION ENERGY.
725	Sr	1	S	1	4.76	113.0		1	2	2	U	EPT		709	
726	Sr	1	S	1	4.8	70.0		2	2	3	U	EPT		546	
727	Sr	1	Se	1	4.42	113.0		1	2	2	U	EP	WHITE	709	
728	Sr	1	Se	1	4.45	70.0		2	2	3	U	EP	WHITE	546	
729	Sr	1	Te	1	3.73	113.0		1	2	2	U			709	
730	Sr	1	Te	1	3.77	70.0		2	2	3	U			546	
731	Y	1	N	1	1.9	300.0		1	2	4	U			556	
732	Y	2	O	3	5.6	300.0		1	2	3	U		BLUE	469	ABSORPTION EDGE.
733	Y	2	O	3	1.46	873.0		2	4	0	U			473	ACTIVATION ENERGY.
734	Zr		C		.6	293.0		1	4	0	U	T		247	ACTIVATION ENERGY.
735	Zr	6	O	1	.18	300.0		1	4	4	U			240	
736	Zr	3	O	1	.2	300.0		1	4	4	U			240	
737	Zr	1	O	2	4.99	300.0		1	1	4	U			68	
738	Zr	1	O	2	0.65	873.0		2	4	6	U			473	ACTIVATION ENERGY.
739	Zr	1	O	2	0.56	523.0		2	4	4	U	EPT	COLORLESS	169	ACTIVATION ENERGY.
740	Zr	1	S	2	1.68	300.0	-4.20e-04	1	2	3	I I		VIOLET	261	
741	Zr	1	S	2	2.75	300.0		1	1	3	D I			261	
742	Zr	1	S	3	2.17	300.0		1	2	3	U		COPPER RED	265	
743	Zr	1	S	3	2.28	300.0		2	3	3	U		COPPER RED	265	
744	Zr	1	S	2	.85	300.0		2	4	4	U	P		542	
745	Zr	1	Se	2	2.	300.0		1	1	3	D I			261	
746	Zr	1	Se	3	1.25	300.0		1	2	3	U		DK GREY	265	
747	Nb	1	N	1		.0		2	0	0	U			371	SUPERCONDUCTOR.
748	Nb	1	O	2	0.25	300.0		1	4	0	U			331	ACTIVATION ENERGY, SEE ALSO REV. MOD. PHYS., 40, 714 (1968).
749	Nb	2	O	5	3.48	300.0		1	2	2	I I			188	
750	Nb	2	O	5	1.65	573.0		2	4	3	U	EPT		262	ACTIVATION ENERGY.
751	Nb	2	O	5	3.08	300.0		2	1	4	U			659	
752	Nb	2	S	3	.12	300.0		1	4	4	U			542	
753	Nb	1	Se	2	1.4	293.0		1	1	3	D D			26	
754	Mo	1	O	3	3.66	300.0		2	4	3	U			173	
755	Mo	1	O	3	3.23	0.0	-6.20e-04	1	2	3	U			173	POLARIZED E ⊥ C.
756	Mo	1	O	3	3.66	0.0	-9.30e-04	1	2	3	U			173	POLARIZED E ⊥ C.
757	Mo	1	O	3	2.8	300.0	-6.20e-04	1	2	3	E			173	POLARIZED E ⊥ C.
758	Mo	1	O	3	2.96	300.0	-9.30e-04	1	2	3	E			173	POLARIZED E ‖ C.
759	Mo	1	O	3	3.54	300.0		2	4	3	U			194	
760	Mo	1	O	3	3.7	300.0		2	2	2	E			171	
761	Mo	1	Si	2		.0		2						466	
762	Mo	1	S	2	1.89	290.0		1	2	3	U			212	
763	Mo	1	S	2	.25	300.0		1	2	3	I I			148	
764	Mo	1	S	2	1.935	70.0		2	2	3	E			211	
765	Mo	1	S	2	1.83	290.0		2	2	3	E			225	
766	Mo	1	S	2	0.874	250.0		2	4	3	U			212	ACTIVATION ENERGY.
767	Mo	1	S	2	1.	300.0		2	4	4	U			542	
768	Mo	1	Te	2	.83	302.0		1	2	3	I I			398	
769	Mo	1	Te	2	1.02	.0	-5.40e-04	2	2	3	I I			398	
770	Mo	1	Te	2	1.08	77.0	-1.50e-04	2	2	3	E			354	
771	Mo	1	Te	2	1.82	300.0		2			E			226	
772	Ru	1	P	2	1.	300.0		1	1	4	U			310	
773	Ru	1	S	2	1.8	300.0		1	1	4	U			311	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
774	Ru	1	As	2	.8	300.0		1	1	4	U			310	
775	Ru	1	Se	2	1.	300.0		1	1	4	U			311	
776	Ru	1	Sb	2	.3	300.0		1	4	4	U			310	
777	Ru	1	Te	2	.25	300.0		1	4	4	U			311	
778	Ru	1	Te	2	.25	300.0		2	4	4	U			717	
779	Rh	2	S	3	.8	300.0		1	4	6	U			312	
780	Rh	1	S	3	1.5	300.0		1	2	6	U			312	
781	Rh	1	Se	2	.6	.0		1	2	6	U			312	METALLIC AT HIGH TEMPERATURES.
782	Rh	1	Se	3	.7	300.0		1	2	6	U			312	
783	Pd	1	O	1	1.5	300.0		1	4	2	U			479	
784	Pd	1	O	1	.6	300.0		2	1	4	U			309	
785	Pd	1	P	2	.65	300.0		1	4	4	U			311	
786	Pd	1	S	1	.5	300.0		1	4	3	U			309	
787	Pd	1	S	2	.75	300.0		1	4	3	U			309	
788	Pd	1	As	2		.0		2						311	METALLIC.
789	Pd	1	Se	1	.2	300.0		1	4	3	U			309	
790	Pd	1	Se	2	.4	300.0		1	4	3	U			309	
791	Pd	1	In	1		.0		2						330	METALLIC.
792	Pd	1	Sb	2		.0		2						311	METALLIC.
793	Pd	1	Te	2	1.8	293.0		1						720	
794	Ag	1	N	3	3.9	300.0		1	3	4	U			686	
795	Ag	1	N	3	3.44	77.0		2	2	3	E			434	
796	Ag	2	O	1	1.2	300.0	2.00e−03	1	3	2	U			224	
797	Ag	2	O	1	1.5	300.0		2	4	2	U			224	
798	Ag	2	O	1	1.591	20.0		2	2	3	E			266	
799	Ag	2	O	1	0.64	500.0		2	4	0	U			608	ACTIVATION ENERGY.
800	Ag	2	F	1		.0		2	0	0	U			23	SUPERCONDUCTOR.
801	Ag	2	S	1	1.03	296.0		1	3	2	U			318	B−PHASE.
802	Ag	2	S	1	.87	300.0		1	2	1	D D			234	A−PHASE.
803	Ag	2	S	1	1.23	77.0		2	3	2	U			318	B−PHASE.
804	Ag	2	S	1	1.	300.0		2	1	3	D D			570	
805	Ag	1	Cl	1	3.25	300.0		1	2	3	I I			557	
806	Ag	1	Cl	1	5.13	300.0		1	2	3	D I			557	
807	Ag	1	Cl	1	3.22	.0		2	2	3	I I			108	
808	Ag	1	Cl	1	5.1	.0		2	9	0	D I			113	TRANSITION G15 -> G1.
809	Ag	1	Cl	1	3.246	4.2		2	2	3	I I	EPT		111	
810	Ag	1	Cl	1	3.25	4.2		2	2	3	I I			113	
811	Ag	1	Cl	1	3.252	4.2		2	2	3	I I			334	
812	Ag	1	Cl	1	3.22	77.0		2	2	3	I I			113	
813	Ag	1	Cl	1	3.226	77.0		2	2	3	I I	EPT		111	
814	Ag	1	Cl	1	3.08	300.0		2	2	3	I I			113	
815	Ag	2	Se	1	.13	80.0		1	2	4	D D			161	B2−PHASE.
816	Ag	2	Se	1	.07	.0		2	4	4	D D			161	B1−PHASE.
817	Ag	2	Se	1	.18	.0		2	4	4	D D			161	B2−PHASE.
818	Ag	2	Se	1	.05	.0		2	4	4	U			48	
819	Ag	2	Se	1	.18	.0		2	4	4	U			48	
820	Ag	1	Br	1	2.68	300.0		1	2	3	I I			557	
821	Ag	1	Br	1	4.29	300.0		1	2	3	D I			557	
822	Ag	1	Br	1	2.97	.0	−1.36e−03	2	2	3	I I			504	
823	Ag	1	Br	1	4.292	.0		2	2	3	E			108	
824	Ag	1	Br	1	2.683	4.2		2	2	3	U	P		111	
825	Ag	1	Br	1	2.69	4.2		2	2	3	I I			113	
826	Ag	1	Br	1	2.691	4.2		2	2	3	I I			334	
827	Ag	1	Br	1	2.676	77.0		2	2	3	U	P		111	
828	Ag	1	Br	1	2.68	77.0		2	2	3	I I			113	
829	Ag	1	Br	1	2.52	300.0		2	2	3	I I			113	
830	Ag	1	Br	1	2.6	300.0	−1.36e−03	2	2	3	I I			504	
831	Ag	2	Te	1	.064	300.0		1	2	2	D D			164	B−PHASE.
832	Ag	1	Te	1	.85	300.0		1	2	4	U			576	
833	Ag	2	Te	1	.064	.0		2	8	4	U			160	B−PHASE.
834	Ag	2	Te	1	.025	300.0		2	8	2	U			491	B−PHASE.
835	Ag	2	Te	1	.028	300.0		2	4	0	U			681	B−PHASE.
836	Ag	2	Te	1	0.13	300.0		2	4	2	U			12	ACTIVATION ENERGY.
837	Ag	2	Te	1	.28	300.0		2	8	0	U			645	A−PHASE.
838	Ag	2	Te	1	.85	300.0		2	1	3	U			576	
839	Ag	2	Te	1	.064	.0		2	4	3	U			160	B−PHASE.
840	Ag	2	Te	1	.67	300.0		2	2	3	U			29	B−PHASE.
841	Ag	2	Te	1	.2	600.0		2	8	6	U			645	A−PHASE.
842	Ag	1	I	1	2.919	80.0		2	2	1	E			134	
843	Ag	1	I	1	2.82	300.0		2	2	2	U	P		385	
844	Cd	1	O	1	1.2	300.0	−3.30e−04	1	2	3	I I			19	
845	Cd	1	O	1	2.3	300.0		1	2	3	D I			19	TRANSITION G15 -> G1.
846	Cd	1	O	1	2.35	295.0		2	1	3	U			453	
847	Cd	1	F	2	6.	300.0		1	8	3	U	PT	COLORLESS	21	
848	Cd	1	P	2	1.55	293.0	−4.20e−04	1			I I			574	TETRAGONAL, POLARIZED E ⊥ C.
849	Cd	1	P	2	1.65	293.0	−3.70e−04	1			I I			574	TETRAGONAL, POLARIZED E ∥ C.
850	Cd	1	P	2	1.92	293.0	−8.60e−04	1			D I			574	TETRAGONAL.
851	Cd	1	P	2	2.02	293.0	−1.12e−04	1	2	3	U	P	DK RED	698	
852	Cd	3	P	2	.52	300.0		1	4	3	U			700	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Entry No.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	Ref	Comment
853	Cd	1	P	4	1.	300.0		1	2	4	U			699	
854	Cd	3	P	2	.58	4.2		2	8	3	U	L		84	
855	Cd	3	P	2	.589	4.2		2	8	3	U	PL	GREY	83	
856	Cd	3	P	2	.586	77.0		2	8	3	U	PL	GREY	83	
857	Cd	1	P	2	2.15	77.0	−1.12e−04	2	2	3	U	P	DK RED	698	
858	Cd	3	P	2	.55	300.0		2	0	0	U			602	
859	Cd	1	P	2	1.93	300.0	−7.00e−04	2	3	3	U			365	
860	Cd	1	P	4	1.15	300.0		2	4	4	U			9	
861	Cd	1	S	1	2.41	300.0		1	3	3	DAD			58	POLARIZED E ⊥ C.
862	Cd	1	S	1	2.425	300.0		1	3	3	DAD			58	POLARIZED E ∥ C.
863	Cd	1	S	1	2.526	4.2		2	8	3	E	L		316	
864	Cd	1	S	1	2.582	4.2		2	1	3	D D			617	CUBIC.
865	Cd	1	S	1	2.386	250.0		2	8	3	E	L		316	
866	Cd	1	S	1	2.582	4.2	−4.90e−04	2	2	3	U			87	
867	Cd	1	S	1	2.573	77.0	−4.90e−04	2	2	3	U			88	
868	Cd	1	Cl	2	5.7	300.0		1	1	4	U			611	
869	Cd	1	Cl	2	5.8	.0		2	0	0	U			537	
870	Cd	1	As	2	1.	297.0		1	2	3	U			629	POLARIZED E ∥ C.
871	Cd	3	As	2	.13	300.0		1	2	3	U			629	
872	Cd	1	As	2	1.04	297.0		2	2	3	U			629	POLARIZED E ⊥ C.
873	Cd	3	As	2	.14	300.0		2	8	3	U			701	
874	Cd	1	As	2	.89	300.0		2	2	2	U			293	
875	Cd	3	As	2	.048	4.2		2	7	3	U			278	
876	Cd	3	As	2	0.425	300.0	−5.80e−04	2	4	3	U		GREY	638	
877	Cd	3	As	2	.53	300.0		2	3	3	U		GREY	638	
878	Cd	1	Se	1	1.714	293.0	−3.60e−04	1	3	3	E			495	POLARIZED E ⊥ C.
879	Cd	1	Se	1	1.816	4.2		2	3	3	E			495	POLARIZED E ⊥ C.
880	Cd	1	Se	1	1.83	4.2		2	3	3	E			495	POLARIZED E ∥ C.
881	Cd	1	Se	1	1.840	4.2		2	2	3	DAD			577	POLARIZED E ⊥ C.
882	Cd	1	Se	1	1.865	4.2		2	2	3	DAD			577	POLARIZED E ∥ C.
883	Cd	1	Se	1	1.815	77.0	−3.60e−04	2	3	3	E	L		495	POLARIZED E ⊥ C.
884	Cd	1	Se	1	1.821	77.0		2	3	3	E			495	POLARIZED E ∥ C.
885	Cd	1	Se	1	1.733	293.0		2	3	3	E			495	POLARIZED E ∥ C.
886	Cd	1	Br	2	4.47	300.0		1	1	4	U			611	
887	Cd	1	In	1	.6	300.0		1	9	0	U			606	
888	Cd	1	Sb	1	.45	300.0		1	2	3	I I			572	
889	Cd	4	Sb	3	1.25	300.0		1	2	3	U			572	
890	Cd	1	Sb	1	.535	.0	−3.56e−04	2	3	3	U			4	
891	Cd	1	Sb	1	.57	.0	−6.00e−04	2	4	3	I I			442	
892	Cd	1	Sb	1	.585	78.0	−5.40e−04	2	2	3	U			628	
893	Cd	1	Sb	1	.428	300.0	−3.56e−04	2	3	3	U			4	
894	Cd	1	Sb	1	.43	300.0		2	2	3	IAI			696	
895	Cd	1	Sb	1	.45	300.0	−6.00e−04	2	2	3	I I			442	
896	Cd	1	Sb	1	.465	300.0	−5.40e−04	2	2	3	U			628	
897	Cd	1	Sb	1	.7	300.0		2	2	3	D I			5	
898	Cd	1	Te	1	1.517	300.0		1	5	3	D D			409	TRANSITION G15 -> G1.
899	Cd	1	Te	1	1.595	6.0		2	5	3	D D			409	TRANSITION G15 -> G1.
900	Cd	1	Te	1	1.594	20.0		2	5	3	D D			409	TRANSITION G15 -> G1.
901	Cd	1	Te	1	1.58	300.0		2	4	3	DAD			302	
902	Cd	1	I	2	3.266	300.0		1	2	3	I I			183	
903	Cd	1	I	2	3.857	300.0		1	2	3	D I			183	
904	Cd	1	I	2	3.478	77.0		2	2	3	I I			183	
905	Cd	1	I	2	3.8	77.0		2	3	3	I I			682	
906	Cd	1	I	2	4.228	80.0		2	2	3	D I			183	
907	Cd	1	I	2	3.2	290.0	−1.50e−03	2	3	3	U			688	
908	Cd	1	I	2	3.19	300.0	−1.20e−03	2	2	3	I I	P	WHITE	261	
909	Cd	1	I	2	3.2	300.0		2	3	3	I I			682	
910	Cd	1	I	2	6.25	77.0		2	2	2	E			627	
911	Cd	1	I	2	3.26	300.0		2	1	4	U			611	
912	Cd	3	Bi	2	.2	300.0		1	9	0	U			602	PROBABLY METALLIC.
913	In	1	N	1	2.4	300.0		1	9	0	U		BLACK	482	
914	In	2	O	3	2.619	300.0		1	2	3	IFI	E	YELLOW	670	
915	In	2	O	3	3.75	300.0		1	2	3	D I	E	YELLOW	670	
916	In	2	O	3	2.8	300.0		2	1	3	I I			669	
917	In	2	O	3	3.55	300.0		2	2	2	D I			642	
918	In	1	P	1	1.351	298.0	−2.90e−04	1	2	3	D D			630	
919	In	1	P	1	1.413	77.0		2	2	3	U	L		205	
920	In	1	P	1	1.34	300.0		2	5	3	D D	L	DK GREY	132	
921	In	1	P	1	1.45	300.0		2	2	2	U	EP		395	
922	In	1	P	1	1.41	.0		2	0	0	U			552	
923	In	2	S	3	1.1	300.0		1	4	3	I I		RED	523	ACTIVATION ENERGY.
924	In	2	S	3	2.03	300.0	−7.00e−04	1	2	3	D I		RED	523	
925	In	1	S	1	1.86	300.0		1	4	3	U			539	
926	In	4	S	5	.9	300.0	−3.00e−04	1	3	3	U			413	
927	In	2	S	3	2.28	.0	−1.04e−03	2	2	3	U			230	
928	In	1	As	1	.356	298.0		1	6	3	D D	EP	DK GREY	8	
929	In	1	As	1	.41	.0		2	6	1	U			507	
930	In	1	As	1	.410	.0		2	6	3	D D	EP	DK GREY	8	
931	In	1	As	1	.409	20.0		2	6	3	D D	EP	DK GREY	8	
932	In	1	As	1	.412	20.0		2	8	3	U	L		70	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
933	In	1	As	1	.404	80.0		2	6	3	D D	EP	DK GREY	8	
934	In	1	As	1	.33	300.0		2	2	3	DAD	P		120	
935	In	1	Se	1	1.187	293.0	−4.20e−04	1	2	3	I I			24	
936	In	1	Se	1	1.293	293.0	−3.00e−04	1	2	3	D I			24	
937	In	2	Se	1	.65	300.0		1	2	3	DFD			73	
938	In	2	Se	1	.828	300.0	−5.50e−04	1	2	3	DAI			73	
939	In	2	Se	3	1.2	300.0		1	2	4	U		BLACK	107	
940	In	1	Se	1	1.285	90.0	−4.20e−04	2	2	3	I I			24	
941	In	1	Se	1	1.357	90.0	−3.00e−04	2	2	3	D I			24	
942	In	1	Se	1	1.12	300.0		2	2	3	I I			711	
943	In	1	Se	1	1.19	300.0		2	1	3	U			15	
944	In	1	Se	1	2.42	300.0		2	2	3	D I			711	
945	In	1	Se	1	1.05	300.0		2	2	4	U			107	
946	In	1	Sb	1	.17	300.0		1	2	3	D D			343	
947	In	1	Sb	1	.235	4.2		2	6	3	D D			715	
948	In	1	Sb	1	.236	4.2	−2.90e−04	2	2	3	U	L		624	
949	In	1	Sb	1	.175	300.0	−2.90e−04	2	2	3	U	L		624	
950	In	1	Sb	1	.234	4.2		2	8	3	DAD			72	
951	In	1	Sb	1	.236	4.2		2	8	3	U	L		498	
952	In	2	Te	3	.84	300.0	−2.00e−04	1	1	3	IAI			458	
953	In	2	Te	3	1.12	300.0	−2.00e−04	1	1	3	DAI			458	
954	In	2	Te	3	1.15	.0		2	4	3	DAI			375	
955	In	2	Te	3	1.11	300.0		2	2	3	DAI			375	
956	In	2	Te	3	.85	300.0		2	2	3	I I			281	
957	In	2	Te	3	1.026	300.0	−3.50e−04	2	4	4	U			707	
958	In	2	Te	3	1.09	300.0		2	2	4	U			231	VALUE VARIES: 1.04–1.14 EV.
959	In	2	Te	3	1.	300.0		2	0	0	U		BLACK	263	
960	Sn	1	O	2	2.7	300.0		1	2	2	I I		BLACK	585	POLARIZED E ⊥ C.
961	Sn	1	O	2	4.3	300.0		1	2	2	D I		BLACK	585	
962	Sn	1	O	2	3.631	.0		2	2	1	U			603	POLARIZED E ⊥ C.
963	Sn	1	O	2	3.947	.0		2	2	1	U			603	POLARIZED E ∥ C.
964	Sn	1	O	2	3.597	1.8		2	2	3	D D			461	
965	Sn	1	O	2	2.6	77.0		2			I I			351	
966	Sn	1	O	2	2.45	300.0		2	2	3	I I			521	
967	Sn	1	O	2	2.55	300.0		2	2	3	I I			521	POLARIZED E ⊥ C.
968	Sn	1	O	2	3.54	300.0	6.00e 04	2	2	3	U			367	
969	Sn	1	O	2	3.57	300.0		2	1	3	D I			604	POLARIZED E ⊥ C.
970	Sn	1	O	2	3.69	300.0		2	2	3	U			603	POLARIZED E ⊥ C.
971	Sn	1	O	2	3.7	300.0		2	2	3	D I			521	POLARIZED E ⊥ C.
972	Sn	1	O	2	3.71	300.0	−2.00e−04	2	2	3				30	
973	Sn	1	O	2	3.93	300.0		2	1	3	D I			604	POLARIZED ∥ C.
974	Sn	1	O	2	4.1	300.0		2	2	3	D I			521	POLARIZED ∥ C.
975	Sn	1	O	2	3.9	300.0		2	1	4	U	EP		63	
976	Sn	1	S	2	2.07	300.0		1	2	3	I I		YELLOW	182	
977	Sn	1	S	2	2.88	300.0		1	2	3	D I		YELLOW	182	
978	Sn	1	S	1	1.08	300.0		1	2	2	U			441	
979	Sn	1	S	2	2.21	300.0	−8.60e−04	2	2	3	I I		YELLOW	261	
980	Sn	1	S	2	2.6	300.0		2	1	4	U			63	
981	Sn	1	S	1	1.3	300.0		2	1	4	U			63	
982	Sn	1	Cl	2	3.9	300.0		1	1	4	U			63	
983	Sn	1	Se	2	1.97	77.0		1	1	3	DAI			210	
984	Sn	1	Se	2	1.03	290.0		1	2	3	IFI			210	
985	Sn	1	Se	1	.91	300.0		1	2	3	I I		GREY	449	
986	Sn	1	Se	1	1.2	300.0		1	2	3	D I		GREY	449	
987	Sn	1	Se	2	.98	77.0		2	2	3	IFI			210	
988	Sn	1	Se	1	.9	300.0		2	2	2	U			441	
989	Sn	1	Se	2	.97	300.0		2	2	3	I I			182	
990	Sn	1	Se	2	1.	300.0		2	2	3	IFI			396	
991	Sn	1	Se	2	1.	300.0		2	4	3	U			122	
992	Sn	1	Se	2	1.3	300.0		2	2	3	IFI			210	
993	Sn	1	Se	2	1.62	300.0		2	2	3	D I			182	
994	Sn	1	Br	2	3.4	300.0		1	1	4	U			63	
995	Sn	1	Br	2	3.5	300.0		2	2	3	U			601	
996	Sn				.075	300.0		1	2	3	D D		GREY	403	
997	Sn				.092	.0	−5.00e−04	2	7	3	U		GREY	213	
998	Sn				.08	300.0		2	3	3	U		GREY	270	
999	Sn	1	Sb	1		.0		2						363	K(LO) = 147.00, K(HI) = .00.
1000	Sn	1	Te	1	.18	300.0		1	2	3	D D		GREY	180	TRANSITION L6+−>L6−.
1001	Sn	1	Te	1	.33	.0		2	8	2	D D			121	
1002	Sn	1	Te	1	.36	.0	−3.60e−04	2	2	2	D D			121	
1003	Sn	1	Te	1	.3	300.0	−3.00e−04	2	4	3	D D			535	
1004	Sn	1	Te	1	.26	300.0		2	2	2	U			441	
1005	Sn	1	I	4	2.38	300.0		1	2	3	U			601	
1006	Sn	1	I	2	2.4	300.0		1	1	4	U			63	
1007	Sb	2	O	3	3.31	300.0		1	1	4	U			611	
1008	Sb	2	O	3	3.2	300.0		2	1	4	U			659	
1009	Sb	2	O	3	4.2	300.0		2	3	2	U			417	
1010	Sb	1	Si	1	1.9	300.0		1	4	1	U			562	
1011	Sb	1	Si	1	1.9	.0	−1.55e−03	2	3	4	U			471	
1012	Sb	2	S	3	1.7	300.0		1	2	3	U			38	POLARIZED E ⊥ C.

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
1013	Sb	2	S	3	1.72	293.2		2	2	3	U			567	
1014	Sb	2	S	3	1.63	298.0	−6.70e−04	2	2	3	U			651	
1015	Sb	2	S	3	1.67	300.0		2	2	3	U			37	POLARIZED E ⊥ C.
1016	Sb	2	S	3	1.69	300.0		2	2	3	U			37	POLARIZED E ∥ C.
1017	Sb	2	S	3	1.7	300.0		2	2	3	U			85	
1018	Sb	2	S	3	1.71	300.0		2	2	3	U			38	POLARIZED E ∥ C.
1019	Sb	2	S	3	1.7	300.0		2	8	5	U			416	
1020	Sb	2	S	3	1.92	300.0		2	1	4	U			611	
1021	Sb		As		.009	273.0		1	4	3	U			478	39.5 % ARSENIC, ACTIVATION ENERGY.
1022	Sb		As		.125	273.0		2	4	3	U			478	29.0 % ARSENIC, ACTIVATION ENERGY.
1023	Sb	2	Se	3	1.2	300.0	−7.00e−04	1	2	3	U			85	
1024	Sb	2	Se	3	1.4	.0	−7.00e−04	2	4	3	U			85	
1025	Sb	2	Se	3	1.1	293.0		2	2	3	U			575	
1026	Sb	2	Se	3	1.15	300.0		2	2	2	U			202	
1027	Sb				.1	300.0		1	1	3	U		GRAY	571	SEE ALSO PHYS. REV., 133, A1685 (1964).
1028	Sb				.101	4.0		2	1	3	U			185	
1029	Sb	2	Te	3	.3	300.0		1	2	3	U			85	
1030	Sb	2	Te	3	.3	300.0		2	1	3	U			575	SEE ALSO J. PHYS. CHEM. SOLIDS, 23, 1219 (1962).
1031	Sb	2	Te	3	.3	300.0		2	0	0	U			602	
1032	Sb	1	I	3	2.22	300.0		1	9	3	DAD		ORANGE	631	
1033	Sb	1	I	3	2.12	295.0		2	2	3	I I			220	
1034	Sb	1	I	3	2.49	.0	−9.00e−04	2	2	3	DAD		ORANGE	631	
1035	Te	1	O	2	3.	300.0		1	3	2	U			417	VALUE GREATER THAN 3.0 EV.
1036	Te	1	O	2		.0		2	0	3	U			34	K(LO) = 24.90, K(HI) = .00.
1037	Te				.332	300.0		1	2	3	DAD			268	
1038	Te				.35	.0	−3.46e−04	2	4	0	U			273	
1039	Te				.334	4.0		2	6	3	DAD	P		18	POLARIZED E ⊥ C.
1040	Te				.335	4.2		2	2	3	DAD			268	
1041	Te				.334	10.0		2	6	3	DAD			267	
1042	Te				.337	10.0	−6.70e−05	2	2	3	I I			633	POLARIZED E ∥ C.
1043	Te				.334	20.0		2	8	3	U	L		71	
1044	Te				.336	77.0	−6.30e−05	2	2	3	E			633	POLARIZED E ⊥ C.
1045	Te				.343	77.0		2	2	3	DAD			268	
1046	Te				.32	295.0		2	2	3	D D			50	POLARIZED E ⊥ C.
1047	Te				.32	300.0		2	2	3	U			355	
1048	Te				.33	300.0		2	4	4	U			89	
1049	Te	1	I	1	1.1	300.0		1	4	0	U		GREY	7	
1050	I				1.3	300.0		1	2	3	U			527	
1051	I				1.68	80.0		2	2	3	U			100	
1052	I				1.6	100.0		2	4	3	U			323	
1053	I				1.5	290.0		2	2	3	U			100	
1054	Cs	1	F	1	10.	80.0		1	2	2	U			198	ABSORPTION SHOULDER.
1055	Cs	2	S	1		.0		2				P		718	K(LO) = 19.00, K(HI) = .00.
1056	Cs	1	Cl	1	8.1	80.0		1	2	2	D D			503	QUESTIONABLE VALUE.
1057	Cs	1	Cl	1	7.8	80.0		2	2	2	E			503	
1058	Cs	1	Cl	1	7.4	300.0		2	9	6	U			379	K(LO) = 7.20, K(HI) = 2.60.
1059	Cs	3	As	1	.6	300.0		1	0	0	U			554	
1060	Cs	1	Br	1	7.18	80.0		1	9	2	D D			503	TRANSITION G15 -> G1.
1061	Cs	1	Br	1	6.9	300.0		2	9	6	U	T		379	K(LO) = 6.51, K(HI) = 2.78, SEE ALSO J. PHYS. (PARIS), 30, 723 (1969).
1062	Cs	1	Br	1	6.8	80.0		2	2	2	E			503	SEE ALSO PHYS. LETT., 27A, 112 (1968).
1063	Cs	3	Sb	1	1.6	300.0		1	2	2	I I	EPT		170	
1064	Cs	3	Sb	1	1.6	300.0		2	8	2	U	PT		588	
1065	Cs	3	Sb	1	1.6	300.0		2	8	2	D I			321	
1066	Cs	3	Sb	1	1.6	300.0		2	8	2	U	EP		586	
1067	Cs	3	Sb	1	2.25	300.0		2	2	2	E	EPT		170	
1068	Cs	2	Te	1	3.5	300.0		1	0	0	U	P		298	
1069	Cs	1	I	1	6.37	10.0		1	2	2	D D			616	TRANSITION G8- -> G6+.
1070	Cs	1	I	1	6.3	80.0		2	2	3	U			198	ABSORPTION SHOULDER.
1071	Cs	1	I	1	6.4	80.0		2	8	2	U			607	PHOTOELECTRIC EMISSION.
1072	Cs	1	I	1	6.2	300.0		2	9	3	U			379	
1073	Cs	1	Bi	2	.55	300.0		1	2	0	U			145	SEE ALSO ANN. PHYS. (LEIPZIG), 19, 344 (1957).
1074	Cs	3	Bi	1	.55	300.0		1	2	0	U			145	
1075	Cs	3	Bi	1	.7	300.0		2	2	2	U			579	VALUE SMALLER THAN 0.7 EV.
1076	Ba	1	O	1	5.13	300.0	−9.00e−04	1	9	2	U			694	
1077	Ba	1	O	1	3.8	300.0		2	2	3	U	EPT	COLORLESS	635	ABSORPTION EDGE.
1078	Ba	1	O	1	4.8	300.0		2	2	6	U	EPT		391	
1079	Ba	1	F	2	9.06	300.0		1	2	3	E			313	TRANSITION TO LOWEST EXCITON LEVEL.
1080	Ba	1	F	2		.0		2						97	K(LO) = 6.94, K(HI) = 2.15.
1081	Ba	1	S	1	3.88	113.0		1	2	2	U			546	
1082	Ba	1	S	1	3.9	77.0		2	2	2	U	EPT		546	K(LO) = 19.27, K(HI) = .00.
1083	Ba	1	Se	1	3.6	77.0		1	2	2	U			546	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
1084	Ba	1	Se	1	3.58	113.0		2	2	2	U			709	
1085	Ba	1	Te	1	3.4	300.0		1	9	2	U			426	
1086	Ba		I			.0		2				PT		641	
1087	La	1	B	6	.08	300.0		1	1	4	U	P		626	
1088	La	1	B	6		.0		2	1	4	U			350	METALLIC.
1089	La	1	B	6	4.9	300.0		2	1	3	U			362	METALLIC.
1090	La	1	B	6	4.1	300.0		2	2	2	U			555	
1091	La	2	O	3	1.05	873.0		1	4	6	U	P	WHITE	473	ACTIVATION ENERGY.
1092	La	2	O	3	2.86	530.0		2						94	
1093	La	1	F	3	6.6	300.0		1	2	3	U			680	ABSORPTION SHOULDER, APPROXIMATE VALUE.
1094	La	1	Al	3		.0		2	0	3	U			672	K(LO) = 24.20, K(HI) = .00.
1095	La	2	S	3	1.32	300.0		1	4	4	U		RED-YELLOW	423	
1096	La	1	S	1		.0		2						706	METALLIC.
1097	La	1	Cl	3		.0		2				PT		75	K(LO) = 9.66, K(HI) = 3.71.
1098	La	2	Se	3	1.97	293.0		1	1	3	D D			691	
1099	La	2	Se	3	1.7	300.0		2	4	4	U			394	
1100	La	1	Se	1		.0		2						706	METALLIC.
1101	La	1	Sb	1	.8	300.0		1	2	2	D D			249	
1102	La	2	Te	3	.1	300.0		1	4	3	U			516	
1103	La	3	Te	4	.43	300.0		1	4	3	U			516	
1104	La	1	Te	1		.0		2						706	METALLIC.
1105	Ce	1	N	1	.7	300.0		1	9	0	U		BRONZE	556	
1106	Ce	1	O	2	2.68	513.0		1	4	4	U			94	ACTIVATION ENERGY.
1107	Ce	1	O	2	2.	.0		2	4	3	U			653	ACTIVATION ENERGY.
1108	Ce	1	O	2	5.5	300.0		2	2	1	U			285	ABSORPTION EDGE, AS INTERPRETED IN SOV. PHYS.-SOLID STATE, 9, 2659 (1968).
1109	Ce	1	O	2	1.1	873.0		2	4	4	U			473	ACTIVATION ENERGY.
1110	Ce	1	F	3	4.85	300.0		1	2	0	U			77	
1111	Ce	2	S	3	1.12	300.0		1						541	
1112	Ce	1	S	1		.0		2						706	METALLIC.
1113	Ce	2	Se	3	1.75	293.0		1	1	3	D D			691	
1114	Ce	2	Se	3	1.62	300.0		2	4	4	U			201	
1115	Ce	2	Se	3	2.	300.0		2	4	4	U			394	
1116	Ce	1	Se	1		.0		2						706	METALLIC.
1117	Ce	2	Te	3	1.4	293.0		1	4	4	U			684	VALUE VARIES: 1.2–1.6 EV.
1118	Ce	1	Te	1		.0		2						706	METALLIC.
1119	Pr	1	B	6	4.9	300.0		1	1	3	U	P		362	K(LO) = .00, K(HI) = 14.90.
1120	Pr	1	O	2	0.66	323.0		1	4	4	U			137	ACTIVATION ENERGY.
1121	Pr	2	O	3	0.84	673.0		1	4	4	U			137	ACTIVATION ENERGY.
1122	Pr	1	O	2	.88	510.0		2						94	ACTIVATION ENERGY.
1123	Pr		O		0.55	873.0		2	4	0	U			473	ACTIVATION ENERGY.
1124	Pr	1	F	3	5.9	300.0		1	2	2	U			77	VALUE VARIES: 5.9–6.4 EV.
1125	Pr	1	F	3	5.3	300.0		2	2	2	U			76	
1126	Pr	1	S	1		.0		2						706	METALLIC.
1127	Pr	1	As	1	1.	300.0		1	2	2	DAD			294	
1128	Pr	2	Se	3	1.8	293.0		1	1	3	U			691	
1129	Pr	2	Se	3	1.9	300.0		2	4	3	U			394	
1130	Pr	1	Se	1		.0		2						706	METALLIC
1131	Pr	1	Sb	1	.66	300.0		1	2	2	DAD			294	
1132	Pr	1	Te	2	1.02	300.0		1	2	3	I I			447	
1133	Pr	1	Te	2	1.288	300.0		1	2	3	D I			447	
1134	Pr	2	Te	3	1.3	293.0		1	2	4	U			684	VALUE VARIES: 1.3–1.7 EV.
1135	Pr	1	Te	1		.0		2						706	METALLIC.
1136	Nd	1	B	6	4.9	300.0		1	1	3	U	P		362	K(LO) = .00, K(HI) = 11.60, ENERGY GAP PROBABLY TRANSITION TO HIGHER BANDS.
1137	Nd	1	B	6	3.4	300.0		2	2	2	U			555	
1138	Nd	1	B	6	4.	300.0		2	2	0	U			556	
1139	Nd	2	O	3	0.97	873.0		1	4	4	U			473	ACTIVATION ENERGY.
1140	Nd	2	O	3		.0		2	0	3	U			721	K(LO) = 9.80, K(HI) = .00.
1141	Nd	1	F	3	6.15	300.0		1	2	2	U			77	VALUE VARIES: 5.9–6.4 EV.
1142	Nd	2	S	3	3.	300.0		1	4	3	U			287	
1143	Nd	1	S	1		.0		2						706	METALLIC.
1144	Nd	1	As	1	1.04	300.0		1	2	2	DAD			294	
1145	Nd	2	Se	3	1.7	300.0		1	1	3	D D			691	
1146	Nd	1	Se	1		.0		2						706	METALLIC.
1147	Nd	2	Te	5	.29	300.0		1	4	6	U			6	
1148	Nd	1	Te	2	.3	300.0		1	4	6	U			6	
1149	Nd	4	Te	7	.38	300.0		1	4	6	U			6	
1150	Nd	2	Te	3	1.12	300.0		1	4	6	U			6	
1151	Nd	1	Te	2	.48	300.0		2						22	
1152	Sm	1	B	6	4.9	300.0		1	1	3	U	P		362	K(LO) = .00, K(HI) = 9.38, ENERGY GAP PROBABLY TRANSITION TO HIGHER BANDS.
1153	Sm	2	O	3	1.17	300.0		1	4	4	U			473	ACTIVATION ENERGY.
1154	Sm	2	O	3	2.27	510.0		2						94	
1155	Sm	1	P	1	1.09	300.0		1	2	2	DAD			294	
1156	Sm	1	S	1	.22	300.0		1	4	0	U			248	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
1157	Sm	2	S	3	3.	300.0		1	1	4	U			691	
1158	Sm	1	S	1	.2	300.0		2	2	3	U			332	
1159	Sm	2	S	3	3.	300.0		2	4	3	U			394	
1160	Sm	1	As	1	1.03	300.0		1	2	2	DAD			294	
1161	Sm	1	Se	1	.46	300.0		1	2	3	U			332	
1162	Sm	2	Se	3	2.3	300.0		1	1	4	U			691	
1163	Sm	2	Se	3	2.3	300.0		2	4	3	U			394	
1164	Sm	1	Sb	1	.59	300.0		1	2	2	DAD			294	
1165	Sm	1	Te	1	.62	300.0		1	2	3	U			333	
1166	Eu	1	N	1	1.25	400.0		1	4	4	U			106	
1167	Eu	1	N	1	1.47	300.0		2	9	6	U			556	
1168	Eu	1	O	1	1.122	300.0	−1.40e−04	1	2	3	U			662	
1169	Eu	3	O	4	.6	300.0		1	4	4	U			540	ACTIVATION ENERGY.
1170	Eu	2	O	3	1.7	300.0		1	4	4	U			540	ACTIVATION ENERGY.
1171	Eu	1	O	1	1.115	300.0		2	1	3	U			660	
1172	Eu	1	O	1	1.1	300.0		2	4	4	U	P		540	ACTIVATION ENERGY.
1173	Eu	1	O	1	4.3	300.0		2	3	2	U			196	
1174	Eu	2	O	3	1.84	513.0		2	4	4	U			94	
1175	Eu	3	P	2	1.2	300.0		1	2	2	U			307	
1176	Eu	1	S	1	1.645	300.0	−1.00e−04	1	2	3	U			660	
1177	Eu	3	S	4	.163	300.0		1	4	6	U			101	ACTIVATION ENERGY.
1178	Eu	1	S	1	1.645	300.0		2	2	2	U			125	
1179	Eu	1	S	1	1.65	300.0		2	1	3	U	P		661	
1180	Eu	1	S	1	1.69	300.0		2	2	3	U			662	
1181	Eu	1	S	1	3.1	300.0		2	2	2	D I			196	
1182	Eu	3	As	2	.6	300.0		1	4	3	U			307	
1183	Eu	1	Se	1	1.78	300.0	−1.00e−04	1	1	3	U			660	
1184	Eu	1	Se	1	1.78	300.0		2	2	2	U	CP		125	
1185	Eu	1	Se	1	1.78	300.0		2	1	3	U			661	
1186	Eu	1	Se	1	1.8	300.0		2	3	3	U			663	
1187	Eu	1	Se	1	1.87	300.0		2	2	3	U			662	
1188	Eu	1	Se	1	3.1	300.0		2	2	2	D I			196	
1189	Eu	1	Te	1	1.959	300.0		1	2	3	U			662	
1190	Eu	1	Te	1	2.	300.0	−1.00e−04	2	1	3	U			660	
1191	Eu	1	Te	1	2.	300.0		2	2	2	U			125	
1192	Gd	1	B	6	3.6	300.0		1	2	2	U			555	
1193	Gd	1	N	1	1.54	300.0		1	2	6	U			556	
1194	Gd	2	O	3	1.36	873.0		1	4	6	U	EP		473	ACTIVATION ENERGY.
1195	Gd	2	O	3	2.9	933.0		2	4	4	U			94	
1196	Gd	1	P	1		.0		2						683	METALLIC.
1197	Gd	1	S	1		.0		2	3	2	U			196	
1198	Gd	1	As	1	.63	300.0		1	2	2	D D			294	
1199	Gd	1	Te	1	1.3	300.0		1	0	0	U			254	
1200	Tb	1	O	2	0.5	300.0		1	4	4	U			137	ACTIVATION ENERGY.
1201	Tb	2	O	3	0.95	650.0		1	4	4	U			137	ACTIVATION ENERGY.
1202	Tb	4	O	7	0.4	873.0		1	4	0	U			473	ACTIVATION ENERGY.
1203	Tb	2	O	3	.86	510.0		2						94	
1204	Tb	1	F	3		.0		2				P		381	
1205	Tb	1	P	1		.0		2						683	METALLIC.
1206	Dy	1	B	6	3.3	300.0		1	2	2	U			555	
1207	Dy	1	N	1	2.6	300.0		1	2	2	D D			553	
1208	Dy	1	N	1	2.1	300.0		2	2	0	U			556	
1209	Dy	2	O	3	3.08	593.0		1	4	4	U			94	K(LO) = 11.10, K(HI) = 3.69.
1210	Dy	2	O	3	1.39	0.0		2	4	4	U			473	ACTIVATION ENERGY.
1211	Dy	1	P	1		.0		2						683	METALLIC
1212	Dy	2	S	3	2.91	300.0		1	2	3	U			288	ABSORPTION EDGE.
1213	Dy	2	S	3	3.	300.0		2	4	3	U			287	
1214	Dy	1	As	1	1.	300.0		1	2	2	DAD			294	
1215	Ho	1	N	1	1.88	300.0		1	2	2	U			553	VALUE VARIES: 1.7–1.88 EV.
1216	Ho	1	N	1	1.9	300.0		2	2	2	U			555	
1217	Ho	2	O	3	2.84	573.0		1	4	4	U			94	K(LO) = 3.62, K(HI) = 14.60.
1218	Er	1	B	6	3.5	300.0		1	2	2	U			555	
1219	Er	1	N	1	2.4	300.0		1	2	2	D D			553	
1220	Er	1	N	1	3.	300.0		2	2	0	U			556	
1221	Er	2	O	3	3.26	653.0		1	4	4	U			94	
1222	Er	2	O	3	1.4	0.0		2	4	4	U			473	ACTIVATION ENERGY.
1223	Er	1	Se	2	1.07	300.0		1	4	4	U			275	
1224	Er	2	Se	3	1.66	300.0		1	4	4	U			275	
1225	Er	3	Te	4	.9	300.0		1	4	4	U			276	
1226	Er	1	Te	1	.9	300.0		1	4	4	U			276	
1227	Er	2	Te	3	.9	300.0		1	4	4	U			276	
1228	Tm	1	As	1	1.18	300.0		1	2	2	I I			294	
1229	Yb	2	O	3	2.99	573.0		1	4	4	U			94	K(LO) = 6.60, K(HI) = 3.47.
1230	Yb	2	O	3	1.53	873.0		2	4	0	U			473	ACTIVATION ENERGY.
1231	Yb		S		.33	300.0		1	4	4	U			179	
1232	Yb		S		.176	500.0		2	4	4	U			158	
1233	Yb	1	As	1	1.02	300.0		1	2	2	DAD			294	
1234	Yb	1	Sb	1	1.	300.0		1	2	2	DAD			294	
1235	Lu	2	O	3	3.94	733.0		1	4	4	U			94	K(LO) = 16.20, K(HI) = 3.54.
1236	Hf	1	O	2	5.55	300.0		1	1	4	U			68	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Entry No.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	Ref	Comment
1237	Hf	1	S	2	1.96	300.0	−4.30e−04	1	2	3	I I		DK RED	261	
1238	Hf	1	S	3	2.8	300.0	−5.50e−04	1	2	3	U		OCHER	265	
1239	Hf	1	S	2	2.9	300.0		1	1	3	D I			261	IDENTIFIED AS BAND GAP IN J. PHYS. D, 2, 1507 (1969).
1240	Hf	1	S	3	2.85	300.0		2	3	3	U		OCHER	265	
1241	Hf	1	Se	2	1.13	300.0	−6.80e−04	1	2	3	I I		DK RED	261	
1242	Hf	1	Se	2	2.2	300.0		1	1	3	D I			261	IDENTIFIED AS BAND GAP IN J. PHYS. D, 2, 1507 (1969).
1243	Ta		N		2.3	300.0		1	2	2	D D			151	VALUE VARIES: 1.95–2.60 EV.
1244	Ta	2	O	5	4.6	300.0		1	3	2	U			28	ABSORPTION EDGE.
1245	Ta	1	S	2	.1	300.0		1	4	0	U			542	
1246	W	1	O	3	2.8	300.0	9.00e−04	1	2	3	U			327	POLARIZED ∥ A.
1247	W	1	O	3	2.7	273.0		2	2	3	U			301	
1248	W	1	O	3	2.9	300.0	6.50e−04	2	2	3	U			327	POLARIZED ∥ C.
1249	W	1	Si	2		.0		2						466	METALLIC.
1250	W	1	S	2	1.1	300.0		1	8	0	U			390	
1251	W	1	S	2	0.45	400.0		2	4	3	U			272	ACTIVATION ENERGY.
1252	W	1	Se	2	1.35	295.0	−4.60e−04	1	2	3	U			640	
1253	W	1	Se	2	1.49	.0	−4.60e−04	2	2	3	U			640	
1254	W	1	Se	2	1.45	77.0	−4.60e−04	2	2	3	U			640	
1255	W	1	Se	2	1.35	295.0		2	0	0	U			250	
1256	W	1	Se	2	1.57	300.0		2	2	3	U			226	ABSORPTION EDGE.
1257	W	1	Te	2	.05	100.0		1	4	3	U			340	
1258	W	1	Te	2	.075	100.0		2	4	3	U			340	
1259	Re	1	O	3		.0		1	1	3				216	METALLIC.
1260	Re	1	O	3	2.3	300.0		1	1	3	U		RED	216	METALLIC, VALUE IS PLASMA EDGE.
1261	Re	1	Si	2	.12	300.0		1	4	4	U			467	
1262	Re	1	S	2	1.1	300.0		1	3	4	U			390	
1263	Re	1	Se	2	.99	250.0		1	4	4	U			723	
1264	Os	1	P	2	1.2	300.0		1	1	4	U			310	
1265	Os	1	S	2	2.	300.0		1	1	4	U			311	
1266	Os	1	As	2	.9	300.0		1	1	4	U			310	
1267	Os	1	Sb	2	.2	300.0		1	4	4	U			337	VALUE GREATER THAN 0.2 EV.
1268	Os	1	Te	2	.3	300.0		1	4	4	U			337	VALUE CREATER THAN 0.3 EV.
1269	Ir	1	S	2	.9	300.0		1	2	0	U			312	APPROXIMATE VALUE.
1270	Ir	1	Se	2	1.	300.0		1	2	0	U			312	APPROXIMATE VALUE.
1271	Ir	1	Te	2		.0		2						312	METALLIC.
1272	Pt	1	O	2	.2	300.0		1	4	4	U			559	ACTIVATION ENERGY.
1273	Pt	1	P	2	.8	300.0		1	4	4	U			337	VALUE GREATER THAN 0.8 EV.
1274	Pt	1	P	2	.6	300.0		2	4	0	U			311	VALUE GREATER THAN 0.6 EV.
1275	Pt	1	S	1	.8	300.0		1	2	3	U			309	
1276	Pt	1	S	2	.75	300.0		1						271	APPROXIMATE VALUE.
1277	Pt	1	As	2	.55	300.0		1	4	3	U			219	
1278	Pt	1	As	2	.5	300.0		2	4	0	U			311	
1279	Pt	1	Se	2	.1	300.0		1						271	APPROXIMATE VALUE.
1280	Pt	1	Sb	2	.11	77.0		1	2	3	I I			476	
1281	Pt	1	Sb	2	.11	.0		2	4	3	U			525	
1282	Pt	1	Sb	2	.112	.0		2	4	3	U			206	
1283	Pt	1	Sb	2	.11	10.0		2	2	3	DFI			525	
1284	Pt	1	Sb	2	.07	.0		2	4	3	U			165	
1285	Pt	1	Te	2		.0		2						271	SEMIMETALLIC.
1286	Pt	1	Bi	2		300.0		2	4	3	U			337	A-PHASE IS SEMIMETALLIC.
1287	Au		Cl			.0		2				P		551	
1288	Au	1	Ga	2		.0		2	1	3	U			654	
1289	Au	1	In	2		.0		2	1	3	U			654	
1290	Hg	1	O	1	2.48	300.0		1	1	4	U			611	
1291	Hg	1	O	1	2.214	300.0		2	1	4	U			659	
1292	Hg	1	O	1	1.02	373.0		2	4	0	U		YELLOW	440	
1293	Hg	1	O	1	1.18	373.0		2	4	0	U		RED	440	
1294	Hg	1	O	1		.0		2	9	0	U			386	K(LO)=15.00, K(HI)=.00.
1295	Hg	1	S	1	.54	300.0	7.70e−04	1	2	1	U			565	B-PHASE, CUBIC.
1296	Hg	1	S	1	1.998	310.0	−6.80e−04	1	2	3	I I			80	A-PHASE, HEXAGONAL.
1297	Hg	1	S	1	2.183	20.4	−6.80e−04	2	2	3	I I			80	A-PHASE, HEXAGONAL.
1298	Hg	1	S	1	2.160	77.0		2	2	3	I I			80	A-PHASE, HEXAGONAL.
1299	Hg	1	S	1	2.095	283.0		2	9	3	I I	C	RED	472	A-PHASE, HEXAGONAL.
1300	Hg	1	S	1	.7	300.0		2	1	3	U			378	B-PHASE, CUBIC.
1301	Hg	1	S	1	−.15	300.0		2	1	4			OPAQUE	693	B-PHASE, CUBIC.
1302	Hg	1	S	1	2.21	300.0		2	1	4	U			611	
1303	Hg	2	Cl	2	3.5	300.0	−1.70e−03	1	1	3	U			204	
1304	Hg	2	Cl	2	3.8	10.0		2	1	3	U			204	
1305	Hg	2	Cl	2	2.84	300.0		2	2	3	U			601	
1306	Hg	1	Cl	2	4.45	300.0		2	2	3	U			689	ABSORPTION EDGE.
1307	Hg	1	Se	1	.24	4.2		1	7	3	D D			674	
1308	Hg	1	Se	1	.6	297.0	−4.30e−04	2	1	3	D D			133	
1309	Hg	1	Se	1	.07	300.0		2	8	3	U	P		283	BAND OVERLAP.
1310	Hg	1	Se	1	.1	300.0		2	4	0	U			360	
1311	Hg	2	Br	2	2.6	300.0		1	2	3	U			601	
1312	Hg	1	Br	2	3.59	300.0		1	2	4	U			689	ABSORPTION EDGE.

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
1313	Hg	1	Te	1	.175	300.0	−8.50e−04	1	4	3	D D			511	TRANSITION G6 -> G8, BAND OVERLAP.
1314	Hg	1	Te	1	.303	1.5		2	7	3	D D			506	TRANSITION G6 -> G8, BAND OVERLAP.
1315	Hg	1	Te	1	.266	77.0		2	7	3	D D			506	TRANSITION G6 -> G8, BAND OVERLAP.
1316	Hg	1	Te	1	.283	30.0		2	7	3	U			269	TRANSITION G6 -> G8, BAND OVERLAP.
1317	Hg	1	Te	1	.15	300.0		2	1	3	D D			650	
1318	Hg	1	Te	1	.19	300.0		2	8	3	U			510	TRANSITION G6 -> G8, BAND OVERLAP.
1319	Hg	1	I	2	2.13	298.0	−1.40e−03	1	1	3	U		RED	118	TETRAGONAL.
1320	Hg	1	I	2	2.33	.0	−4.00e−04	2	2	3	U		RED	566	
1321	Hg	1	I	2	2.47	.0	−4.00e−04	2	2	3	U		ORANGE	566	
1322	Hg	1	I	2	2.322	20.0		2	2	3	E	EP		253	
1323	Hg	1	I	2	2.29	77.0		2	5	3	U			168	
1324	Hg	1	I	2	2.29	87.0		2	1	3	U		RED	118	TETRAGONAL.
1325	Hg	1	I	2	3.045	90.0	−2.40e−03	2	1	3	U		YELLOW	118	ORTHORHOMBIC.
1326	Hg	1	I	2	2.795	204.0	−2.40e−03	2	1	3	U		YELLOW	118	ORTHORHOMBIC.
1327	Hg	1	I	2	2.095	280.0		2	3	3	U		RED	118	TETRAGONAL.
1328	Hg	1	I	2	2.11	300.0	−4.00e−04	2	2	3	U		RED	566	
1329	Hg	1	I	2	2.35	300.0	−4.00e−04	2	2	3	U		ORANGE	566	
1330	Hg	1	I	2	2.315	403.0	−2.40e−03	2	1	3	U		YELLOW	118	ORTHORHOMBIC.
1331	Hg	1	I	2	2.19	300.0		2	2	3	U			689	ABSORPTION EDGE.
1332	Hg	2	I	2	2.37	300.0		2	2	3	U			601	
1333	Tl	1	N	3	3.58	77.0		1	2	2	E			172	
1334	Tl	2	O	3	1.4	300.0		1	2	2	I I			235	
1335	Tl	2	O	3	2.25	300.0		1	2	2	D I			235	
1336	Tl	1	F	1		.0		2						568	K(LO) = 35.00, K(HI) = .00.
1337	Tl	1	S	1	1.36	300.0		1	1	3	I I			345	
1338	Tl		S		.98	300.0		2	4	0	U			65	50 % SULFUR.
1339	Tl	2	S	1	.59	250.0		2	3	6	U			657	
1340	Tl	2	S	1	.19	300.0		2	3	3	U			214	ACTIVATION ENERGY.
1341	Tl	1	Cl	1	3.56	300.0		1	2	3	U			430	
1342	Tl	1	Cl	1	3.468	80.0		2	2	3	E			108	
1343	Tl	1	Cl	1	3.46	300.0		2	2	3	U			292	
1344	Tl	1	Cl	1	3.5	300.0		2	2	1	U			634	
1345	Tl	1	Se	1	.73	300.0	−4.50e−04	1	2	3	I I			505	
1346	Tl	1	Se	1	.57	.0	−3.90e−04	2	9	3	U			13	
1347	Tl	1	Se	1	.96	77.0	−4.50e−04	2	2	3	I I			505	
1348	Tl	1	Se	1	.67	300.0	−3.90e−04	2	3	3	U			13	
1349	Tl	1	Se	1	.7	300.0	−3.90e−04	2	2	3	U			13	
1350	Tl		Se		.84	300.0		2	4	0	U			65	50 % SELENIUM.
1351	Tl	1	Se	1	.74	300.0		2	1	3	I I			345	
1352	Tl	1	Br	1	3.05	300.0		1	1	3	E			292	
1353	Tl	1	Br	1	3.115	4.2		2	2	3	D D			397	
1354	Tl	1	Br	1	3.073	80.0		2	2	3	E			108	
1355	Tl	1	Br	1	3.1	300.0		2	2	3	U	P		634	
1356	Tl	2	Te	3	.7	303.0	−2.68e−04	1	2	3	U			155	
1357	Tl	2	Te	1	.5	300.0		1	4	4	U			347	ACTIVATION ENERGY.
1358	Tl	2	Te	3	.69	250.0		2	4	3	U			156	
1359	Tl	2	Te	3	.48	77.0		2	4	3	U			432	
1360	Tl	2	Te	3	.2	300.0		2	4	0	U			222	
1361	Tl	1	I	1	2.67	300.0		1	2	3	U			689	ABSORPTION EDGE.
1362	Tl	1	I	1	2.88	4.7		2	2	2	E	EP		46	ORTHORHOMBIC.
1363	Pb	1	N	6	3.02	300.0		1	2	2	E			176	
1364	Pb	1	N	6	2.98	295.0		2	3	3	D D			177	
1365	Pb	1	O	1	1.936	300.0	−1.00e−04	1	2	3	I I		RED	644	TETRAGONAL.
1366	Pb	1	O	1	2.76	300.0	−1.00e−03	1	2	3	IAI	T	YELLOW	320	ORTHORHOMBIC, POLARIZED E ‖ B.
1367	Pb	1	O	1	2.84	300.0		1	2	3	DFI		RED	644	TETRAGONAL.
1368	Pb	2	O	3	1.67	300.0		1	2	4	U			353	ABSORPTION EDGE.
1369	Pb	1	O	2	1.7	300.0		1						445	B–PHASE, TETRAGONAL.
1370	Pb	1	O	2	2.	300.0		1						445	A–PHASE, ORTHORHOMBIC.
1371	Pb	3	O	4	2.12	300.0		1	2	4	U			353	ABSORPTION EDGE.
1372	Pb	1	O	1	2.88	4.2		2	2	3	I I		YELLOW	277	ORTHORHOMBIC.
1373	Pb	1	O	1	2.86	77.0		2	2	3	I I		YELLOW	277	ORTHORHOMBIC.
1374	Pb	1	O	1	2.66	300.0		2	2	3	I I		YELLOW	277	ORTHORHOMBIC.
1375	Pb	1	O	1	2.73	300.0	−1.00e−03	2	2	3	IFI	T	YELLOW	320	ORTHORHOMBIC. POLARIZED E ‖ A.
1376	Pb	1	O	2	1.4	300.0		2	2	2	U			445	B–PHASE, TETRAGONAL.
1377	Pb	1	O	2	1.45	300.0		2	2	2	U			445	A–PHASE, ORTHORHOMBIC.
1378	Pb	1	O	2	1.5	300.0		2						393	
1379	Pb	1	O	1	2.	300.0		2	2	2	U			550	
1380	Pb	1	O	2	2.	300.0		2						393	
1381	Pb	1	O	1	2.6	300.0		2	2	2	U			550	
1382	Pb	1	O	1	2.73	300.0		2	1	4	U			611	
1383	Pb	1	O	1	3.18	300.0		2	8	2	D I	EPT	RED	377	
1384	Pb	1	O	1	3.36	300.0		2	8	2	D I	EPT	YELLOW	377	

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
1385	Pb	1	F	2		.0		2					COLORLESS	43	K(LO) = 26.30, K(HI) = 2.99.
1386	Pb	1	S	1	.41	300.0		1	1	1	D D			163	
1387	Pb	1	S	1	.286	4.2		2	6	1	D D			163	
1388	Pb	1	S	1	.307	77.0		2	6	1	D D			163	
1389	Pb	1	S	1	.285	300.0		2	1	3	D D			484	
1390	Pb	1	S	1	.44	373.0		2	1	1	D D			163	
1391	Pb	1	S	1	.281	4.2		2	8	3	U	L		314	
1392	Pb	1	S	1	.3	77.0		2	8	3	U	L		139	
1393	Pb	1	S	1	.37	300.0		2	2	3	I I			549	
1394	Pb	1	S	1	.41	300.0		2	2	3	D I			549	
1395	Pb	1	S	1	.307	77.0		2	6	1	D D			487	
1396	Pb	1	Cl	2	3.82	300.0		1	2	3	U			652	
1397	Pb	1	Cl	2	3.94	300.0		2	2	3	U	PT		689	ABSORPTION EDGE.
1398	Pb	1	Cl	2	4.1	300.0		2	1	4	U			611	
1399	Pb	1	Se	1	.27	300.0		1	1	1	D D			702	
1400	Pb	1	Se	1	.165	4.2	4.10e−04	2	6	3	D D		GREY	450	
1401	Pb	1	Se	1	.165	4.2		2	6	1	D D			163	
1402	Pb	1	Se	1	.165	77.0	4.50e−04	2	2	1	U			595	
1403	Pb	1	Se	1	.176	77.0	4.10e−04	2	6	3	D D		GREY	450	
1404	Pb	1	Se	1	.176	77.0		2	6	1	D D			163	
1405	Pb	1	Se	1	.26	300.0		2	2	3	I I			549	
1406	Pb	1	Se	1	.27	300.0		2	1	1	D D			163	
1407	Pb	1	Se	1	.275	300.0	4.50e−04	2	2	1	U			595	
1408	Pb	1	Se	1	.29	300.0		2	2	3	D I			549	
1409	Pb	1	Se	1	.31	373.0		2	1	1	D D			163	
1410	Pb	1	Se	1	.14	4.2		2	8	3	U	L		314	
1411	Pb	1	Br	2	3.2	300.0		1	2	3	U			652	ABSORPTION EDGE.
1412	Pb	1	Br	2	3.5	77.0		2	2	3	U			652	ABSORPTION EDGE.
1413	Pb	1	Br	2	3.23	300.0		2	2	4	U		COLORLESS	689	ABSORPTION EDGE.
1414	Pb	1	Br	2	3.31	300.0		2	1	4	U			611	
1415	Pb	1	Te	1	.31	300.0		1	1	1	D D			163	
1416	Pb	1	Te	1	.185	.0		2	3	3	D D		WHITE	389	
1417	Pb	1	Te	1	.19	.0	4.10e−04	2	2	3	IAI			613	
1418	Pb	1	Te	1	.19	4.2		2	6	1	D D			163	
1419	Pb	1	Te	1	.21	77.0		2	1	3	I I	EPT		129	
1420	Pb	1	Te	1	.21	77.0	4.85e−04	2	3	3	D D		WHITE	389	
1421	Pb	1	Te	1	.217	77.0		2	6	1	D D			163	
1422	Pb	1	Te	1	.19	300.0		2	1	3	D D			484	
1423	Pb	1	Te	1	.29	300.0		2	1	3	I I	EPT		129	
1424	Pb	1	Te	1	.31	300.0	4.85e−04	2	3	3	D D		WHITE	389	
1425	Pb	1	Te	1	.34	373.0		2	1	1	D D			163	
1426	Pb	1	Te	1	.191	4.2		2	8	3	U	L		314	
1427	Pb	1	Te	1	.29	300.0		2	2	3	I I			549	
1428	Pb	1	Te	1	.32	300.0		2	2	3	D I			549	
1429	Pb	1	I	2	2.32	300.0		1	2	3	U			189	
1430	Pb	1	I	2	2.41	.0		2	8	3	U	P		190	
1431	Pb	1	I	2	2.535	.0	−9.95e−04	2	2	3	U			189	
1432	Pb	1	I	2	3.01	.0		2	2	3	E			627	
1433	Pb	1	I	2	2.32	300.0		2	2	3	U	P	YELLOW	689	
1434	Pb	1	I	2	2.36	300.0		2	1	4	U			611	
1435	Bi	2	O	3	2.6	300.0		1	2	2	I I			241	
1436	Bi	2	O	3	2.91	300.0		1	2	2	D I			241	
1437	Bi	2	O	3	3.1	77.0	−1.10e−03	2	2	2	U			431	
1438	Bi	2	O	3	2.15	300.0		2	4	2	D D			241	
1439	Bi	2	O	3	2.58	300.0	−1.00e−03	2	3	2	IAI			242	
1440	Bi	2	O	3	2.85	300.0	−1.10e−03	2	2	2	U			431	
1441	Bi	2	O	3	2.86	300.0		2	1	4	U			611	
1442	Bi	2	O	3	2.07	400.0	−1.10e−03	2	4	2	U			431	
1443	Bi	2	O	3	2.85	300.0	−1.40e−03	2	3	2	D I			242	
1444	Bi	1	F	3		.0		2					GREY	386	K(LO) = 20.00, K(HI) = .00.
1445	Bi	2	S	3	1.2	300.0	−8.00e−04	1	2	3	U			237	
1446	Bi	2	S	3	1.4	77.0	−8.00e−04	2	2	3	U			237	
1447	Bi	2	S	3	1.3	293.0		2	2	4	U			575	
1448	Bi	2	S	3	.72	300.0		2	4	2	U			237	
1449	Bi	2	S	3	1.3	300.0		2	2	4	U			85	
1450	Bi	2	Se	3	.21	300.0	−1.00e−04	1	2	3	U			243	
1451	Bi	2	Se	3	.4	77.0	−2.00e−04	2	2	3	U			85	
1452	Bi	2	Se	3	.35	293.0		2	2	3	U			575	
1453	Bi	2	Se	3	.35	300.0	−2.00e−04	2	2	3	U			85	
1454	Bi	2	Se	3	.161	300.0		2	2	3	I I			260	
1455	Bi	1	Br	3	2.66	300.0		1	2	4	U			689	ABSORPTION EDGE, PRESSURE DEPENDENCE OF.
1456	Bi	1	Sb	1	.023	4.2		2	7	0	U			620	15 % ANTIMONY.
1457	Bi		Sb		.008	80.0		2	8	3	U			685	3 % ANTIMONY.
1458	Bi		Sb		.022	80.0		2	8	3	U			685	10 % ANTIMONY.
1459	Bi		Sb		.024	300.0		2	8	3	U			110	15 % ANTIMONY.
1460	Bi		Sb		.007	300.0		2	4	3	U			329	8 % ANTIMONY.
1461	Bi		Sb		.007	300.0		2	4	3	U			329	30 % ANTIMONY.
1462	Bi		Sb		.008	300.0		2	4	3	U			329	20 % ANTIMONY.
1463	Bi		Sb		.01	300.0		2	4	3	U			329	15 % ANTIMONY.

Energy band gaps in elemental and binary compound semiconductors and insulators—Continued

Entry No.	1 Compound	2	3	4	5 E(g) (eV)	6 Temp. (Kelvin)	7 dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment
1464	Bi		Sb		.01	300.0		2	4	3	U			329	9 % ANTIMONY.
1465	Bi		Sb		.011	300.0		2	4	3	U	P		191	8 % ANTIMONY.
1466	Bi		Sb		.012	300.0		2	4	3	U			329	10 % ANTIMONY.
1467	Bi	1	Sb	1	.014	300.0		2	7	3	U			621	10 % ANTIMONY.
1468	Bi		Sb		.014	300.0		2	4	3	U			329	12 % ANTIMONY.
1469	Bi		Sb		.015	300.0		2	4	3	U	P		191	10 % ANTIMONY.
1470	Bi		Sb		.018	300.0		2	4	3	U	P		191	13 % ANTIMONY.
1471	Bi	1	Sb	1	.022	300.0		2	7	3	U			621	15 % ANTIMONY.
1472	Bi	2	Te	3	.145	300.0	−1.00e−04	1	2	3	I I			260	
1473	Bi	2	Te	3	.15	.0		2	4	3	U			558	
1474	Bi	2	Te	3	.13	300.0	−9.50e−05	2	2	3	I I			41	
1475	Bi	2	Te	3	.14	300.0		2	4	3	U			558	
1476	Bi	2	Te	3	.16	.0	−9.00e−05	2	4	3	U			85	
1477	Bi	2	Te	3	.15	300.0	−9.00e−05	2	2	3	U			85	
1478	Bi	2	Te	3	.153	300.0		2	4	3	U			387	
1479	Bi	2	Te	3	.171	300.0		2	4	3	U			400	
1480	Bi	2	Te	3	.2	300.0		2	8	3	U			545	
1481	Bi	1	I	3	1.73	293.0	−9.20e−04	1	2	3	I I	P		646	
1482	Bi	1	I	3	2.195	293.0		1			D I			647	
1483	Bi	1	I	3	2.03	.0	−3.50e−04	2	2	3	D D			631	
1484	Bi	1	I	3	2.029	20.4	−9.20e−04	2	2	3	I I	P		646	
1485	Bi	1	I	3	1.922	85.0	−9.20e−04	2	2	3	I I	P		646	
1486	Bi	1	I	3	1.81	295.0		2	2	3	D D			220	
1487	Bi	1	I	3	1.93	300.0	−3.50e−04	2	2	3	D D			631	
1488	Bi	1	I	3	2.52	.0		2	4	4	U			220	
1489	Bi				.015	4.2		1	7	3	U			114	
1490	Bi				.024	4.2		2	6	3	D D			208	
1491	Bi				.006	77.4		2	4	0	U			582	VALUE AT 15 KBAR, METALLIC AT TEMPERATURES ABOVE 150 deg. k.
1492	Th	1	C	1		9.0		2	0	0	U			149	SUPERCONDUCTOR.
1493	Th	1	O	2	5.75	300.0		1						529	
1494	Th	1	O	2	3.5	300.0		1	2	2	U	PT	WHITE	91	
1495	Th	1	O	2	2.56	300.0		2	4	0	U			671	
1496	Th	1	O	2	3.3	300.0		2	2	3	U		RED	167	ABSORPTION EDGE.
1497	Th	1	O	2	5.02	300.0		2	2	3	U			62	ABSORPTION EDGE.
1498	Th	1	O	2	3.2	000.0		2	4	4	U			166	ACTIVATION ENERGY.
1499	Th	1	O	2	3.3	300.0		2	1	4	U			659	
1500	U		O		1.5	300.0		1	4	4	U			704	U3−O8.
1501	U	1	O	2	2.18	300.0		1	2	3	U			20	
1502	U		O		.6	473.0		2	4	4	U			705	U1−O2.
1503	U	1	O	2	1.3	100.0		2	4	4	U			460	ACTIVATION ENERGY.
1504	U	1	P	2		300.0		2	4	3	U			289	

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