



Thin Film Evaporation Material Source Reference

Name	Symbol	Melting Point (°C)	Density (g/cm ³)	Temp (°C) at Vap. Press.			Evaporation Techniques				Remarks (n = index of refraction)
				10 ⁻⁸ Torr	10 ⁻⁶ Torr	10 ⁻⁴ Torr	Electron Beam	Crucible	Coil	Boat	
Aluminum	Al	660	2.7	677	821	1010	XInt.	TiB ₂ -BN ZrB ₂ BN	W	TiB ₂ W	Alloys and wets; tungsten-stranded superior
Aluminum Antimonide	AlSb	1080	4.3								
Aluminum Arsenide	AlAs	1600	3.7			~1300					
Aluminum Bromide	AlBr ₃	97	3.01			~50		Graphite		Mo	
Aluminum Carbide	Al ₄ C ₃	1400	2.36			~800	Fair				n=2.7
Aluminum 2% Copper	Al2%Cu	640	2.82								Wire feed and flash. Difficult from dual sources.
Aluminum Fluoride	AlF ₃	1257 Subl.	3.07	410 Subl.	490 Subl.	700 Subl.	Poor	Graphite		Mo, W	n=1.38 at 0.55μ
Aluminum Nitride	AlN	Subl.	3.26			~1750	Fair				Decomposes. Reactice evaporate in 10 ⁻³ N ₂ with glow discharge.
Aluminum Oxide (alumina)	Al ₂ O ₃	2045	3.97			1550	XInt.			W	Sapphire xInt in EB, forms smooth hard films. N=1.66
Alumnum 2% Silicon	Al2%Si	640	2.69			1010		TiB ₂ -BN			Wire feed and flash. Difficult from dual sources.
Antimony	Sb	630	6.68	279 Subl.	345 Subl.	425 Subl.	Poor	BN C Al ₂ O ₃	Mo Ta	Mo Ta Al ₂ O ₃ Coated	Toxic. Evaporates well. Film structure is rate-dependent.
Antimony Telluride	Sb ₂ Te ₃	619	6.5			600		Carbon			Decomposes over 750 degrees C.
Antimony Trioxide	Sb ₂ O ₃	656	5.2 or 5.76	Subl.	Subl.	~300 Subl.	Good	BN Al ₂ O ₃		Pt	Toxic. Decomposes on W. n=2.05
Antimony Triselenide	Sb ₂ Se ₃	611						Carbon		Ta	Stoichiometry variable.



Antimony Trisulphide	Sb ₂ S ₃	550	4.64			~200	Good	Al ₂ O ₃		Mo Ta	n=3.01 at 0.55μ. No decomposition.
Arsenic	As	814	5.73	107 Subl.	150 Subl.	210 Subl.	Poor	Al ₂ O ₃ BeO Vit. Carbon		C	Toxic. Sublimes rapidly at low temperature.
Arsenic Selenide	As ₂ Se ₃	360	4.75					Al ₂ O ₃ Quartz			n=2.41 at 3.8μ.
Arsenic Trisulphide	As ₂ S ₃	300	3.43			~400	Fair	Al ₂ O ₃ Quartz		Mo	n=2.8
Arsenic Telluride	As ₂ Te ₃	362								Flash	
Barium	Ba	710	3.78	545	627	735	Fair	Metals	W	W Ta Mo	Wets w/o alloying - reacts with ceramics
Barium Chloride	BaCl ₂	962	3.86			~650				Ta, Mo	Use gentle preheat to outgas
Barium Fluoride	BaF ₂	1280	4.83	Subl.	Subl.	~700 Subl.	Good			Mo	n=1.29 at 5μ. Density Rate Dependent.
Barium Oxide	BaO	1923	5.72 or 5.32			~1300	Poor	Al ₂ O ₃		Pt	Decomposes slightly. n=1.98
Barium Sulphide	BaS	2200	4.25			1100				Mo	n=2.16
Barium Titanate	BaTiO ₃	Decomposes	6	Dec.	Dec.	Dec.					Decomposes, yields free Ba from single source; sputtering preferred; or co-evaporate from 2 sources
Beryllium	Be	1278	1.85	710	878	1000	XInt.	BeO C Vit. Carbon	W	W Ta	Wets W/Mo/Ta. Metal powder and oxides are toxic. Evaporates easily.
Beryllium Chloride	BeCl ₂	440	1.9			~150					
Beryllium Fluoride	BeF ₂	800	1.99	Subl.	Subl.	~200 Subl.	Good				Toxic.
Beryllium Oxide	BeO	2530	3.01			1900	Good				Powders toxic. No decomposition from EB guns. n=1.72
Bismuth	Bi	271	9.8	330	410	520	XInt.	Al ₂ O ₃ Vit. Carbon	W	W Mo Al ₂ O ₃ Ta	Vapors are toxic. High Resistivity. No shorting of baskets.
Bismuth Fluoride	BiF ₃	727	8.75	Subl.	Subl.	~300 Subl.		Graphite			n=1.74 at 1μ. 1.64 at 10μ



Bismuth Oxide	Bi ₂ O ₃	820	8.9			~1400	Poor			Pt	Vapors are toxic. n=2.55
Bismuth Selenide	Bi ₂ Se ₃	710	7.66			~650	Good	Graphite Quartz			Sputtering preferred; or co-evaporate from 2 sources.
Bismuth Telluride	Bi ₂ Te ₃	585	7.85			~600		Graphite Quartz		W Mo	Sputtering preferred; or co-evaporate from 2 sources.
Bismuth Titanate	Bi ₂ Ti ₂ O ₇			Dec.	Dec.	Dec.					Decomposes. Sputtering preferred; or co-evaporate from 2 sources in 10-2O ₂
Bismuth Trisulphide	Bi ₂ S ₃	685	7.39								n = 1.5 (approx.)
Boron	B	2100	2.36	1278 Subl.	1548 Subl.	1797 Subl.	XInt.	C Vit. Carbon		C	Material explodes with rapid cooling. Forms carbide with container.
Boron Carbide	B ₄ C	2350	2.5	2500	2580	2650	XInt.				Similar to chromium.
Boron Nitride	BN	2300	2.2	Subl.	Subl.	~1600 Subl.	Poor				Sputtering preferred; Decomposes.
Boron Oxide	B ₂ O ₃	460	1.82			~1400	Good			Pt Mo	n=1.46
Boron Trisulphide	B ₂ S ₃	310	1.55			800		Graphite			
Cadmium	Cd	321	8.64	64	120	180	Poor	Al ₂ O ₃ Quartz		W Cb Mo Ta	Poisons vacuum systems, low sticking coefficient
Cadmium Antimonide	CdSb	456	6.92								
Cadmium Arsenide	Cd ₃ As ₂	721	6.21					Quartz			
Cadmium Bromide	CdBr ₂	567	5.19			~300					
Cadmium Chloride	CdCl ₂	570	4.05			~400					
Cadmium Fluoride	CdF ₂	1070	6.64			~500					n=1.56
Cadmium Iodide	CdI ₂	400	5.3			~250					
Cadmium Oxide	CdO	900	6.95			~530					Disproportionates. n=2.49
Cadmium Selenide	CdSe	1264	5.81	Subl.	Subl.	540 Subl.	Good	Al ₂ O ₃ Quartz		Mo Ta	Evaporates easily. n=2.4 at 0.6μ



Cadmium Silicide	CdSiO ₂					~600					n=1.69
Cadmium Sulphide	CdS	1750	4.82	Subl.	Subl.	550 Subl.	Fair	Al ₂ O ₃ Quartz		W Mo Ta	Sticking coefficient strongly affected by substrate temperature. n=2.4, JVST 12, 188 (1975)
Cadmium Telluride	CdTe	1098	6.2			450			W	W Mo Ta	Stoichiometry depends on substrate temperature. n=2.6
Calcium	Ca	842	1.55	272 Subl.	357 Subl.	459 Subl.	Poor	Al ₂ O ₃ Quartz	W	W	Corrodes in air.
Calcium Fluoride	CaF ₂	1360	3.18			~1100	Xint.	Quartz	W Mo Ta	W Mo Ta	Rate control important. Use gentle preheat to outgas. n=1.2 - 1.4
Calcium Oxide	CaO	2580	3.35			~1700		ZrO ₂		W Mo	Forms volatile oxides with W and Mo. n=1.84
Calcium Silicate	CaO-SiO ₂	1540	2.9				Good	Quartz			n=1.61
Calcium Sulphide	CaS	Subl.	2.18			1100				Mo	Decomposes. n=2.14
Calcium Titanate	CaTiO ₃	1975	4.1	1490	1600	1690	Poor				Disproportionates except in sputtering.
Calcium Tungstate	CaWO ₄	1620	6.06				Good			W	n=1.92
Carbon	C	Subl.	1.8 - 2.3	1657 Subl.	1867 Subl.	2137 Subl.	Xint.				EB preferred. Arc evaporation. Poor film adhesion. Vitreous carbon n=1.47
Cerium	Ce	795	8.23	970	1150	1380	Good	Al ₂ O ₃ BeO Vit. Carbon	W	W Ta	Films oxidize easily.
Ceric Oxide	CeO ₂	2600	7.3	1890 Subl.	2000 Subl.	2310 Subl.	Good			W	Use 250-300 °C substrate temperature. n=2.2-2.4. Reacts with W.
Cerium Fluoride	CeF ₃	1418	6.16			~900	Good			W Mo Ta	Use gentle preheat to outgas. n=1.63 at 0.55μ
Cerium Oxide	Ce ₂ O ₃	1692	6.87				Fair			W	Alloys with source; use 0.015-0.020 W boat. n=1.95
Cesium	Cs	28	1.87	-16	22	30		Quartz		S.S.	
Cesium Bromide	CsBr	636	4.44			~400				W	n=1.70
Cesium Chloride	CsCl	646	3.97			~500				W	n=1.64 Hygroscopic
Cesium Fluoride	CsF	684	3.59			~500				W	



Cesium Hydroxide	CsOH	272	3.67			550				Pt		
Cesium Iodide	CsI	621	4.51			~500		Pt Quartz		W Pt	n=1.79	
Chiolote	Na ₅ Al ₃ F ₁₄		2.9			~800				Mo W	n=1.33	
Chromium	Cr	1890	7.2	837 Subl.	977 Subl.	1157 Subl.	Good	Vit. Carbon	W	Cr-plated rod or strip	Films very adherent. High rates possible.	
Chromium Boride	CrB	2760	6.17									
Chromium Bromide	CrB ₂	842	4.36			550				Inconel		
Chromium Carbide	Cr ₃ C ₂	1890	6.68			~2000	Fair			W		
Chromium Chloride	CrCl ₂	824	2.75			550				Fe Inconel	Sublimes easily.	
Chromium Oxide	Cr ₂ O ₃	2435	5.21			~2000	Good			W, Mo	Disproportionates to lower oxides, reoxidizes at 600 °C in air. n=2.4	
Chromium Silicide	Cr ₃ Si	1710	6.51									
Chromium Silicon Monoxide	Cr-SiO	Influenced by composition...						Good			W	Flash.
Cobalt	Co	1495	8.9	850	990	1200	XInt.	Al ₂ O ₃ BeO		W Cb	Alloys with refractory metals.	
Cobalt Bromide	CoBr ₂	678	4.91	Subl.	Subl.	400 Subl.				Inconel		
Cobalt Chloride	CoCl ₂	740	3.36	Subl.	Subl.	472 Subl.				Inconel		
Cobalt Oxide	CoO	1935	5.68								Sputtering preferred.	
Copper	Cu	1083	8.92	727	857	1017	XInt.	Al ₂ O ₃ Mo, Ta	W	Mo	Films do not adhere well. Use intermediate layer, e.g. chromium. Evaporates from any source materials.	
Copper Chloride	CuCl	422	3.53			~600					n=1.93	
Copper Oxide	Cu ₂ O	1235	6	Subl.	Subl.	~600 Subl.	Good	Al ₂ O ₃		Ta	Evaporate in 10 ⁻² - 10 ⁻⁴ of O ₂ ; n=2.70 J. Electrochem. Soc. 110, 119 (1967)	
Copper Sulphide	CuS	1113	6.75	Subl.	Subl.	~500 Subl.					n=1.45	
Cryolite	Na ₃ AlF ₆	1000	2.9	1020	1260	1480	XInt.	Vit. Carbon		W, Mo, Ta	Large chunks reduce spitting. Little decomposition. n=2.34 at 6330A.	



Dysprosium	Dy	1409	8.54	625	750	900	Good			Ta	
Dysprosium Fluoride	DyF ₃	1360		Subl.	Subl.	~800 Subl.	Good			Ta	
Dysprosium Oxide	Dy ₂ O ₃	2340	7.81			~1400				Ir	Loses oxygen.
Erbium	Er	1497	9.06	650 Subl.	775 Subl.	930 Subl.	Good			W, Ta	
Erbium Fluoride	ErF ₃	1350	7.81			~750				Mo	
Erbium Oxide	Er ₂ O ₃	2400	8.64			~1600				Ir	Loses oxygen.
Europium	Eu	822	5.26	280 Subl.	360 Subl.	480 Subl.	Fair	Al ₂ O ₃		W, Ta	Low tantalum solubility.
Europium Fluoride	EuF ₂	1380	6.5			~950				Mo	
Europium Oxide	Eu ₂ O ₃	2056	7.42			~1600	Good	ThO ₂		Ir, Ta, W	Loses oxygen; films clear and hard.
Europium Sulphide	EuS		5.75				Good				
Gadolinium	Gd	1312	7.89	760	900	1175	XInt.	Al ₂ O ₃		Ta	High Ta solubility.
Gadolinium Oxide	Gd ₂ O ₃	2310	7.41				Fair			Ir	Loses oxygen. n=1.8 at 0.55μ
Gallium	Ga	30	5.9	619	742	907	Good	Al ₂ O ₃ BeO Quartz			Alloys with refractory metals. Use EB gun.
Gallium Antimonide	GaSb	710	5.6				Fair			W, Ta	Flash evaporate.
Gallium Arsenide	GaAs	1238	5.3				Good	Carbon		W, Ta	Flash evaporate. n=5.64 at 10.6μ
Gallium Nitride	GaN	Subl.	6.1			~200		Al ₂ O ₃			Evaporate Ga in 10 ⁻³ N ₂ .
Gallium Oxide	Ga ₂ O ₃	1900	5.88							Pr, W	Loses oxygen.
Gallium Phosphide	GaP	1540	4.1		770	920		Quartz		W, Ta	Decomposes vapor mostly P.
Germanium	Ge	937	5.35	812	957	1167	XInt.	Quartz Al ₂ O ₃		W, C, Ta	Excellent film from EB sources. Use 0.040 W. n=4.01
Germanium Nitride	Ge ₃ N ₂	450	5.2	Subl.	Subl.	~650 Subl.					Sputtering preferred.
Germanium Oxide	GeO ₂	1086	6.24			~625	Good	Quartz Al ₂ O ₃		Ta, Mo	Similar to SiO, film predominantly GeO.



Germanium Telluride	GeTe	725	6.2			381		Quartz Al ₂ O ₃		W, Mo	
Glass, Schott 8329			2.2				XInt.				Evaporable alkali glass. Melt in air before evaporating. N=1.47
Gold	Au	1062	19.32	807	947	1132	XInt.	Al ₂ O ₃ BN Vit. Carbon	W	W, Mo Coated Al ₂ O ₃	Films soft, not very adherent.
Hafnium	Hf	2230	13.09	2160	2250	3090	Good				
Hafnium Boride	HfB ₂	3250	10.5								
Hafnium Carbide	HfC	4160	12.2	Subl.	Subl.	~2600 Subl.					
Hafnium Nitride	HfN	2852	13.8								
Hafnium Oxide	HfO ₂	2812	9.68			~2500	Fair			W	Film HfO n=2.0 at 0.5μ
Hafnium Silicide	HfSi ₂	1750	7.2								
Holmium	Ho	1470	8.8	650 Subl.	770 Subl.	950 Subl.	Good		W	W, Ta	
Holmium Fluoride	HoF ₃	1143	7.64			~800		Quartz			
Holmium Oxide	Ho ₂ O ₃	2370	8.41							Ir	Loses oxygen.
Inconel	Ni/Cr/Fe	1425	8.5				Good		W	W	Use fine wire pre-wrapped on W. Low rate req'd for smooth films.
Indium	In	157	7.3	487	597	742	XInt.; Mo Liner req'd	Graphite Al ₂ O ₃	W	W, Mo	Wets W and Cu; use Mo liner in guns.
Indium Antimonide	InSb	535	5.8	500		~400				W	Toxic, Decomposes; sputtering preferred; or co-evaporate from 2 sources; flash. n=4.3 at 1μ
Indium Arsenide	InAs	943	5.7	780	870	970				W	Toxic, Sputtering preferred; or co-evaporate from 2 sources; flash. n=4.5 at 1μ
Indium Oxide	In ₂ O ₃	1565	7.18	Subl.	Subl.	~1200 Subl.	Good	Al ₂ O ₃		W, Pt	Film In ₂ O; transparent conductor.
Indium Phosphide	InP	1058	4.8		630	730		Graphite		W, Ta	Deposits P rich. Flash evaporate.
Indium Selenide	In ₂ Se ₃	890	5.7								Sputtering preferred; or co-evaporate from 2 sources. Flash.



Indium Sesqui-sulphide	In ₂ S ₃	1050	4.9	Subl.	Subl.	850 Subl.		Graphite			Film In ₂ S
Indium Sulphide	In ₂ S	653	5.87			650		Graphite			
Indium Telluride	In ₂ Te ₃	667	5.8								Sputtering preferred; or co-evaporate from 2 sources; flash.
Iridium	Ir	2459	22.65	1850	2080	2380	Fair	ThO ₂			
Iron	Fe	1535	7.86	858	998	1180	XInt.	Al ₂ O ₃ BeO	W	W	Attacks W. Films hard, smooth. Use gentle preheat to outgas.
Iron Bromide	Fe Br ₂	689	4.64			561		Fe			
Iron Chloride	FeCl ₂	670	2.98	Subl.	Subl.	300 Subl.		Fe			
Iron Iodide	FeI ₂	592	5.31			400		Fe			
Iron Oxide	FeO	1425	5.7				Poor				Decomposes; sputtering preferred.
Iron Oxide	Fe ₂ O ₃	1565	5.24				Good			W	Disproportionates to Fe ₃ O ₄ at 1530 °C, n=3.0
Iron Sulphide	FeS	1195	4.84					Al ₂ O ₃			Decomposes.
Kanthal	FeCrAl	1500	7.1			~1150			W	W	
Lanthanum	La	920	6.17	990	1212	1388	XInt.	Al ₂ O ₃		W, Ta	Films will burn in air if scraped.
Lanthanum Boride	LaB ₆	2210	2.61				Good				
Lanthanum Bromide	LaBr ₃	783	5.06								n=1.94 Hygroscopic
Lanthanum Fluoride	LaF ₃	1490	6	Subl.	Subl.	900 Subl.	Good			Ta, Mo	No decomposition. n=1.59 at 0.55μ
Lanthanum Oxide	La ₂ O ₃	2250	5.84			1400	Good			W, Ta	Loses oxygen. n=1.9 at 0.5μ
Lead	Pb	328	11.34	342	427	497	XInt.	Al ₂ O ₃ Quartz	W	W, Mo	Toxic. Carefully controlled rates req'd for superconductors.
Lead Bromide	PbBr ₂	373	6.66			~300					
Lead Chloride	PbCl ₂	501	5.85			~325		Al ₂ O ₃		Pt	Little decomposition. n=2.2
Lead Fluoride	PbF ₂	822	8.24	Subl.	Subl.	~400 Subl.		BeO		W, Pt, Mo	Toxic. n=1.75 at 0.3μ
Lead Iodide	PbI ₂	502	6.16			~500		Quartz		Pt	n=2.7
Lead Oxide	PbO	890	9.53			~550		Quartz Al ₂ O ₃		Pt	No decomposition. n=2.55
Lead Stannate	PbSnO ₃	1115	8.1	670	780	905	Poor	Al ₂ O ₃		Pt	Disproportionates.



Lead Selenide	PbSe	1065	8.1	Subl.	Subl.	~500 Subl.		Graphite Al ₂ O ₃		W, Mo	
Lead Sulphide	PbS	1114	7.5	Subl.	Subl.	550 Subl.		Quartz Al ₂ O ₃		W	Little decomposition. n=3.91
Lead Telluride	PbTe	917	8.16	780	910	1050		Al ₂ O ₃ Graphite		Mo, Pt, Ta	Vapors toxic. Deposits Te rich. Sputtering preferred, or co-evaporate from sources. n=5.6 at 5μ
Lead Titanate	PbTiO ₃		7.52							Ta	
Lithium	Li	179	0.53	227	307	407	Good	Al ₂ O ₃ BeO		Ta, S.S.	Metal reacts violently in air.
Lithium Bromide	LiBr	547	3.46			~500				Ni	n=1.78
Lithium Chloride	LiCl	613	2.07			400				Ni	Use gentle preheat for outgas. n=1.66
Lithium Fluoride	LiF	870	2.6	875	1020	1180	Good	Al ₂ O ₃		Ni, Ta, Mo, W	Rate control important for optical films. Use gentle preheat for outgas. n=1.36
Lithium Iodide	LiI	446	4.06			400				Mo, W	
Lithium Oxide	Li ₂ O	1427	2.01			850				Pt, Ir	n=1.64
Lutetium	Lu	1652	9.84			1300	XInt.	Al ₂ O ₃		Ta	
Lutetium Oxide	Lu ₂ O ₃	2489	9.41			1400				Ir	Decomposes.
Magnesium	Mg	651	1.74	185 Subl.	247 Subl.	327 Subl.	Good	Al ₂ O ₃ Vit. Carbon	W	W, Mo Ta, Cb	Extremely high rates possible.
Magnesium Aluminate	MgAl ₂ O ₄	2135	3.6				Good				Natural spinel.
Magnesium Bromide	MgBr ₂	700	3.72			~450				Ni	Decomposes.
Magnesium Chloride	MgCl ₂	708	2.32			400				Ni	Decomposes. n=1.6
Magnesium Fluoride	MgF ₂	1266	2.9-3.2			1000	XInt.	Al ₂ O ₃		Mo, Ta	Rate control and substrate heat important for optical films. n=1.38
Magnesium Iodide	MgI ₂	700	4.24			200				Ir	
Magnesium Oxide	MgO	2800	3.58			1300	Good	Carbon Al ₂ O ₃			W produces volatile oxides. n=1.7.
Manganese	Mn	1244	7.2	507 Subl.	572 Subl.	647 Subl.	Good	Al ₂ O ₃ BeO	W	W, Ta, Mo	
Manganese Bromide	MnBr ₂	695	4.38			500				Inconel	



Niobium Carbide	NbC	3800	7.82				Fair				
Niobium Nitride	NbN	2573	8.4								Reactive, evaporate Nb in 10 ⁻³ N ₂ .
Niobium Oxide	NbO		6.27			1100				Pt	
Niobium Pentoxide	Nb ₂ O ₅	1530	4.47							W	n=2.3
Niobium Telluride	NbTe _x		7.6								Composition variable.
Niobium-Tin	Nb ₃ Sn						XInt.				Co-evaporate from 2 sources.
Niobium Trioxide	Nb ₂ O ₃	1780	7.5							W	
Osmium	Os	1700	22.5	2170	2340	2760	Fair				
Palladium	Pd	1550	12.4	842	992	1192	XInt.	Al ₂ O ₃ BeO	W	W	Alloys with refractory metals; rapid evaporation suggested. Spits in EB.
Palladium Oxide	PdO	870	8.31			575		Al ₂ O ₃			Decomposes.
Parylene (Union Carbide)	C ₈ H ₈	300-400	1.1								Vapor depositable plastic
Permalloy	Ni/Fe	1395	8.7	947	1047	1307	Good	Al ₂ O ₃ Vit. Carbon		W	Film low in Ni content. Use 84% Ni source.
Phosphorus	P	41.4	1.82	327	361	402		Al ₂ O ₃			Metal reacts violently in air.
Platinum	Pt	1769	21.45	1292	1492	1747	XInt.	C, ThO ₂	W	W	Alloys with metals. Films soft, poor adhesion.
Plutonium	Pu	635	19							W	Toxic, radioactive.
Polonium	Po	254	9.4	117	170	244		Quartz			Radioactive
Potassium	K	64	0.86	23	60	125		Quartz		Mo	Metal reacts violently in air. Use gentle preheat to outgas.
Potassium Bromide	KBr	730	2.75			~450		Quartz		Ta, Mo	Use gentle preheat to outgas. n=1.56
Potassium Chloride	KCl	776	1.98			510	Good			Ta, Ni	Use gentle preheat to outgas. n=1.49
Potassium Fluoride	KF	880	2.48			~500	Poor	Quartz			Use gentle preheat to outgas. n=1.35
Potassium Hydroxide	KOH	360	2.04			~400				Pt	Use gentle preheat to outgas.
Potassium Iodide	KI	723	3.13			~500				Ta	Use gentle preheat to outgas. n=1.68
Praseodymium	Pr	931	6.78	800	950	1150	Good			Ta	



Praseodymium Oxide	Pr ₂ O ₃	2125	6.88			1400	Good	ThO ₂		Ir	Loses oxygen. n=2.0
Radium	Ra	700	5	246	320	416					
Rhenium	Re	3180	20.53	1928	2207	2571	Poor				Fine wire will self-evaporate.
Rhenium Oxide	Re ₂ O ₇	297	8.2			~100					
Rhodium	Rh	1966	12.41	1277	1472	1707	Good	ThO ₂ Vit. Carbon	W	W	EB gun preferred.
Rubidium	Rb	38.5	1.47	-3	37	111		Quartz			
Rubidium Chloride	RbCl	715	2.76			~550		Quartz			n=1.49
Rubidium Iodide	RbI	642	3.55			~400		Quartz			
Ruthenium	Ru	2700	12.45	1780	1990	2260	Poor			W	Spits violently in EB. Requires degas.
Samarium	Sm	1072	7.54	373	460	573	Good	Al ₂ O ₃		Ta	
Samarium Oxide	Sm ₂ O ₃	2350	7.43				Good	ThO ₂		Ir	Loses O ₂ . Films smooth, clear.
Samarium Sulphide	Sm ₂ S ₃	1900	5.72				Good				
Scandium	Sc	1539	2.99	714	837	1002	XInt.	Al ₂ O ₃ BeO		W	Alloys with Ta
Scandium Oxide	Sc ₂ O ₃	2300	3.86			~400	Fair				Loses oxygen. n=1.88 at 0.5μ
Selenium	Se	217	4.79	89	125	170	Good	Al ₂ O ₃ Vit. Carbon	W Mo	W, Mo	Toxic. Poisons vacuum systems.
Silicon	Si	1410	2.42	992	1147	1337	Fair	BeO Ta Vit. Carbon		W Ta	Alloys with W; use heavy W boat. SiO produced above 4 x 10 ⁻⁶ Torr. EB best. n=3.42
Silicon Boride	SiB ₆		2.47				Poor				
Silicon Carbide	SiC	2700	3.22			1000					Sputtering preferred.
Silicon Dioxide	SiO ₂	1610-1710	2.2-2.7			~1025	XInt.	Al ₂ O ₃			Quartz excellent in EB. n=1.47
Silicon Monoxide	SiO	1702	2.1	Subl.	Subl.	850 Subl.	Fair	Ta	W	Ta	Baffle box source best for resistance evaporation. Low rate suggested. n=1.6
Silicon Nitride	Si ₃ N ₄	Subl.	3.44			~800					n=2.1
Silicon Selenide	SiSe					550		Quartz			



Silicon Sulphide	SiS	Subl.	1.85			450		Quartz			
Silicon Telluride	SiTe ₂		4.39			550		Quartz			
Silver	Ag	961	10.49	847	958	1105	XInt.	Al ₂ O ₃ Mo	W	Ta Mo	Evaporates well from any source.
Silver Bromide	AgBr	432	6.47			~380		Quartz		Ta	n=2.25
Silver Chloride	AgCl	455	5.56			~520		Quartz		Mo, Pt	n=2.07
Silver Iodide	AgI	558	5.67			~500				Ta	n=2.21
Sodium	Na	97	0.97	74	124	192		Quartz		Ta, S.S.	Use gentle preheat to outgas. Metal reacts violently in air.
Sodium Bromide	NaBr	755	3.2			~400		Quartz			Use gentle preheat to outgas. n=1.64
Sodium Chloride	NaCl	801	2.16			530	Good	Quartz		Ta, W, Mo	Cu ovens, little decomposition. Use gentle preheat to outgas. n=1.54
Sodium Cyanide	NaCN	563				~550				Ag	Use gentle preheat to outgas. n=1.45
Sodium Fluoride	NaF	988	2.79			~700	Good	BeO		Mo, Ta, W	Use gentle preheat to outgas. No decomposition. n=1.30 at 0.55μ.
Sodium Hydroxide	NaOH	318	2.13			~470				Pt	Use gentle preheat to outgas. n=1.36
Spinel	MgO ₃ 5Al ₂ O ₃		8				Good				n=1.72
Strontium	Sr	769	2.6	239	309	403	Poor	Vit. Carbon	W	W, Ta, Mo	Wets but does not alloy with refractory metals. May react violently in air.
Strontium Fluoride	SrF ₂	1190	4.24			~1000		Al ₂ O ₃			n=1.44
Strontium Oxide	SrO	2460	4.7	Subl.	Subl.	1500 Subl.		Al ₂ O ₃		Mo	Reacts with Mo and W; n=1.87
Strontium Sulphide	SrS	Above 2000	3.7							Mo	Decomposes. n=2.11
Sulphur	S ₈	115	2	13	19	57	Poor	Quartz		W	Poisons vacuum system.
Superalloy	Ni/Fe/Mo	1410	8.9				Good				Sputtering preferred; or co-evaporate from 2 sources, Permalloy and Mo.
Tantalum	Ta	2996	16.6	1960	2240	2590	XInt.				Forms good films.
Tantalum Boride	TaB ₂	3000	12.38								
Tantalum Carbide	TaC	3880	14.65			~2500					
Tantalum Nitride	TaN	3360	16.3								Reactive; evaporate Ta in 10 ⁻³ N ₂ .



Tantalum Pentoxide	Ta ₂ O ₅	1800	8.74	1550	1780	1920	Good	Vit. Carbon	W	Ta	Slight decomposition; evaporate in 10 ⁻³ Torr of O ₂ . n=2.0 at 1.5μ
Tantalum Sulphide	TaS ₂	1300									
Technetium	Tc	2200	11.5	1570	1800	2090					
Teflon	PTFE	330	2.9							W	Baffled Source. Film structure doubtful.
Tellurium	Te	452	6.25	157	207	277	Poor	Al ₂ O ₃ Quartz	W	W, Ta	Wets w/o alloying. Toxic.
Terbium	Tb	1357	8.27	800	950	1150	XInt.	Al ₂ O ₃		Ta	
Terbium Fluoride	TbF ₃	1176				~800					
Terbium Oxide	Tb ₂ O ₃	2387	7.87			1300				Ir	Partially decomposes.
Terbium Oxide	Tb ₄ O ₇									Ta	Films TbO.
Thallium	Tl	302	11.85	280	360	470	Poor	Al ₂ O ₃ Quartz		W, Ta	Wets freely, very toxic.
Thallium Bromide	TlBr	480	7.56	Subl.	Subl.	~250 Subl.		Quartz		Ta	Toxic. n=2.3
Thallium Chloride	TlCl	430	7	Subl.	Subl.	~150 Subl.		Quartz		Ta	Toxic. n=2.25
Thallium Iodide (B)	TlI	440	7.09	Subl.	Subl.	~250 Subl.		Quartz			Toxic. n=2.78
Thallium Oxide	Tl ₂ O ₃	717	9.65			350					Toxic, Goes to Tl ₂ O at 850 °C
Thorium	Th	1875	11.7	1430	1660	1925	XInt.		W	W, Ta, Mo	Toxic, radioactive.
Thorium Bromide	ThBr ₄		5.67	Subl.	Subl.	Subl.				Mo	Toxic, n=2.47 at 5μ
Thorium Carbide	ThC ₂	2773	8.96			~2300		Carbon			Radioactive
Thorium Dioxide	ThO ₂	3050	10.03			~2100	Good			W	Radioactive. n=1.86 at 2.2 microns
Thorium Fluoride	ThF ₄	1110	6.3			~750	Fair	Vit. Carbon		Mo	Radioactive. n=1.52. Heat substrate to above 150°C.
Thorium Oxyfluoride	ThOF ₂	900	9.1							Mo, Ta	Radioactive, n=1.52
Thorium Sulphide	ThS ₂		6.8								Sputtering preferred; or co-evaporate from 2 sources.
Thulium	Tm	1545	9.32	461 Subl.	554 Subl.	680 Subl.	Good	Al ₂ O ₃		Ta	
Thulium Oxide	Tm ₂ O ₃		8.9			1500				Ir	Decomposes.



Tin	Sn	232	7.75	682	807	997	XInt.	Al ₂ O ₃	W	Mo	Wets Mo; use a Ta liner in EB guns.
Tin Oxide	SnO ₂	1127	6.95	Subl.	Subl.	~1000 Subl.	XInt.	Quartz Al ₂ O ₃	W	W	Films from W oxygen deficient, oxidize in air. n=2.0
Tin Selenide	SnSe	861	6.18			~400	Good	Quartz			
Tin Sulphide	SnS	882	5.08			~450		Quartz			
Tin Telluride	SnTe	780	6.44			~450		Quartz			
Titanium	Ti	1675	4.5	1067	1235	1453	XInt.	TiC		W	Alloys with refractory metals; evolves gas on first heating.
Titanium Boride	TiB ₂	2980	4.5				Poor				
Titanium Carbide	TiC	3140	4.93			~2300					
Titanium Dioxide (rutile)	TiO ₂	1640	4.29			~1300	Fair			W, Mo	Evaporate in 10-4 of O ₂ onto 350° substrates. n=2.4
Titanium Monoxide	TiO	1750	4.93			~1500	Good	Vit. Carbon		W, Mo	Use gentle preheat to outgas. Films TiO ₂ if evaporated like TiO ₂ ; n=2.2
Titanium Nitride	TiN	2930	5.43				Good			Mo	Sputtering preferred. Decomposes with thermal evaporation.
Titanium Sesquioxide	Ti ₂ O ₃	2130	4.6				Good			W	Decomposes.
Tungsten	W	3410	19.3	2117	2407	2757	Good				Forms volatile oxides. Films hard & adherent.
Tungsten Boride	WB ₂	2900	12.75				Poor				
Tungsten Carbide	W ₂ C	2860	17.15	1480	1720	2120	XInt.			C	
Tungsten Telluride	WTe ₃		9.49					Quartz			
Tungsten Trioxide	WO ₃	1473	7.16	Subl.	Subl.	980 Subl.	Good			W, Pt	Use gentle preheat to outgas. W reduces oxide slightly. n=1.68
Uranium	U	1132	19.07	1132	1327	1582	Good		W	Mo, W	Films oxidize.
Uranium Carbide	UC ₂	2260	11.28			2100		Carbon			Decomposes.
Uranium Dioxide	UO ₂	2176	10.9							W	Ta causes decomposition
Uranium Fluoride	UF ₄	~1000				300				Ni	
Uranium Oxide	U ₃ O ₈	Dec	8.3							W	Decomposes at 1300°C to UO ₂
Uranium Phosphide	UP ₂		8.57			1200				Ta	Decomposes



Uranium Sulphide	U ₂ S ₃					1400				W	Slight decomposition
Vanadium	V	1890	5.96	1162	1332	1547	XInt.			W, Mo	Wets Mo. EB evaporated films preferred.
Vanadium Boride	VB ₂	2400	5.1								
Vanadium Carbide	VC	2810	5.77			~1800					
Vanadium Dioxide	VO ₂	1967	4.34	Subl.	Subl.	~575					Deposit metal in 1 x 10 ⁻³ O ₂
Vanadium Nitride	VN	2320	6.13								
Vanadium Pentoxide	V ₂ O ₅	690	3.36			~500		Quartz			
Vanadium Silicide	VSi ₂	1700	4.42								
Ytterbium	Yb	824	6.98	520 Subl.	590 Subl.	690 Subl.	Good			Ta	
Ytterbium Fluoride	YbF ₃	1157	8.17			~800				Mo	n=1.57 at 3.8μ
Ytterbium Oxide	Yb ₂ O ₃	2346	9.17	Subl.	Subl.	~1500				Ir	Loses oxygen.
Yttrium	Y	1509	4.48	830	973	1157	XInt.	Al ₂ O ₃	W	W, Ta	High Ta solubility.
Yttrium Aluminum Oxide	Y ₃ Al ₅ O ₁₂	1990					Good		W		Films not ferroelectric
Yttrium Fluoride	YF ₃	1387	4.01								
Yttrium Oxide	Y ₂ O ₃	2680	4.84	Subl.	Subl.	~2000	Good	C		W	Loses oxygen, films smooth and clear. n=1.79 at 1μ
Zinc	Zn	419	7.14	127	177	250	XInt.	Al ₂ O ₃ Quartz	W	Mo, W, Ta	Evaporates well under wide range of conditions.
Zinc Antimonide	Zn ₃ Sb ₂	546	6.3								
Zinc Bromide	ZnBr ₂	394	4.22			~300		Carbon		W	Decomposes.
Zinc Fluoride	ZnF ₂	872	4.84			~800		Quartz		Pt, Ta	
Zinc Nitride	Zn ₃ N ₂		6.22							Mo	Decomposes.
Zinc Oxide	ZnO	1975	5.61			~1800	Fair				Anneal in air at 450°C to reoxidize; n=2.0
Zinc Selenide	ZnSe	1526	5.42			660		Quartz	W Mo	Ta, W, Mo	Use gentle preheat to outgas. Evaporates well, n=2.6



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Zinc Sulphide	ZnS	1830	4.09	Subl.	Subl.	~800 Subl.	Good			Ta, Mo	Use gentle preheat to outgas. Films partially decompose. Sticking coefficient varies with substrate temperature. n=2.3 at 0.5 μ
Zinc Telluride	ZnTe	1238	6.34			~600				Mo, Ta	Use gentle preheat to outgas. n=2.85 at 0.5 μ
Zircon	ZrSiO ₄	2550	4.56								
Zirconium	Zr	1852	6.4	1477	1702	1987	XInt.			W	Alloys with W. Films oxidize readily.
Zirconium Boride	ZrB ₂	3040	6.08				Good				
Zirconium Carbide	ZrC	3540	6.73			~2500					
Zirconium Nitride	ZrN	2980	7.09								Reactively evaporate in 10 ⁻³ N ₂ atmosphere.
Zirconium Oxide	ZrO ₂	2700	5.49			~2200	Good			W	Films oxygen deficient, clear, and hard. n=2.05 at 0.75 μ
Zirconium Silicide	ZrSi ₂	1700	4.88								