

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

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# 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],<sup>1</sup> 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 contribu-

tion 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,  $\alpha$ , is measured as a function of energy from below to above the absorption edge. At

<sup>1</sup> Numbers in brackets indicate references in section 6.

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the absorption edge  $\alpha$  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  $\alpha$  vs energy curve to a value of  $\alpha$  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  $\alpha$  (usually between 1 and  $100 \text{ cm}^{-1}$ ) 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 element
- 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.	Compound			5	6	7	8	9	10	11	12	13	14	Comment	
				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	Ref		
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	
5	Li	1	F	1	12.	200.0		2	2	3	U			313	
6	Li	1	F	1	11.7	300.0		2	2	3	U			313	
7	Li	1	Cl	1	9.33	55.0		1	1	3	U			55	
8	Li	1	Br	1	7.95	80.0		1	2	2	D D			501	
9	Li	1	Br	1	7.5	55.0		2	1	3	U			55	
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	
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	
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			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	
24	Be	1	Se	1	3.61	.0		1			I I			598	
25	Be	3	Sb	2	.67	300.0		1	4	2	U			637	
26	Re	1	Te	1	2.89	.0		1			I I			598	
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			T	16
40	B	1	N	1	3.8	300.0		2	2	2	U				517
41	B	2	O	3	7.	300.0		1							328
42	B	2	O	3	4.9	300.0		2	8	2	U			RED	417
43	B	1	P	1	2.	300.0		1	2	3	I I				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	144
54	C				7.02	295.0	-6.30e-04	1	1	3	D I			EPT	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			P	178 NATURAL DIAMOND.
59	C				5.41	100.0		2	2	3	E				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			T	601
62	C	1	I	4	2.26	300.0		1	2	4	U				601
63	Na	1	N		.0			2							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
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				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.	Compound			E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	Ref	15	
	1	2	3	4	5	6	7	8	9	10	11	12	Color	Ref	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	UU			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	.-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	Ge	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	Co	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	.67	77.0		2	1	3	DAI	P		648	TRANSITION G15 → G1.
119	Mg	2	Ge	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	.-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	.-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			90	
140	Mg	3	Sb	2	.82	.-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	EPT		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			135	ACTIVATION ENERGY.
150	Al	1	B	1	.5	300.0		2	4	3	U			135	ACTIVATION ENERGY.
151	Al	1	B	1	.74	400.0		2	4	3	U			136	ACTIVATION ENERGY.
152	Al	1	N	1	5.74	300.0		1	2	3	D I	EPT	WHITE	496	POLARIZED E    C.
153	Al	1	N	1	5.88	300.0		2	2	3	D I	EPT	WHITE	496	POLARIZED E ⊥ 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			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	.-1.50e-03		2	0	3	U			284	

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

Entry No.	Compound			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	2	3	4											
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	EP	264	
165	Al	1	P	1	2.65	300.0		2	9	3	U	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	ORANGE		436	
168	Al	1	As	1	2.9	300.0		1	0	3	D I			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 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 I			407	
178	Al	1	As	1	2.215	145.0		2	2	3	I 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 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 I	YELLOW		499	CUBIC.
189	Si	1	C	1	2.86	300.0	-3.30e-04	1	2	3	I 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 I	YELLOW		708	CUBIC.
192	Si	1	C	1	2.86	300.0		2	2	3	I I I	EPT		499	HEXAGONAL.
193	Si	1	C	1	3.33	4.2		2	2	3	I 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 I			415	
203	Si				1.166	4.2		2	8	3	I I I			207	
204	Si				1.17	4.2		2	2	3	I I I			415	
205	Si				1.165	35.0		2	2	3	I I I			57	
206	Si				1.16	77.0		2	2	3	I I I			415	
207	Si				1.16	85.0		2	2	3	I I I			57	
208	Si				1.12	300.0		2	2	3	I I I			57	
209	Si	1	P	2	1.89	300.0		1	2	3	U			591	ORTORHOMBIC.
210	Si	1	As	1	1.45	300.0		1	2	3	I 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 I			286	POLARIZED E    C.
215	Si	1	Se	2	1.74	300.0		2	2	3	I 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 I			649	
218	Si	1	Te	2	1.85	300.0		1	2	3	I 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	BLACK		571	
222	P				1.6	300.0		1	1	3	U	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.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	8 R	9 By	10 On	11 Tr	12 Effect	13 Color	14 Ref	15 Comment	
	1	2	3	4												
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	PT	WHITE		673	
272	Ca	1	O	1	7.5	300.0		2	9	3	U				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	I I	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	1	C	1	.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	U				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	.0	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.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	Ref	15	
	1	2	3	4											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				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				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				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				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	Sc	2	.6	300.0		1	4	4	U				107	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				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.	Compound				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	2	3	4											15	
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				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		.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				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	EPT			134	
430	Zn	1	O	1	3.35	300.0		1	1	3	U				296	
431	Zn	1	O	1	3.435	1.2		2	1	3	D D	L			494	
432	Zn	1	O	1	3.26	77.0		2	8	3	E				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		1	I I				574	TETRAHEDRAL, POLARIZED E ⊥ C.
436	Zn	1	P	2	1.85	293.0	-2.30e-04	1		1	I I				574	TETRAHEDRAL, POLARIZED E    C.
437	Zn	1	P	2	2.18	293.0	-5.50e-04	1		1	D I				574	TETRAHEDRAL.
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			365	TETRAHEDRAL.
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	WHITE			463	POLARIZED E ⊥ C.
444	Zn	1	S	1	3.73	300.0		2	2	3	U				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	A <sub>s</sub>	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	A <sub>s</sub>	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	YELLOW			401	HEXAGONAL.
455	Zn	1	Se	1	2.81	23.0		2	1	3	E	L			42	
456	Zn	1	Se	1	2.68	150.0		2	8	3	U				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.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	13 Color	14 Ref	15 Comment		
	1	2	3	4													
463	Zn	1	Sb	1	.508	4.9		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				462	TRANSITION G15 -> G1.	
479	Zn	1	Te	1	2.385	4.2		2	2	3	DAD				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				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				128	TRANSITION G15 -> G1.	
490	Zn	1	Te	1	2.29	110.0		2	8	3	U				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				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				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				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				104		
509	Ga	1	S	1	2.7	77.0		2	8	3	U				14		
510	Ga	1	S	1	2.58	150.0		2	2	3	I I				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				195	TRANSITION G15 -> G1.	
532	Ga	1	As	1	1.33	500.0		2	8	3	D D				599		
533	Ga	1	As	1	1.435	294.0		2	2	3	D D				418		
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	G- AND E- PHASES.	
539	Ga	1	Se	1	2.065	77.0		2	2	3	I I				61		
540	Ga	1	Se	1	2.07	77.0		2	8	3	E		L		346		
541	Ga	1	Se	1	2.109	77.0		2	5	3	U				39	B-PHASE.	
542	Ga	1	Se	1	2.117	77.0		2	2	3	I I				39		

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

Entry No.	Compound			5	6	7	8	9	10	11	12	13	14	15	
				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			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			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	Tc	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			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			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	P		366	6.45 % SILICON.
578	Ge	Si			1.042	300.0		2	5	2	U			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			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			402	
591	Ge				.665	291.0		1	2	3	I I			414	
592	Ge				.005	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 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 I			614	
601	Ge	1	As	1	.65	300.0		1	2	3	I I I			519	VALUE VARIES: 0.6-0.7 EV.
602	Ge	1	As	2	1.	300.0		1	2	3	I 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			232	
609	Ge	1	Se	2	2.69	.0		2	2	3	D I			51	VALUE VARIES: 0.73-0.95 EV.
610	Ge	1	Se	1	1.	100.0		2	4	3	U			720	
611	Ge	1	Se	1	1.17	300.0		2	3	3	U			35	
612	Ge	1	Sn	1	.8	300.0		1	0	0	U			344	
613	Ge	1	Te	1	.84	300.0		1	2	2	D D			126	
614	Ge	1	Te	2	.3	293.0		1						51	
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.	Compound				E(g) (eV)	Temp. Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	14 Ref	15	
	1	2	3	4											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 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				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				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	Ae	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				290	TRIGONAL, POLARIZED E ⊥ C.
690	Se				2.01	300.0		2	1	3	U				369	HEXAGONAL.
691	Se				2.14	300.0	-2.38e-03	2	3	3	U				544	
692	Se				2.2	300.0		2	1	3	D D				512	HEXAGONAL.
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.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	13 Color	14 Ref	15 Comment	
	1	2	3	4												
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 C8- -> 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 EDCE.
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		DK GREY		261	
746	Zr	1	Se	3	1.25	300.0		1	2	3	U				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 E				173	POLARIZED E ⊥ C.
758	Mo	1	O	3	2.96	300.0	-9.30e-04	1	2	3	E U				173	POLARIZED E    C.
759	Mo	1	O	3	3.54	300.0		2	4	3	U E				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 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							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.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	13 Color	14 Ref	15 Comment	
	1	2	3	4												
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 I				557	
806	Ag	1	Cl	1	5.13	300.0		1	2	3	D I I				557	
807	Ag	1	Cl	1	3.22	.0		2	2	3	I I I				108	
808	Ag	1	Cl	1	5.1	.0		2	9	0	D I I				113	TRANSITION G15 -> G1.
809	Ag	1	Cl	1	3.246	4.2		2	2	3	I I I	EPT			111	
810	Ag	1	Cl	1	3.25	4.2		2	2	3	I I I				113	
811	Ag	1	Cl	1	3.252	4.2		2	2	3	I I I				334	
812	Ag	1	Cl	1	3.22	77.0		2	2	3	I I I	EPT			113	
813	Ag	1	Cl	1	3.226	77.0		2	2	3	I I I				111	
814	Ag	1	Cl	1	3.08	300.0		2	2	3	I 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 I				557	
821	Ag	1	Br	1	4.29	300.0		1	2	3	D I I				557	
822	Ag	1	Br	1	2.97	.0	-1.36e-03	2	2	3	I I I				504	
823	Ag	1	Br	1	4.292	.0		2	2	3	E I				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 I				113	
826	Ag	1	Br	1	2.691	4.2		2	2	3	I 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 I				113	
829	Ag	1	Br	1	2.52	300.0		2	2	3	I I I				113	
830	Ag	1	Br	1	2.6	300.0	-1.36e-03	2	2	3	I I I				504	
831	Ag	2	Te	1	.064	300.0		1	2	2	D D				164	B-PHASE.
832	Ag	1	Tc	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	.013	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				385	
844	Cd	1	O	1	1.2	300.0	-3.30e-04	1	2	3	I I I				19	TRANSITION G15 -> G1.
845	Cd	1	O	1	2.3	300.0		1	2	3	D I I				453	
846	Cd	1	O	1	2.35	295.0		2	1	3	U				21	
847	Cd	1	F	2	6.	300.0		1	8	3	U	PT	COLORLESS			
848	Cd	1	P	2	1.55	293.0	-4.20e-04	1			I I I				574	TETRAHEDRAL, POLARIZED E ⊥ C.
849	Cd	1	P	2	1.65	293.0	-3.70e-04	1			I I I				574	TETRAHEDRAL, POLARIZED E    C.
850	Cd	1	P	2	1.92	293.0	-8.60e-04	1			D I I				574	TETRAHEDRAL.
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

Entry No.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	13 Color	14 Ref	15 Comment		
	1	2	3	4													
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	L			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	Sc	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	L			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				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	3	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	DK GREY		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	EP	DK GREY		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.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	13 Color	14 Ref	15 Comment	
	1	2	3	4												
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			263		
960	Sn	1 O	2	2.7		300.0		1	2	2	I I			585	POLARIZED E ⊥ C.	
961	Sn	1 O	2	4.3		300.0		1	2	2	D I			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		3	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	1	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	Sn	2 O	3	3.31		300.0		1	1	4	U			611		
1008	Sn	2 O	3	3.2		300.0		2	1	4	U			659		
1009	Sn	2 O	3	4.2		300.0		2	3	2	U			417		
1010	Sn	1 Si	1	1.9		300.0		1	4	1	U			562		
1011	Sn	1 Si	1	1.9		.0	-1.55e-03	2	3	4	U			471		
1012	Sn	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.	Compound			5	6	7	8	9	10	11	12	13	14	15	
				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	Ref	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			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			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			71	
1044	Te			.336	77.0	-6.30e-05		2	2	3	E		L	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		T	503	TRANSITION G15 → G1.
1061	Cs	1	Br	1	6.9	300.0		2	9	6	U			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	EPT	COLORLESS	694	
1077	Ba	1	O	1	3.8	300.0		2	2	3	U	EPT		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.	Compound				5	6	7	8	9	10	11	12	13	14	15	
			E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color	Ref	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							641		
1087	La	1 B	6	.08	300.0		1	1	4	U	PT			626		
1088	La	1 B	6	.0			2	1	4	U	P			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, K(LO) = 24.20, K(HI) = .00.	
1094	La	1 Al	3	.0			2	0	3	U				672		
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.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	13 Color	14 Ref	15	
	1	2	3	4											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	Sc	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				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				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				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				473	ACTIVATION ENERGY.
1195	Gd	2	O	3	2.9	933.0		2	4	4	U				94	METALLIC.
1196	Gd	1	P	1	.0			2							683	
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							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	D	D			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	1	S	1	.33	300.0		1	4	4	U				179	
1232	Yb	1	S	1	.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

Entry No.	Compound	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		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		
1244	Ta	2	O	5	4.6	300.0		1	3	2	U			28	VALUE VARIES: 1.95–2.60 EV.	
1245	Ta	1	S	2	.1	300.0		1	4	0	U			542	ABSORPTION EDGE.	
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	U			216	METALLIC.	
1260	Re	1	O	3	2.3	300.0		1	1	3	U			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	II			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	O <sub>e</sub>	1	Te	2	.3	300.0		1	4	4	U			337	VALUE GREATER 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						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			440		
1293	Hg	1	O	1	1.18	373.0		2	4	0	U			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			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	U			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			233	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.	Compound				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	2	3	4												
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	
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	TETRAHEDRAL.
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	TETRAHEDRAL.
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	Tl	1	I	2	2.19	300.0		2	2	3	U				689	ABSORPTION EDGE.
1332	Tl	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	1	S	1	.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	1	Se	1	.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	.42		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	T	RED		644	TETRAHEDRAL.
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	TETRAHEDRAL.
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, TETRAHEDRAL.
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, TETRAHEDRAL.
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.	Compound		5	6	7	8	9	10	11	12	13	14	Ref	Comment
	E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	R	By	On	Tr	Effect	Color					
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	GREY	595		
1403	Pb	1 Se	1	.176	77.0	4.10e-04	2	6	3	D D		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	WHITE	163		
1416	Pb	1 Te	1	.185	.0		2	3	3	D D		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.	Compound				E(g) (eV)	Temp. (Kelvin)	dE/dT (eV/Deg)	7			8		9		10		11		12		13		Ref	15		Comment*
	1	2	3	4				R	By	On	Tr	Effect	Color	14	15	Ref	Comment*									
1464	Bi	Sb		.01	300.0			2	4	3	U													329	9 % ANTIMONY.	
1465	Bi	Sb		.011	300.0			2	4	3	U													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													191	10 % ANTIMONY.	
1470	Bi	Sb		.018	300.0			2	4	3	U													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													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													646		
1485	Bi	1 I	3	1.922	85.0	-9.20e-04		2	2	3	I I													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	1 I	3	.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													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													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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