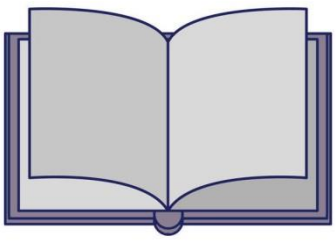
VACUUM DEPOSITION GUIDE

- Technical Guide about Thin Films Deposition .....III 02
- Vapor Pressures Table .....III 03



Technical Guide about Thin Film Deposition

SYMBOLS

Gr	Graphite	G	Good	RF	RF sputtering is effective
Q	Quartz	F	Fair	RF-R	Reactive RF sputter is effective
VC	Vitreous carbon	P	Poor	DC	DC sputtering is effective
SS	Stainless steel	S	Sublimes	DC-R	Reactive DC sputtering is effective
Int	Intermetallic	D	Decomposes		

REMARK:

The data were obtained from reliable literature and scientists who working on vacuum deposition. However, it is intended as a general guide only, for very critical data, please do not hesitate to contact us.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Aluminium	Al	660	-	2.7	1.08	677	821	1,010	Excellent	Gr, Int	Int, W, Al_2O_3	W	W	Int	RF, DC	0.93@0.6	Alloys and wets W. Stranded W is best. Slow sputtering
Aluminium Antimonide	AlSb	1,080	-	4.3	-	-	-	-	-	-	-	-	-	-	RF	3.62	-
Aluminium Arsenide	AlAs	1,600	-	3.7	-	-	-	~1300	-	-	-	-	-	-	RF	-	-
Aluminium Bromide	$AlBr_3$	97	-	2.64	-	-	-	~50	-	-	Mo	-	-	Gr	-	-	-
Aluminium Carbide	Al_4C_3	~1,400	D	2.36	-	-	-	~800	Fair	-	-	-	-	-	RF	2.75@0.7	-
Aluminium Fluoride	AlF_3	1,291	S	2.88	-	410	490	700	Poor	Graphite	Mo，W，Ta	-	-	Gr	RF	1.4@0.5	-
Aluminium Nitride	AlN	>2,200	S	3.26	**1.00	-	-	~1750	Fair	-	-	-	-	-	R-RF	-	Reactive evap in 10-3 N2 with glow discharge. Good electrical stability.
Aluminium Oxide	Al_2O_3	2,072	-	3.97	0.336	-	-	1,550	Excellent	Tungsten	W	-	W	-	R-RF	1.63@0.55	Sapphire excellent in E-beam. Forms smooth, hard films.
Aluminium Phosphide	AlP	2,000	-	2.42	-	-	-	-	-	-	-	-	-	-	RF	-	-
Aluminium，1% Copper	Al/Cu 99/1wt%	640	-	2.82	**1.00	-	-	-	-	-	-	-	-	-	DC	-	-
Aluminium，1% Silicon	Al/Si 99/1wt%	640	-	2.69	**1.00	-	-	1,010	-	-	-	-	-	TiB_2-BN	DC，RF	-	-
Antimony	Sb	630	S	6.68	0.768	279	345	425	Poor	-	Mo**Ta**	Mo，Ta	Mo，Ta	BN，C，Al_2O_3	DC，RF	3.4@1	Toxic. Evaporates well. Film structure is rate dependent.
Antimony Oxide	Sb_2O_3	656	S	5.2	-	-	-	~300	Good	-	-	-	-	BN，Al_2O_3	R-RF	2.1@0.55	Toxic. Decomposes on W. Use low rate.
Antimony Selenide	Sb_2Se_3	611	-	-	-	-	-	-	-	-	Ta	-	-	C	RF	3.01@0.55	Stoichiometry variable. Toxic.
Antimony Sulfide	Sb_2S_3	550	-	4.64	-	-	-	~200	Good	Mo, Ta	Mo，Ta	-	Mo,Ta	Al_2O_3	-	3.2@0.55	Toxic. No decomposition.
Antimony Telluride	Sb_2Te_3	629	-	6.5	**1.00	-	-	600	-	-	-	-	-	C	RF	-	Toxic. Decomposes over 750°C
Arsenic	As	817	S	5.73		107	150	210	Poor	Gr, VC, Al2O3	Gr	-	-	Al2O3, 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	RF	3.03@0.82	Toxic.
Arsenic Sulfide	As_2S_3	300	-	3.43	-	-	-	~400	Fair	-	Mo	-	-	Al_2O_3	RF	2.69@0.56	Toxic.
Arsenic Telluride	As_2Te_3	362	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-	Flash. Toxic.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Barium	Ba	725	-	3.51	2.1	545	627	735	Fair	-	Mo，W，Ta	W	W	Metals	RF	0.9@0.57	Toxic. Wets without alloying from refractory metals. Reacts with ceramics. Evaporates easily.
Barium Chloride	$BaCl_2$	963	-	3.92	-	-	-	~650	-	-	Ta，Mo	-	-	-	RF	0.74@0.58	Preheat gently to outgas.
Barium Fluoride	BaF_2	1,355	S	4.89	0.793	-	-	~700	Good	Moly	Mo	-	-	-	RF	1.3@0.55	Denstity rate dependent.
Barium Oxide	BaO	1,918	-	5.72	-	-	-	~1,300	Poor	-	-	-	-	Al2O3	RF，R-RF	1.98@0.59	Decomposes slightly.
Barium Sulfide	BaS	1,200	-	4.25	-	-	-	1,100	-	-	Mo	-	-	-	RF	2.16@ 0.59	-
Barium Titanate	$BaTiO_3$	1,625	D	6.02	0.464	-	-	-	-	-	-	-	-	-	RF	2.4@0.55	Gives Ba. Co-evap. from 2 sources or sputter.
Beryllium	Be	1,278	-	1.85	-	710	878	1,000	Excellent	Graphite	W，Ta	W	W	C	DC	2.5@0.5	Wets W/Mo/Ta. Powder and oxides toxic. Evaporates easily
Bismuth	Bi	271	-	9.8	0.79	330	410	520	Excellent	Graphite	Mo，W，Ta	W	W	Al2O3	DC	2.61@0.8	Toxic vapor. High resistivity. No shorting of baskets.
Bismuth Fluoride	BiF_3	727	S	5.32	-	-	-	~300	-	-	-	-	-	Gr	RF	1.7@0.55	Toxic.
Bismuth Oxide	Bi_2O_3	860	-	8.55	**1.00	-	-	~1,400	Poor	-	-	-	-	-	RF,R-RF	1.9@0.55	Toxic vapor.
Bismuth Selenide	Bi_2Se_3	710	D	6.82	**1.00	-	-	~650	Good	-	-	-	-	Gr，Q	RF	-	Toxic. Co-evaporate from two sources or sputter.
Bismuth Sulfide	Bi_2S_3	685	D	7.39	-	-	-	-	-	-	-	-	-	-	RF	1.5	Toxic.
Bismuth Telluride	Bi_2Te_3	572	-	7.7	**1.00	-	-	~600	-	-	W，Mo	-	-	Gr，Q	RF	-	Toxic. Co-evaporate from two sources or sputter
Bismuth Titanate	$Bi_2Ti_2O_7$	870	D	-	-	-	-	-	-	-	-	-	-	-	RF	-	Toxic. Sputter or co-evaporate from two sources in 10-2 Torr oxygen.
Boron	B	2,079	-	2.34	0.389	1,278	1,548	1,797	Excellent	Graphite	C	-	-	C	RF	-	Explodes with rapid cooling. Forms carbide with Gr. Boats must be heated.
Boron Carbide	B_4C	2,350	-	2.52	**1.00	2,500	2,580	2,650	Excellent	Graphite	-	-	-	-	RF	-	Similar to chromium. Films very adherent. Sputter quickly
Boron Nitride	BN	~3,000	S	2.25	-	-	-	~1,600	Poor	-	-	-	-	-	RF，R-RF	-	Decomposes under sputtering; sensitive to thermic shocks. Sputtering preferred.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Boron Oxide	B_2O_3	~450	-	1.81	-	-	-	~1,400	Good	Moly	Mo	-	-	-	-	1.46	-
Boron Sulfide	B_2S_3	310	-	1.55	-	-	-	800	-	-	-	-	-	Gr	RF	-	-
Cadmium	Cd	321	-	8.64	0.682	64	120	180	Poor	-	Mo，W，Ta	-	Mo，W，Ta	Al2O3，Q	DC，RF	1.13@0.6	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		Toxic.
Cadmium Bromide	$CdBr_2$	567	-	5.19	-	-	-	~300	-	-	-	-	-	-	-		
Cadmium Chloride	$CdCl_2$	568	-	4.05	-	-	-	~400	-	-	-	-	-	-	-		
Cadmium Fluoride	CdF_2	1,100	-	6.64	-	-	-	~500	-	-	-	-	-	-	RF	1.56@0.58	
Cadmium Iodide	CdI_2	387	-	5.67	-	-	-	~250	-	-	-	-	-	-	-		
Cadmium Oxide	CdO	>1,500	D	6.95	-	-	-	~530	-	-	-	-	-	-	R-RF	2.49@0.67	Reactive RF (O + Ar) 2 or (O + N).
Cadmium Selenide	CdSe	>1,350	S	5.81	**1.00	-	-	540	Good	Mo,Ta	Mo，Ta	-	-	Al2O3，Q	RF	2.4@0.58	Toxic. Evaporates easily.
Cadmium Sulfide	CdS	1,750	S	4.82	1.02	-	-	550	Fair	-	W，Mo，Ta	-	W	Al2O3，Q	RF	2.5@0.55	Sticking coefficient affected by substrate temperature. Stoichiometry variable.
Cadmium Telluride	CdTe	1,092	-	5.85	0.98	-	-	450	-	-	W，Mo，Ta	W	Mo，W，Ta	-	RF	2.6	Toxic. Stoichiometry depends on substrate temperature.
Calcium	Ca	839	S	1.54	2.62	272	357	459	Poor	-	W	W	W	Al2O3，Q	-	0.29@0.58	Flammable. Corrodes in air.
Calcium Fluoride	CaF_2	1,423	-	3.18	0.775	-	-	~1,100	-	-	W，Mo，Ta	W,Mo,Ta	W,Mo,Ta	Q	RF	1.4@0.55	Rate control important. Preheat gently to outgas.
Calcium Oxide	CaO	2,614	-	~3.3	-	-	-	~1,700	-	-	W，Mo	-	-	ZrO2	R-RF	1.84@0.59	Forms volatile oxides with tungsten and molybdenum.
Calcium Silicate	$CaSiO_3$	1,540	-	2.91	-	-	-	-	Good	-	-	-	-	Q	RF	-	-
Calcium Sulfide	CaS	2,525	D	2.5	-	-	-	1,100	-	-	Mo	-	-	-	RF	2.14@0.59	-
Calcium Titanate	$CaTiO_3$	1,975	-	4.1	-	1,490	1,600	1,690	Poor	-	-	-	-	-	RF	2.34@0.59	Disproportionates except in sputtering.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Calcium Tungstate	$CaWO_4$	1,200	-	6.06	-	-	-	-	Good	-	W	-	-	-	RF	1.92@0.59	-
Carbon	C	~3,652	S	1.8-2.1	3.26	1,657	1,867	2,137	Excellent	Graphite	-	-	-	-	RF	1.47	E-beam preferred. Arc evaporation. Poor film adhesion.
Cerium	Ce	798	-	~6.7	**1.00	970	1,150	1,380	Good	-	W，Ta	W	W，Ta	Al2O3	DC，RF	1.91@0.59	Films oxide easily.
Cerium(III) Oxide	Ce_2O_3	1,692	-	6.86	-	-	-	-	Fair	-	W	-	-	-	-	2.18@0.58	Alloys with source. Use 0.015 ”-0.020” tungsten boat. E-beam gun preferred.
Cerium(IV)Oxide	CeO_2	~2,600	-	7.13	**1.00	1,890	2,000	2,310	Good	Tantalum, Graphite	W	-	-	-	RF，R-RF	2.18@0.55	Very little decomposition. Use 250°C substrate temperature.
Cerium Fluoride	CeF_3	1,460	-	6.16	**1.00	-	-	~900	Good	W, Mo,Ta	W, Mo, Ta	-	Mo,Ta	-	RF	1.63@0.55	Preheat gently to outgas.
Cesium	Cs	28		1.88		-17	22	75			SS			Q		-	Flammable.
Cesium Bromide	CsBr	636		3.04				~400			W				RF	-	-
Cesium Chloride	CsCl	645		3.99				~500			W				RF	-	Hygroscopic.
Cesium Fluoride	CsF	682		4.12				~500			W				RF	1.5@0.55	
Cesium Hydroxide	CsOH	272		3.68				550			Pt					-	-
Cesium Iodide	CsI	626		4.51				~500			W				RF	1.99@0.23	-
Chromium	Cr	1,857	S	7.2	0.305	837	977	1,157	Good	Graphite, Tungsten	Cr Plated W Rods	W	W	VitC	DC	3.28@0.7	Films very adherent. High rates possible.
Chromium Boride	CrB	1950-2050	-	6.17	-	-	-	-	-	-	-	-	-	-	RF	-	-
Chromium(II) Bromide	$CrBr_2$	842	-	4.36	-	-	-	550	-	-	-	-	-	-	RF	-	-
Chromium Carbide	CrC_2	1,895	-	6.68	-	-	-	~2000	Fair	-	W	-	-	-	RF	-	-
Chromium Chloride	$CrCl_2$	824	-	2.88	-	-	-	550	-	-	Fe	-	-	-	RF	-	Sublimes easily.
Chromium Oxide	Cr_2O_3	2,266	-	5.21	**1.00	-	-	~2,000	Good	-	W，Mo	-	W	-	RF,R-RF	2.55@0.59	Disproportionates to lower oxides; reoxidizes at 600°C in air.
Chromium Silicide	$CrSi_2$	1,490	-	5.5	-	-	-	-	-	-	-	-	-	-	RF	-	-
Chromium-Silicon Monoxide	Cr-SiO	-	S	*	-	-	-	*	Good	-	W	-	W	-	RF	-	Flash.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Cobalt	Co	1,495	-	8.9	0.343	850	990	1,200	Excellent	Direct in Hearth	W，Nb	-	W	Al2O3	DC	2.17@0.62	Alloys with refractory metals.
Cobalt Bromide	$CoBr_2$	678	D	4.91	-	-	-	400	-	-	-	-	-	-	RF	-	-
Cobalt Chloride	$CoCl_2$	724	D	3.36	-	-	-	472	-	-	-	-	-	-	RF	1.51@0.63	-
Cobalt Oxide	CoO	1,795	-	6.45	0.412	-	-	-	-	-	-	-	-	-	R-RF, DC-R	-	Sputter preferred.
Copper	Cu	1,083	-	8.92	0.437	727	857	1,017	Excellent	Gr, Mo	Mo	W	W	Al_2O_3, Mo, Ta	DC	0.17@0.8	Adhesion poor. Use interlayer (Cr). Evaporates using any source material.
Copper Chloride	CuCl	430	-	4.14	-	-	-	~600	-	-	-	-	-	-	RF	1.93	-
Copper Oxide	Cu_2O	1,235	S	6	**1.00	-	-	~600	Good	Tantalum, Graphite	Ta	-	-	Al2O3	R-RF, DC-R	2.71@0.59	Evaporate in 10-2 to 104 of O2.
Copper Sulfide	Cu_2S	1,100	-	5.6	-	-	-	-	-	-	-	-	-	C	-	-	-
Dysprosium	Dy	1,412	-	8.55	0.6	625	750	900	Good	Direct in Hearth	Ta	-	-	-	DC	-	Flammable
Dysprosium Fluoride	DyF_3	1,360	S	-	-	-	-	~800	Good	-	Ta	-	-	-	RF	1.6@0.55	-
Dysprosium Oxide	Dy_2O_3	2,340	-	7.81	-	-	-	~1,400	-	-	-	-	-	-	RF,R-RF	1.9@0.55	Loses oxygen.
Erbium	Er	1,529	S	9.07	0.74	650	775	930	Good	W, Ta	W，Ta	-	-	-	DC	-	-
ErbiumFluoride	ErF_3	1,350	-	7.82	-	-	-	~750	-	-	Mo	-	-	-	RF	1.5@0.55	-
ErbiumOxide	Er_2O_3	2,350	-	8.64	**1.00	-	-	~1,600	-	-	-	-	-	-	RF，R-RF	1.9@0.55	Loses oxygen.
Europium	Eu	822	S	5.24	**1.00	280	360	480	Fair	-	W，Ta	-	-	Al2O3	DC	-	Flammable. Low tantalum solubility.
Europium Fluoride	EuF_2	1,380	-	6.5	-	-	-	~950	-	-	Mo	-	-	-	RF	-	-
Europium Oxide	Eu_2O_3	2,350	-	7.42	-	-	-	~1,600	Good	-	Ta，W	-	-	ThO2	RF,R-RF	1.9@0.55	Loses oxygen. Films clear and hard.
Europium Sulfide	EuS	-	-	5.75	-	-	-	-	Good	-	-	-	-	-	RF	-	-
Gadoliniium	Gd	1,313	-	7.9	0.67	760	900	1,175	Excellent	Direct in Hearth	Ta	-	-	Al2O3	DC	-	Flammable. High tantalum solubility.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Gadoliniium Carbide	GdC_2	-	-	-	-	-	-	1,500	-	-	-	-	-	C	RF	-	Decomposes under sputtering.
Gadoliniium Oxide	Gd_2O_3	2,330	-	7.41	-	-	-	-	Fair	-	-	-	-	-	RF,R-RF	1.8@0.55	Loses oxygen.
Gallium	Ga	30	-	5.9	-	619	742	907	Good	-	-	-	-	Al2O3, Q	-	-	Alloys with refractory metals. Use E-beam gun. Attack crucibles above 1000°C.
Gallium Antimonide	GaSb	710	-	5.6	-	-	-	-	Fair	-	W，Ta	-	-	-	RF	3.8@2.2	Flash evaporate.
Gallium Arsenide	GaAs	1,238	-	5.3	-	-	-	-	Good	Graphite	W，Ta	-	-	C	RF	3.34@0.78	Flash evaporate.
Gallium Nitride	GaN	800	S	6.1	-	-	-	~200	-	-	-	-	-	Al2O3	RF,R-RF	-	Evaporates gallium in 10-3 Torr nitrogen.
Gallium Oxide	Ga_2O_3	1,900	-	6.44	-	-	-	-	-	-	W	-	-	-	RF	-	Loses oxygen.
Gallium Phosphide	GaP	1,540	-	4.1	-	-	770	920	-	-	W，Ta	-	W	Q	RF	3@2.15	Does not decompose. Rate control important.
Germanium	Ge	937	-	5.35	0.516	812	957	1,167	Excellent	Graphite	W，C，Ta	-	-	Q, Al2O3	DC	4@2	Excellent films from E-beam guns. Wets W, Ta and Mo
Germanium(II) Oxide	GeO	700	S	-	-	-	-	500	-	-	-	-	-	Q	RF	-	-
Germanium(IV) Oxide	GeO_2	1,086	-	6.24	-	-	-	~625	Good	Ta, Mo	Ta, Mo	-	W, Mo	Q, Al2O3	R-RF	-	Similar to SiO; film predominantly GeO
Germanium Nitride	Ge_3N_2	450	S	5.2	-	-	-	~650	-	-	-	-	-	-	R-RF	-	Sputtering preferred.
Germanium Telluride	GeTe	725	-	6.2	-	-	-	381	-	-	W，Mo	-	W	Q, Al2O3	RF	-	-
Gold	Au	1,064	-	19.32	0.381	807	947	1,132	Excellent	Tungsten	W**Mo **W	-	-	BN,Al_2O_3	DC	0.2@0.6	Films soft, not very adherent. Wets W and Mo. Sputtering preferred.
Hafnium	Hf	2,227	-	13.31	0.36	2,160	2,250	3,090	Good	-	-	-	-	-	DC	-	-
Hafnium Boride	HfB_2	3,250	-	10.5	-	-	-	-	-	-	-	-	-	-	DC，RF	-	-
Hafnium Carbide	HfC	~3,890	S	12.2	**1.00	-	-	~2,600	-	-	-	-	-	-	RF	-	-
Hafnium Nitride	HfN	3,305	-	13.8	**1.00	-	-	-	-	-	-	-	-	-	RF,R-RF	-	-

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Hafnium Oxide	HfO_2	2,758	-	9.68	**1.00	-	-	~2,500	Fair	Direct in Hearth	-	-	-	-	RF,R-RF	1.9@0.55	Film HfO.
Hafnium Silicide	$HfSi_2$	1,750	-	7.2	-	-	-	-	-	-	-	-	-	-	RF	-	-
Holmium	Ho	1,474	-	8.8	0.58	650	770	950	Good	-	W，Ta	W	W	-	-	-	-
Holmium Oxide	Ho_2O_3	2,370	-	8.41	-	-	-	-	-	-	-	-	-	-	RF,R-RF	1.9@0.55	Loses oxygen
Holmium Fluoride	HoF_3	1,143	-	-	-	-	-	~800	-	-	-	-	-	Q	-	1.6@0.55	-
Inconel	Ni/Cr/Fe	1,425	-	8.5	-	-	-	-	Good	Tungsten	W	W	W	-	DC	-	-
Indium	In	157	-	7.3	0.841	487	597	742	Excellent	Gr,Mo	W，Mo	-	W	Gr, Al2O3	DC	1.38@0.71	Wets tungsten and copper.
Indium(I) Oxide	In_2O	~600	S	6.99	-	-	-	650	-	-	-	-	-	-	RF	-	Decomposes under sputtering.
Indium (III) Oxide	In_2O_3	850	-	7.18	**1.00	-	-	~1,200	Good	-	W，Pt	-	-	Al2O3	-	2@0.55	Film In2O. Transparent conductor
Indium (I) Sulfide	In_2S	653	-	5.87	-	-	-	650	-	-	-	-	-	Gr	RF	2	-
Indium (II) Sulfide	InS	692	S	5.18	-	-	-	650	-	-	-	-	-	Gr	RF	-	-
Indium(III) Sulfide	In_2S_3	1,050	S	4.9	-	-	-	850	-	-	-	-	-	Gr	RF	-	Film In2S.
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 Antimonide	InSb	535	-	5.8	-	-	-	-	-	-	W	-	-	-	RF	1@0.55	Toxic. Sputter preferred or co-evaporate on heated substrat 900°C. Flash.
Indium Arsenide	InAs	943	-	5.7	-	780	870	970	-	-	W	-	-	-	RF	4.5@1	Toxic. Sputtering preferred or co-evap from 2 sources. Flash.
Indium Nitride	InN	1,200	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-
Indium Phosphide	InP	1,070	-	4.8	-	-	-	730	-	-	W，Ta	-	W，Ta	Gr	RF	3@2.15	Deposits are phosphorus rich. Flash evaporate.
Indium Selenide	In_2Se_3	890	-	5.67	-	-	-	-	-	-	-	-	-	-	RF	-	Sputtering preferred; or co-evaporate from two sources; flash.
Indium Tin Oxide	In_2O_3/SnO_2 90/10wt%	1,800	S	-	-	-	-	-	-	Graphite	-	-	-	-	-	-	Loses oxygen.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Iridium	Ir	2,410	-	22.42	0.129	1,850	2,080	2,380	Fair	-	-	-	-	-	DC	-	-
Iron	Fe	1,535	-	7.86	0.349	858	998	1,180	Excellent	-	W	W	W	Al2O3	DC	2@0.58	Attacks tungsten. Films hard, smooth. Preheat gently to outgas.
Iron(II) Oxide	FeO	1,369	-	5.7	-	-	-	-	Poor	-	-	-	-	-	RF,R-RF	2.32@0.59	Sputtering preferred.
Iron(III) Oxide	Fe_2O_3	1,565	-	5.24	**1.00	-	-	-	Good	-	W	-	W	-	-	3@0.55	Disproportionates to Fe3O4 at 1530°C.
Iron Bromide	$FeBr_2$	684	D	4.64	-	-	-	561	-	-	-	-	-	Fe	RF	-	-
Iron Chloride	$FeCl_2$	670	S	3.16	-	-	-	300	-	-	-	-	-	Fe	RF	1.57@0.59	-
Iron Iodide	FeI_2	-	-	5.32	-	-	-	400	-	-	-	-	-	Fe	RF	-	-
Iron Sulfide	FeS	1,193	D	4.74	-	-	-	-	-	-	-	-	-	Al2O3	RF	-	-
Kanthal	FeCrAl	-	-	7.1	-	-	-	-	-	-	W	W	W	-	DC	1.74@0.58	-
Lanthanum	La	921	-	6.15	0.92	990	1,212	1,388	Excellent	W,Ta	W,Ta	-	-	Al2O3	RF		Films will burn in air if scraped.
Lanthanum Boride	LaB_6	2,210	D	2.61	**1.00	-	-	-	Good	-	-	-	-	-	RF	-	Toxic.
Lanthanum Bromide	$LaBr_3$	783	-	5.06	-	-	-	-	-	-	-	-	Ta	-	RF	-	Hygroscopic.
Lanthanum Fluoride	LaF_3	1,490	S	~6.0	-	-	-	900	Good	Mo，Ta	Ta，Mo	-	Ta	-	RF	1.6@0.55	No decomposition. Heat substrate over 300°C.
Lanthanum Oxide	La_2O_3	2,307	-	6.51	**1.00	-	-	1,400	Good	Gr，W	W，Ta	-	-	-	RF	1.9@0.55	Loses oxygen.
Lead	Pb	328	-	11.34	1.13	342	427	497	Excellent	-	W，Mo	W	W，Ta	Al2O3，Q	DC	1.51@0.8	Toxic.
Lead Bromide	$PbBr_2$	373	-	6.66	-	-	-	~300	-	-	-	-	-	-	-		Toxic
Lead Chloride	$PbCl_2$	501	-	5.85	-	-	-	~325	-	-	-	-	-	Al2O3	RF	2.3@0.55	Toxic. Little decomposition
Lead Fluoride	PbF_2	855	S	8.24	-	-	-	~400	-	-	W，Mo	-	-	BeO	RF	1.75@0.55	Toxic
Lead Iodide	PbI_2	402	-	6.16	-	-	-	~500	-	-	-	-	-	Q	-	-	-
Lead Oxide	PbO	886	-	9.53	-	-	-	~550	-	-	-	-	-	Q，Al2O3	R-RF	2.51@0.59	No decomposition.
Lead Selenide	PbSe	1,065	S	8.1	-	-	-	~500	-	-	W，Mo	-	-	Gr，Al2O3	RF	3.5@1.0	-
Lead Stannate	$PbSnO_3$	1,115	-	8.1	-	670	780	905	Poor	-	-	-	-	Al2O3	RF	-	-

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Lead Sulfide	PbS	1,114	S	7.5	-	-	-	500	-	-	W	-	-	Q, Al2O3	RF	3.9@0.5	Little decomposition.
Lead Telluride	PbTe	917	-	8.16	0.651	780	910	1,050	-	-	Mo，Pt，Ta	-	-	Al2O3，Gr	RF	5.6@5 / 3.4@30	Deposits are ta rich. Sputtering preferred.
Lead Titanate	$PbTiO_3$	-	-	7.52	1.16	-	-	-	-	-	Ta	-	-	-	RF	-	-
Lithium	Li	181	-	0.53	5.9	227	307	407	Good	Tantalum	Ta	-	-	Al2O3	-	-	Metal reacts quickly in air.
Lithium Bromide	LiBr	550	-	3.46	-	-	-	~500	-	-	Ni	-	-	-	RF	1.78@0.59	-
Lithium Chloride	LiCl	605	-	2.07	-	-	-	400	-	-	Ni	-	-	-	RF	1.66@0.59	Use gently preheat for outgas.
Lithium Fluoride	LiF	845	-	2.64	0.778	875	1,020	1,180	Good	W, Ta Mo	Ni, Ta, Mo, W	-	-	Al2O3	RF	1.44@0.19 / 1.36@3.5	Toxic. Preheat gently to outgas. Evaporates well.
Lithium Iodide	LiI	449	-	4.08	-	-	-	400	-	-	Mo，W	-	-	-	RF	1.96@0.59	-
Lithium Niobate	$LiNbO_3$	-	-	-	0.463	-	-	-	-	-	-	-	-	-	-	-	-
Lithium Oxide	Li_2O	>1,700	-	2.01	-	-	-	850	-	-	-	-	-	-	RF	1.64@0.59	-
Lutetium	Lu	1,663	-	9.84	-	-	-	1,300	Excellent	Direct in Hearth	Ta	-	-	Al2O3	DC，RF	-	-
Lutetium Oxide	Lu_2O_3	-	-	9.42	-	-	-	1,400	-	-	-	-	-	-	RF	1.9@0.55	-
Magnesium	Mg	649	S	1.74	1.61	185	247	327	Good	Graphite, Tungsten	W, Mo, Ta, Cb	W	W	Al2O3	DC	0.52@0.4	Flammable. Extremely high rates possible. Sputtering possible but enough slow.
Magnesium Aluminate	$MgAl_2O_4$	2,135	-	3.6	-	-	-	-	Good	-	-	-	-	-	RF	-	Natural spinel.
Magnesium Bromide	$MgBr_2$	700	-	3.72	-	-	-	~450	-	-	Ni	-	-	-	RF	-	-
Magnesium Chloride	$MgCl_2$	714	-	2.32	-	-	-	400	-	-	Ni	-	-	-	RF	1.6	-
Magnesium Fluoride	MgF_2	1,261	-	2.9-3.2	0.637	-	-	1,000	Excellent	Gr, Mo	Mo，Ta	-	-	Al2O3	RF	1.38@0.55	Rate control and substrate heat important for optical films. Reacts with tungsten. Excellent with molybdenum.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Magnesium Iodide	MgI_2	<637	D	4.43	-	-	-	200	-	-	-	-	-	-	RF	-	-
Magnesium Oxide	MgO	2,852	-	3.58	0.411	-	-	1,300	Good	Graphite	-	-	-	C, Al2O3	RF，R-RF	1.7@0.55	Evaporates in 10-3 Torr oxygen for stoichiometry. Tungsten gives volatile oxides.
Manganese	Mn	1,244	S	7.2	0.377	507	572	647	Good	Tungsten	W,Ta, Mo	W	W	Al2O3	DC	2.59@0.59	Flammable. Wets refractair metals.
Manganese(II) Oxide	MnO	1,945	-	5.37	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese(III) Oxide	Mn_2O_3	1,080	-	4.5	0.467	-	-	-	-	-	-	-	-	-	-	-	-
Manganese(IV) Oxide	MnO_2	535	-	5.03	-	-	-	-	Poor	-	W	-	W	-	R-RF	-	Loses oxygen at 535°C.
Manganese Bromide	$MnBr_2$	-	D	4.39	-	-	-	500	-	-	-	-	-	-	RF	-	-
Manganese Chloride	$MnCl_2$	650	-	2.98	-	-	-	450	-	-	-	-	-	-	RF	-	-
Manganese Sulfide	MnS	-	D	3.99	-	-	-	1,300	-	-	Mo	-	-	-	RF	2.7	-
Mercury	Hg	-39	-	13.55	-	-68	-42	-6	-	-	-	-	-	-	-	-	Toxic.
Mercury Sulfide	HgS	584	S	8.1	-	-	-	250	-	-	-	-	-	Al2O3	RF	-	Toxic.
Molybdenum	Mo	2,617	-	10.2	0.257	1,592	1,822	2,117	Excellent	Graphite	-	-	-	-	DC	3.65@0.59	Films smooth, hard. Careful degas required.
Molybdenum Boride	MoB_2	2,100	-	7.12	-	-	-	-	Poor	-	-	-	-	-	RF	-	-
Molybdenum Carbide	Mo_2C	2,687	-	8.9	**1.00	-	-	-	Fair	-	-	-	-	-	RF	-	Evaporation of Mo(CO)6 yields Mo2C.
Molybdenum Sulfide	MoS_2	1,185	-	4.8	**1.00	-	-	~50	-	-	-	-	-	-	RF	-	-
Molybdenum Oxide	MoO_3	795	S	4.69	**1.00	-	-	~900	-	-	Mo	-	Mo	Al2O3, BN	RF	1.9@0.55	Slight oxygen loss.
Molybdenum Silicide	$MoSi_2$	2,050	-	6.31	**1.00	-	-	-	-	-	W	-	-	-	RF	1.9	Slight O2 loss.
Neodymium	Nd	1,021	-	7.01	**1.00	731	871	1,062	Excellent	Ta	Ta	-	-	Al2O3	DC	0.3@0.88	Flammable. Low tantalum solubility.
Neodymium Fluoride	NdF_3	1,410	-	6.5	-	-	-	~900	Good	W，Mo	Mo，W	-	Mo,Ta	Al2O3	RF	1.61@0.55	Very little decomposition.
Neodymium Oxide	Nd_2O_3	~1900	-	7.24	-	-	-	~1,400	Good	Ta, W	Ta，W	-	-	ThO2	RF，R-RF	2@0.55	Loses oxygen. Films clear. E-beam preferred. Hygroscopic. N varies with substrate temperature.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Nichrome	Ni/Cr	1,395	-	8.5	**1.00	847	987	1,217	Excellent	-	***	W	W，Ta	Al2O3	DC	3.74@8.8	Alloys with refractory metals.
Nickel	Ni	1,453	-	8.9	0.331	927	1,072	1,262	Excellent	-	W***	-	-	Al2O3	DC	2.37@0.81	Alloys with refractory metals. Forms smooth adherent films.
Nickel Bromide	$NiBr_2$	963	S	5.1	-	-	-	362	-	-	-	-	-	-	RF	-	-
Nickel Chloride	$NiCl_2$	1,001	S	3.55	-	-	-	444	-	-	-	-	-	-	RF	-	-
Nickel Oxide	NiO	1,984	-	6.67	**1.00	-	-	~1,470	-	-	-	-	-	Al2O3	R-RF	2.18@0.48	Dissociates on heating.
Inconel	Ni/Cr/Fe	1,425	-	8.5	-	-	-	-	Good	-	W	W	W	-	DC，RF	-	Use fine wire wrapped on tungsten. Low rate required for smooth films.
Nickel/Iron	Ni/Fe	-	-	-	**1.00	-	-	-	-	-	-	-	-	-	-		Film low in nickel. Use 84% Ni source
Supermalloy	Ni/Fe/Mo	1,410	-	8.9	-	-	-	-	Good	-	-	-	-	-	DC，RF	-	Sputtering preferred; or co-evaporate from two sources, permalloy and molybdenum
Supermalloy	Ni/Fe/Mo/Mn	1,395	-	8.7	-	947	1,047	1,307	Good	Graphite	W	-	-	Al2O3	DC	-	Film poor in Ni.
Nimendium	Ni3%Mn	1,425	-	8.8	-	-	-	-	-	-	-	-	-	-	DC	-	-
Niobium	Nb	2,468	-	8.57	0.492	1,728	1,977	2,287	Excellent	-	-	-	-	-	DC	1.8@0.58	Attacks tungsten source.
Niobium(II) Oxide	NbO	-	-	7.3	-	-	-	1,100	-	-	-	-	-	-	RF	-	-
Niobium(III) Oxide	Nb_2O_3	1,780	-	7.5	-	-	-	-	-	-	W	-	W	-	RF，R-RF	-	-
Niobium(V) Oxide	Nb_2O_5	1,485	-	4.47	**1.00	-	-	-	-	-	W	-	W	-	RF,R-RF	2.3@0.55	-
Niobium Boride	NbB_2	2,900	-	6.97	-	-	-	-	-	-	-	-	-	-	RF	-	-
Niobium Carbide	NbC	3,500	-	7.6	**1.00	-	-	-	Fair	-	-	-	-	-	RF	-	-
Niobium Nitride	NbN	2,573	-	8.4	**1.00	-	-	-	-	-	-	-	-	-	RF,R-RF	-	Sputters reactive or evaporates niobium in 10-3 Torr nitrogen.
Niobium Telluride	$NbTe_2$	-	-	7.6	-	-	-	-	-	-	-	-	-	-	RF	-	Composition variable.
Niobium-Tin	Nb_3Sn	-	-	-	-	-	-	-	Excellent	-	-	-	-	-	DC	-	Co-evaporate from two sources.
Osmium	Os	3,045	-	22.48	-	2,170	2,430	2,760	Fair	-	-	-	-	-	DC		Toxic.
Osmium Oxide	Os_2O_3	-	D	-	-	-	-	-	-	-	-	-	-	-	-		Deposits osmium in 10-3 Torr oxygen.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Palladium	Pd	1,554	S	12.02	0.357	842	992	1,192	Excellent	Graphite, Tungsten	W***	W	W	Al2O3	DC	2.3@0.54	Alloys with refractory metals. Rapid evaporation suggested. Spits in E-beam.
Palladium Oxide	PdO	870	-	9.7	-	-	-	575	-	-	-	-	-	Al2O3	R-RF		
Phosphorus	P	44	-	1.82	-	327	361	402	-	-	-	-	-	Al2O3	-		Material reacts violently in air.
Phosphorus Nitride	P_3N_5	-	-	2.51	-	-	-	-	-	-	-	-	-	-	RF,R-RF		
Platinum	Pt	1,772	-	21.45	0.245	1,292	1,492	1,747	Excellent	Graphite	W	W	W	C	DC	3.42@1.0	Alloys with metals. Films soft, poor adhesion. E-beam required.
Platinum Oxide	PtO_2	450	-	10.2	-	-	-	-	-	-	-	-	-	-	R-RF		
Potassium	K	63	-	0.86	-	23	60	125	-	-	Mo	-	-	Q	-	0.74@0.25	Metal reacts rapidly in air. Preheat gently to outgas.
Potassium Bromide	KBr	734	-	2.75	-	-	-	~450	-	-	Ta，Mo	-	-	Q	RF	1.56@0.48	Preheat gently to outgas.
Potassium Chloride	KCl	770	S	1.98	-	-	-	510	Excellent	Tantalum	Ta，Ni	-	-	-	RF	1.72@0.2	Preheat gently to outgas.
Potassium Fluoride	KF	858	-	2.48	-	-	-	~500	-	-	-	-	-	Q	RF	1.35@1.4	Preheat gently to outgas.
Potassium Hydroxide	KOH	360	-	2.04	-	-	-	~400	-	-	-	-	-	-	-	-	Preheat gently to outgas. Hygroscopic.
Potassium Iodide	KI	681	-	3.13	-	-	-	~500	-	-	Ta	-	-	-	RF	1.92@0.27	Preheat gently to outgas.
Praseodymium	Pr	931	-	6.77	**1.00	800	950	1,150	Good	-	Ta	-	-	ThO2	DC		Flammable
Praseodymium Oxide	Pr_2O_3	-	D	7.07	-	-	-	1,400	Good	-	-	-	-	-	RF,R-RF	2@0.55	Loses oxygen.
Rhenium	Re	3,180	-	20.53	1928	2,207	2,571	-	Good	-	-	-	-	-	DC，RF	3.18@0.59	Fine wire will self-evaporate.
Rhenium Oxide	ReO_3	-	-	~7	-	-	-	-	-	-	-	-	-	-	RF	-	Evaporate rhenium in 10-3 Torr.
Rhodium	Rh	1,966	-	12.4	0.21	1,277	1,472	1,707	Good	Tungsten	W	W	W	ThO2，VitC	DC	2.03@0.8	E-beam gun preferred.
Rubidium	Rb	39	-	1.48	-	-3	37	111	-	-	-	-	-	Q	-	1.03@0.25	-

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Rubidium Chloride	RbCl	718	-	2.09	-	-	-	~550	-	-	-	-	-	Q	RF	1.49	-
Rubidium Iodide	RbI	647	-	3.55	-	-	-	~400	-	-	-	-	-	Q	RF	1.68@0.58	-
Ruthenium	Ru	2,310	-	12.3	0.182	1,780	1,990	2,260	Poor	-	-	-	-	-	DC	-	Spit violently in E-beam. Require long degas.
Samarium	Sm	1,074	-	7.52	0.89	373	460	573	Good	-	Ta	-	-	Al2O3	DC	-	-
Samarium Oxide	Sm_2O_3	2,350	-	8.35	-	-	-	-	Good	-	-	-	-	ThO2	RF,R-RF	1.9@0.55	Loses oxygen. Films smooth, clear.
Samarium Sulfide	Sm_2S_3	1,900	-	5.73	-	-	-	-	Good	-	-	-	-	-	-	-	-
Scandium	Sc	1,541	-	2.99	0.91	714	837	1,002	Excellent	W Mo	W	-	-	Al2O3	RF	-	Flammabble. Alloys with tantalum.
Scandium Oxide	Sc_2O_3	2,300	-	3.86	-	-	-	~400	Fair	-	-	-	-	-	RF,R-RF	1.89@0.55	Loses oxygen.
Selenium	Se	217	-	4.81	0.864	89	125	170	Good	W, Mo	W, Mo	W,Mo	W，Mo	Al2O3	-	2.78	Toxic. Bad for vacuum systems. Wets all sources.
Silicon	Si	1,410	-	2.32	0.712	992	1,147	1,337	Fair	Tantalum	-	-	-	-	DC，RF	4.06@0.8	Alloys with tungsten; use heavy tungsten boat. SiO produced above 4.10-6 Torr. E-beam preferred.
Silicon（II）Oxide	SiO	>1702	S	2.13	0.87	-	-	850	Fair	Tungsten, Tantalum	Ta	W	W	Ta	RF,R-RF	1.9@2	For resistance evaporation, use baffle box and low rate. E-beam preferred.
Silicon（IV）Oxide	SiO_2	1,610	-	~2.65	**1.00	-	-	1,025	Excellent	Ta, Gr	-	-	-	Al2O3	RF	1.46@0.55	Quartz excellent in E-beam.
Silicon(N-type)	Si	1,410	-	2.32	0.712	992	1,147	1,337	Fair	Tantalum	-	-	-	-	DC，RF	-	-
Silicon(P-type)	Si(P-type)	1,410	-	2.32	0.712	992	1,147	1,337	Fair	Tantalum	-	-	-	-	DC，RF	-	-
Silicon Boride	SiB_6	-	-	-	-	-	-	-	Poor	-	-	-	-	-	RF	-	-
Silicon Carbide	SiC	~2,700	S,D	3.22	**1.00	-	-	1,000	-	-	-	-	-	-	RF	2.7@0.55	Sputtering preferred.
Silicon Nitride	Si_3N_4	1,900	-	3.44	**1.00	*	*	~800	-	-	-	-	-	-	RF,R-RF	2@0.12	-

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Silicon Selenide	SiSe	-	-	-	-	-	-	550	-	-	-	-	-	Q	RF	-	Toxic.
Silicon Sulfide	SiS	940	S	1.85	-	-	-	450	-	-	-	-	-	Q	RF	-	-
Silicon Telluride	$SiTe_2$	-	-	4.39	-	-	-	550	-	-	-	-	-	Q	RF	-	Toxic.
Silver	Ag	962	-	10.5	0.529	847	958	1,105	Excellent	W, Mo,Ta	W	Mo	Ta,Mo	Al2O3, W	DC	0.06@0.6	Evaporates well from any source.
Silver Bromide	AgBr	432	D	6.47	-	-	-	~380	-	-	Ta	-	-	Q	RF	2.28@0.58	-
Silver Chloride	AgCl	455	-	5.56	-	-	-	~520	-	-	Mo	-	Mo	Q	RF	2.13@0.43	-
Silver Iodide	AgI	558	-	6.01	-	-	-	~500	-	-	Ta	-	-	-	RF	2.02@0.59	-
Sodium	Na	98	-	0.97	-	74	124	192	-	-	Ta	-	-	Q	-	0.03@0.59	Preheat gently to outgas. Metal reacts quickly in air.
Sodium Bromide	NaBr	747	-	3.2	-	-	-	~400	-	-	-	-	-	Q	RF	1.64@0.59	Preheat gently to outgas.
Sodium Chloride	NaCl	801	-	2.17	-	-	-	530	Good	-	Ta，W，Mo	-	-	Q	RF	1.79@0.2	Copper oven. Little decomposition. Preheat gently to outgas. Hygrocsopic.
Sodium Fluoride	NaF	993	-	2.56	-	-	-	~1,000	Good	Tungsten	Mo,Ta, W	-	-	BeO	RF	1.3@0.55	Preheat gently to outgas. No decomposition.
Sodium Hydroxide	NaOH	318	-	2.13	-	-	-	~470	-	-	-	-	-	-	-	1.36	Preheat gently to outgas.
Cryolite	Na_3AlF_6	1000	-	2.9	-	1020	1260	1480	Excellent	Tungsten	W, Mo, Ta	-	W, Mo,Ta	VitC	RF	1.35@0.55	Large chunks reduce spitting. Little decomposition.
Strontium	Sr	769	-	2.6	**1.00	239	309	403	Poor	-	W，Ta，Mo	W	W	VitC	RF	0.61@0.58	Toxic. Wets but does not alloy with refractory metals. May react in air.
Strontium Chloride	$SrCl_2$	875	-	3.05	-	-	-	-	-	-	-	-	-	-	-	-	-
Strontium Fluoride	SrF_2	1,473	-	4.24	-	-	-	~1000	-	-	-	-	-	Al2O3	RF	1.44@0.59	-
Strontium Oxide	SrO	2,430	S	4.7	-	-	-	1,500	-	-	Mo	-	-	Al2O3	RF	1.88@0.58	Reacts with Molybdenum and tungsten.
Strontium Sulfide	SrS	>2,000	-	3.7	-	-	-	-	-	-	Mo	-	-	-	RF	2.11@0.59	-
Strontium Titanate	$SrTiO_3$	-	-	-	0.31	-	-	-	-	-	-	-	-	-	-	-	-

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Sulfur	S	113	-	2.07	-	13	19	57	Poor	-	W	-	W	-	-		Toxic. Bad for vacuum systems.
Tantalum	Ta	2,996	-	16.6	0.262	1,960	2,240	2,590	Excellent	Graphite	-	-	-	-	DC	2.05@0.58	Forms good films. Traps O2. Sputtering preferred.
Tantalum Boride	TaB_2	3,000	-	11.15	-	-	-	-	-	-	-	-	-	-	RF	-	-
Tantalum Carbide	TaC	3,880	-	13.9	**1.00	-	-	~2500	-	-	-	-	-	-	RF	-	-
Tantalum Nitride	TaN	3,360	-	16.3	**1.00	-	-	-	-	-	-	-	-	-	RF，R-RF	-	Evaporates tantalum in 10-3 Torr nitrogen.
Tantalum Oxide	Ta_2O_5	1,872	-	8.2	0.3	1,550	1,780	1,920	Good	Tantalum	Ta	W	W	VitC	RF，R-RF	2.1@0.50	Slight decomposition. Evaporates in 10-3 Torr oxygen. Films with high dielectric constant.
Tantalum Sulfide	TaS_2	>1300	-	-	-	-	-	-	-	-	-	-	-	-	RF	-	-
Tellurium	Te	449	-	6.25	0.9	157	207	277	Poor	-	W，Ta	W	W，Ta	Al2O3，Q	RF	4.7@0.55	Toxic. Wets refractory metals without alloying.
Terbium	Tb	1,356	-	8.23	0.66	800	950	1,150	Excellent	Gr, Ta	Ta	-	-	Al2O3	RF	-	-
Terbium Fluoride	TbF_3	1,172	-	-	-	-	-	~800	-	-	-	-	-	-	RF	-	-
Terbium Oxide	Tb_2O_3	2,387	-	7.87	-	-	-	1,300	-	-	-	-	-	-	RF	-	-
Terbium Oxide	Tb_4O_7	-	D	-	-	-	-	-	-	-	Ta	-	-	-	RF	-	--
Thorium	Tm	1,545	S	9.32	-	461	554	680	Good	-	Ta	-	-	Al2O3	DC	-	-
Thorium Oxide	Tm_2O_3	-	-	8.9	-	-	-	1,500	-	-	-	-	-	-	RF	-	-
Tin	Sn	232	-	7.28	0.724	682	807	997	Excellent	Tantalum	Mo	W	W	Al2O3	DC	1.48@0.59	Wets molybdenum.
Tin Oxide	SnO_2	1,630	S	6.95	**1.00	-	-	~1,000	Excellent	-	W	W	W	Q，Al2O3	RF,R-RF	2.08@0.58	Films from tungsten are oxygen deficient, oxidize in air.
Tin Selenide	SnSe	861	-	6.18	-	-	-	~400	Good	-	-	-	-	Q	RF	-	-
Tin Sulfide	SnS	882	-	5.22	-	-	-	~450	-	-	-	-	-	Q	RF	-	-
Tin Telluride	SnTe	780	D	6.48	-	-	-	~450	-	-	-	-	-	Q	RF	-	-

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Titanium	Ti	1,660	-	4.5	0.628	1,067	1,235	1,453	Excellent	-	W	-	-	TiC	DC	2.64@0.58	Alloys with refractory metals; evolves gas on first heating
Titanium (II)Oxide	TiO	1,750	-	4.93	**1.00	-	-	~1,500	Good	Tantalum	W，Mo	-	-	VitC	RF	2.4@0.55	Film TiO2 if evaporated like TiO2. Preheat gently to outgas.
Titanium (III) Oxide	Ti_2O_3	2,130	D	4.6	-	-	-	-	Good	Tantalum	W	-	-	-	RF	2.3@0.5	-
Titanium(IV) Oxide	TiO_2	1,830	-	4.26	0.4	-	-	~1,300	Fair	Tantalum	W，Mo	-	W	-	RF,R-RF	2.3@0.5	Suboxide, must be reoxidized to rutile. Tantalum reduces TiO2 to TiO and titanium.
Titanium Boride	TiB_2	2,900	-	4.5	**1.00	-	-	-	Poor	-	-	-	-	-	RF	-	-
Titanium Carbide	TiC	3,140	-	4.93	**1.00	-	-	~2,300	-	-	-	-	-	-	RF	-	-
Titanium Nitride	TiN	2,930	-	5.22	**1.00	-	-	-	Good	Moly	Mo	-	-	-	RF,R-RF	-	Sputtering preferred. Decomposes with thermal evaporation.
Tungsten	W	3,410	-	19.35	0.163	2,117	2,407	2,757	Good	Direct in Hearth	-	-	-	-	RF	2.76@0.58	Forms volatile oxides. Films hard and adherent.
Tungsten Boride	WB_2	~2,900	-	10.77	-	-	-	-	Poor	-	-	-	-	-	DC	-	-
Tungsten Carbide	WC	2,860	-	17.15	0.151	1,480	1,720	2,120	Excellent	Graphite	C	-	-	-	RF	-	-
Tungsten Sulfide	WS_2	1,250	D	7.5	**1.00	-	-	-	-	-	-	-	-	-	RF	-	-
Tungsten Oxide	WO_3	1,473	S	7.16	**1.00	-	-	980	Good	Tungsten	W	-	-	-	RF	1.7@0.55	Preheat gently to outgas. Tungsten reduces oxide slightly.
Tungsten Selenide	WSe_2	-	-	9	-	-	-	-	-	-	-	-	-	-	R-RF	-	-
Tungsten Silicide	WSi_2	>900	-	9.4	**1.00	-	-	-	-	-	-	-	-	-	RF	-	-
Tungsten Telluride	WTe_2	-	-	9.49	-	-	-	-	-	-	-	-	-	Q	RF	-	-
Vanadium	V	1,890	-	5.96	0.53	1,162	1,332	1,547	Excellent	Tungsten	W，Mo	-	-	-	DC	3.03@0.58	Wets molybdenum. E-beam-evaporated films preferred. Alloy slightly with W.
Vanadium(IV) Oxide	VO_2	1,967	S	4.34	-	-	-	~575	-	-	-	-	-	-	RF,R-RF	2.51@0.63	Sputtering preferred.
Vanadium(V) Oxide	V_2O_5	690	D	3.36	**1.00	-	-	~500	-	-	-	-	-	Q	RF	-	-
Vanadium Boride	VB_2	2,400	-	5.1	-	-	-	-	-	-	-	-	-	-	RF	-	-
Vanadium Carbide	VC	2,810	-	5.77	**1.00	-	-	~1,800	-	-	-	-	-	-	RF	-	-

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Vanadium Nitride	VN	2,320	-	6.13	-	-	-	-	-	-	-	-	-	-	RF，R-RF	-	-
Vanadium Silicide	VSi_2	1,700	-	4.42	-	-	-	-	-	-	-	-	-	-	RF	-	-
Ytterbium	Yb	819	S	6.96	1.13	520	590	690	Good	Tantalum	Ta	-	-	-	-	-	-
Ytterbium Fluoride	YbF_3	1,157	-	-	-	-	-	~800	-	Ta, Mo	Mo	-	-	-	RF	1.5@0.55	-
Ytterbium Oxide	Yb_2O_3	2,346	S	9.17	**1.00	-	-	~1,500	-	-	-	-	-	-	RF,R-RF	1.9@0.55	Loses oxygen.
Yttrium	Y	1,522	-	4.47	0.835	830	973	1,157	Excellent	Tungsten	W，Ta	W	W	Al2O3	DC，RF	-	High tantalum solubility
Yttrium Aluminum Oxide	$Y_3Al_5O_{12}$	1,990	-	-	-	-	-	-	Good	-	-	W	W	-	RF	-	Films not ferroelectric.
Yttrium Fluoride	YF_3	1,387	-	4.01	-	-	-	-	-	Ta, Mo	-	-	-	-	RF	1.5@0.55	-
Yttrium Oxide	Y_2O_3	2,410	-	5.01	**1.00	-	-	~2,000	Good	Gr, W	W	-	-	C	RF,R-RF	1.79@0.589	Loses oxygen, films smooth and clear.
Zinc	Zn	420	-	7.14	0.514	127	177	250	Excellent	Graphit, Tungsten	Ta, W, Mo	W	W	Al2O3，Q	DC	1.93@0.589	Evaporates well under wide range of conditions. Bad for vacuum systems. Wets refractory metals.
Zinc	Zn_3Sb_2	570	-	6.33	-	-	-	-	-	-	-	-	-	-	RF	-	-
Zinc Bromide	$ZnBr_2$	394	-	4.2	-	-	-	~300	-	-	W	-	-	C	RF	1.58@0.58	-
Zinc Fluoride	ZnF_2	872	-	4.95	-	-	-	~800	-	-	Ta	-	-	Q	RF	-	-
Zinc Nitride	Zn_3N_2	-	-	6.22	-	-	-	-	-	-	Mo	-	-	-	RF	-	-
Zinc Oxide	ZnO	1,975	-	5.61	0.556	-	-	~1800	Fair	-	-	-	-	-	RF,R-RF	2@0.55	Anneal in air at 450°C to re oxidize.
Zinc Selenide	ZnSe	>1,100	-	5.42	0.722	-	-	660	-	Ta, Mo	Ta,W, Mo	W,Mo	W，Mo	Q	RF	2.6@0.55	Toxic. Preheat gently to outgas. Evaporates well.
Zinc Sulfide	ZnS	1,700	S	3.98	0.775	-	-	~800	Good	Ta, Mo	Ta，Mo	-	-	-	RF	2.3@0.55	Preheat gently to outgas. Films partially decompose. Sticking coefficient varies with substrate temperature.
Zinc Telluride	ZnTe	1,239	-	6.34	0.77	-	-	~600	-	-	Mo，Ta	-	-	-	RF	3.56@0.59	Toxic. Preheat gently to outgas. Evaporates well.

Material	Symbol	MP (℃)	S/D	Density (g/cm^3)	Z-Ratio (**Z-Ratio is unknown)	Temp.(℃)for Given Vap. Press.(Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Index of Refraction (@μm)	Comments
						10^{-8}	10^{-6}	10^{-4}	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible			
Zirconium	Zr	1,852	-	6.49	0.6	-	-	1,987	Excellent	-	W	-	-	-	DC	-	Flammable. Alloys with tungsten. Films oxidize readily
Zirconium Boride	ZrB_2	~3,200	-	6.09	-	-	-	-	Good	-	-	-	-	-	RF	-	-
Zirconium Carbide	ZrC	3,540	-	6.73	0.264	-	-	~2,500	-	-	-	-	-	-	RF	-	-
Zirconium Nitride	ZrN	2,980	-	7.09	**1.00	-	-	-	-	-	-	-	-	-	RF,R-RF	-	Reactively evaporates in 10-3 Torr nitrogen.
Zirconium Oxide	ZrO_2	~2,700	-	5.89	**1.00	-	-	~2,200	Good	Gr, W	W	-	-	-	RF,R-RF	2.05@0.5	Films oxygen deficient, clear and hard.
Zirconium Silicate	$ZrSiO_4$	2,550	-	4.56	-	-	-	-	-	-	-	-	-	-	RF	1.96@0.59	-
Zirconium Silicide	$ZrSi_2$	1,700	-	4.88	-	-	-	-	-	-	-	-	-	-	RF	-	-