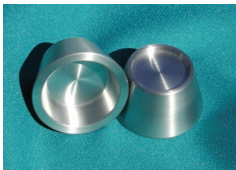


Thin Film Evaporation Guide



This guide was prepared by Edward Graper of Lebow Corporation, and has been made available to assist customers of Vacuum Engineering & Materials, Inc.

In the preparation of this guide, every effort was made to ensure accuracy, completeness and clarity. Unfortunately, in a work of this scope errors are inevitable. Neither Edward Graper nor Lebow Corporation nor Vacuum Engineering & Materials warrants the complete accuracy of this information or the results of its application. Therefore, this information should be used as a general guide and certainly at your own risk. It is recommended that you use a second, independent source for very critical data.

This guide may not be reproduced in any way without written permission from Lebow Corporation and Vacuum Engineering & Materials, Inc.

Vacuum Engineering & Materials Co., Inc.

390 Reed Street
Santa Clara, CA 95050
USA

Toll Free: 877-986-8900
Phone: 408-871-9900
Fax: 408-562-9125
E-mail: info@vem-co.com

ISO 9001: 2008 Registered

Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Aluminum	Al	660	2.7	1.08	677	821	1010	eBeam (XInt), Thermal	TiB2-BN, ZrB2, BN	TiB2,W	Alloys and wets. Fill Boat 2/3.
Aluminum Antimonide	AlSb	1080	4.3	--	--	--	--	--	--	--	--
Aluminum Arsenide	AlAs	1600	3.7	--	--	--	~1300	--	--	--	--
Aluminum Bromide	AlBr3	97	3.01	--	--	--	~50	--	G	Mo	--
Aluminum Carbide	Al4C3	1400	2.36	--	--	--	~800	ebeam (Fair)	--	--	n = 2.7
Aluminum 2% Copper	Al2%Cu	640	2.8	--	--	--	--	--	--	--	Wire feed and flash. Difficult from dual sources
Aluminum Fluoride	AlF3	1257	3.07	--	410	490	700	eBeam (Poor)	G	Mo, W	n = 1.38 @ .55µ
		sublimes			sublimes						
Aluminum Nitride	AlN	--	3.26	--	--	--	~1750	ebeam (Fair)	--	--	Decomposes. Reactive evaporate in 10-3 N2 with glow discharge.
		sublimes			sublimes						
Aluminum Oxide (Alumina)	Al2O3	2045	3.97	0.336	--	--	1550	eBeam (XInt), sputter	--	W	Sapphire xint in ebeam, forms smooth, hard films. n=1.66
Aluminum 2% Silicon	Al2%Si	640	2.6	--	--	--	1010	--	TiB2-BN	--	Wire feed and flash. Difficult from dual sources.
Antimony	Sb	630	6.68	--	279	345	425	eBeam (Poor)	BN, C, Al2O3	Mo, Ta, Al2O3 Coated	Toxic. Evaporates well. Film structure is rate-dependent.
					sublimes						
Antimony Telluride	Sb2Te3	619	6.5	--	--	--	600	--	C	--	Decomposes over 750 ° C
Antimony Trioxide	Sb2O3	656	5.2 or 5.76	--	--	--	~300	eBeam (Good)	BN, Al2O3	Pt	Toxic. Decomposes on W. n = 2.05
					sublimes						
Antimony Triselenide	Sb2Se3	611	--	--	--	--	--	--	C	Ta	Stoichiometry variable
Antimony Trisulphide	Sb2S3	550	4.64	--	--	--	~200	ebeam (Good)	Al2O3	Mo, Ta	n = 3.01 @.55µ No Decomposition.
Arsenic	As	814	5.73	--	107	150	210	eBeam (Poor)	Al2O3, BeO, VC	C	Toxic. Sublimes rapidly at low temperature.
					sublimes						
Arsenic Selenide	As2Se3	360	4.75	--	--	--	--	--	Al2O3, Quartz	--	n = 2.41 @3.8µ JVST 10, 748(1973)
Arsenic Trisulphide	As2S3	300	3.43	--	--	--	~400	ebeam (Fair)	Al2O3, Quartz	Mo	n = 2.8 JVST 10, 748(1973)
Arsenic Tritelluride	As2Te3	362	--	--	--	--	--	--	--	Flash	JVST 10, 748(1975)
Barium	Ba	710	3.78	--	545	627	735	eBeam (Fair)	Metals	W, Ta, Mo	Wets w/o alloying - reacts with ceramics.
Barium Chloride	BaCl2	962	3.86	--	--	--	~650	--	--	Ta, Mo	use general preheat to outgas.
Barium Fluoride	BaF2	1280	4.83	--	--	--	~700	eBeam (Good)	--	Mo	n = 1.29 @5µ JVST 21, 2052 (1982) Density Rate Dependent
					sublimes						
Barium Oxide	BaO	1923	5.72 or 5.32	--	--	--	~1300	ebeam (Poor)	Al2O3	Pt	Decomposes slightly. n = 1.98
Barium Sulphide	BaS	2200	4.25	--	--	--	1100	--	--	Mo	n = 2.16
Barium Titanate	BaTiO3	Decomposes	6	--	Decomposes			--	--	--	Decomposes, yields free Ba from single source; sputtering preferred; or co-evaporate from 2 sources
Beryllium	Be	1278	1.85	--	710	878	1000	eBeam (XInt)	BeO, C, Vit. Carbon	W, Ta	Wets W/Mo/Ta. Metal powder and oxides are toxic. Evaporates easily.
Beryllium Chloride	BeCl2	440	1.9	--	--	--	~150	--	--	--	--
Beryllium Fluoride	BeF2	800	1.99	--	--	--	~200	eBeam (Good)	--	--	Toxic.
					sublimes						
Beryllium Oxide	BeO	2530	3.01	--	--	--	1900	ebeam (Good)	--	--	Powders toxic. No decomposition from EB guns. n = 1.72
Bismuth	Bi	271	9.8	--	330	410	520	eBeam (XInt)	Al2O3, VC	W, Mo, Al2O3, Ta	Vapors are toxic. High resistivity. No shorting of baskets.



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Bismuth Fluoride	BiF3	727	8.75	--	--	--	~300	--	G	--	n = 1.74 @ 1μ, 1.64 @ 10μ App. Opt. 18, 105 (1979)
					sublimes						
Bismuth Oxide	Bi2O3	820	8.9	--	--	--	~1400	ebeam (Poor)	--	Pt	Vapors are toxic. n = 2.55. JVST 12, 63 (1975)
Bismuth Selenide	Bi2Se3	710	7.66	--	--	--	~650	ebeam (Good)	G, Quartz	--	Sputtering preferred; co-evaporate from 2 sources.
Bismuth Telluride	Bi2Te3	585	7.85	--	--	--	~600	--	G, Quartz	W, Mo	Sputtering preferred; co-evaporate from 2 sources.
Bismuth Titanate	Bi2Ti2O7	--	--	--	Decomposes			--	--	--	Decomposes. Sputtering preferred; or co-evaporate from 2 sources in 10-2O2.
Bismuth Trisulphide	Bi2S3	685	7.39	--	--	--	--	--	--	--	n = 1.5
Boron	B	2100	2.36	0.389	1278	1548	1797	eBeam (XInt), sputter	C, VC	C	Material explodes with rapid cooling. Forms carbide with container.
					sublimes						
Boron Carbide	B4C	2350	2.5	--	2500	2580	2650	ebeam (xInt)	--	--	similar to Chromium.
Boron Nitride	BN	2300	2.2	--	--	--	~1600	eBeam (Poor)	--	--	Sputtering preferred; Decomposes.
					sublimes						
Boron Oxide	B2O3	460	1.82	--	--	--	~1400	ebeam (Good)	--	Pt, Mo	n = 1.46
Boron Trisulphide	B2S3	310	1.55	--	--	--	800	--	G	--	--
Cadmium	Cd	321	8.64	--	64	120	180	ebeam (Poor)	Al2O3, Quartz	W, Cb, Mo, Ta	Poisons vacuum systems, low sticking coefficient.
Cadmium Antimonide	CdSb	456	6.92	--	--	--	--	--	--	--	--
Cadmium Arsenide	Cd3As2	721	6.21	--	--	--	--	--	Quartz	--	--
Cadmium Bromide	CdBr2	567	5.19	--	--	--	~300	--	--	--	--
Cadmium Chloride	CdCl2	570	4.05	--	--	--	~400	--	--	--	--
Cadmium Fluoride	CdF2	1070	6.64	--	--	--	~500	--	--	--	n = 1.56
Cadmium Iodide	CdI2	400	5.3	--	--	--	~250	--	--	--	--
Cadmium Oxide	CdO	900	6.95	--	--	--	~530	--	--	--	Disproportionates. n = 2.49
Cadmium Selenide	CdSe	1264	5.81	--	--	--	540	eBeam (Good)	Al2O3, Quartz	Mo, Ta	Evaporates easily. n = 2.4 @ 6μ
					sublimes						
Cadmium Silicide	CdSiO2	--	--	--	--	--	~600	--	--	--	Disproportionates. n = 1.69
Cadmium Sulphide	CdS	1750	4.82	--	--	--	550	eBeam (Fair)	Al2O3, Quartz	W, Mo, Ta	Sticking Coefficient strongly affected by substrate temperature. Stoichiometry variable. n = 2.4. JVST 12, 188(1975)
					sublimes						
Cadmium Telluride	CdTe	1098	6.2	--	--	--	450	--	--	W, Mo, Ta	Stoichiometry depends in substrate temperature. n = 2.6.
Calcium	Ca	842	1.55	--	272	357	459	eBeam (Poor)	Al2O3, Quartz	W	Corrodes in air.
					sublimes						
Calcium Fluoride	CaF2	1360	3.18	--	--	--	~1100	ebeam (XInt)	Quartz	W, Mo, Ta	Rate control important. Use gentle preheat to outgas. n = 1.2-1.4
Calcium Oxide	CaO	2580	3.35	--	--	--	~1700	--	ZrO2	W, Mo	Forms volatile oxides with W and Mo. n = 1.84.
Calcium Silicate	CaO - SiO2	1540	2.9	--	--	--	--	ebeam(Good)	Quartz	--	n = 1.61
Calcium Sulphide	CaS	--	2.18	--	--	--	1100	--	--	Mo	Decomposes. n = 2.14
		sublimes									
Calcium Titanate	CaTiO3	1975	4.1	--	1490	1600	1690	ebeam (Poor)	--	--	Disproportionates except in sputtering.
Calcium Tungstate	CaWO4	1620	6.06	--	--	--	--	ebeam (Good)	--	W	n = 1.92



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Carbon (diamond)	C	--	1.8-2.3	0.22	1657	1867	2137	eBeam (XInt), sputter	--	--	EB preferred. Arc evaporation. Poor film adhesion. Sublimes. Vitreous carbon n = 1.47
		sublimes			sublimes						
Cerium	Ce	795	8.23	--	970	1150	1380	ebeam (Good)	Al2O3, BeO, VC	W, Ta	Films oxidize easily.
Ceric Oxide	CeO2	2600	7.3	--	1890	2000	2310	eBeam (Good)	--	W	Use 250-300° C substrate temperature. n = 2.2 - 2.4. Reacts with W.
					sublimes						
Cerium Fluoride	CeF3	1418	6.16	--	--	--	-900	ebeam (Good)	--	W, Mo, Ta	Use gentle preheat to outgas. n = 1.63@ .55µ
Cerium Oxide	Ce2O3	1692	6.87	--	--	--	--	ebeam (Fair)	--	W	Alloys with source; use .015-.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	Na5Al3F14	--	2.9	--	--	--	-800	--	--	Mo, W	n = 1.33
Chromium	Cr	1890	7.2	0.305	837	977	1157	eBeam (Good), Thermal	VC	W, Cr rod or strip	Films very adherent. High rates possible.
					sublimes						
Chromium Boride	CrB	2760	6.17	--	--	--	--	--	--	--	--
Chromium Bromide	CrBr2	842	4.36	--	--	--	550	--	--	Inconel	--
Chromium Carbide	Cr3C2	1890	6.68	--	--	--	-2000	ebeam (Fair)	--	W	--
Chromium Chloride	CrCl2	824	2.75	--	--	--	550	--	--	Fe, Inconel	Sublimes easily.
Chromium Oxide	Cr2O3	2435	5.21	--	--	--	-2000	ebeam (Good)	--	W, Mo	Disproportionates to lower oxides, reoxidizes @600° C in air. n = 2.4
Chromium Silicide	Cr3Si	1710	6.51	--	--	--	--	--	--	--	--
Chromium Silicon Monoxide	Cr-SiO	Influenced by Composition						ebeam (Good)	--	W	Flash
Cobalt	Co	1495	8.9	--	850	990	1200	eBeam (XInt)	Al2O3, BeO	W, Cb	Alloys with refractory metals.
Cobalt Bromide	CoBr2	678	4.91	--	--	--	400	--	--	Inconel	--
					sublimes						
Cobalt Chloride	CoCl2	740	3.36	--	--	--	472	--	--	Inconel	--
					sublimes						
Cobalt Oxide	CoO	1935	5.68	--	--	--	--	--	--	--	Sputtering preferred.
Copper	Cu	1083	8.92	0.437	727	857	1017	eBeam (XInt)	Al2O3, Mo, Ta	W, Mo	Films do not adhere well. Use intermediate layer, e.g. Chromium. Evaporates from any source material.
								Thermal			
Copper Chloride	CuCl	422	3.53	--	--	--	-600	--	--	--	n = 1.93
Copper Oxide	Cu2O	1235	6	--	--	--	-600	eBeam (Good), Thermal	Al2O3		Evaporate in 10-2-10-4 of O2; n = 2.70. J. Electrochem. Soc. 110, 119(1967)
					sublimes						
Copper Sulfide	CuS	1113	6.75	--	--	--	-500	--	--	--	n = 1.45
					sublimes						



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Cryolite	Na3AlF6	1000	2.9	--	1020	1260	1480	eBeam (XInt)	VC	W, Mo, Ta	Large chunks reduce spitting. Little decomposition. n = 2.34 at 6330A App. Opt. 15, 1969(1976)
Dysprosium	Dy	1409	8.54	--	625	750	900	ebeam (Good)	--	Ta	--
Dysprosium Fluoride	DyF3	1360	6	--	--	--	~800	eBeam (Good)	--	Ta	--
Dysprosium Oxide	Dy2O3	2340	7.81	--	--	--	~1400	--	--	Ir	Loses Oxygen.
Erbium	Er	1497	9.06	0.74	650	775	930	eBeam (good), Thermal	--	W,Ta	Sublimes
Erbium Fluoride	ErF3	1350	7.81	--	--	--	~750	--	--	Mo	JVST A3 (6) 2320
Erbium Oxide	Er2O3	2400	8.64	--	--	--	~1600	--	--	Ir	Loses Oxygen.
Europium	Eu	822	5.26	--	280	360	480	eBeam (Fair)	Al2O3	W,Ta	Low Tantalum solubility.
Europium Fluoride	EuF2	1380	6.5	--	--	--	~950	--	--	Mo	--
Europium Oxide	Eu2O3	2056	7.42	--	--	--	~1600	ebeam (Good)	ThO2	Ir, Ta, W	Loses Oxygen; films clear and hard.
Europium Sulphide	EuS	--	5.75	--	--	--	--	ebeam (Good)	--	--	--
Gadolinium	Gd	1312	7.89	--	760	900	1175	ebeam (XInt)	Al2O3	Ta	High Ta solubility.
Gadolinium Oxide	Gd2O3	2310	7.41	--	--	--	--	ebeam (Fair)	--	Ir	Loses Oxygen; n = 1.8 @ .55µ
Gallium	Ga	30	5.9	--	619	742	907	ebeam (Good)	Al2O3, BeO, Quartz	--	Alloys with refractory metals. Use EB gun.
Gallium Atimonide	GaSb	710	5.6	--	--	--	--	ebeam (Fair)	--	W, Ta	Flash Evaporate.
Gallium Arsenide	GaAs	1238	5.3	--	--	--	--	ebeam (Good)	Carbon	W, Ta	Flash Evaporate. n = 5.64 @ 10.6µ
Gallium Nitride	GaN	--	6.1	--	--	--	~200	Al2O3	--	--	Evaporate Ga in 10-3 N2.
Gallium Oxide (β)	Ga2O3	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	0.516	812	957	1167	eBeam (XInt)	--	W, C, Ta	Excellent films from EB sources. Use .040 W. n = 4.01
Germanium Nitride	Ge3N2	450	5.2	--	--	--	~650	--	--	--	Sputtering preferred.
Germanium Oxide	GeO2	1086	6.24	--	--	--	~625	ebeam(Good)	Quartz, Al2O3	Ta, Mo	Similar to SiO, film predominantly GeO.
Germanium Telluride	GeTe	725	6.2	--	--	--	381	--	Quartz, Al2O3	W, Mo	--
Glass Schott 8329	--	--	2.2	--	--	--	--	ebeam (XInt)	--	--	Evaporable alkali glass. Melt in air before evaporating. n = 1.47.
Gold	Au	1062	19.32	0.381	807	947	1132	eBeam (XInt), Thermal	BN, Al2O3, VC	W, Mo, Al2O3	May not adhere well. Films soft.
Hafnium	Hf	2230	13.09	--	2160	2250	3090	eBeam (Good)	--	--	--
Hafnium Boride	HfB2	3250	10.5	--	--	--	--	--	--	--	--
Hafnium Carbide	HfC	4160	12.2	--	--	--	~2600	--	--	--	--
Hafnium Nitride	HfN	2852	13.8	--	--	--	--	--	--	--	--
Hafnium Oxide	HfO2	2812	9.68	--	--	--	~2500	ebeam (Fair)	--	W	Film HfO n = 2.0 @ .5µ App. Opt. Apr. 1977



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Hafnium Silicide	HfSi2	1750	7.2	--	--	--	--	--	--	--	--
Holmium	Ho	1470	8.8	--	650	770	950	ebeam (Good)	--	W, Ta	--
			sublimes								
Holmium Fluoride	HoF3	1143	7.64	--	--	--	~800	--	Quartz	--	--
Holmium Oxide	Ho2O3	2370	8.41	--	--	--	--	--	--	Ir	Loses Oxygen.
Inconel	Ni/Cr/Fe	1425	8.5	--	--	--	--	ebeam (Good)	--	W	Use fine wire pre-wrapped on W. Low rate req'd. for smooth films.
Indium	In	157	7.3	0.841	487	597	742	eBeam (XInt)	G, Al2O3, Mo liner	W, Mo	Wets W and Cu. use Mo liner in gun.
Indium Antimonide	InSb	535	5.8	--	500	--	~400		--	--	W
Indium Arsenide	InAs	943	5.7	--	780	870	970	--	--	W	Toxic. Sputtering preferred; or co-evaporate from 2 sources; flash. n = 4.5 @ 1µ
Indium Oxide	In2O3	1565	7.18	--	--	--	~1200	ebeam (Good)	Al2O3	W, Pt	Film In2O; transparent conductor. JVST 12, 99(1975)
			sublimes								
Indium Phosphide	InP	1058	4.8	--	--	630	730	--	G	W, Ta	Deposits P. rich. Flash evaporate.
Indium Selenide	In2Se3	890	5.7	--	--	--	--	--	--	--	Sputtering preferred; or co-evaporate from 2 sources; flash.
Indium Sesquisulphide	In2S3	1050	4.9	--	--	--	850	--	G	--	Film In2S
			sublimes								
Indium Sulphide	In2S	653	5.87	--	--	--	650	--	G	--	--
Indium Telluride	In2Te3	667	5.8	--	--	--	--	--	--	--	Sputtering preferred; or co-evaporate from 2 sources; flash.
Indium Tin Oxide	In2O3-SnO2	1800	6.43-7.14	--	--	--	--	eBeam (good)	G	W, Mo	Sublimes. 90 In2O3:10 SnO2 wt%. anneal req. for transparency and improved conductivity.
Iridium	Ir	2459	22.65	--	1850	2080	2380	ebeam (Fair)	ThO2	--	--
Iron	Fe	1535	7.86	0.349	858	998	1180	eBeam (XInt)	BeO, Al2O3	W	Attacks Tungsten. Use gentle preheat to outgas. Films hard, smooth.
Iron Bromide	2-FeBr	689	4.64	--	--	--	561	--	Fe	--	--
Iron Chloride	FeCl2	670	2.98	--	--	--	300				
Iron Iodide	FeI2	592	5.31	--	--	--	400	--	Fe	--	--
Iron Oxide	FeO	1425	5.7	--	--	--	--	ebeam (Poor)	--	--	Decomposes; sputtering preferred.
Iron Oxide	Fe2O3	1565	5.24	--	--	--	--	ebeam (Good)	--	W	Disproportionates at Fe3O4 at 1530° C, n = 3.0
Iron Sulphide	FeS	1195	4.84	--	--	--	--	--	Al2O3	--	Decomposes.
Kanthal	FeCrAl	1500	7.1	--	--	--	~1150	--	--	W	JVST 7, 739(1980)
Lanthanum	La	920	6.17	--	990	1212	1388	ebeam (XInt)	Al2O3	W, Ta	Films will burn in air if Scraped.
Lanthanum Boride	LaB6	2210	2.61	--	--	--	--	ebeam (Good)	--	--	--
Lanthanum Bromide	LaBr3	783	5.06	--	--	--	--	--	--	--	n = 1.94 Hygroscopic
Lanthanum Fluoride	LaF3	1490	6	--	--	--	900	ebeam (Good)	--	Ta, Mo	No Decomposition. n = 1.59 @ .55µ
		sublimes.....								



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Lanthanum Oxide	La2O3	2250	5.84	--	--	--	1400	ebeam (Good)	--	W, Ta	Loses oxygen. n = 1.9 @ .5μ
Lead	Pb	328	11.34	1.13	342	427	497	eBeam (xInt), Thermal	Quartz, Al2O3	W, Mo	Toxic. Carefully controlled rates req'd. for superconductors.
Lead Bromide	PbBr2	373	6.66	--	--	--	~300	--	--	--	--
Lead Chloride	PbCl2	501	5.85	--	--	--	~325	--	Al2O3	Pt	Little decomposition. n = 2.2
Lead Fluoride	PbF2	822	8.24	--	--	--	~400	--	BeO	W, Pt, Mo	Toxic. n = 1.75 @ .3μ
Lead Iodide	PbI2	502	6.16	--	--	--	~500	--	Quartz	Pt	n = 2.7 J.Opt. Soci. 65, 914
Lead Oxide	PbO	890	9.53	--	--	--	~550	--	Quartz, Al2O3	Pt	No Decomposition. n = 2.55
Lead Stannate	PbSnO3	1115	8.1	--	670	780	905	ebeam (Poor)	Al2O3	Pt	Disproportionates.
Lead Selenide	PbSe	1065	8.1	--	--	--	~500	--	G, Al2O3	W, Mo	--
Lead Sulphide	PbS	1114	7.5	--	--	--	550	--	Quartz, Al2O3	W	Little Decomposition. n = 3.91
Lead Telluride	PbTe	917	8.16	--	780	910	1050	--	G, Al2O3	Mo, Pt, Ta	Vapors toxic. Deposits Te rich. Sputtering preferred, or co-evaporate from sources. n = 5.6 @ 5μ
Lead Titanate	PbTiO3	--	7.52	--	--	--	--	--	--	Ta	--
Lithium	Li	179	0.53	--	227	307	407	ebeam (Good)	BeO, Al2O3	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	ebeam (Good)	Al2O3	Ni, Ta, Mo, W	Rate control important for optical films. Use gentle preheat for outgas. n = 1.36. J. Appl. Opt. 11, 2245(1972)
Lithium Iodide	LiI	446	4.06	--	--	--	400	--	--	Mo, W	--
Lithium Oxide	Li2O	1427	2.01	--	--	--	850	--	--	Pt, Ir	n = 1.64
Lutetium	Lu	1652	9.84	--	--	--	1300	ebeam (XInt)	Al2O3	Ta	--
Lutetium Oxide	Lu2O3	2489	9.41	--	--	--	1400	--	--	Ir	Decomposes.
Magnesium	Mg	651	1.74	--	185	247	327	ebeam (Good)	VC, Al2O3	W, Mo, Ta, Cb	Extremely high rates possible.
Magnesium Aluminate	MgAl2O4	2135	3.6	--	--	--	--	ebeam (Good)	--	--	Natural spinel.
Magnesium Bromide	MgBr2	700	3.72	--	--	--	~450	--	--	Ni	Decomposes.
Magnesium Chloride	MgCl2	708	2.32	--	--	--	400	--	--	Ni	Decomposes. n = 1.6
Magnesium Fluoride	MgF2	1266	2.9-3.2	--	--	--	1000	ebeam (XInt)	Al2O3	Mo, Ta	Rate control and substrate heat important for optical films. n = 1.38 J. Appl. Opt. 11, 2245(1972)
Magnesium Iodide	MgI2	700	4.24	--	--	--	200	--	--	Ir	--
Magnesium Oxide	MgO	2800	3.58	--	--	--	1300	ebeam (Good)	C, Al2O3	--	W produces volatile oxides. n = 1.7 J. Appl. Opt. 11, 2243 (1972)
Manganese	Mn	1244	7.2	--	507	572	647	ebeam (Good)	BeO, Al2O3	W, Mo, Ta	--
Manganese Bromide	MnBr2	695	4.38	--	--	--	500	--	--	Inconel	--



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Manganese Chloride	MnCl2	650	2.98	--	--	--	450	--	--	Inconel	--
Manganese Oxide	Mn3O4	1705	4.86	--	--	--	--	--	--	W	--
Manganese Sulphide	MnS	1615	3.99	--	--	--	1300	--	--	Mo	Decomposes. n = 2.7
Mercury	Hg	-39	13.55	--	-68	-42	-6	--	--	--	--
Mercury Sulphide	HgS	-- sublimes	8.1	--	--	--	250	--	Al2O3	--	Decomposes.
Molybdenum	Mo	2610	10.22	--	1592	1822	2117	ebeam (XInt)	--	--	Films smooth, hard. Careful degas req'd.
Molybdenum Boride	MoB2	2100	7.12	--	--	--	--	ebeam (Poor)	--	--	--
Molybdenum Carbide	Mo2C	2687	9.18	--	--	--	--	ebeam (Fair)	--	--	Evaporation of Mo(CO)6 yields Mo2C
Molybdenum Disulphide	MoS2	1185	4.8	--	--	--	~50	--	--	--	--
Molybdenum Silicide	MoSi2	2050	6.3	--	--	--	~50	--	--	W	Decomposes.
Molybdenum Trioxide	MoO3	795	4.7	--	--	--	~900	--	Al2O3, BN	Mo, Pt	Slight O2 loss. n = 1.9
Neodymium	Nd	1024	7	--	731	871	1062	ebeam (XInt)	Al2O3	Ta	Low Ta solubility.
Neodymium Fluoride	NdF3	1410	6.5	--	--	--	~900	ebeam (Good)	Al2O3	Mo, W	Very little decomposition. n = 1.61 @ 55µ
Neodymium Oxide	Nd2O3	2272	7.24	--	--	--	~1400	ebeam (Good)	ThO2	Ta, W	Loses oxygen, films clear, EB preferred. Hygroscopic n = 1.79 n varies with substrate temp.
Nichrome IV	Ni/Cr	1395	8.5	0.3258	847	987	1217	ebeam (XInt)	Al2O3, VC, BeO	W, Al2O3 coated	Alloys with refractory metals.
Nickel	Ni	1453	8.91	0.331	927	1072	1262	eBeam (xInt), Thermal	Al2O3, BeO, CG	W	Alloys with refractory metals. Forms smooth adherent films.
Nickel Bromide	NiBr2	963	4.64	--	--	--	362	--	--	Inconel	--
Nickel Chloride	NiCl2	1001	3.55	--	--	--	444	--	--	Inconel	--
Nickel Oxide	NiO	1990	7.45	--	--	--	~1470	--	Al2O3	--	Dissociates upon heating n = 2.18
Niobium	Nb	2468	8.55	--	1728	1977	2287	ebeam (XInt)	--	W	Attacks W source.
(Columbium)											
Niobium Boride	NbB2	3050	6.97	--	--	--	--	--	--	--	--
Niobium Carbide	NbC	3800	7.82	--	--	--	--	ebeam (Fair)	--	--	--
Niobium Nitride	NbN	2573	8.4	--	--	--	--	--	--	--	Reactive, evaporate Nb in 10-3 N2.
Niobium Oxide	NbO	--	6.27	--	--	--	1100	--	--	Pt	--
Niobium Pentoxide	Nb2O5	1530	4.47	--	--	--	--	--	--	W	n = 2.3
Niobium Telluride	NbTex	--	7.6	--	--	--	--	--	--	--	Composition variable.
Niobium-Tin	Nb3Sn	--	--	--	--	--	--	ebeam (XInt)	--	--	Co-evaporate from 2 sources.
Niobium Trioxide	Nb2O3	1780	7.5	--	--	--	--	--	--	W	--
Osmium	Os	1700	22.5	--	2170	2430	2760	ebeam (Fair)	--	--	--
Palladium	Pd	1550	12.4	--	842	992	1192	ebeam (XInt)	Al2O3, BeO	W	Alloys with refractory metals; rapid evaporation suggested. Spits in EB.
Palladium Oxide	PdO	870	8.31	--	--	--	575	--	Al2O3	--	Decomposes.
Parylene (Union Carbide)	C8H8	300-400	1.1	--	--	--	--	--	--	--	Vapor depositable plastic.



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks	
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴					
Permalloy	Ni/Fe	1395	8.7	--	947	1047	1307	ebeam (Good)	Al2O3, VC	W	Film low in Ni content. Use 84% Ni source. JVST Vol. 7, No. 6, p. 573	
Phosphorus	P	41.4	1.82	--	327	361	402	--	Al2O3	--	Metal reacts violently in air.	
Platinum	Pt	1769	21.45	0.245	1292	1492	1747	eBeam (xInt), Thermal	CG, ThO2	W	Alloys with metals; poor adhesion; films soft	
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	Mo, Ta	Use gentle preheat to outgas. n = 1.56	
Potassium Chloride	KCl	776	1.98	--	--	--	510	ebeam (Good)	--	Ta, Ni	Use gentle preheat to outgas. n = 1.49	
Potassium Fluoride	KF	880	2.48	--	--	--	~500	ebeam (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	72	3.13	--	--	--	~500	--	--	Ta	Use gentle preheat to outgas. n = 1.68	
Praseodymium	Pr	931	6.78	--	800	950	1150	ebeam (Good)	--	Ta	--	
Praseodymium Oxide	Pr2O3	2125	6.88	--	--	--	1400	ebeam (Good)	ThO2	Ir	Loses oxygen. n = 2.0	
Radium	Ra	700	5	--	246	320	416	--	--	--	--	
Rhenium	Re	3180	20.53	--	1928	2207	2571	ebeam (Poor)	--	--	Fine wire will self-evaporate.	
Rhenium Oxide	Re2O7	297	8.2	--	--	--	~100	--	--	--	--	
Rhodium	Rh	1966	12.41	--	1277	1472	1707	ebeam (Good)	ThO2, VC	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	ebeam (Poor)	ThO2, VC	--	Splits violently in EB. Requires degas.	
Samarium	Sm	1072	7.54	--	373	460	573	ebeam (Good)	Al2O3	Ta	--	
Samarium Oxide	Sm2O3	2350	7.43	--	--	--	--	ebeam (Good)	ThO2	Ir	Loses O2. Films smooth, clear.	
Samarium Sulphide	Sm2S3	1900	5.72	--	--	--	--	ebeam (Good)	--	--	AIP conf. Proc. on Mag. & Mag. Mat. B, 5, 860 (1971)	
Scandium	Sc	1539	2.99	--	714	837	1002	ebeam (XInt)	Al2O3, BeO	W	Alloys with Ta	
Scandium Oxide	Sc2O3	2300	3.86	--	--	--	~400	ebeam (Fair)	--	--	Loses Oxygen. n = 1.88 @ .5µ	
Selenium	Se	217	4.79	--	89	125	170	ebeam (Good)	Al2O3, VC	W, Mo	Toxic. Poisons vacuum systems. JVST 9, 387 (1972); 12, 573 & 807 (1975)	
Silicon	Si	1410	2.42	0.712	992	1147	1337	eBeam (Fair), sputter	BeO, Ta, VC	W, Ta	Alloys with W; use heavy W boat. SiO produced above 4x10 ⁻⁶ Torr. EB best. n = 3.42 App. Opt. 15, 2348 (1976)	
Silicon Boride	SiB6	--	2.47	--	--	--	--	ebeam (Poor)	--	--	--	
Silicon Carbide	SiC	2700	3.22	--	--	--	1000	--	--	--	Sputtering preferred.	
Silicon Dioxide	SiO2	1610-1710	2.2-2.7	1	--	--	~1025	eBeam (XInt), sputter	Al2O3	--	Quartz excellent in EB. n = 1.47	
					Influenced by composition							



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Silicon Monoxide	SiO	1702	2.1	--	--	--	850	eBeam (Fair)	Ta	W, Ta	Baffle box source best for resistance evaporation. Low rate suggested. n = 1.6.
					sublimes						
Silicon Nitride	Si3N4	-- sublimes	3.44	--	--	--	~800	eBeam, sputter	--	--	n = 2.1
Silicon Selenide	SiSe	--	--	--	--	--	550	--	Quartz	--	--
Silicon Sulphide	SiS	-- sublimes	1.85	--	--	--	450	--	Quartz	--	--
Silicon Telluride	SiTe2	--	4.39	--	--	--	550	--	Quartz	--	--
Silver	Ag	961	10.49	0.529	847	958	1105	eBeam (xInt), Thermal	Al2O3, Mo	Mo, Ta	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
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	ebeam (Good)	Quartz	Ta, Mo, W	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	ebeam (Good)	BeO	Mo, Ta, W	Use gentle preheat to outgas. No decomposition n = 1.30 @ .55µ
Sodium Hydroxide	NaOH	318	2.13	--	--	--	~470	--	--	Pt	Use gentle preheat to outgas. n = 1.36
Spinel	MgO3	--	8	--	--	--	--	ebeam (Good)	--	--	n = 1.72
	5Al2O3										
Strontium	Sr	769	2.6	--	239	309	403	ebeam (Poor)	VC	W, Ta, Mo	Wets but does not alloy with refractory metals. May react violently in air.
Strontium Fluoride	SrF2	1190	4.24	--	--	--	~1000	--	Al2O3	--	n = 1.44
Strontium Oxide	SrO	2460	4.7	--	--	--	1500	--	Al2O3	Mo	Reacts with Mo, and W; n = 1.87
					sublimes						
Strontium Sulphide	SrS	Above 2000	3.7	--	--	--	--	--	--	Mo	Decomposes. n = 2.11
Sulphur	S8	115	2	--	13	19	57	ebeam (Poor)	Quartz	W	Poisons vacuum system.
Supermalloy	Ni/Fe/Mo	1410	8.9	--	--	--	--	ebeam (Good)	--	--	Sputtering preferred; co-evaporate from 2 sources, Permalloy and Mo.
Tantalum	Ta	2996	16.6	--	1960	2240	2590	ebeam (XInt)	--	--	Forms good films.
Tantalum Boride	TaB2	3000	12.38	--	--	--	--	--	--	--	--
Tantalum Carbide	TaC	3880	14.65	--	--	--	~2500	--	--	--	JVST 12, 811 (1975)
Tantalum Nitride	TaN	3360	16.3	--	--	--	--	--	--	--	Reactive; evaporate Ta in 10-3N2.
Tantalum Pentoxide	Ta2O5	1800	8.74	--	1550	1780	1920	ebeam (Good)	VC	W, Ta	Slight decomposition; evaporate in 10-3 Torr of O2. n = 2.0 @ 1.5µ App. Opt. 19, 1737 (1980)
Tantalum Sulphide	TaS2	1300	--	--	--	--	--	--	--	--	--



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
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	ebeam (Poor)	Al2O3, Quartz	W, Ta	Wets without alloying. Toxic.
Terbium	Tb	1357	8.27	--	800	950	1150	ebeam (Xlnt)	Al2O3	Ta	--
Terbium Fluoride	TbF3	1176	--	--	--	--	~800	--	--	--	--
Terbium Oxide	Tb2O3	2387	7.87	--	--	--	1300	--	--	Ir	Partially decomposes.
Terbium Oxide	Tb4O7	--	--	--	--	--	--	--	--	Ta	Films TbO.
Thallium	Tl	302	11.85	--	280	360	470	ebeam (Poor)	Al2O3, Quartz	W, Ta	Wets freely, very Toxic.
Thallium Bromide	TlBr	480	7.56	--	--	--	~250	--	Quartz	Ta	Toxic n = 2.3
					sublimes						
Thallium Chloride	TlCl	430	7	--	--	--	~150	--	Quartz	Ta	Toxic n = 2.25
					sublimes						
Thallium Iodide (B)	TlI	440	7.09	--	--	--	~250	--	Quartz	--	Toxic n = 2.78
					sublimes						
Thallium Oxide	Tl2O3	717	9.65	--	--	--	350	--	--	--	Toxic, Goes to Tl2O @ 850° C.
Thorium	Th	1875	11.7	--	1430	1660	1925	ebeam (Xlnt)	W	W, Ta, Mo	Toxic, radioactive.
Thorium Bromide	ThBr4	--	5.67	--	--	--	--	--	--	Mo	Toxic n = 2.47 @ 5µ
					sublimes						
Thorium Carbide	ThC2	2773	8.96	--	--	--	~2300	--	Carbon	--	Radioactive.
Thorium Dioxide	ThO2	3050	10.03	--	--	--	~2100	ebeam (Good)	--	--	Radioactive. n = 1.86 @ 2.2µ
Thorium Fluoride	ThF4	1110	6.3	--	--	--	~750	ebeam (Fair)	VC	Mo	Radioactive. n = 1.52 Heat substrate to above 150° C. JVST 12, 919, (1975)
Thorium Oxyfluoride	ThOF2	900	9.1	--	--	--	--	--	--	Mo, Ta	Radioactive. n = 1.52
Thorium Sulphide	ThS2	--	6.8	--	--	--	--	--	--	--	Sputtering preferred; co-evaporate from 2 sources.
Thulium	Tm	1545	9.32	--	461	554	680	ebeam (Good)	Al2O3	Ta	--
					sublimes						
Thulium Oxide	Tm2O3	--	8.9	--	--	--	1500	--	--	Ir	Decomposes.
Tin	Sn	232	7.75	0.724	682	807	997	eBeam (Xlnt), Thermal	Al2O3, Ta	Mo	Wets Mo; use Ta liner in EB guns.
Tin Oxide	SnO2	1127	6.95	--	--	--	~1000	ebeam (Xlnt)	Al2O3, Quartz	W	Films from W oxygen deficient, oxidize in air. n = 2.0
					sublimes						
Tin Selenide	SnSe	861	6.18	--	--	--	~400	ebeam (Good)	Quartz	--	JVST 12, 110 (1975)
Tin Sulphide	SnS	882	5.08	--	--	--	~450	--	Quartz	--	--
Tin Telluride	SnTe	780	6.44	--	--	--	~450	--	Quartz	--	--
Titanium	Ti	1675	4.5	0.628	1067	1235	1453	eBeam (Xlnt), Thermal	TiC	W	Alloys with refractory metals. Evolves gas on first heating.
Titanium Boride	TiB2	2980	4.5	--	--	--	--	ebeam (Poor)	--	--	--
Titanium Carbide	TiC	3140	4.93	--	--	--	~2300	--	--	--	JVST 12, 851, (1975)
Titanium Dioxide (rutile)	TiO2	1640	4.29	--	--	--	~1300	ebeam (Fair)	--	W, Mo	Evaporate in 10-4 of O2 onto 350° substrates. n = 2.4 App. Opt. 15, 2986 (1976)
Titanium Monoxide	TiO	1750	4.93	--	--	--	~1500	ebeam (Good)	VC	W, Mo	Use gentle preheat to outgas. Films TiO2 if evaporated like TiO2; n = 2.2



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Titanium Nitride	TiN	2930	5.43	--	--	--	--	ebeam (Good)	--	Mo	Sputtering preferred. Decomposes with thermal evaporation.
Titanium Sesquioxide	Ti2O3	2130	4.6	--	--	--	--	ebeam (Good)	--	W	Decomposes.
Tungsten	W	3410	19.3	0.163	2117	2407	2757	eBeam (good), Thermal	--	--	Forms volatile oxides. Films hard & adherent.
Tungsten Boride	WB2	2900	12.75	--	--	--	--	eBeam (Poor)	--	--	--
Tungsten Carbide	W2C	2860	17.15	--	1480	1720	2120	eBeam (XInt)	--	C	--
Tungsten Telluride	WTe3	--	9.49	--	--	--	--	--	Quartz	--	--
Tungsten Trioxide	WO3	1473	7.16	--	--	980		ebeam (Good)	--	W, Pt	Use gentle preheat to outgas. W reduces oxides slightly. n = 1.68
					sublimes						
Uranium	U	1132	19.07	--	1132	1327	1582	eBeam (Good)	--	W, Mo	Films oxidize.
Uranium Carbide	UC2	2260	11.28	--	--	--	2100	--	Carbon	--	Decomposes.
Uranium Dioxide	UO2	2176	10.9	--	--	--	--	--	--	W	Ta causes decomposition.
Uranium Fluoride	UF4	~1000	--	--	--	--	300	--	--	Ni	--
Uranium Oxide	U3O8	Decomposes	8.3	--	--	--	--	--	--	W	Decomposes at 1300° C to UO2.
Uranium Phosphide	UP2	--	8.57	--	--	--	1200	--	--	Ta	Decomposes.
Uranium Sulphide	U2S3	--	--	--	--	--	1400	--	--	W	Slight decomposition.
Vanadium	V	1890	5.96	--	1162	1332	1547	eBeam (XInt)	--	W, Mo	Wets Mo. EB evaporated films preferred.
Vanadium Boride	VB2	2400	5.1	--	--	--	--	--	--	--	--
Vanadium Carbide	VC	2810	5.77	--	--	--	~1800	--	--	--	--
Vanadium Dioxide	VO2	1967	4.34	--	--	--	~575				Deposit metal in 1 X 10-302 JVST A2(2) 301 (1984)
					sublimes						
Vanadium Nitride	VN	2320	6.13	--	--	--	--	--	--	--	--
Vanadium Pentoxide	V2O5	690	3.36	--	--	--	~500	--	Quartz	--	--
Vanadium Silicide	VSi2	1700	4.42	--	--	--	--	--	--	--	--
Ytterbium	Yb	824	6.98	--	520	590	690	ebeam (Good)	--	Ta	--
					sublimes						
Ytterbium	YbF3	1157	8.17	--	--	--	~800	--	--	Mo	n = 1.57 @3.8µ
Ytterbium Oxide	Yb2O3	2346	9.17	--	--	--	~1500			Ir	Loses Oxygen.
					sublimes						
Yttrium	Y	1509	4.48	--	830	973	1157	ebeam (XInt)	Al2O3	W, Ta	High Ta solubility
Yttrium Aluminum Oxide	Y3Al5O12	1990	--	--	--	--	--	ebeam (Good)	--	W	Films not ferroelectric.
Yttrium Fluoride	YF3	1387	4.01	--	--	--	--	--	--	--	--
Yttrium Oxide	Y2O3	2680	4.84	--	--	--	~2000	ebeam (Good)	C	W	Loses Oxygen. films smooth and clear. n = 1.79 @ 1µ
					sublimes						
Zinc	Zn	419	7.14	0.514	127	177	250	eBeam (XInt), Thermal	Al2O3, Quartz	Mo, W, Ta	Evaporates well under wide range of conditions.
Zinc Antimonide	Zn3Sb2	546	6.3	--	--	--	--	--	--	--	--
Zinc Bromide	ZnBr2	394	4.22	--	--	--	~300	--	C	W	Decomposes.
Zinc Fluoride	ZnF2	872	4.84	--	--	--	~800	--	Quartz	Pt, Ta	--
Zinc Nitride	Zn3N2	--	6.22	--	--	--	--	--	--	Mo	Decomposes.



Element	Symbol	Melting Point °C	Density (bulk, g/cm3)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Key	Boat	Remarks
					10 ⁻⁸	10 ⁻⁶	10 ⁻⁴				
Zinc Oxide	ZnO	1975	5.61	--	--	--	~1800	ebeam (Fair)	--	--	Anneal in air at 450° C to reoxidize; n = 2.0 JVST 12, 879 (1975)
Zinc Selenide	ZnSe	1526	5.42	--	--	--	660	--	Quartz	Mo, W, Ta	Use gentle preheat to outgas. Evaporates well n = 2.6.
Zinc Sulphide	ZnS	1830	4.09	--	--	--	~800	ebeam (Good)	--	Ta, Mo	Use gentle preheat to outgas. Films partially decompose. Sticking coefficient varies with substrate temperature. n = 2.3 @ .5μ
					sublimes						
Zinc Telluride	ZnTe	1238	6.34	--	--	--	~600	ebeam (Fair)	--	Mo, Ta	Use gentle preheat to outgas. n = 2.85 @ .5μ
Zircon	ZrSiO4	2550	4.56	--	--	--	--	--	--	--	--
Zirconium	Zr	1852	6.4	--	1477	1702	1987	eBeam (XInt)	--	W	Alloys with W. Films oxidize readily.
Zirconium Boride	ZrB2	3040	6.08	--	--	--	--	ebeam (Good)	--	--	--
Zirconium Carbide	ZrC	3540	6.73	--	--	--	~2500	--	--	--	--
Zirconium Nitride	ZrN	2980	7.09	--	--	--	--	--	--	--	Reactively evaporate in 10-3N2 atmosphere.
Zirconium Oxide	ZrO2	2700	5.49	--	--	--	~220	ebeam (Good)	--	W	Films oxygen deficient, clear and hard. n = 2.05 @ .75μ
Zirconium Silicide	ZrSi2	1700	4.88	--	--	--	--	--	--	--	--

