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Vacuum Deposition Techniques and Tables

for thin film applications

The vacuum deposition techniques table lists the best suited methods, such as thermal evaporation, E-Beam evaporation or sputtering for a large number of materials. The list is sorted by material name. It also suggests the best thermal source, if applicable.
The table also lists useful information such as melting point, density, and temperatures for given vapor pressures. This list is useful to determine the optimum vacuum deposition technique, thermal source, and power supply requirements.

- Deposition Techniques: Material names A-E
- Deposition Techniques: Material names G-L
- Deposition Techniques: Material names M-R
- Deposition Techniques: Material names S-Z

* influenced by composition ** Cr-plated rod or strip ***All metals alumina coated C = carbon Gr = graphite Q = quartz Incl = Inconel VC = vitreous carbon SS = stainless steel Ex = excellent	G = good F = fair P = poor S = sublimes D = decomposes RF = RF sputtering is effective RF-R = reactive RF sputter is effective DC = DC sputtering is effective DC-R = reactive DC sputtering is effective

Material	Symbol	MP (°C)	S/D	g/cm^3	Temp.(°C) for Given Vap. Press. (Torr)			Evaporation Techniques					Sputter	Comments
					10^{-8}	10^{-6}	10^{-4}	E-Beam	Thermal Sources					
									Boat	Coil	Basket	Crucible		
Aluminum	Al	660		2.70	677	821	1010	Ex	TiB_2,W	W	W	TiB_2-BN, ZrB_2, BN	RF, DC	Alloys and wets. Stranded W is best.
Aluminum Antimonide	AlSb	1080		4.3	-	-	-	-	-	-	-	-	RF	-
Aluminum Arsenide	AlAs	1600		3.7	-	-	~ 1300	-	-	-	-	-	RF	-
Aluminum Bromide	$AlBr_3$	97		2.64	-	-	~ 50	-	Mo	-	-	Gr	RF	-
Aluminum Carbide	Al_4C_3	~1400	D	2.36	-	-	~ 800	F	-	-	-	-	RF	n = 2.7
Aluminum, 2% Copper	Al2%Cu	640		2.82	-	-	-	-	-	-	-	-	RF, DC	Wire feed and flash. Difficult from dual sources.
Aluminum Fluoride	AlF_3	1291	S	2.88	410	490	700	P	Mo, W, Ta	-	-	Gr	RF	-
Aluminum Nitride	AlN	>2200	S	3.26	-	-	~1750	F	-	-	-	-	RF, RF-R	Decomposes. Reactive evap in 10^{-3} T N2 with glow discharge.
Aluminum Oxide	Al_2O_3	2072		3.97	-	-	1550	Ex	W	-	W	-	RF-R	Sapphire excellent in E-beam; forms smooth, hard films. n = 1.66

Aluminum Phosphide	AlP	2000		2.42	-	-	-	-	-	-	-	-	RF	-
Aluminum, 2% Silicon	Al2%Si	640		2.69	-	-	1010	-	-	-	-	TiB_2-BN	RF, DC	Wire feed and flash. Difficult from dual sources.
Antimony	Sb	630	S	6.68	279	345	425	P	Mo,*** Ta***	Mo, Ta	Mo, Ta	BN, C, Al_2O_3	RF, DC	Toxic. Evaporates well.
Antimony Oxide	Sb_2O_3	656	S	5.2	-	-	~300	G	Pt	-	Pt	BN, Al_2O_3	RF-R	Toxic. Decomposes on W. n = 2.09, 2.18, 2.35
Antimony Selenide	Sb_2Se_3	611		-	-	-	-	-	Ta	-	-	C	RF	Stoichiometry variable.
Antimony Sulfide	Sb_2S_3	550		4.64	-	-	~200	G	Mo, Ta	-	Mo, Ta	Al_2O_3	-	No decomposition. n=3.19, 4.06, 4.3
Antimony Telluride	Sb_2Te_3	629		6.50	-	-	600	-	-	-	-	C	RF	Decomposes over 750°C.
Arsenic	As	817	S	5.73	107	150	210	P	C	-	-	Al_2O_3, BeO, VC	-	Toxic. Sublimes rapidly at low temperature.
Arsenic Oxide	As_2O_3	312		3.74	-	-	-	-	-	-	-	-	-	-
Arsenic Selenide	As_2Se_3	~360		4.75	-	-	-	-	-	-	-	Al_2O_3, Q	RF	-
Arsenic Sulfide	As_2S_3	300		3.43	-	-	~400	F	Mo	-	-	Al_2O_3, Q	RF	n = 2.4, 2.81, 3.02
Arsenic Telluride	As_2Te_3	362		-	-	-	-	-	Flash	-	-	-	-	*JVST*. 1973;10:748.
Barium	Ba	725		3.51	545	627	735	F	W, Ta, Mo	W	W	Metals	RF	Wets without alloying reacts with ceramics.
Barium Chloride	$BaCl_2$	963		3.92	-	-	~650	-	Ta, Mo	-	-	-	RF	Preheat gently to outgas. n = 1.73
Barium Fluoride	BaF_2	1355	S	4.89	-	-	~700	G	Mo	-	-	-	RF	n = 1.47
Barium Oxide	BaO	1918		5.72	-	-	~1300	P	Pt	-	Pt	Al_2O_3	RF, RF-R	Decomposes slightly. n = 1.98
Barium Sulfide	BaS	1200		4.25	-	-	1100	-	Mo	-	-	-	RF	n = 2.16
Barium Titanate	$BaTiO_3$	-	D	6.02	-	-	-	-	-	-	-	-	RF	Gives Ba. Co-evap. from 2 sources or sputter. n = 2.40
Beryllium	Be	1278		1.85	710	878	1000	Ex	W, Ta	W	W	BeO, C, VC	RF, DC	Wets W/Mo/Ta. Powder and oxides toxic. Evaporates easily.
Beryllium Carbide	Be_2C	>2100	D	1.90	-	-	-	-	-	-	-	-	-	-
Beryllium Chloride	$BeCl_2$	405		1.90	-	-	~150	-	-	-	-	-	RF	-
Beryllium Fluoride	BeF_2	800	S	1.99	-	-	~200	G	-	-	-	-	-	Toxic. n = <1.33
Beryllium Oxide	BeO	2530		3.01	-	-	1900	G	-	-	W	-	RF, RF-R	Toxic. No decomposition from E-beam guns. n=1.72
Bismuth	Bi	271		9.80	330	410	520	Ex	W, Mo, Ta	W	W	Al_2O_3, VC	DC, RF	Toxic vapor. Resistivity high. No shorting of baskets.
Bismuth Fluoride	BiF_3	727	S	5.32	-	-	~300	-	-	-	-	Gr	RF	n = 1.74
Bismuth Oxide	Bi_2O_3	860		8.55	-	-	~1400	P	Pt	-	Pt	-	RF, RF-R	Toxic vapor. n = 1.91
Bismuth Selenide	Bi_2Se_3	710	D	6.82	-	-	~650	G	-	-	-	Gr, Q	RF	Co-evaporate from two sources or sputter.
Bismuth Sulfide	Bi_2S_3	685	D	7.39	-	-	-	-	-	-	-	-	RF	n = 1.34, 1.46
Bismuth Telluride	Bi_2Te_3	573		7.7	-	-	~600	-	W, Mo	-	-	Gr, Q	RF	Co-evaporate from two sources or sputter.

Bismuth Titanate	$Bi_2Ti_2O_7$	-	D	-	-	-	-	-	-	-	-	-	RF	Sputter or co-evaporate from two sources in 10^{-2} Torr oxygen.
Boron	B	2300		2.34	1278	1548	1797	Ex	C	-	-	C, VC	RF	Explodes with rapid cooling. Forms carbide with container.
Boron Carbide	B_4C	2350		2.52	2500	2580	2650	Ex	-	-	-	-	RF	Similar to chromium.
Boron Nitride	BN	~3000	S	2.25	-	-	~1600	P	-	-	-	-	RF, RF-R	Decomposes under sputtering; reactive preferred.
Boron Oxide	B_2O_3	~450		1.81	-	-	~1400	G	Pt, Mo	-	-	-	-	n = 1.48
Boron Sulfide	B_2S_3	310		1.55	-	-	800	-	-	-	-	Gr	RF	-
Cadmium	Cd	321		8.64	64	120	180	P	W, Mo, Ta	-	W, Mo, Ta	Al_2O_3, Q	DC, RF	Bad for vacuum systems. Low sticking coefficient.
Cadmium Antimonide	Cd_3Sb_2	456		6.92	-	-	-	-	-	-	-	-	-	-
Cadmium Arsenide	Cd_3As_2	721		6.21	-	-	-	-	-	-	-	Q	RF	-
Cadmium Bromide	$CdBr_2$	567		5.19	-	-	~300	-	-	-	-	-	-	-
Cadmium Chloride	$CdCl_2$	568		4.05	-	-	~400	-	-	-	-	-	-	-
Cadmium Fluoride	CdF_2	1100		6.64	-	-	~500	-	-	-	-	-	RF	n = 1.56
Cadmium Iodide	CdI_2	387		5.67	-	-	~250	-	-	-	-	-	-	-
Cadmium Oxide	CdO	>1500	D	6.95	-	-	~530	-	-	-	-	-	RF-R	Disproportionates. n = 2.49
Cadmium Selenide	CdSe	>1350	S	5.81	-	-	540	G	Mo, Ta	-	-	Al_2O_3, Q	RF	Evaporates easily. n = 2.4
Cadmium Sulfide	CdS	1750	S	4.82	-	-	550	F	W, Mo, Ta	-	W	Al_2O_3, Q	RF	Sticking coefficient affected by substrate temperature. Stoichiometry variable. n = 2.51, 2.53
Cadmium Telluride	CdTe	1121		5.85	-	-	450	-	W, Mo, Ta	W	W, Ta, Mo	-	RF	Stoichiometry depends on substrate temperature. n~ 2.6
Calcium	Ca	839	S	1.54	272	357	459	P	W	W	W	Al_2O_3, Q	-	Corrodes in air.
Calcium Fluoride	CaF_2	1423		3.18	-	-	~1100	-	W, Mo, Ta	W, Mo, Ta	W, Mo, Ta	Q	RF	Rate control important. Preheat gently to outgas. n = 1.43
Calcium Oxide	CaO	2614		~3.3	-	-	~1700	-	W, Mo	-	-	ZrO_2	RF, RF-R	Forms volatile oxides with tungsten and molybdenum. n = 1.84
Calcium Silicate	$CaSiO_3$	1540		2.91	-	-	-	G	-	-	-	Q	RF	n = 1.61, 1.66
Calcium Sulfide	CaS	-	D	2.5	-	-	1100	-	Mo	-	-	-	RF	Decomposes. n = 2.14
Calcium Titanate	$CaTiO_3$	1975		4.10	1490	1600	1690	P	-	-	-	-	RF	Disproportionates except in sputtering. n = 2.34
Calcium Tungstate	$CaWO_4$	-		6.06	-	-	-	G	W	-	-	-	RF	n = 1.92
Carbon	C	~3652	S	1.8-2.1	1657	1867	2137	Ex	-	-	-	-	RF	E-beam preferred. Arc evaporation. Poor film adhesion.
Cerium	Ce	798		~6.70	970	1150	1380	G	W, Ta	W	W, Ta	Al_2O_3, BeO, VC	DC, RF	-
Cerium	CeF_3	1460		6.16	-	-	~900	G	W, Mo,	-	Mo, Ta	-	RF	Preheat gently to

Fluoride									Ta					outgas. n ~ 1.7
Cerium (III) Oxide	Ce_2O_3	1692		6.86	-	-	-	F	W	-	-	-	-	Alloys with source. Use 0.015"-0.020" tungsten boat. n = 1.95
Cerium (IV) Oxide	CeO_2	~2600		7.13	1890	2000	2310	G	W	-	-	-	RF, RF-R	Very little decomposition.
Cesium	Cs	28		1.88	-16	22	80	-	SS	-	-	Q	-	-
Cesium Bromide	CsBr	636		3.04	-	-	~400	-	W	-	-	-	RF	n = 1.70
Cesium Chloride	CsCl	645		3.99	-	-	~500	-	W	-	-	-	RF	n = 1.64
Cesium Fluoride	CsF	682		4.12	-	-	~500	-	W	-	-	-	RF	n = 1.48
Cesium Hydroxide	CsOH	272		3.68	-	-	550	-	Pt	-	-	-	-	-
Cesium Iodide	CsI	626		4.51	-	-	~500	-	W	-	-	Pt, Q	RF	n = 1.79
Chiolote	$Na_5Al_3F_{14}$	-		2.9	-	-	~800	-	Mo, W	-	-	-	RF	n = 1.33
Chromium	Cr	1857	S	7.20	837	977	1157	G	**	W	W	VC	RF, DC	Films very adherent. High rates possible.
Chromium Boride	CrB	2760(?)		6.17	-	-	-	-	-	-	-	-	RF, DC	-
Chromium Bromide	$CrBr_2$	842		4.36	-	-	550	-	Incl	-	-	-	RF	-
Chromium Carbide	Cr_3C_2	1980		6.68	-	-	~2000	F	W	-	-	-	RF, DC	-
Chromium Chloride	$CrCl_2$	824		2.88	-	-	550	-	Fe, Incl	-	-	-	RF	-
Chromium Oxide	Cr_2O_3	2266		5.21	-	-	~2000	G	W, Mo	-	W	-	RF, RF-R	Disproportionates to lower oxides; reoxidizes at 600°C in air.n = 2.55
Chromium Silicide	Cr_3Si_2	-		5.5	-	-	-	-	-	-	-	-	RF, DC	-
Chromium-Silicon Monoxide	Cr-SiO	-	S	*	*	*	*	G	W	-	W	-	DC, RF	Flash.
Cobalt	Co	1495		8.9	850	990	1200	Ex	W, Nb	-	W	Al_2O_3, BeO	DC, RF	Alloys with refractory metals.
Cobalt Bromide	$CoBr_2$	678	D	4.91	-	-	400	-	Incl	-	-	-	RF	-
Cobalt Chloride	$CoCl_2$	724	D	3.36	-	-	472	-	Incl	-	-	-	RF	-
Cobalt Oxide	CoO	1795		6.45	-	-	-	-	-	-	-	-	DC-R, RF-R	Sputter preferred.
Copper	Cu	1083		8.92	727	857	1017	Ex	Mo	W	W	Al_2O_3, Mo, Ta	DC, RF	Adhesion poor. Use interlayer (Cr). Evaporates using any source material.
Copper Chloride	CuCl	430		4.14	-	-	~600	-	-	-	-	-	RF	n = 1.93
Copper Oxide	Cu_2O	1235	S	6.0	-	-	~600	G	Ta	-	-	Al_2O_3	DC-R, RF-R	n = 2.71
Copper Sulfide	Cu_2S	1100		5.6	-	-	-	-	-	-	-	-	-	-
Cryolite	Na_3AlF_6	1000		2.9	1020	1260	1480	Ex	W, Mo, Ta	-	W, Mo, Ta	VC	RF	Large chunks reduce spitting. Little decomposition.
Dysprosium	Dy	1412		8.55	625	750	900	G	Ta	-	-	-	RF, DC	-
Dysprosium Fluoride	DyF_3	1360	S	-	-	-	~800	G	Ta	-	-	-	RF	-
Dysprosium Oxide	Dy_2O_3	2340		7.81	-	-	~1400	-	Ir	-	-	-	RF, RF-R	Loses oxygen.
Erbium	Er	1529	S	9.07	650	775	930	G	W, Ta	-	-	-	DC, RF	-
Erbium	ErF_3	1350		-	-	-	~750	-	Mo	-	-	-	RF	*JVST.*

Fluoride														1985;A3(6):2320.
Erbium Oxide	Er_2O_3	Infus.		8.64	-	-	~1600	-	Ir	-	-	-	RF, RF-R	Loses oxygen.
Europium	Eu	822	S	5.24	280	360	480	F	W, Ta	-	-	Al_2O_3	RF, DC	Low tantalum solubility.
Europium Fluoride	EuF_2	1380		6.50	-	-	~950	-	Mo	-	-	-	RF	-
Europium Oxide	Eu_2O_3	-		7.42	-	-	~1600	G	Ir, Ta, W	-	-	ThO_2	RF, RF-R	Loses oxygen. Films clear and hard.
Europium Sulfide	EuS	-		5.75	-	-	-	G	-	-	-	-	RF	-

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Material	Symbol	MP (°C)	S/D	g/cm³	Temp.(°C) for Given Vap. Press. (Torr)			Evaporation Techniques					Sputter	Comments
								E-Beam	Thermal Sources					
					10^{-8}	10^{-6}	10^{-4}		Boat	Coil	Basket	Crucible		
Gadolinium	Gd	1313		7.90	760	900	1175	Ex	Ta	-	-	Al_2O_3	RF, DC	High tantalum solubility.
Gadolinium Carbide	GdC_2	-		-	-	-	1500	-	-	-	-	C	RF	Decomposes under sputtering.
Gadolinium Oxide	Gd_2O_3	2330		7.41	-	-	-	F	Ir	-	-	-	RF, RF-R	Loses oxygen.
Gallium	Ga	30		5.90	619	742	907	G	-	-	-	Al_2O_3, BeO, Q	-	Alloys with refractory metals. Use E-beam gun.
Gallium Antimonide	GaSb	710		5.6	-	-	-	F	W, Ta	-	-	-	RF	Flash evaporate.
Gallium Arsenide	GaAs	1238		5.3	-	-	-	G	W, Ta	-	-	C	RF	Flash evaporate.
Gallium Nitride	GaN	800	S	6.1	-	-	~200	-	-	-	-	Al_2O_3	RF, RF-R	Evaporates gallium in 10-3 Torr nitrogen.
Gallium Oxide	Ga_2O_3	1900		6.44	-	-	-	-	Pr, W	-	-	-	RF	Loses oxygen. n = 1.92
Gallium Phosphide	GaP	1540		4.1	-	770	920	-	W, Ta	-	W	Q	RF	Does not decompose. Rate control important.
Germanium	Ge	937		5.35	812	957	1167	Ex	W, C, Ta	-	-	Q, Al_2O_3	DC, RF	Excellent films from E-beam guns.
Germanium Nitride	Ge_3N_2	450	S	5.2	-	-	~650	-	-	-	-	-	RF-R	Sputtering preferred.
Germanium (II) Oxide	GeO	710	S	-	-	-	500	-	-	-	-	Q	RF	n = 1.61
Germanium (III) Oxide	GeO_2	1086		6.24	-	-	~625	G	Ta, Mo	-	W, Mo	Q, Al_2O_3	RF-R	Similar to SiO; film predominantly GeO.
Germanium Telluride	GeTe	725		6.20	-	-	381	-	W, Mo	-	W	Q, Al_2O_3	RF	-
Glass, Schott 8329	-	-		2.20	-	-	-	Ex	-	-	-	-	RF	Evaporable alkali glass. Melt in air before evaporating.
Gold	Au	1064		19.32	807	947	1132	Ex	W	W	W*** Mo***	Al_2O_3, BN, VC, W	DC, RF	Films soft, not very adherent.
Hafnium	Hf	2227		13.31	2160	2250	3090	G	-	-	-	-	DC, RF	-
Hafnium Boride	HfB_2	3250		10.5	-	-	-	-	-	-	-	-	DC, RF	-
Hafnium Carbide	HfC	~3890	S	12.20	-	-	~2600	-	-	-	-	-	DC, RF	-
Hafnium	HfN	3305		-	-	-	-	-	-	-	-	-	RF, RF-	-

Nitride													R	
Hafnium Oxide	HfO_2	2758		9.68	-	-	~2500	F	W	-	-	-	DC, RF, RF-R	Film HfO.
Hafnium Silicide	$HfSi_2$	1750		7.2	-	-	-	-	-	-	-	-	RF	-
Holmium	Ho	1474		8.80	650	770	950	G	W, Ta	W	W	-	-	-
Holmium Fluoride	HoF_3	1143		-	-	-	~800	-	-	-	-	Q	DC, RF	-
Holmium Oxide	Ho_2O_3	2370		8.41	-	-	-	-	Ir	-	-	-	RF, RF-R	Loses oxygen.
Inconel	Ni/Cr/Fe	1425		8.5	-	-	-	G	W	W	W	-	DC, RF	Use fine wire wrapped on tungsten. Low rate required for smooth films.
Indium	In	157		7.30	487	597	742	Ex	W, Mo	-	W	Gr, Al_2O_3	DC, RF	Wets tungsten and copper. Use molybdenum liner.
Indium Antimonide	InSb	535		5.8	-	-	-	-	W	-	-	-	RF	Decomposes; sputter preferred; or co-evaporate
Indium Arsenide	InAs	943		5.7	780	870	970	-	W	-	-	-	RF	-
Indium Nitride	InN	1200		7.0	-	-	-	-	-	-	-	-	-	-
Indium (I) Oxide	In_2O	~600	S	6.99	-	-	650	-	-	-	-	-	RF	Decomposes under sputtering.
Indium (III) Oxide	In_2O_3	850		7.18	-	-	~1200	G	W, Pt	-	-	Al_2O_3	-	-
Indium Phosphide	InP	1070		4.8	-	630	730	-	W, Ta	-	W, Ta	Gr	RF	Deposits are phosphorus rich.
Indium Selenide	In_2Se_3	890		5.67	-	-	-	-	-	-	-	-	RF	Sputtering preferred; or co-evaporate from two sources; flash.
Indium (I) Sulfide	In_2S	653		5.87	-	-	650	-	-	-	-	Gr	RF	-
Indium (II) Sulfide	InS	692	S	5.18	-	-	650	-	-	-	-	Gr	RF	-
Indium (III) Sulfide	In_2S_3	1050	S	4.90	-	-	850	-	-	-	-	Gr	RF	Film In_2S.
Indium (II) Telluride	InTe	696		6.29	-	-	-	-	-	-	-	-	-	-
Indium (III) Telluride	In_2Te_3	667		5.78	-	-	-	-	-	-	-	-	RF	Sputtering preferred; or co-evaporate from two sources; flash.
Indium Tin Oxide	In_2O_3-SnO_2	1800	S	-	-	-	-	-	-	-	-	-	-	-
Iridium	Ir	2410		22.42	1850	2080	2380	F	-	-	-	ThO_2	DC, RF	-
Iron	Fe	1535		7.86	858	998	1180	Ex	W	W	W	Al_2O_3, BeO	DC, RF	Attacks tungsten. Films hard, smooth. Preheat gently to outgas.
Iron Bromide	$FeBr_2$	684	D	4.64	-	-	561	-	-	-	-	Fe	RF	-
Iron Chloride	$FeCl_2$	670	S	3.16	-	-	300	-	-	-	-	Fe	RF	n = 1.57
Iron Iodide	FeI_2	-		5.32	-	-	400	-	-	-	-	Fe	RF	-
Iron (II) Oxide	FeO	1369		5.7	-	-	-	P	-	-	-	-	RF, RF-R	Decomposes; sputtering preferred. n=2.32
Iron (III) Oxide	Fe_2O_3	1565		5.24	-	-	-	G	W	-	W	-	-	Disproportionates to Fe_3O_4 at 1530°C. n = 3.01
Iron Sulfide	FeS	1193	D	4.74	-	-	-	-	-	-	-	Al_2O_3	RF	Decomposes.
Kanthal	FeCrAl	-		7.1	-	-	-	-	W	W	W	-	DC, RF	-
Lanthanum	La	921		6.15	990	1212	1388	Ex	W, Ta	-	-	Al_2O_3	RF	Films will burn in air if scraped.
Lanthanum Boride	LaB_6	2210	D	2.61	-	-	-	G	-	-	-	-	RF	-
Lanthanum Bromide	$LaBr_3$	783		5.06	-	-	-	-	-	-	Ta	-	RF	n=1.94. Hygroscopic.

Lanthanum Fluoride	LaF_3	1490	S	~6.0	-	-	900	G	Ta, Mo	-	Ta	-	RF	No decomposition. n ~1.6
Lanthanum Oxide	La_2O_3	2307		6.51	-	-	1400	G	W, Ta	-	-	-	RF	Loses oxygen. n~1.73
Lead	Pb	328		11.34	342	427	497	Ex	W, Mo	W	W, Ta	Al_2O_3, Q	DC, RF	Toxic.
Lead Bromide	$PbBr_2$	373		6.66	-	-	~300	-	-	-	-	-	-	-
Lead Chloride	$PbCl_2$	501		5.85	-	-	~325	-	Pt	-	-	Al_2O_3	RF	Little decomposition.
Lead Fluoride	PbF_2	855	S	8.24	-	-	~400	-	W, Pt, Mo	-	-	BeO	RF	n = 1.75
Lead Iodide	PbI_2	402		6.16	-	-	~500	-	Pt	-	-	Q	-	-
Lead Oxide	PbO	886		9.53	-	-	~550	-	Pt	-	-	Q, Al_2O_3	RF-R	No decomposition. n ~2.6
Lead Selenide	PbSe	1065	S	8.10	-	-	~500	-	W, Mo	-	W	Gr, Al_2O_3	RF	-
Lead Stannate	$PbSnO_3$	1115		8.1	670	780	905	P	Pt	-	Pt	Al_2O_3	RF	Disproportionates.
Lead Sulfide	PbS	1114	S	7.5	-	-	500	-	W	-	W, Mo	Q, Al_2O_3	RF	Little decomposition. n = 3.92
Lead Telluride	PbTe	917		8.16	780	910	1050	-	Mo, Pt, Ta	-	-	Al_2O_3, Gr	RF	Vapors toxic. Deposits aretellurium rich. Sputtering preferred or co-evaporate from two sources.
Lead Titanate	$PbTiO_3$	-		7.52	-	-	-	-	Ta	-	-	-	RF	-
Lithium	Li	181		0.53	227	307	407	G	Ta, SS	-	-	Al_2O_3, BeO	-	Metal reacts quickly in air.
Lithium Bromide	LiBr	550		3.46	-	-	~500	-	Ni	-	-	-	RF	n = 1.78
Lithium Chloride	LiCl	605		2.07	-	-	400	-	Ni	-	-	-	RF	Preheat gently to outgas. n = 1.66
Lithium Fluoride	LiF	845		2.64	875	1020	1180	G	Ni, Ta, Mo, W	-	-	Al_2O_3	RF	Rate control important for optical films. Preheat gently to outgas. n = 1.39
Lithium Iodide	LiI	449		4.08	-	-	400	-	Mo, W	-	-	-	RF	n = 1.96
Lithium Oxide	Li_2O	>1700		2.01	-	-	850	-	Pt, Ir	-	-	-	RF	n = 1.64
Lutetium	Lu	1663		9.84	-	-	1300	Ex	Ta	-	-	Al_2O_3	RF, DC	-
Lutetium Oxide	Lu_2O_3	-		9.42	-	-	1400	-	Ir	-	-	-	RF	Decomposes.

* influenced by composition ** Cr-plated rod or strip ***All metals alumina coated C = carbon Gr = graphite Q = quartz Incl = Inconel VC = vitreous carbon SS = stainless steel Ex = excellent	G = good F = fair P = poor S = sublimes D = decomposes RF = RF sputtering is effective RF-R = reactive RF sputter is effective DC = DC sputtering is effective DC-R = reactive DC sputtering is effective

Material	Symbol	MP (°C)	S/D	g/cm^3	Temp.(°C) for Given Vap. Press. (Torr)			Evaporation Techniques					Sputter	Comments
									Thermal Sources					
					10^{-8}	10^{-6}	10^{-4}	E-Beam	Boat	Coil	Basket	Crucible		
Magnesium	Mg	649	S	1.74	185	247	327	G	W, Mo, Ta, Cb	W	W	Al_2O_3, VC	DC, RF	Extremely high rates possible.
Magnesium Aluminate	$MgAl_2O_4$	2135		3.6	-	-	-	G	-	-	-	-	RF	Natural spinel. n = 1.72
Magnesium	$MgBr_2$	700		3.72	-	-	~450	-	Ni	-	-	-	RF	Decomposes.

Bromide														
Magnesium Chloride	$MgCl_2$	714		2.32	-	-	400	-	Ni	-	-	-	RF	Decomposes. n = 1.67
Magnesium Fluoride	MgF_2	1261		2.9-3.2	-	-	1000	Ex	Mo, Ta	-	-	Al_2O_3	RF	Rate control and substrate heat important for optical films. Reacts with tungsten. Excellent with molybdenum. n = 1.38
Magnesium Iodide	MgI_2	<637	D	4.43	-	-	200	-	Ir	-	-	-	RF	-
Magnesium Oxide	MgO	2852		3.58	-	-	1300	G	-	-	-	C, Al_2O_3	RF, RF-R	Evaporates in 10^{-3} Torr oxygen for stoichiometry. Tungsten gives volatile oxides. n~1.7
Manganese	Mn	1244	S	7.20	507	572	647	G	W, Ta, Mo	W	W	Al_2O_3, BeO	DC, RF	-
Manganese Bromide	$MnBr_2$	-	D	4.39	-	-	500	-	Incl	-	-	-	RF	-
Manganese Chloride	$MnCl_2$	650		2.98	-	-	450	-	Incl	-	-	-	RF	-
Manganese (III) Oxide	Mn_2O_3	1080		4.50	-	-	-	-	-	-	-	-	-	-
Manganese (IV) Oxide	MnO_2	535		5.03	-	-	-	P	W	-	W	-	RF-R	Loses oxygen at 535°C.
Manganese Sulfide	MnS	-	D	3.99	-	-	1300	-	Mo	-	-	-	RF	Decomposes. n = 2.70
Mercury	Hg	-39		13.55	-68	-42	-6	-	-	-	-	-	-	-
Mercury Sulfide	HgS	584	S	8.10	-	-	250	-	-	-	-	Al_2O_3	RF	Decomposes. n = 2.85, 3.20
Molybdenum	Mo	2610		10.2	1592	1822	2117	Ex	-	-	-	-	DC, RF	Films smooth, hard. Careful degas required.
Molybdenum Boride	MoB_2	2100		7.12	-	-	-	P	-	-	-	-	RF, DC	-
Molybdenum Carbide	Mo_2C	2687		8.9	-	-	-	F	-	-	-	-	RF, DC	Evaporation of $Mo(CO)_6$ yields Mo_2C.
Molybdenum Disulfide	MoS_2	1185		4.80	-	-	~50	-	-	-	-	-	RF	-
Molybdenum Oxide	MoO_3	795	S	4.69	-	-	~900	-	Mo, Pt	-	Mo	Al_2O_3, BN	RF	Slight oxygen loss. n = 1.9
Molybdenum Silicide	$MoSi_2$	2050		6.31	-	-	-	-	W	-	-	-	RF	Decomposes.
Neodymium	Nd	1021		7.01	731	871	1062	Ex	Ta	-	-	Al_2O_3	DC, RF	Low tantalum solubility.
Neodymium Fluoride	NdF_3	1410		6.5	-	-	~900	G	Mo, W	-	Mo, Ta	Al_2O_3	RF	Very little decomposition. n = 1.6
Neodymium Oxide	Nd_2O_3	~1900		7.24	-	-	~1400	G	Ta, W	-	-	ThO_2	RF, RF-R	Loses oxygen, films clear. E-beam preferred. n = 1.79
Nichrome IV	Ni/Cr	1395		8.50	847	987	1217	Ex	***	W	W, Ta	Al_2O_3, VC, BeO	DC, RF	Alloys with refractory metals.
Nickel	Ni	1455		8.90	927	1072	1262	Ex	W	W	W	Al_2O_3, BeO, VC	DC, RF	Alloys with refractory metals. Forms smooth adherent films.
Nickel Bromide	$NiBr_2$	963	S	5.10	-	-	362	-	Incl	-	-	-	RF	-
Nickel Chloride	$NiCl_2$	1001	S	3.55	-	-	444	-	Incl	-	-	-	RF	-
Nickel Oxide	NiO	1984		6.67	-	-	~1470	-	-	-	-	Al_2O_3	RF-R	Dissociates on heating. n = 2.18
Niobium	Nb	2468		8.57	1728	1977	2287	Ex	W	-	-	-	DC, RF	Attacks tungsten

														source. n = 1.80
Niobium Boride	NbB_2	2900(?)		6.97	-	-	-	-	-	-	-	-	RF, DC	-
Niobium Carbide	NbC	3500		7.6	-	-	-	F	-	-	-	-	RF, DC	-
Niobium Nitride	NbN	2573		8.4	-	-	-	-	-	-	-	-	RF, RF-R	Reactive. Evaporates niobium in 10^{-3} Torr nitrogen.
Niobium (II) Oxide	NbO	-		7.30	-	-	1100	-	Pt	-	-	-	RF	-
Niobium (III) Oxide	Nb_2O_3	1780		7.5	-	-	-	-	W	-	W	-	RF, DC, RF-R	-
Niobium (V) Oxide	Nb_2O_5	1485		4.47	-	-	-	-	W	-	W	-	RF, RF-R	n = 1.95
Niobium Telluride	$NbTe_x$	-		7.6	-	-	-	-	-	-	-	-	RF	Composition variable.
Niobium-Tin	Nb_3Sn	-		-	-	-	-	Ex	-	-	-	-	RF, DC	Co-evaporate from two sources.
Osmium	Os	2700		22.48	2170	2430	2760	F	-	-	-	-	DC, RF	-
Osmium Oxide	Os_2O_3	-	D	-	-	-	-	-	-	-	-	-	-	Deposits osmium in 10^{-3} Torr oxygen.
Palladium	Pd	1554	S	12.02	842	992	1192	Ex	W	W	W	Al_2O_3, BeO	DC, RF	Alloys with refractory metals. Rapid evaporation suggested.
Palladium Oxide	PdO	870		9.70	-	-	575	-	-	-	-	Al_2O_3	RF-R	Decomposes.
Parylene	C_8H_8	300-400		1.1	-	-	-	-	-	-	-	-	-	Vapor-depositable plastic.
Permalloy	Ni/Fe	1395		8.7	947	1047	1307	G	W	-	-	Al_2O_3, VC	DC	F, Film low in nickel.
Phosphorus	P	44.1		1.82	327	361	402	-	-	-	-	Al_2O_3	-	Material reacts violently in air. n = 2.14
Phosphorus Nitride	P_3N_5	-		2.51	-	-	-	-	-	-	-	-	RF, RF-R	-
Platinum	Pt	1772		21.45	1292	1492	1747	Ex	W	W	W	C, ThO_2	DC, RF	Alloys with metals. Films soft, poor adhesion.
Platinum Oxide	PtO_2	450		10.2	-	-	-	-	-	-	-	-	RF-R	-
Plutonium	Pu	641		19.84	-	-	-	-	W	-	-	-	-	Toxic, radioactive.
Polonium	Po	254		9.4	117	170	244	-	-	-	-	Q	-	Radioactive.
Potassium	K	63		0.86	23	60	125	-	Mo	-	-	Q	-	Metal reacts rapidly in air. Preheat gently to outgas.
Potassium Bromide	KBr	734		2.75	-	-	~450	-	Ta, Mo	-	-	Q	RF	Preheat gently to outgas. n = 1.559
Potassium Chloride	KCl	770	S	1.98	-	-	510	G	Ta, Ni	-	-	-	RF	Preheat gently to outgas. n = 1.49
Potassium Fluoride	KF	858		2.48	-	-	~500	-	-	-	-	Q	RF	Preheat gently to outgas. n = 1.363
Potassium Hydroxide	KOH	360		2.04	-	-	~400	-	Pt	-	-	-	-	Preheat gently to outgas.
Potassium Iodide	KI	681		3.13	-	-	~500	-	Ta	-	-	-	RF	Preheat gently to outgas. n = 1.677
Praseodymium	Pr	931		6.77	800	950	1150	G	Ta	-	-	-	RF, DC	-
Praseodymium Oxide	Pr_2O_3	-	D	7.07	-	-	1400	G	Ir	-	-	ThO_2	RF, RF-R	Loses oxygen.
Radium	Ra	700		5 (?)	246	320	416	-	-	-	-	-	-	-
Rhenium	Re	3180		20.53	1928	2207	2571	P	-	-	-	-	DC, RF	Fine wire will self-evaporate.
Rhenium Oxide	ReO_3	-	D	~7	-	-	-	-	-	-	-	-	RF	Evaporate rhenium in 10^{-3} Torr
Rhodium	Rh	1966		12.4	1277	1472	1707	G	W	W	W	ThO_2, VC	DC, RF	E-beam gun preferred.

Rubidium	Rb	39		1.48	-3	37	111	-	-	-	-	Q	DC, RF	-
Rubidium Chloride	RbCl	718		2.09	-	-	~550	-	-	-	-	Q	RF	n = 1.493
Rubidium Iodide	RbI	647		3.55	-	-	~400	-	-	-	-	Q	RF	n = 1.647
Ruthenium	Ru	2310		12.3	1780	1990	2260	P	W	-	-	-	DC, RF	-

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Material	Symbol	MP (°C)	S/D	g/cm^3	Temp.(°C) for Given Vap. Press. (Torr)			Evaporation Techniques					Sputter	Comments
									Thermal Sources					
					10^{-8}	10^{-6}	10^{-4}	E-Beam	Boat	Coil	Basket	Crucible		
Samarium	Sm	1074		7.52	373	460	573	G	Ta	-	-	Al_2O_3	RF, DC	-
Samarium Oxide	Sm_2O_3	2350		8.35	-	-	-	G	Ir	-	-	ThO_2	RF, RF-R	Loses oxygen. Films smooth, clear.
Samarium Sulfide	Sm_2S_3	1900		5.73	-	-	-	G	-	-	-	-	-	-
Scandium	Sc	1541		2.99	714	837	1002	Ex	W	-	-	Al_2O_3, BeO	RF	Alloys with tantalum.
Scandium Oxide	Sc_2O_3	2300		3.86	-	-	~400	F	-	-	-	-	RF, RF-R	-
Selenium	Se	217		4.81	89	125	170	G	W, Mo	W, Mo	W, Mo	Al_2O_3, VC	RF, DC	Toxic. Bad for vacuum systems.
Silicon	Si	1410		2.32	992	1147	1337	F	W, Ta	-	-	BeO, Ta, VC	DC, RF	Alloys with tungsten; use heavy tungsten boat. SiO produced above 4 x 10^{-6} Torr. E-beam best.
Silicon Boride	SiB_6	-		-	-	-	-	P	-	-	-	-	RF	-
Silicon Carbide	SiC	~2700	S, D	3.22	-	-	1000	-	-	-	-	-	RF	Sputtering preferred. n = 2.654, 2.697
Silicon Nitride	Si_3N_4	1900		3.44	-	-	~800	-	-	-	-	-	RF, RF-R	-
Silicon (II) Oxide	SiO	>1702	S	2.13	-	-	850	F	Ta	W	W	Ta	RF, RF-R	For resistance evaporation, use baffle box and low rate. n = 1.6
Silicon (IV) Oxide	SiO_2	1610		~2.65	*	*	1025*	Ex	-	-	-	Al_2O_3	RF	Quartz excellent in E-beam. n = 1.544, 1.553
Silicon Selenide	SiSe	-		-	-	-	550	-	-	-	-	Q	RF	-
Silicon Sulfide	SiS	940	S	1.85	-	-	450	-	-	-	-	Q	RF	n = 1.853
Silicon Telluride	$SiTe_2$	-		4.39	-	-	550	-	-	-	-	Q	RF	-
Silver	Ag	962		10.5	847	958	1105	Ex	W	Mo	Ta, Mo	Al_2O_3	W	DC, RF
Silver Bromide	AgBr	432	D	6.47	-	-	~380	-	Ta	-	-	Q	RF	n = 2.253
Silver Chloride	AgCl	455		5.56	-	-	~520	-	Mo, Pt	-	Mo	Q	RF	n = 2.07
Silver Iodide	AgI	558		6.01	-	-	~500	-	Ta	-	-	-	RF	n = 2.21
Sodium	Na	98		0.97	74	124	192	-	Ta, SS	-	-	Q	-	Preheat gently to outgas. Metal reacts quickly in air.n = 4.22
Sodium Bromide	NaBr	747		3.20	-	-	~400	-	-	-	-	Q	RF	Preheat gently to outgas. n = 1.641

Sodium Chloride	NaCl	801		2.17	-	-	530	G	Ta, W, Mo	-	-	Q	RF	Copper oven, little decomposition. Preheat gently to outgas. n = 1.544
Sodium Cyanide	NaCN	564		-	-	-	~550	-	Ag	-	-	-	RF	Preheat gently to outgas. n = 1.452
Sodium Fluoride	NaF	993		2.56	-	-	~1000	G	Mo, Ta, W	-	-	BeO	RF	Preheat gently to outgas. No decomposition. n = 1.336
Sodium Hydroxide	NaOH	318		2.13	-	-	~470	-	Pt	-	-	-	-	Preheat gently to outgas. n = 1.358
Spinel	$MgO_3 5Al_2O_3$	-		8.0	-	-	-	G	-	-	-	-	RF	n = 1.72
Strontium	Sr	769		2.6	239	309	403	P	W, Ta, Mo	W	W	VC	RF, DC	Wets but does not alloy with refractory metals. May react in air.
Strontium Chloride	$SrCl_2$	875		3.05	-	-	-	-	-	-	-	-	-	n = 1.650
Strontium Fluoride	SrF_2	1473		4.24	-	-	~1000	-	-	-	-	Al_2O_3	RF	n = 1.442
Strontium Oxide	SrO	2430	S	4.7	-	-	1500	-	Mo	-	-	Al_2O_3	RF	Reacts with molybdenum and tungsten. n = 1.810
Strontium Sulfide	SrS	>2000		3.70	-	-	-	-	Mo	-	-	-	RF	Decomposes. n = 2.107
Sulfur	S_8	113		2.07	13	19	57	P	W	-	W	Q	-	Bad for vacuum systems. n = 1.957
Supermalloy	Ni/Fe/Mo	1410		8.9	-	-	-	G	-	-	-	-	RF, DC	Sputtering preferred; or co-evaporate from two sources, permalloy and molybdenum.
Tantalum	Ta	2996		16.6	1960	2240	2590	Ex	-	-	-	-	DC, RF	Forms good films.
Tantalum Boride	TaB_2	3000(?)		11.15	-	-	-	-	-	-	-	-	RF, DC	-
Tantalum Carbide	TaC	3880		13.9	-	-	~2500	-	-	-	-	-	RF, DC	-
Tantalum Nitride	TaN	3360		16.30	-	-	-	-	-	-	-	-	RF, RF-R, DC	Evaporates tantalum in 10^{-3} Torr nitrogen.
Tantalum Pentoxide	Ta_2O_5	1872		8.2	1550	1780	1920	G	Ta	W	W	VC	RF, RF-R	Slight decomposition.Evaporates in 10^{-3} Torr oxygen. n = 2.6
Tantalum Sulfide	TaS_2	>1300		-	-	-	-	-	-	-	-	-	RF	-
Technetium	Tc	2200		11.5	1570	1800	2090	-	-	-	-	-	-	-
PTFE	PTFE	330		2.9	-	-	-	-	W	-	-	-	RF	Baffled source. Film structure doubtful.
Tellurium	Te	452		6.25	157	207	277	P	W, Ta	W	W, Ta	Al_2O_3, Q	RF	Toxic. Wets without alloying. n =1.002
Terbium	Tb	1356		8.23	800	950	1150	Ex	Ta	-	-	Al_2O_3	RF	-
Terbium Fluoride	TbF_3	1172		-	-	-	~800	-	-	-	-	-	RF	-
Terbium Oxide	Tb_2O_3	2387		7.87	-	-	1300	-	Ir	-	-	-	RF	Partially decomposes.
Terbium Peroxide	Tb_4O_7	-	D	-	-	-	-	-	Ta	-	-	-	RF	Films TbO.
Thallium	Tl	304		11.85	280	360	470	P	W, Ta	-	W	Al_2O_3, Q	DC	Very toxic. Wets freely.
Thallium Bromide	TlBr	480	S	7.56	-	-	~250	-	Ta	-	-	Q	RF	Toxic. n = 2.4 - 2.8
Thallium Chloride	TlCl	430	S	7.00	-	-	~150	-	Ta	-	-	Q	RF	n = 2.247
Thallium Iodide	TlI	440	S	7.1	-	-	~250	-	-	-	-	Q	RF	n = 2.78
Thallium Oxide	Tl_2O_2	717		10.19	-	-	350	-	-	-	-	-	RF	Disproportionates at 850°C to Tl_2O.
Thorium	Th	1875		11.7	1430	1660	1925	Ex	W, Ta,Mo	W	W	-	-	Toxic, radioactive.
Thorium	$ThBr_4$	610	S	5.67	-	-	-	-	Mo	-	-	-	-	Toxic. n=2.47

Bromide													
Thorium Carbide	ThC_2	2655		8.96	-	-	~2300	-	-	-	-	C	RF, DC	Radioactive.
Thorium Fluoride	ThF_4	>900		6.32	-	-	~750	F	Mo	-	W	VC	RF	Radioactive.
Thorium Oxide	ThO_2	3220		9.86	-	-	~2100	G	W	-	-	-	RF, RF-R	Radioactive.
Thorium Oxyfluoride	$ThOF_2$	900		9.1	-	-	-	-	Mo, Ta	-	-	-	-	Radioactive. n = 1.52
Thorium Sulfide	ThS_2	1925		7.30	-	-	-	-	-	-	-	-	RF	Sputtering preferred; or co-evaporate from two sources.
Thulium	Tm	1545	S	9.32	461	554	680	G	Ta	-	-	Al_2O_3	DC	-
Thulium Oxide	Tm_2O_3	-		8.90	-	-	1500	-	Ir	-	-	-	RF	Decomposes.
Tin	Sn	232		7.28	682	807	997	Ex	Mo	W	W	Al_2O_3	DC, RF	Wets molybdenum. Use tantalum liner in E-beam guns.
Tin Oxide	SnO_2	1630	S	6.95	-	-	~1000	Ex	W	W	W	Q, Al_2O_3	RF, RF-R	Films from tungsten are oxygen deficient, oxidize in air. n = 2.0
Tin Selenide	SnSe	861		6.18	-	-	~400	G	-	-	-	Q	RF	-
Tin Sulfide	SnS	882		5.22	-	-	~450	-	-	-	-	Q	RF	-
Tin Telluride	SnTe	780	D	6.48	-	-	~450	-	-	-	-	Q	RF	-
Titanium	Ti	1660		4.5	1067	1235	1453	Ex	W	-	-	TiC	DC, RF	Alloys with refractory metals; evolves gas on first heating.
Titanium Boride	TiB_2	2900		4.50	-	-	-	P	-	-	-	-	RF, DC	-
Titanium Carbide	TiC	3140		4.93	-	-	~2300	-	-	-	-	-	RF, DC	-
Titanium Nitride	TiN	2930		5.22	-	-	-	G	Mo	-	-	-	RF, RF-R, DC	Sputtering preferred. Decomposes with thermal evaporation.
Titanium (II) Oxide	TiO	1750		4.93	-	-	~1500	G	W, Mo	-	-	VC	RF	Preheat gently to outgas. n = 2.2
Titanium (III) Oxide	Ti_2O_3	2130	D	4.6	-	-	-	G	W	-	-	-	RF	Decomposes.
Titanium (IV) Oxide	TiO_2	1830		4.26	-	-	~1300	F	W, Mo	-	W	-	RF, RF-R	Suboxide, must be reoxidized to rutile. Tantalum reduces TiO_2 to TiO and titanium. n = 2.616, 2.903
Tungsten	W	3410		19.35	2117	2407	2757	G	-	-	-	-	RF, DC	Forms volatile oxides. Films hard and adherent.
Tungsten Boride	WB_2	~2900		10.77	-	-	-	P	-	-	-	-	RF	-
Tungsten Carbide	W_2C	2860		17.15	1480	1720	2120	Ex	C	-	-	-	RF, DC	-
Tungsten Disulfide	WS_2	1250	D	7.5	-	-	-	-	-	-	-	-	RF	-
Tungsten Oxide	WO_3	1473	S	7.16	-	-	980	G	W, Pt	-	-	-	RF-R	Preheat gently to outgas. Tungsten reduces oxide slightly. n = 1.68
Tungsten Selenide	WSe_2	-		9.0	-	-	-	-	-	-	-	-	RF	-
Tungsten Silicide	WSi_2	>900		9.4	-	-	-	-	-	-	-	-	RF, DC	-
Tungsten Telluride	WTe_3	-		9.49	-	-	-	-	-	-	-	Q	RF	-
Uranium	U	1132		19.05	1132	1327	1582	G	Mo, W	W	W	-	-	Films oxidize.
Uranium Carbide	UC_2	2350		11.28	-	-	2100	-	-	-	-	C	RF	Decomposes.
Uranium Fluoride	UF_4	960		6.70	-	-	300	-	Ni	-	-	-	RF	-

Uranium (III) Oxide	U_2O_3	1300	D	8.30	-	-	-	-	W	-	W	-	RF-R	Disproportionates at 1300°C to UO_2.
Uranium (IV) Oxide	UO_2	2878		10.96	-	-	-	-	W	-	W	-	RF	Tantalum causes decomposition.
Uranium Phosphide	UP_2	-		8.57	-	-	1200	-	Ta	-	-	-	RF	Decomposes.
Uranium (II) Sulfide	US	>2000		10.87	-	-	-	-	-	-	-	-	-	-
Uranium (IV) Sulfide	US_2	>1100		7.96	-	-	-	-	W	-	-	-	RF	Slight decomposition.
Vanadium	V	1890		5.96	1162	1332	1547	Ex	W, Mo	-	-	-	DC, RF	Wets molybdenum. E-beam-evaporated films preferred. n = 3.03
Vanadium Boride	VB_2	2400		5.10	-	-	-	-	-	-	-	-	RF, DC	-
Vanadium Carbide	VC	2810		5.77	-	-	~1800	-	-	-	-	-	RF, DC	-
Vanadium Nitride	VN	2320		6.13	-	-	-	-	-	-	-	-	RF, RF-R, DC	-
Vanadium (IV) Oxide	VO_2	1967	S	4.34	-	-	~575	-	-	-	-	-	RF, RF-R	Sputtering preferred.
Vanadium (V) Oxide	V_2O_5	690	D	3.36	-	-	~500	-	-	-	-	Q	RF	n = 1.46, 1.52, 1.76
Vanadium Silicide	VSi_2	1700		4.42	-	-	-	-	-	-	-	-	RF	-
Ytterbium	Yb	819	S	6.96	520	590	690	G	Ta	-	-	-	DC, RF	-
Ytterbium Fluoride	YbF_3	1157		-	-	-	~800	-	Mo	-	-	-	RF	-
Ytterbium Oxide	Yb_2O_3	2346	S	9.17	-	-	~1500	-	Ir	-	-	-	RF, RF-R	Loses oxygen.
Yttrium	Y	1522		4.47	830	973	1157	Ex	W, Ta	W	W	Al_2O_3	RF, DC	High tantalum solubility.
Yttrium Aluminum Oxide	$Y_3Al_5O_{12}$	1990		-	-	-	-	G	-	W	W	-	RF	Films not ferroelectric.
Yttrium Fluoride	YF_3	1387		4.01	-	-	-	-	-	-	-	-	RF	-
Yttrium Oxide	Y_2O_3	2410		5.01	-	-	~2000	G	W	-	-	C	RF, RF-R	Loses oxygen, films smooth and clear. n = 1.79
Zinc	Zn	420		7.14	127	177	250	Ex	Mo, W, Ta	W	W	Al_2O_3, Q	DC, RF	Evaporates well under wide range ofconditions.
Zinc Antimonide	Zn_3Sb_2	570		6.33	-	-	-	-	-	-	-	-	RF	-
Zinc Bromide	$ZnBr_2$	394		4.20	-	-	~300	-	W	-	-	C	RF	Decomposes. n= 1.545
Zinc Fluoride	ZnF_2	872		4.95	-	-	~800	-	Pt, Ta	-	-	Q	RF	-
Zinc Nitride	Zn_3N_2	-		6.22	-	-	-	-	Mo	-	-	-	RF	Decomposes.
Zinc Oxide	ZnO	1975		5.61	-	-	~1800	F	-	-	-	-	RF-R	n = 2.008, 2.029
Zinc Selenide	ZnSe	>1100		5.42	-	-	660	-	Ta, W, Mo	W,Mo	W, Mo	Q	RF	Preheat gently to outgas. Evaporates well. n = 2.89
Zinc Sulfide	ZnS	1700	S	3.98	-	-	~800	G	Ta, Mo	-	-	-	RF	Preheat gently to outgas. Films partially decompose. Sticking coefficient varies with substrate temperature. n =2.356
Zinc Telluride	ZnTe	1239		6.34	-	-	~600	-	Mo, Ta	-	-	-	RF	Preheat gently to outgas. n = 3.56
Zirconium	Zr	1852		6.49	1477	1702	1987	Ex	W	-	-	-	RF, DC	Alloys with tungsten. Films oxidize readily.
Zirconium Boride	ZrB_2	~3200		6.09	-	-	-	G	-	-	-	-	RF, DC	-
Zirconium Carbide	ZrC	3540		6.73	-	-	~2500	-	-	-	-	-	RF, DC	-
Zirconium													RF, RF-	Reactively evaporates in

Nitride	ZrN	2980		7.09	-	-	-	-	-	-	-	-	R, DC	10^{-3} Torr nitrogen.
Zirconium Oxide	ZrO_2	~2700		5.89	-	-	~2200	G	W	-	-	-	RF, RF-R	Films oxygen deficient, clear and hard. n = 2.13, 2.19, 2.20
Zirconium Silicate	$ZrSiO_4$	2550		4.56	-	-	-	-	-	-	-	-	RF	n = 1.92 - 1.96; 1.97 - 2.02
Zirconium Silicide	$ZrSi_2$	1700		4.88	-	-	-	-	-	-	-	-	RF, DC	-

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