

THIN FILM EVAPORATION SOURCE REFERENCE



R.D. Mathis Company

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NAME	SYMBOL	MELTING POINT °C	DENSITY g/cm ³	TEMPERATURE (°C) @ 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 Sublimes	490	700	Poor	Graphite	—	Mo, W	n = 1.38 @ .55μ	
Aluminum Nitride	AlN	Subl.	3.26	—	—	~ 1750	Fair	—	—	—	Decomposes. Reactive evaporate in 10 ⁻³ N ₂ with glow discharge.	
Aluminum Oxide (a) (alumina)	Al ₂ O ₃	2045	3.97	—	—	1550	XInt.	—	—	W	Sapphire xint. in EB, forms smooth, hard films. n = 1.66	
Aluminum 2% Silicon	Al2%Si	640	2.69	—	—	1010	—	—	—	—	Wire feed and flash. Difficult from dual sources.	
Antimony	Sb	630	6.68	279 Sublimes	345	425	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	—	Mo	Decomposes over 750°C	
Antimony Trioxide	Sb ₂ O ₃	656	5.2 or 5.76	— Sublimes	—	~ 300	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 Se ₃	550	4.64	—	—	~ 200	Good	Al ₂ O ₃	—	Mo Ta	n = 3.01 @ .55μ No decomposition.	
Arsenic	As	814	5.73	107 Sublimes	150	210	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 @ 3.8μ JVST 10, 748 (1973)	
Arsenic Trisulphide	As ₂ S ₃	300	3.43	—	—	~ 400	Fair	Al ₂ O ₃ Quartz	—	Mo	n = 2.8 JVST 10, 748 (1973)	
Arsenic Tritelluride	As ₂ Te ₃	362	—	—	—	—	—	—	—	C	Flash evaporate. JVST 10, 748 (1975)	
Barium	Ba	710	3.78	545	627	735	Fair	Metals	W	W Mo Ta	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	— Sublimes	—	~ 700	Good	—	—	Mo	n = 1.29 @ 5μ Density rate dependent.	
Barium Oxide	BaO	1923	5.72 or 5.32	—	—	~ 1300	Poor	—	—	Pt	Decomposes slightly. n = 1.98	
Barium Sulphide	BaS	2200	4.25	—	—	1100	—	—	—	Mo	n = 2.16	
Barium Titanate	BaTiO ₃	Dec.	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	XInt.	BeO C Vit. Carbon	W	W Ta	Wets W/Mo/Ta. Metal powder and oxides are toxic. Evaporates easily.	



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				10 ⁻⁸ TORR	10 ⁻⁶ TORR	10 ⁻⁴ TORR	ELECTRON BEAM	CRUCIBLE	COIL	BOAT	
Beryllium Chloride	BeCl ₂	440	1.9	—	—	~ 150	—	—	—	—	—
Beryllium Fluoride	BeF ₂	800	1.99	Sublimes			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	Sublimes			—	Graphite	—	—	n = 1.74 @ 1μ, 1.64 @ 10μ App. Opt. 18, 105 (1979)
Bismuth Oxide	Bi ₂ O ₃	820	8.9	—	—	~ 1400	Poor	—	—	Pt	Vapors are toxic. n = 2.55. JVST 12, 63 (1975)
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	—	—	Decomposes			—	—	—	—	Decomposes. Sputtering preferred; or co-evaporate from 2 sources in 10-20 ₂ .
Bismuth Trisulphide	Bi ₂ S ₃	685	7.39	—	—	—	—	—	—	—	n = 1.5
Boron	B	2100	2.36	1278	1548	1797	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	Sublimes			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	Sublimes			Good	Al ₂ O ₃ Quartz	—	Mo Ta	Evaporates easily. n = 2.4 @ .6μ
Cadmium Silicide	CdSiO ₂	—	—	—	—	~ 600	—	—	—	—	n = 1.69
Cadmium Sulphide	CdS	1750	4.82	Sublimes			Fair	Al ₂ O ₃ Quartz	—	W Mo Ta	Sticking coefficient strongly affected by substrate temperature. Stoichiometry variable 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	357	459	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	1867	2137	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.



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				10 ⁻⁸ TORR	10 ⁻⁶ TORR	10 ⁻⁴ TORR	ELECTRON BEAM	CRUCIBLE	COIL	BOAT	
Ceric Oxide	CeO ₂	2600	7.3	1890 Sublimes	2000	2310	Good	—	—	W	Reacts with W. Use 250 - 300°C substrate temperature. n = 2.2 - 2.4.
Cerium Fluoride	CeF ₃	1418	6.16	—	—	~ 900	Good	—	—	W Mo Ta	Use gentle preheat to outgas. n = 1.63 @ .55μ
Cerium Oxide	Ce ₂ O ₃	1692	6.87	—	—	—	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	4.4	—	—	~ 400	—	—	—	W	n = 1.70
Cesium Chloride	CsCl	646	3.97	—	—	~ 500	—	—	—	W	Hygroscopic. n = 1.64
Cesium Fluoride	CsF	684	3.59	—	—	~ 500	—	—	—	W	—
Cesium Hydroxide	CsOH	272	3.67	—	—	500	—	—	—	Pt	—
Cesium Iodide	CsI	621	4.51	—	—	~ 500	—	Pt Quartz	—	Ta 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 Sublimes	997	1157	Good	Vit. Carbon	W	Cr-plated rod or strip	Films very adherent. High rates possible.
Chromium Boride	CrB	2760	6.17	—	—	—	—	—	—	—	—
Chromium Bromide	CrBr 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 @ 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 evaporate.
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	—	—	400	—	—	—	Inconel	—
Cobalt Chloride	CoCl ₂	740	3.36	—	—	472	—	—	—	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 material.
Copper Chloride	CuCl	422	3.53	—	—	~ 600	—	—	—	—	n = 1.93
Copper Oxide	Cu ₂ O	1235	6	—	—	~ 600	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 Sulfide	CuS	1113	6.75	—	—	~ 500	—	—	—	—	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 App. Opt. 15, 1969 (1976)
Dysprosium	Dy	1409	8.54	625	750	900	Good	—	—	Ta	—
Dysprosium Oxide	Dy ₂ O ₃	2340	7.81	—	—	~ 1400	—	—	—	Ir	Loses oxygen.
Erbium	Er	1497	9.06	650 Sublimes	775	930	Good	—	—	W Ta	—
Erbium Fluoride	ErF ₃	1350	7.81	—	—	~ 750	—	—	—	Mo	JVST A3 (6) 2320
Erbium Oxide	Er ₂ O ₃	2400	8.64	—	—	~ 1600	—	—	—	Ir	Loses oxygen.
Europium	Eu	822	5.26	280 Sublimes	360	480	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	—	—	—	—



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				10 ⁻⁸ TORR	10 ⁻⁶ TORR	10 ⁻⁴ TORR	ELECTRON BEAM	CRUCIBLE	COIL	BOAT	
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 @ .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 @ 10.6μ
Gallium Nitride	GaN	Subl.	6.1	—	—	—	—	Al ₂ O ₃	—	—	Evaporative Ga in 10 ⁻³ N ₂ .
Gallium Oxide(β)	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 films from EB sources. Use .040 W. n = 4.01
Germanium Nitride	Ge ₃ N ₂	450	5.2	—	—	~ 650	—	—	—	—	Sublimes Sputtering preferred.
Germanium Oxide	GeO ₂	1086	6.24	—	—	~ 625	Good	Quartz Al ₂ O ₃	—	Ta Mo	Similar to SiO ₂ , film predominantly GeO.
Germanium Telluride	GeTe	725	6.2	—	—	381	—	Quartz Al ₂ O ₃	—	W Mo	—
Glass Schott 8329	—	—	2.2	—	—	—	XInt.	—	—	—	Evaporative 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	—	—	~ 2600	—	—	—	—	Sublimes
Hafnium Nitride	HfN	2852	13.8	—	—	—	—	—	—	—	—
Hafnium Oxide	HfO ₂	2812	9.68	—	—	~ 2500	Fair	—	—	W	Film HfO. n = 2.0 @ .5μ App. Opt. Apr. 1977
Hafnium Silicide	HfSi ₂	1750	7.2	—	—	—	—	—	—	—	—
Holmium	Ho	1470	8.8	650	770	950	Good	—	W	W Ta	Sublimes
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 required for smooth films.
Indium	In	157	7.3	487	597	742	XInt.; Mo Liner req'd	Graphite Al ₂ O ₃ , BN	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 @ 1μ
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	In ₂ O ₃	1565	7.18	—	—	~ 1200	Good	Al ₂ O ₃ , BN	—	W Pt	Film In ₂ O; transparent conductor. JVST 12, 99 (1975)
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	—	—	—	—	—	—	—	—
Indium Sesquisulphide	In ₂ S ₃	1050	4.9	—	—	850	—	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	FeBr ₂	689	4.64	—	—	561	—	Fe	—	—	—



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Iron Chloride	FeCl ₂	670	2.98	—	—	300	—	Fe	—	—	—
				Sublimes							
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	JVST 7, 739 (1980)
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	—	—	—	—	—	—	—	Hygroscopic. n = 1.94
Lanthanum Fluoride	LaF ₃	1490	6	—	—	900	Good	—	—	Ta Mo	No decomposition. n = 1.59 @ .55μ
				Sublimes							
Lanthanum Oxide	La ₂ O ₃	2250	5.84	—	—	1400	Good	—	—	W Ta	Loses oxygen. n ≈ 1.9 @ .5μ
Lead	Pb	328	11.34	342	427	497	XInt.	Al ₂ O ₃ Quartz	W	W Mo	Toxic. Carefully controlled rates required for superconductors.
Lead Bromide	PbBr ₂	373	6.66	—	—	~ 300	—	—	—	—	—
Lead Chloride	PbCl ₂	501	5.85	—	—	~ 325	—	Al ₂ O ₃	—	Pt, Mo	Little decomposition. n = 2.2
Lead Fluoride	PbF ₂	822	8.24	—	—	~ 400	—	BeO	—	W Pt, Mo	Toxic. n = 1.75 @ .3μ
				Sublimes							
Lead Iodide	PbI ₂	502	6.16	—	—	~ 500	—	Quartz	—	Pt	n = 2.7 J. Opt. Soci. 65, 914
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	—	—	~ 500	—	Graphite Al ₂ O ₃	—	W Mo	—
				Sublimes							
Lead Sulphide	PbS	1114	7.5	—	—	500	—	Quartz Al ₂ O ₃	—	W	Little decomposition. n = 3.91
				Sublimes							
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 @ 5μ
Lead Titanate	PbTiO ₃	—	7.52	—	—	—	—	—	—	Ta	—
Lithium	Li	179	0.53	227	307	407	Good	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, Mo Ta W	Rate control important for optical films. Use gentle preheat to outgas. n = 1.36. J. Appl. Opt. 11, 2245 (1972)
Lithium Iodide	LiI	446	4.06	—	—	400	—	—	—	W Mo	—
Lithium Oxide	Li ₂ O	1427	2.01	—	—	850	—	—	—	Pt Ir, W	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	247	327	Good	Al ₂ O ₃ Vit. Carbon	W	W Mo Ta, Cb	Extremely high rates possible.
				Sublimes							
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 J. Appl. Opt. 11, 2245 (1972)
Magnesium Iodide	MgI ₂	700	4.24	—	—	200	—	—	—	Ir	—



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				10 ⁻⁸ TORR	10 ⁻⁶ TORR	10 ⁻⁴ TORR	ELECTRON BEAM	CRUCIBLE	COIL	BOAT	
Magnesium Oxide	MgO	2800	3.58	—	—	1300	Good	Carbon Al ₂ O ₃	—	—	W produces volatile oxides. n = 1.7. J. Appl. Opt. 11, 2243 (1972)
Manganese	Mn	1244	7.2	507 572 647 Sublimes			Good	Al ₂ O ₃ BeO	W	W Ta Mo	—
Manganese Bromide	MnBr ₂	695	4.38	—	—	500	—	—	—	Inconel	—
Manganese Chloride	MnCl ₂	650	2.98	—	—	450	—	—	—	Inconel	—
Manganese Oxide	Mn ₃ O ₄	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	Subl.	8.1	— — 250 Sublimes			—	Al ₂ O ₃	—	—	Decomposes.
Molybdenum	Mo	2610	10.22	1592	1822	2117	XInt.	—	—	—	Films smooth, hard. Careful degas required.
Molybdenum Boride	MoB ₂	2100	7.12	—	—	—	Poor	—	—	—	—
Molybdenum Carbide	Mo ₂ C	2687	9.18	—	—	—	Fair	—	—	—	Evaporation of Mo (CO) ₆ yields Mo ₂ C.
Molybdenum Disulphide	MoS ₂	1185	4.8	—	—	~ 50	—	—	—	—	—
Molybdenum Silicide	MoSi ₂	2050	6.3	—	—	—	—	—	—	W	Decomposes.
Molybdenum Trioxide	MoO ₃	795	4.7	—	—	~ 900	—	Al ₂ O ₃ BN	—	Mo Pt	Slight O ₂ loss. n = 1.9
Neodymium	Nd	1024	7	731	871	1062	XInt.	Al ₂ O ₃	—	Ta	Low Ta solubility.
Neodymium Fluoride	NdF ₃	1410	6.5	—	—	~ 900	Good	Al ₂ O ₃	—	Mo W	Very little decomposition. n = 1.61 @ .55μ
Neodymium Oxide	Nd ₂ O ₃	2272	7.24	—	—	~ 1400	Good	ThO ₂	—	Ta W	Loses oxygen, films clear, EB preferred. Hygroscopic. n = 1.79 (n varies with substrate temp)
Nichrome IV	Ni/Cr	1395	8.5	847	987	1217	XInt.	Al ₂ O ₃ Vit. Carbon BeO	W	Al ₂ O ₃ Coated	Alloys with refractory metals.
Nickel	Ni	1453	8.9	927	1072	1262	XInt.	Al ₂ O ₃ BeO Vit. Carbon	W	W	Alloys with refractory metals. Forms smooth adherent films.
Nickel Bromide	NiBr ₂	963	4.64	— — 362 Sublimes			—	—	—	Inconel	—
Nickel Chloride	NiCl ₂	1001	3.55	— — 444 Sublimes			—	—	—	Inconel	—
Nickel Oxide	NiO	1990	7.45	—	—	~ 1470	—	Al ₂ O ₃	—	—	Dissociates upon heating. n = 2.18
Niobium (Columbium)	Nb	2468	8.55	1728	1977	2287	XInt.	—	—	W	Attacks W source.
Niobium Boride	NbB ₂	3050	6.97	—	—	—	—	—	—	—	—
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	3033	22.5	2170	2430	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 ¹	Films low in Ni content. Use 84% Ni source. JVST Vol. 7, No. 6, p. 573



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				10 ⁻⁸ TORR	10 ⁻⁶ TORR	10 ⁻⁴ TORR	ELECTRON BEAM	CRUCIBLE	COIL	BOAT	
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 oxygen. Films smooth, clear.
Samarium Sulphide	Sm ₂ S ₃	1900	5.72	—	—	—	Good	—	—	—	AIP Conf. Proc. on Mag. & Mat. B, 5, 860 (1971).
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 @ .5μ
Selenium	Se	217	4.79	89	125	170	Good	Al ₂ O ₃ Vit. Carbon	W Mo	W Mo	Toxic. Poisons vacuum systems. JVST 9, 387 (1972); 12, 573 & 807 (1975)
Silicon	Si	1410	2.42	992	1147	1337	Fair	BeO Ta Vit. Carbon	—	W Ta	Alloys with W; use heavy W boat. EB best. SiO produced above 4 x 10 ⁻⁶ Torr. n = 3.42. App. Opt. 15, 2348 (1976)
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 xInt in EB. n = 1.47
Silicon Monoxide	SiO	1702	2.1	—	—	850	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



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				10 ⁻⁸ TORR	10 ⁻⁶ TORR	10 ⁻⁴ TORR	ELECTRON BEAM	CRUCIBLE	COIL	BOAT	
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, Mo 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 @ .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 allow 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	2640	4.7	—	—	1500	—	Al ₂ O ₃	—	Mo	Sublimes Reacts with Mo and W. n = 1.87
Strontium Sulphide	SrS	> 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	—	—	—	—	JVST 12, 811 (1975)
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 @ 1.5μ. App. Opt. 19, 1737 (1980)
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	—	—	~ 250	—	Quartz	—	Ta	Sublimes Toxic. n = 2.3
Thallium Chloride	TlCl	430	7	—	—	~ 150	—	Quartz	—	Ta	Sublimes Toxic. n = 2.25
Thallium Iodide (B)	TlI	440	7.09	—	—	~ 250	—	Quartz	—	—	Sublimes Toxic. n = 2.78
Thallium Oxide	Tl ₂ O ₃	717	9.65	—	—	350	—	—	—	—	Toxic. Goes to Tl ₂ @ 850° C.
Thorium	Th	1875	11.7	1430	1660	1925	XInt.	—	W	W Ta Mo	Toxic, radioactive.
Thorium Bromide	ThBr ₄	—	5.67	—	—	—	—	—	—	Mo	Sublimes Toxic. n = 2.47 @ 5μ
Thorium Carbide	ThC ₂	2773	8.96	—	—	~ 2300	—	Carbon	—	—	Radioactive.



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				10 ⁻⁸ TORR	10 ⁻⁶ TORR	10 ⁻⁴ TORR	ELECTRON BEAM	CRUCIBLE	COIL	BOAT	
Thorium Dioxide	ThO ₂	3050	10.03	—	—	~ 2100	Good	—	—	W ¹	Radioactive. n = 1.86 at 2.2 microns
Thorium Fluoride	ThF ₄	1110	6.3	—	—	~ 750	Fair	Vit. Carbon	—	Ta Mo	Radioactive. Heat substrate to above 150° C. n = 1.52 JVST 12, 919, (1975)
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 Sublimes	554	680	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 Ta liner in EB guns.
Tin Oxide	SnO ₂	1127	6.95	— Sublimes	—	~ 1000	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	—	—	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	1067	1235	1453	XInt.	TiC	—	W	Alloys with refractory metal; evolves gas on first heating.
Titanium Boride	TiB ₂	2980	4.5	—	—	—	Poor	—	—	—	—
Titanium Carbide	TiC	3140	4.93	—	—	~ 2300	—	—	—	—	JVST 12, 851, (1975)
Titanium Dioxide (rutile)	TiO ₂	1640	4.29	—	—	~ 1300	Fair	—	—	W Mo	Evaporate in 10 ⁻⁴ of O ₂ onto 350°C substrates. n = 2.4. App. Opt. 15, 2986 (1976)
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	— Sublimes	—	980	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	— Sublimes	—	~ 575	—	—	—	—	Deposit metal in 1 x 10 ⁻³ O ₂ . JVST A2(2) 301 (1984)
Vanadium Nitride	VN	2320	6.13	—	—	—	—	—	—	—	—
Vanadium Pentoxide	V ₂ O ₅	690	3.36	—	—	~ 500	—	Quartz	—	—	—
Vanadium Silicide	VS ₂	1700	4.42	—	—	—	—	—	—	—	—



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				10 ⁻⁸ TORR	10 ⁻⁶ TORR	10 ⁻⁴ TORR	ELECTRON BEAM	CRUCIBLE	COIL	BOAT	
Ytterbium	Yb	824	6.98	520 Sublimes	590	690	Good	—	—	Ta	—
Ytterbium Fluoride	YbF ₃	1157	8.17	—	—	~ 800	—	—	—	Mo	n = 1.57 @ 3.8μ
Ytterbium Oxide	Yb ₂ O ₃	2346	9.17	— Sublimes	—	~ 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	—	—	—	—	—	—	Mo	—
Yttrium Oxide	Y ₂ O ₃	2680	4.84	— Sublimes	—	~ 2000	Good	C	—	W	Loses oxygen, films smooth and clear. n = 1.79 @ 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. JVST 12, 879 (1975)
Zinc Selenide	ZnSe	1526	5.42	—	—	660	—	Quartz	W Mo	Ta W Mo	Use gentle preheat to outgas. Evaporates well. n = 2.6
Zinc Sulphide	ZnS	1830	4.09	— Sublimes	—	~ 800	Good	—	—	Ta Mo	Use gentle preheat to outgas. Films partially decompose. Sticking coefficient varies with substrate temperature. n = 2.3 @ .5μ
Zinc Telluride	ZnTe	1238	6.34	—	—	~ 660	—	—	—	Mo Ta	Use gentle preheat to outgas. n = 2.85 @ .5μ
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 @ .75μ
Zirconium Silicide	ZrSi ₂	1700	4.88	—	—	—	—	—	—	—	—



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