

Element	Symbol	Melting Point °C	Bulk Density g/cm ³	Acoustic Impedance Ratio (880) Z	Acoustic Impedance (860, 861) g/cm ²	Temperature °C @ Vapor Pressure		Recommended Crucible Liner(s)	Sweep	Remarks
						10 ⁻⁶ mbar	10 ⁻⁴ mbar			
Aluminum	Al	660	2.7	1.05	8.41		1010	Re-infiltrated	none	
Aluminum Oxide (Alumina)	Al ₂ O ₃	2045	3.96	0.36	24.53		1550	Re-infiltrated, Graphite, Mo	large	
Beryllium	Be	1283	1.85	0.55	16.05	710	1000	Vit. Carbon		Powder very toxic. Wets W/Mo/Ta.
Beryllium Oxide	BeO	2575	3.01				1900		large	Powder very toxic. No decomposition from EB.
Boron	B	2100	2.34	0.45	19.62	1548	1797	Vit. Carbon		Material explodes with rapid cooling.
Cadmium Selenide	CdSe	1351	5.79				580	Al ₂ O ₃	large	Toxic, sublimes.
Carbon	C	3727	3.52	0.22	40.14				large	
Chromium	Cr	1875	7.19	0.31	28.48	977	1157	Re-infiltrated, Vit. Carbon	large	Sublimes. High rates possible.
Cobalt	Co	1495	8.92	0.34	25.97	990	1200	Al ₂ O ₃	medium	Alloys with refractory metals.
Copper	Cu	1083	8.94	0.43	20.53	857	1017	Graphite, Re-infiltrated	none or small	
Gallium	Ga	30	5.91	0.59	14.97	742	907	Al ₂ O ₃		
Germanium	Ge	937	5.32	0.51	17.31	957	1167	Re-infiltrated, Al ₂ O ₃	medium	
Germanium Oxide	GeO ₂	1086	6.24				≈625	Al ₂ O ₃		
Gold	Au	1962	19.32	0.39	22.64	947	1132	Re-infiltrated, Mo, W	none or small	
Hafnium	Hf	2222	13.09	0.34	25.97	2250	3090		medium	
Hafnium Oxide	HfO ₂	2811	9.69				≈2500	Re-infiltrated, Mo	large	
Indium	In	157	7.31	0.84	10.51	597	742	Graphite, Mo	small	Wets W and Cu
Indium Oxide	In ₂ O ₃	1565	7.18				≈1200	Al ₂ O ₃	large	Sublimes
Indium Tin Oxide	IN ₂ O ₃ -SnO ₂	1800	6.43 – 7.14							
Iridium	Ir	2454	22.45	0.13	67.92	2080	2380			
Iron	Fe	1536	7.87	0.35	25.23	998	1180	Al ₂ O ₃	medium	
Iron (III) Oxide	Fe ₂ O ₃	1538	5.18							Disproportionates to Fe ₃ O ₄ at 1530°C.

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		°C	g/cm ³	Z	g/cm ²	10 ⁻⁶ mbar	10 ⁻⁴ mbar			
Lithium	Li	180	0.53	5.95	1.48	307	407	Al ₂ O ₃	medium	Metal reacts rapidly in air.
Lithium Fluoride	LiF	841	2.59	0.78	11.32	1020	1180	Al ₂ O ₃		
Magnesium	Mg	650	1.74	1.61	5.48	247	327	Al ₂ O ₃ Vit Carbon	large	Flammable, sublimes. Extremely high rates possible.
Magnesium Fluoride	MgF ₂	1248	3	≈ 0.68	≈ 12.99		1000	Re-infiltrated, Graphite, Mo	medium	Substrate heat req'd for optical films.
Magnesium Oxide	MgO	2800	3.58	0.38	23.24		1300	Re-infiltrated, Graphite, Al ₂ O ₃	large	
Manganese	Mn	1241	7.39	0.43	20.53	572	648	Al ₂ O ₃		Flammable, sublimes.
Molybdenum	Mo	2610	10.22	0.27	32.70	1822	2117	Re-infiltrated	medium to large	Careful degas req'd.
Neodymium	Nd	1024	7	0.84	10.51	871	1062	Al ₂ O ₃		Flammable.
Nichrome IV	Ni/Cr	1395	8.5	0.33	26.76	987	1217	Re-infiltrated, Graphite, Al ₂ O ₃	medium	Alloys with refractory metals.
Nickel	Ni	1453	8.91	0.33	26.76	1072	1262	Re-infiltrated, Graphite, Al ₂ O ₃	medium	Alloys with refractory metals.
Palladium	Pd	1552	12.02	0.38	23.24	992	1192	Re-infiltrated Al ₂ O ₃	medium	Alloys with refractory metals. Spits in EB.
Permalloy	Ni/Fe	1395	8.7			1047	1307	Al ₂ O ₃ Vit. Carbon	medium	
Platinum	Pt	1769	21.45	0.24	36.79	1492	1747	Graphite Re-infiltrated	medium	
Rhodium	Rh	1966	12.41			1472	1707		medium	
Silicon Dioxide	SiO ₂	1610 – 1710	2.20 – 2.70	1	8.83	≈1025 influenced by composition		Re-infiltrated, Graphite, Mo	large	Quartz xlnt. in EB.
Silicon Monoxide	SiO	1702	2.1	0.5	17.66		850	Re-infiltrated, Graphite, Mo	large	Sublimes.
Silver	Ag	961	10.49	0.5	17.66	958	1105	Re-infiltrated, Graphite, Mo	none or small	
Tantalum	Ta	2996	16.6	0.26	33.96	2240	2590	Re-infiltrated	medium	
Tantalum Pentoxide	Ta ₂ O ₅	1800	8.74			1780	1920	Re-infiltrated, Graphite, Mo	large	
Tin	Sn	232	7.29	0.74	11.93	807	997	Re-infiltrated	none	
Tin Oxide	SnO ₂	1131	6.99				≈1000	Al ₂ O ₃	large	
Titanium	Ti	1668	4.5	0.63	14.02	1235	1453	Re-infiltrated		Alloys with refractory metals; evolves gas on first heating.
Titanium Dioxide (rutile)	TiO ₂	1640	4.29				≈1300	Re-infiltrated, Graphite, Mo	large	
Titanium Monoxide	TiO	1750	4.93				≈1500	Re-infiltrated, Graphite, Mo	large	



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		°C	g/cm ³			10 ⁻⁶ mbar	10 ⁻⁴ mbar			
Tungsten	W	3387	19.3	0.16	55.19	2407	2757		medium to large	
Yttrium	Y	1509	4.47	0.82	10.77	973	1157	Al ₂ O ₃	medium	
Zinc	Zn	419	7.14	0.5	17.66	177	250	Mo		
Zinc Oxide	ZnO	1975	5.6	0.55	16.05		≈1800		large	Anneal in air at 450°C to reoxidize.
Zirconium	Zr	1852	6.4			1702	1987		medium	Flammable. Films oxidize readily.
Zirconium Oxide	ZrO ₂	2715	5.49				≈2200		large	

Liners

Liner	Standard Graphite Part Number	Reinfiltrated Graphite Part Number	Vitreous Carbon Over Graphite Part Number	Copper Part Number
1.5cc	271-7000-1	N/A	271-7000-8	271-7000-0
4cc	271-7004-1	271-7004-6	271-7005-8	271-7005-0
7cc	271-7007-1	271-7007-6	271-7008-8	271-7007-0
15cc	271-7015-1	271-7015-6	271-7016-8	271-7015-0
25cc Standard, Shallow	271-7025-1	271-7025-6	271-7026-8	271-7025-0
25cc Deeper Version	271-7025-2	271-7029-6	271-7027-8	271-7027-0
30cc with Web	271-7030-1	271-7030-6	271-7031-8	271-7030-0
30cc w/o Web	271-7030-2	271-7033-6	271-7032-8	271-7033-0
40cc	271-7040-1	271-7040-6	271-7041-8	271-7040-0
100cc	271-7100-1	271-7100-6	271-7101-8	271-7100-0

Liner	Molybdenum Part Number	Tungsten Part Number	Alumina Al ₂ O ₃ Part Number	Boron Nitride Part Number
1.5cc	271-7000-3	271-7000-9	271-7001-5	271-7001-1
4cc	271-7004-3	271-7005-9	271-7005-5	271-7005-1
7cc	271-7007-3	271-7008-9	271-7008-5	271-7008-1
15cc	271-7015-3	271-7016-9	271-7016-5	271-7016-1
25cc Standard, Shallow	271-7025-3	271-7026-9	271-7026-5	271-7026-1
25cc Deeper Version	271-7025-4	271-7027-9	271-7027-5	271-7027-1
30cc with Web	271-7030-3	271-7031-9	271-7031-5	271-7031-1
30cc w/o Web	271-7030-4	271-7032-9	271-7032-5	271-7032-1
40cc	271-7040-3	271-7041-9	271-7041-5	271-7041-1
100cc	271-7100-3	271-7101-9	271-7101-5	271-7101-1



“Re-infiltrated Graphite“ Liners for Aluminum Deposition

A long standing problem with standard graphite liners and aluminum deposition is the formation of aluminum carbide (AlC, yellow film on Al slug) from loose graphite particles on the liner surface. Standard graphite is porous and holds a large amount of particles on the surface. Even more so, when suppliers machine their own liners from industrial graphite rods.

“Semiconductor Grade” Graphite is a lot better in this respect, but still doesn’t resolve the issue altogether.

“Re-infiltrated Graphite” is by far the best liner material for the evaporation of aluminum, even in comparison to “Intermetallic” Liners that are recommended for Al deposition by some vendors.



Description of “Re-infiltrated Graphite”

This material offers cleaner handling with drastically reduced particle content in the melt compared to other forms of graphite.

Additional benefits are reduced wetting and extended lifetime.

It is a highly densified and purified graphite, undergoing a special surface treatment with amorphous carbon. This treatment coats the surface and locks onto the graphite, providing a harder surface with porosity sealed.

It is an excellent liner material for Aluminum, but also providing the above benefits for any other coating material that can be evaporated from standard graphite liners.