PhotonExport

Sputtering Targets
Evaporation Materials
Material Vacuum Deposition Techniques

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PhotonExport

MISSION

At PhotonExport we are specialsit in this films and nano-technology supplies. We lead the entire value chain of thin film from the substrate through material evaporation or sputtering targets to the vacuum deposition equipment.

We focus on quality supplies for thin film and nano-technology applications by providing high value for money of advanced ande enginereed materials to and Development innovation.

We provide standard and custom made consumables for your industrial coating applications with on time delivery according to all the industry quality standards for your cost-effective manufacturing process.

PhotonExport offers quality certified sputtering targets, manufactured with the latest improvement in Hot Isostatic Pressing and Vacuum Hot Pressing. We offer the largest diversity of **Cathode Sputtering Targets** for thin film deposition. Circular, rectangular, triangular, flat, S-Guns electrode or any shape will fit all leading manufactured Physical Vapor Deposition system and also your custom made bench top sputtering equipment.

Materials with low impurities & minimal surface contamination for PVD Evaporation. Highly pure, clean ands reproducible materials.
Our broad range of precious metal & non-precious are available in various purities ranging from 99.9% to 99.999.%.

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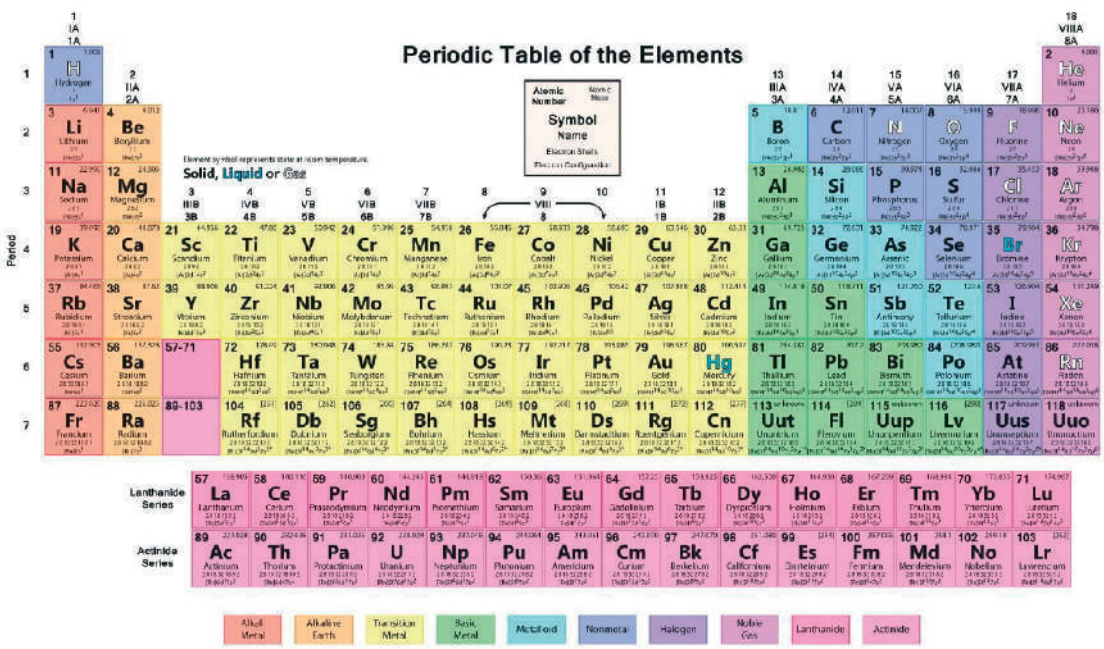

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quote in less than 24h

Material Vacuum Deposition Techniques

Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible		
Aluminum	Al	99,9 - 99,999%	2,7	660	-	1,08	677	821	1010	**Excellent**	Fabmate®, Intermetallic	-	-	W	TiB2-BN, BN	**DC**	Alloys W/Mo/Ta, Flash evap or use BN crucible,
Aluminum Antimonide	AlSb	99,9 - 99,999%	4,3	1080	-	-	-	-	-	-	-	-	-	-	-	**RF**	-
Aluminum Arsenide	AlAs	99,9 - 99,999%	3,7	1600	-	-	-	-	≈1300	-	-	-	-	-	-	**RF**	-
Aluminum Bromide	AlBr3	99,9 - 99,999%	2,64	97	-	-	-	-	≈50	-	-	Mo	-	-	Gr	**-**	-
Aluminum Carbide	Al4C3	99,9 - 99,999%	2,36	≈1400	D	-	-	-	≈800	Fair	-	-	-	-	-	**RF**	-
Aluminum Fluoride	AlF3	99,9 - 99,999%	2,88	1291	S	-	410	490	700	Poor	Graphite, Fabmate®	Mo, W, Ta	-	-	Gr	**RF**	-
Aluminum Nitride	AlN	99,9 - 99,999%	3,26	>2200	S	**1,00	-	-	≈1750	Fair	-	-	-	-	-	**RF-R**	Decomposes, Reactive evap in 10-3 T N2 with glow discharge,
Aluminum Oxide	Al2O3	99,9 - 99,999%	3,97	2072	-	0,336	-	-	1550	**Excellent**	Fabmate®, Tungsten	W	-	W	-	**RF-R**	Sapphire excellent in E-beam; forms smooth, hard films,
Aluminum Phosphide	AlP	99,9 - 99,999%	2,42	2	-	-	-	-	-	-	-	-	-	-	-	**RF**	-
Aluminum, 1% Copper	Al/Cu 99/1 wt%	99,9 - 99,999%	2,82	640	-	**1,00	-	-	-	-	-	-	-	-	-	**DC**	Wire feed & flash, Difficult from dual sources,
Aluminum, 1% Silicon	Al/Si 99/1 wt %	99,9 - 99,999%	2,69	640	-	**1,00	-	-	1010	-	-	-	-	-	TiB2-BN	**RF, DC**	Wire feed & flash, Difficult from dual sources,
Antimony	Sb	99,9 - 99,999%	6,68	630	S	0,768	279	345	425	Poor	-	Mo*** Ta***	Mo, Ta	Mo, Ta	BN, C, Al2O3	**RF, DC**	Evaporates well,
Antimony Oxide	Sb2O3	99,9 - 99,999%	5,2	656	S	-	-	-	≈300	Good	-	-	-	-	BN, Al2O3	**RF-R**	Decomposes on W,
Antimony Selenide	Sb2Se3	99,9 - 99,999%	-	611	-	-	-	-	-	-	-	Ta	-	-	C	**RF**	Stoichiometry variable,
Antimony Sulfide	Sb2S3	99,9 - 99,999%	4,64	550	-	-	-	-	≈200	Good	Molybdenum, Tantalum	Mo, Ta	-	Mo, Ta	Al2O3	**-**	No decomposition,
Antimony Telluride	Sb2Te3	99,9 - 99,999%	6,5	629	-	**1,00	-	-	600	-	-	-	-	-	C	**RF**	Decomposes over 750°C,
Arsenic	As	99,9 - 99,999%	5,73	817	S	-	107	150	210	Poor	Fabmate®	C	-	-	Al2O3	**-**	Sublimes rapidly at low temp,
Arsenic Oxide	As2O3	99,9 - 99,999%	3,74	312	-	-	-	-	-	-	-	-	-	-	-	**-**	-
Arsenic Selenide	As2Se3	99,9 - 99,999%	4,75	~360	-	-	-	-	-	-	-	-	-	-	Al2O3, Q	**RF**	-
Arsenic Sulfide	As2S3	99,9 - 99,999%	3,43	300	-	-	-	-	≈400	Fair	-	Mo	-	-	Al2O3, Q	**RF**	-
Arsenic Telluride	As2Te3	99,9 - 99,999%	6,5	362	-	-	-	-	-	-	-	Flash	-	-	-	**-**	See JVST, 1973, 10:748
Barium	Ba	99,50%	3,51	725	-	2,1	545	627	735	Fair	-	W, Ta, Mo	W	W	Metals	**RF**	Wets without alloying, reacts with ceramics,
Barium Chloride	BaCl2	99,50%	3,92	963	-	-	-	-	≈650	-	-	Ta, Mo	-	-	-	**RF**	Preheat gently to outgas,
Barium Fluoride	BaF2	99,50%	4,89	0,355	S	0,793	-	-	≈700	Good	Molybdenum	Mo	-	-	-	**RF**	-
Barium Oxide	BaO	99,50%	5,72	1918	-	-	-	-	≈1300	Poor	-	-	-	-	Al2O3	**RF, RF-R**	Decomposes slightly,
Barium Sulfide	BaS	99,50%	4,25	1200	-	-	-	-	1,1	-	-	Mo	-	-	-	**RF**	-
Barium Titanate	BaTiO3	99,50%	6,02	1625	D	0,464	-	-	-	-	-	-	-	-	-	**RF**	Gives Ba, Co-evap and Sputter OK,
Beryllium	Be	98 - 99,9%	1,85	1278	-	-	710	878	1	**Excellent**	Graphite, Fabmate®	W, Ta	W	W	C	**DC**	Wets W/Mo/Ta, Evaporates easily
Beryllium Carbide	Be2C	98 - 99,9%	1,9	>2100	D	-	-	-	-	-	-	-	-	-	-	**-**	-
Beryllium Chloride	BeCl2	98 - 99,9%	1,9	405	-	-	-	-	≈150	-	-	-	-	-	-	**RF**	-
Beryllium Fluoride	BeF2	98 - 99,9%	1,99	800	S	-	-	-	≈200	Good	-	-	-	-	-	**-**	-

Symbols legend
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‡ One run only
* Influenced by composition
** The z-ratio is unknown, Therefore, we recommend using 1,00 or an experimentally determined value, Please click here for instructions on how to determine this value,
*** All metals alumina coated

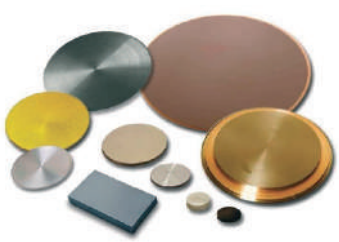
Termal evaporation accessories materials
C = carbon
Gr = graphite
Q = quartz
VitC = vitreous carbon

S = sublimes D = decomposes

Effective Sputtering Techiques:

PDC = Pulsed DC sputtering		**RF = RF sputtering**	**RF-R = reactive RF sputter**	**DC = DC sputtering**	**DC-R = reactive DC sputtering**

Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible		
Beryllium Oxide	BeO	98 - 99,9%	3,01	2530	-	-	-	-	1900	Good	-	-	-	W	-	RF, RF-R	No decomposition from E-beam guns,
Bismuth	Bi	99,9 - 99,999%	9,8	271	-	0,79	330	410	520	**Excellent**	Fabmate®, Graphite	W, Mo, Ta	W	W	Al2O3	DC	Resistivity high, Low Melting Point materials not ideal for sputtering,
Bismuth Fluoride	BiF3	99,9 - 99,999%	5,32	727	S	-	-	-	≈300	-	-	-	-	-	Gr	RF	-
Bismuth Oxide	Bi2O3	99,9 - 99,999%	8,55	860	-	**1,00	-	-	≈1400	Poor	-	-	-	-	-	RF, RF-R	-
Bismuth Selenide	Bi2Se3	99,9 - 99,999%	6,82	710	D	**1,00	-	-	≈650	Good	-	-	-	-	Gr, Q	RF	Co-evap from 2 sources or sputter,
Bismuth Sulfide	Bi2S3	99,9 - 99,999%	7,39	685	D	-	-	-	-	-	-	-	-	-	-	RF	-
Bismuth Telluride	Bi2Te3	99,9 - 99,999%	7,7	573	-	**1,00	-	-	≈600	-	-	W, Mo	-	-	Gr, Q	RF	Co-evap from 2 sources or sputter,
Bismuth Titanate	Bi2Ti2O7	99,9 - 99,999%	-	870	D	-	-	-	-	-	-	-	-	-	-	RF	Sputter or co-evap from 2 sources in 10-2 Torr O2,
Boron	B	99,9 - 99,999%	2,34	2079	-	0,389	1,278	1,548	1797	**Excellent**	Fabmate®, Graphite	C	-	-	C	RF	Explodes with rapid cooling, Forms carbide with container,
Boron Carbide	B4C	99,9 - 99,999%	2,52	2350	-	**1,00	2,5	2,58	2650	**Excellent**	Fabmate®, Graphite	-	-	-	-	RF	Similar to chromium,
Boron Nitride	BN	99,9 - 99,999%	2,25	3000	S	-	-	-	1600	Poor	-	-	-	-	-	RF, RF-R	Decomposes when sputtered, Reactive preferred,
Boron Oxide	B2O3	99,9 - 99,999%	1,81	≈450	-	-	-	-	≈1400	Good	Molybdenum	Mo	-	-	-	-	-
Boron Sulfide	B2S3	99,9 - 99,999%	1,55	310	-	-	-	-	800	-	-	-	-	-	Gr	RF	-
Cadmium	Cd	99,99%	8,64	321	-	0,682	64	120	180	Poor	-	W, Mo, Ta	-	W, Mo, Ta	Al2O3, Q	DC, RF	Bad for vacuum systems, Low sticking coefficient,
Cadmium Antimonide	Cd3Sb2	99,999%	6,92	456	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium Arsenide	Cd3As2	99,999%	6,21	721	-	-	-	-	-	-	-	-	-	-	Q	RF	-
Cadmium Bromide	CdBr2	99,999%	5,19	567	-	-	-	-	≈300	-	-	-	-	-	-	-	-
Cadmium Chloride	CdCl2	99,999%	4,05	568	-	-	-	-	≈400	-	-	-	-	-	-	-	-
Cadmium Fluoride	CdF2	99,999%	6,64	1,1	-	-	-	-	≈500	-	-	-	-	-	-	RF	-
Cadmium Iodide	CdI2	99,999%	5,67	387	-	-	-	-	≈250	-	-	-	-	-	-	-	-
Cadmium Oxide	CdO	99,999%	6,95	>1500	D	-	-	-	≈530	-	-	-	-	-	-	RF-R	Disproportionates,
Cadmium Selenide	CdSe	99,999%	5,81	>1350	S	**1,00	-	-	540	Good	Molybdenum, Tantalum	Mo, Ta	-	-	Al2O3, Q	RF	Evaporates easily,
Cadmium Sulfide	CdS	99,999%	4,82	1750	S	1,02	-	-	550	Fair	-	W, Mo, Ta	-	W	Al2O3, Q	RF	Sticking coefficient affected by substrate,
Cadmium Telluride	CdTe	99,999%	5,85	1092	-	0,98	-	-	450	-	-	W, Mo, Ta	W	W, Ta, Mo	-	RF	Stoichiometry depends on substrate temp, n~2,6,
Calcium	Ca	99,5%	1,54	839	S	2,62	272	357	459	Poor	-	W	W	W	Al2O3, Q	-	Corrodes in air,
Calcium Fluoride	CaF2	99,5%	3,18	1423	-	0,775	-	-	≈1100	-	-	W, Mo, Ta	W, Mo, Ta	W, Mo, Ta	Q	RF	Rate control important, Preheat gently to outgas,
Calcium Oxide	CaO	99,5%	~3,3	2614	-	-	-	-	≈1700	-	-	W, Mo	-	-	ZrO2	RF-R	Forms volatile oxides with W/Mo,
Calcium Silicate	CaSiO3	99,5%	2,91	1540	-	-	-	-	-	Good	-	-	-	-	Q	RF	-
Calcium Sulfide	CaS	99,5%	2,5	2525	D	-	-	-	1100	-	-	Mo	-	-	-	RF	Decomposes,
Calcium Titanate	CaTiO3	99,5%	4,1	1975	-	-	1490	1600	1690	Poor	-	-	-	-	-	RF	Disproportionates except in sputtering,
Calcium Tungstate	CaWO4	99,5%	6,06	1200	-	-	-	-	-	Good	-	W	-	-	-	RF	-
Carbon	C	99,999%	1,8–2,1	≈3652	S	3,26	1657	1867	2137	**Excellent**	Fabmate®, Graphite	-	-	-	-	PDC	E-beam preferred, Arc evaporation, Poor film adhesion,



Symbols legend
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*** All metals alumina coated

Termal evaporation accessories materials
C = carbon
Gr = graphite
Q = quartz
VitC = vitreous carbon

S = sublimes D = decomposes

Effective Sputtering Techiques:

PDC = Pulsed DC sputtering		**RF = RF sputtering**	**RF-R = reactive RF sputter**	**DC = DC sputtering**	**DC-R = reactive DC sputtering**

Material Vacuum Deposition Techniques

Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performa	Liner Material	Boat	Coil	Basket	Crucible		
Cerium	Ce	99,9%	~6,70	798	-	**1,00	970	1150	1380	Good	-	W, Ta	W	W, Ta	Al2O3	DC, RF	-
Cerium (III) Oxide	Ce2O3	99,9%	6,86	1692	-	-	-	-	-	Fair	-	W	-	-	-	-	Alloys with source, Use 0,015"–0,020" W boat,
Cerium (IV) Oxide	CeO2	99,9%	7,13	≈2600	-	**1,00	1890	2000	2310	Good	Tantalum, Graphite, Fabmate®	W	-	-	-	RF, RF-R	Very little decomposition,
Cerium Fluoride	CeF3	99,9%	6,16	1460	-	**1,00	-	-	≈900	Good	Tungsten, Tantalum, Molybdenum	W, Mo, Ta	-	Mo, Ta	-	RF	Preheat gently to outgas, n~1,7,
Cesium	Cs	99,9%	1,88	28	-	-	-16	22	80	-	-	-	-	-	Q	-	-
Cesium Bromide	CsBr	99,9%	3,04	636	-	-	-	-	≈400	-	-	W	-	-	-	RF	-
Cesium Chloride	CsCl	99,9%	3,99	645	-	-	-	-	≈500	-	-	W	-	-	-	RF	-
Cesium Fluoride	CsF	99,9%	4,12	682	-	-	-	-	≈500	-	-	W	-	-	-	RF	-
Cesium Hydroxide	CsOH	99,9%	3,68	272	-	-	-	-	550	-	-	-	-	-	-	-	-
Cesium Iodide	CsI	99,9%	4,51	626	-	-	-	-	≈500	-	-	W	-	-	Q	RF	-
Chiolite	Na5Al3F14	99,9%	2,9	735	-	-	-	-	≈800	-	-	Mo, W	-	-	-	RF	-
Chromium	Cr	99,95%	7,2	1,857	S	0,305	837	977	1157	Good	Fabmate®, Graphite, Tungsten	Cr Plated W Rods	W	W	VitC	DC	Films very adherent, High rates possible,
Chromium Boride	CrB	99,95%	6,17	1950-2050	-	-	-	-	-	-	-	-	-	-	-	RF	-
Chromium (II) Bromide	CrBr2	99,95%	4,36	842	-	-	-	-	550	-	-	-	-	-	-	RF	-
Chromium Carbide	Cr3C2	99,95%	6,68	1895	-	-	-	-	≈2000	Fair	-	W	-	-	-	RF	-
Chromium Chloride	CrCl2	99,95%	2,88	824	-	-	-	-	550	-	-	Fe	-	-	-	RF	-
Chromium Oxide	Cr2O3	99,95%	5,21	2266	-	**1,00	-	-	≈2000	Good	-	W, Mo	-	W	-	RF, RF-R	Disproportionates to lower oxides; reoxidizes at 600°C in air,
Chromium Silicide	CrSi2	99,95%	5,5	1490	-	-	-	-	-	-	-	-	-	-	-	RF	-
Chromium-Silicon Monoxide	Cr-SiO	99,95%	*	-	S	-	*	*	*	Good	-	W	-	W	-	RF	Flash evaporate,
Cobalt †	Co	99,9%	8,9	1495	-	0,343	850	990	1200	**Excellent**	Direct in Hearth	W, Nb	-	W	Al2O3	DC	Alloys with W/Ta/Mo,
Cobalt Bromide	CoBr2	99,9%	4,91	678	D	-	-	-	400	-	-	-	-	-	-	RF	-
Cobalt Chloride	CoCl2	99,9%	3,36	724	D	-	-	-	472	-	-	-	-	-	-	RF	-
Cobalt Oxide	CoO	99,9%	6,45	1795	-	0,412	-	-	-	-	-	-	-	-	-	DC-R, RF-R	Sputtering preferred,
Copper	Cu	99,99, 99,999%	8,92	1083	-	0,437	727	857	1017	**Excellent**	Graphite, Molybdenum	Mo	W	W	Al2O3, Mo, Ta	DC	Adhesion poor, Use interlayer (Cr), Evaporates using any source material,
Copper Chloride	CuCl	99,99, 99,999%	4,14	430	-	-	-	-	≈600	-	-	-	-	-	-	RF	-
Copper Oxide	Cu2O	99,99, 99,999%	6	1235	S	**1,00	-	-	≈600	Good	Graphite, Fabmate®, Tantalum	Ta	-	-	Al2O3	DC-R, RF-R	-
Copper Sulfide	Cu2S	99,99, 99,999%	5,6	1100	-	-	-	-	-	-	-	-	-	-	-	-	-
Cryolite	Na3AlF6	99,99%	2,9	1	-	-	1020	1260	1480	**Excellent**	Fabmate®, Tungsten	W, Mo, Ta	-	W, Mo, Ta	VitC	RF	Large chunks reduce spitting, Little decomposition,
Dysprosium	Dy	99,9%	8,55	1412	-	0,6	625	750	900	Good	Direct in Hearth	Ta	-	-	-	DC	-
Dysprosium Fluoride	DyF3	99,9%	-	1360	S	-	-	-	≈800	Good	-	Ta	-	-	-	RF	-
Dysprosium Oxide	Dy2O3	99,9%	7,81	2340	-	-	-	-	≈1,400	-	-	-	-	-	-	RF, RF-R	Loses oxygen,
Erbium	Er	99,9 - 99,999%	9,07	1529	S	0,74	650	775	930	Good	Tungsten, Tantalum	W, Ta	-	-	-	DC	-
Erbium Fluoride	ErF3	99,9 - 99,999%	7,82	1350	-	-	-	-	≈750	-	-	Mo	-	-	-	RF	See JVST, 1985; A3(6):2320,
Erbium Oxide	Er2O3	99,9 - 99,999%	8,64	2350	-	**1,00	-	-	≈1600	-	-	-	-	-	-	RF, RF-R	Loses oxygen,
Europium	Eu	99,9 - 99,999%	5,24	822	S	**1,00	280	360	480	Fair	-	W, Ta	-	-	Al2O3	DC	Low Ta solubility,
Europium Fluoride	EuF2	99,9 - 99,999%	6,5	1380	-	-	-	-	≈950	-	-	Mo	-	-	-	RF	-

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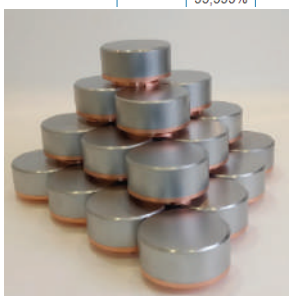
Europium Oxide	Eu2O3	99,9 - 99,999%	7,42	2350	-	-	-	-	≈1600	Good	-	Ta, W	-	-	ThO2	**RF, RF-R**	Loses oxygen, Films clear and hard,
Europium Sulfide	EuS	99,9 - 99,999%	5,75	-	-	-	-	-	-	Good	-	-	-	-	-	**RF**	-
Gadolinium †	Gd	99,9 %	7,9	1313	-	0,67	760	900	1175	**Excellent**	Direct in Hearth	Ta	-	-	Al2O3	**DC**	High Ta solubility
Gadolinium Carbide	GdC2	99,9 %	-	-	-	-	-	-	1500	-	-	-	-	-	C	**RF**	Decomposes under sputtering,
Gadolinium Oxide	Gd2O3	99,9 %	7,41	2330	-	-	-	-	-	Fair	-	-	-	-	-	**RF, RF-R**	Loses oxygen,
Gallium	Ga	99,9 %	5,9	30	-	-	619	742	907	Good	Fabmate®	-	-	-	Al2O3, Q	**-**	Alloys with W/Ta/Mo, Use E-beam gun, Low Melting Point materials not ideal for sputtering,
Gallium Antimonide	GaSb	99,9 %	5,6	710	-	-	-	-	-	Fair	-	W, Ta	-	-	-	**RF**	Flash evaporate,
Gallium Arsenide	GaAs	99,9 %	5,3	1238	-	-	-	-	-	Good	Graphite, Fabmate®	W, Ta	-	-	C	**RF**	Flash evaporate,
Gallium Nitride	GaN	99,9 %	6,1	800	S	-	-	-	≈200	-	-	-	-	-	Al2O3	**RF, RF-R**	Evaporate Ga in 10-3 Torr N2,
Gallium Oxide	Ga2O3	99,9 %	6,44	1900	-	-	-	-	-	-	-	W	-	-	-	**RF**	Loses oxygen,
Gallium Phosphide	GaP	99,9 %	4,1	1540	-	-	-	770	920	-	-	W, Ta	-	W	Q	**RF**	Does not decompose, Rate control important,
Germanium	Ge	99,999%	5,35	937	-	0,516	812	957	1167	**Excellent**	Fabmate®, Graphite	W, C, Ta	-	-	Q, Al2O3	**DC**	Excellent films from E-beam,
Germanium (II) Oxide	GeO	99,999%	-	700	S	-	-	-	500	-	-	-	-	-	Q	**RF**	-
Germanium (III) Oxide	GeO2	99,999%	6,24	1086	-	-	-	-	≈625	Good	Fabmate®, Tantalum, Molybdenum	Ta, Mo	-	W, Mo	Q, Al2O3	**RF-R**	Similar to SiO; film predominantly GeO,
Germanium Nitride	Ge3N2	99,999%	5,2	450	S	-	-	-	~650	-	-	-	-	-	-	**RF-R**	Sputtering preferred,
Glass, Schott® 8329	—		2,2	1,3	-	-	-	-	-	**Excellent**	-	-	-	-	-	**RF**	Evaporable alkali glass, Melt in air before evaporating,
Gold	Au	99,99 - 99,999%	19,32	1064	-	0,381	807	947	1132	**Excellent**	Fabmate®, Tungsten	W*** Mo*** W	-	-	Al2O3, BN	**DC**	Films soft; not very adherent,
Hafnium	Hf	99,9%	13,31	2227	-	0,36	2160	2250	3090	Good	-	-	-	-	-	**DC**	-
Hafnium Boride	HfB2	99,9%	10,5	3250	-	-	-	-	-	-	-	-	-	-	-	**DC, RF**	-
Hafnium Carbide	HfC	99,9%	12,2	≈3890	S	**1,00	-	-	≈2600	-	-	-	-	-	-	**RF**	-
Hafnium Nitride	HfN	99,9%	13,8	3305	-	**1,00	-	-	-	-	-	-	-	-	-	**RF, RF-R**	-
Hafnium Oxide	HfO2	99,9%	9,68	2758	-	**1,00	-	-	≈2500	Fair	Direct in Hearth	-	-	-	-	**RF, RF-R**	Film HfO,
Hafnium Silicide	HfSi2	99,9%	7,2	1750	-	-	-	-	-	-	-	-	-	-	-	**RF**	-
Holmium	Ho	99,9%	8,8	1474	-	0,58	650	770	950	Good	-	W, Ta	W	W	-	**-**	-
Holmium Fluoride	HoF3	99,9%	7,68	1143	-	-	-	-	≈800	-	-	-	-	-	Q	**DC, RF**	-
Holmium Oxide	Ho2O3	99,9%	8,41	2370	-	-	-	-	-	-	-	-	-	-	-	**RF, RF-R**	Loses oxygen,
Inconel®	Ni/Cr/Fe	99,5%	8,5	1425	-	-	-	-	-	Good	Fabmate®, Tungsten	W	W	W	-	**DC**	Use fine wire wrapped on W, Low rate required for smooth films,
Indium	In	99,99 - 99,999%	7,3	157	-	0,841	487	597	742	**Excellent**	Fabmate®, Graphite, Molybdenum	W, Mo	-	W	Gr, Al2O3	**DC**	Wets W and Cu, Use Mo liner, Low Melting Point materials not ideal for sputtering,
Indium (I) Oxide	In2O	99,99 - 99,999%	6,99	≈600	S	-	-	-	650	-	-	-	-	-	-	**RF**	Decomposes under sputtering,
Indium (III) Oxide	In2O3	99,99 - 99,999%	7,18	850	-	**1,00	-	-	≈1200	Good	-	W, Pt	-	-	Al2O3	**-**	-
Indium (I) Sulfide	In2S	99,99 - 99,999%	5,87	653	-	-	-	-	650	-	-	-	-	-	Gr	**RF**	-
Indium (II) Sulfide	InS	99,99 - 99,999%	5,18	692	S	-	-	-	650	-	-	-	-	-	Gr	**RF**	-



Symbols legend
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** The z-ratio is unknown, Therefore, we recommend using 1,00 or an experimentally determined value, Please click here for instructions on how to determine this value,
*** All metals alumina coated

Termal evaporation accessories materials
C = carbon
Gr = graphite
Q = quartz
VitC = vitreous carbon

S = sublimes D = decomposes

Effective Sputtering Techiques:

PDC = Pulsed DC sputtering		**RF = RF sputtering**	**RF-R = reactive RF sputter**	**DC = DC sputtering**	**DC-R = reactive DC sputtering**

Material Vacuum Deposition Techniques

Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible		
Indium (III) Sulfide	In2S3	99,99 - 99,999%	4,9	1050	S	-	-	-	850	-	-	-	-	-	Gr	**RF**	Film In2S,
Indium (II) Telluride	InTe	99,99 - 99,999%	6,29	696	-	-	-	-	-	-	-	-	-	-	-	**-**	-
Indium (III) Telluride	In2Te3	99,99 - 99,999%	5,78	667	-	-	-	-	-	-	-	-	-	-	-	**RF**	Sputtering preferred; or co-evaporate from 2 sources; flash,
Indium Antimonide	InSb	99,99 - 99,999%	5,8	535	-	-	-	-	-	-	-	W	-	-	-	**RF**	Decomposes, Sputtering preferred; or co-evaporate,
Indium Arsenide	InAs	99,99 - 99,999%	5,7	943	-	-	780	870	970	-	-	W	-	-	-	**RF**	-
Indium Nitride	InN	99,99 - 99,999%	7	1200	-	-	-	-	-	-	-	-	-	-	-	**-**	-
Indium Phosphide	InP	99,99 - 99,999%	4,8	1070	-	-	-	630	730	-	-	W, Ta	-	W, Ta	Gr	**RF**	Deposits are P rich,
Indium Selenide	In2Se3	99,99 - 99,999%	5,67	890	-	-	-	-	-	-	-	-	-	-	-	**RF**	Sputtering preferred; or co-evaporate from 2 sources; flash,
Indium Tin Oxide	In2O3/SnO290/10 wt %	99,99 - 99,999%	-	1,8	S	-	-	-	-	-	Fabmate®, Graphite	-	-	-	-	**-**	-
Iridium	Ir	99,90%	22,42	2410	-	0,129	1850	2080	2380	Fair	-	-	-	-	-	**DC**	-
Iron †	Fe	99,9 - 99,95%	7,86	1535	-	0,349	858	998	1180	**Excellent**	Fabmate® ‡	W	W	W	Al2O3	**DC**	Attacks W, Films hard, smooth, Preheat gently to outgas,
Iron (II) Oxide	FeO	99,9 - 99,95%	5,7	1369	-	-	-	-	-	Poor	-	-	-	-	-	**RF, RF-R**	Decomposes; sputtering preferred,
Iron (III) Oxide	Fe2O3	99,9 - 99,95%	5,24	1565	-	**1,00	-	-	-	Good	-	W	-	W	-	**-**	Disproportionate to Fe3O4 at 1,530°C,
Iron Bromide	37288	99,9 - 99,95%	4,64	684	D	-	-	-	561	-	-	-	-	-	Fe	**RF**	-
Iron Chloride	FeCl2	99,9 - 99,95%	3,16	670	S	-	-	-	300	-	-	-	-	-	Fe	**RF**	-
Iron Iodide	FeI2	99,9 - 99,95%	5,32	-	-	-	-	-	400	-	-	-	-	-	Fe	**RF**	-
Iron Sulfide	FeS	99,9 - 99,95%	4,74	1193	D	-	-	-	-	-	-	-	-	-	Al2O3	**RF**	Decomposes
Kanthal®	FeCrAl		7,1	-	-	-	-	-	-	-	-	W	W	W	-	**DC**	-
Lanthanum	La	99,50%	6,15	921	-	0,92	990	1212	1388	**Excellent**	Tungsten, Tantalum	W, Ta	-	-	Al2O3	**RF**	Films will burn in air if scraped,
Lanthanum Boride	LaB6	99,50%	2,61	2210	D	**1,00	-	-	-	Good	-	-	-	-	-	**RF**	-
Lanthanum Bromide	LaBr3	99,5%	5,06	783	-	-	-	-	-	-	-	-	-	Ta	-	**RF**	Hygroscopic,
Lanthanum Fluoride	LaF3	99,5%	~6,0	1490	S	-	-	-	900	Good	Tantalum, Molybdenum	Ta, Mo	-	Ta	-	**RF**	No decomposition, n~1,6,
Lanthanum Oxide	La2O3	99,5%	6,51	2307	-	**1,00	-	-	1400	Good	Graphite, Fabmate®, Tungsten	W, Ta	-	-	-	**RF**	Loses oxygen, n~1,73,
Lead	Pb	99,995%	11,34	328	-	1,13	342	427	497	**Excellent**	Fabmate®	W, Mo	W	W, Ta	Al2O3, Q	**DC**	-
Lead Bromide	PbBr2	99,9%	6,66	373	-	-	-	-	≈300	-	-	-	-	-	-	**-**	-
Lead Chloride	PbCl2	99,9%	5,85	501	-	-	-	-	≈325	-	-	-	-	-	Al2O3	**RF**	Little decomposition,
Lead Fluoride	PbF2	99,9%	8,24	855	S	-	-	-	≈400	-	-	W, Mo	-	-	BeO	**RF**	-
Lead Iodide	PbI2	99,9%	6,16	402	-	-	-	-	≈500	-	-	-	-	-	Q	**-**	-
Lead Oxide	PbO	99,9%	9,53	886	-	-	-	-	≈550	-	-	-	-	-	Q, Al2O3	**RF-R**	No decomposition, n~2,6,
Lead Selenide	PbSe	99,9%	8,1	1065	S	-	-	-	≈500	-	-	W, Mo	-	W	Gr, Al2O3	**RF**	-
Lead Stannate	PbSnO3	99,9%	8,1	1115	-	-	670	780	905	Poor	-	-	-	-	Al2O3	**RF**	Disproportionates,
Lead Sulfide	PbS	99,9%	7,5	1114	S	-	-	-	500	-	-	W	-	W, Mo	Q, Al2O3	**RF**	Little decomposition,
Lead Telluride	PbTe	99,9%	8,16	917	-	0,651	780	910	1050	-	-	Mo, Pt, Ta	-	-	Al2O3, Gr	**RF**	Deposits are Ta rich, Sputtering preferred,
Lead Titanate	PbTiO3	99,9%	7,52	-	-	1,16	-	-	-	-	-	Ta	-	-	-	**RF**	-
Lithium	Li	99,9%	0,53	181	-	5,9	227	307	407	Good	Tantalum	Ta	-	-	Al2O3	**-**	Metal reacts quickly in air,
Lithium Bromide	LiBr	99,9%	3,46	550	-	-	-	-	≈500	-	-	Ni	-	-	-	**RF**	-
Lithium Chloride	LiCl	99,9%	2,07	605	-	-	-	-	400	-	-	Ni	-	-	-	**RF**	Preheat gently to outgas,

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Effective Sputtering Techiques:

PDC = Pulsed DC sputtering		RF = RF sputtering	RF-R = reactive RF sputter	DC = DC sputtering	DC-R = reactive DC sputtering

Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible		
Lithium Fluoride	LiF	99,9%	2,64	845	-	0,778	875	1020	1180	Good	Tantalum, Tungsten, Molybdenum	Ni, Ta, Mo, W	-	-	Al2O3	RF	Rate control important for optical films, Preheat gently to outgas,
Lithium Iodide	LiI	99,9%	4,08	449	-	-	-	-	400	-	-	Mo, W	-	-	-	RF	-
Lithium Niobate	LiNbO3	99,9%	-	-	-	0,463	-	-	-	-	-	-	-	-	-	-	-
Lithium Oxide	Li2O	99,9%	2,01	>1700	-	-	-	-	850	-	-	-	-	-	-	RF	-
Lutetium	Lu	99,9%	9,84	1663	-	-	-	-	1300	Excellent	Direct in Hearth	Ta	-	-	Al2O3	RF, DC	-
Lutetium Oxide	Lu2O3	99,9%	9,42	-	-	-	-	-	1400	-	-	-	-	-	-	RF	Decomposes,
Magnesium	Mg	99,95%	1,74	649	S	1,61	185	247	327	Good	Fabmate®, Graphite, Tungsten	W, Mo, Ta, Cb	W	W	Al2O3	DC	Extremely high rates possible,
Magnesium Aluminate	MgAl2O4	99,95%	3,6	2135	-	-	-	-	-	Good	-	-	-	-	-	RF	Natural spinel,
Magnesium Bromide	MgBr2	99,95%	3,72	700	-	-	-	-	≈450	-	-	Ni	-	-	-	RF	Decomposes,
Magnesium Chloride	MgCl2	99,95%	2,32	714	-	-	-	-	400	-	-	Ni	-	-	-	RF	Decomposes,
Magnesium Fluoride	MgF2	99,95%	2,9–3,2	1261	-	0,637	-	-	1	Excellent	Fabmate®, Graphite, Molybdenum	Mo, Ta	-	-	Al2O3	RF	Substrate temp and rate control important, Reacts with W, Mo OK,
Magnesium Iodide	MgI2	99,95%	4,43	<637	D	-	-	-	200	-	-	-	-	-	-	RF	-
Magnesium Oxide	MgO	99,95%	3,58	2852	-	0,411	-	-	1300	Good	Fabmate®, Graphite	-	-	-	C, Al2O3	RF, RF-R	Evaporates in 10-3Torr O2 for stoichiometry,
Manganese	Mn	99,90%	7,2	1244	S	0,377	507	572	647	Good	Tungsten	W, Ta, Mo	W	W	Al2O3	DC	-
Manganese (II) Oxide	MnO	99,90%	5,37	1945	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese (III) Oxide	Mn2O3	99,90%	4,5	1080	-	0,467	-	-	-	-	-	-	-	-	-	-	-
Manganese (IV) Oxide	MnO2	99,90%	5,03	535	-	-	-	-	-	Poor	-	W	-	W	-	RF-R	Loses oxygen at 535°C,
Manganese Chloride	MnCl2	99,90%	2,98	650	-	-	-	-	450	-	-	-	-	-	-	RF	-
Manganese Sulfide	MnS	99,90%	3,99	-	D	-	-	-	1300	-	-	Mo	-	-	-	RF	Decomposes,
Mercury	Hg		13,55	≈39	-	-	-68	-42	-6	-	-	-	-	-	-	-	-
Mercury Sulfide	HgS		8,1	584	S	-	-	-	250	-	-	-	-	-	Al2O3	RF	Decomposes,
Molybdenum	Mo	99,95%	10,2	2617	-	0,257	1592	1822	2117	Excellent	Fabmate®, Graphite	-	-	-	-	DC	Films smooth, hard, Careful degas required,
Molybdenum Boride	MoB2	99,95%	7,12	2100	-	-	-	-	-	Poor	-	-	-	-	-	RF	-
Molybdenum Carbide	Mo2C	99,95%	8,9	2687	-	**1,00	-	-	-	Fair	-	-	-	-	-	RF	Evaporation of Mo(CO)6 yields Mo2C,
Molybdenum Sulfide	MoS2	99,95%	4,8	1185	-	**1,00	-	-	≈50	-	-	-	-	-	-	RF	-
Molybdenum Oxide	MoO3	99,95%	4,69	795	S	**1,00	-	-	≈900	-	-	Mo	-	Mo	Al2O3, BN	RF	Slight oxygen loss,
Molybdenum Silicide	MoSi2	99,95%	6,31	2050	-	**1,00	-	-	-	-	-	W	-	-	-	RF	Decomposes,
Neodymium	Nd	99,9%	7,01	1021	-	**1,00	731	871	1062	Excellent	Tantalum	Ta	-	-	Al2O3	DC	Low W solubility,
Neodymium Fluoride	NdF3	99,9%	6,5	1410	-	-	-	-	≈900	Good	Tungsten, Molybdenum	Mo, W	-	Mo, Ta	Al2O3	RF	Very little decomposition,
Neodymium Oxide	Nd2O3	99,9%	7,24	≈1900	-	-	-	-	≈1400	Good	Tantalum, Tungsten	Ta, W	-	-	ThO2	RF, RF-R	Loses oxygen; films clear, E-beam preferred,
Nichrome IV® †	Ni/Cr		8,5	1395	-	**1,00	847	987	1217	Excellent	Fabmate®	***	W	W, Ta	Al2O3	DC	Alloys with W/Ta/Mo,
Nickel †	Ni	99,7 - 99,995%	8,9	1453	-	0,331	927	1072	1262	Excellent	Fabmate® ‡	W***	-	-	Al2O3	DC	Alloys with W/Ta/Mo, Smooth adherent films,
Nickel Bromide	NiBr2	99,7 - 99,995%	5,1	963	S	-	-	-	362	-	-	-	-	-	-	RF	-
Nickel Chloride	NiCl2	99,7 - 99,995%	3,55	1001	S	-	-	-	444	-	-	-	-	-	-	RF	-
Nickel Oxide	NiO	99,7 - 99,995%	6,67	1984	-	**1,00	-	-	≈1470	-	-	-	-	-	Al2O3	RF-R	Dissociates on heating,

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Material Vacuum Deposition Techniques

Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible		
Nickel/Iron †	Ni/Fe	99,7 - 99,995%	-	-	-	**1,00	-	-	-	-	Fabmate® ‡,	-	-	-	-	-	-
Nimendium †	Ni3%Mn		8,8	1425	-	-	-	-	-	-	-	-	-	-	-	DC	-
Niobium	Nb	99,95%	8,57	2468	-	0,492	1728	1977	2287	Excellent	Fabmate®	-	-	-	-	DC	Attacks W source,
Niobium (II) Oxide	NbO	99,95%	7,3	-	-	-	-	-	1100	-	-	-	-	-	-	RF	-
Niobium (III) Oxide	Nb2O3	99,95%	7,5	1780	-	-	-	-	-	-	-	W	-	W	-	RF, RF-R	-
Niobium (V) Oxide	Nb2O5	99,95%	4,47	1485	-	**1,00	-	-	-	-	-	W	-	W	-	RF, RF-R	-
Niobium Boride	NbB2	99,95%	6,97	2900	-	-	-	-	-	-	-	-	-	-	-	RF	-
Niobium Carbide	NbC	99,95%	7,6	3500	-	**1,00	-	-	-	Fair	-	-	-	-	-	RF	-
Niobium Nitride	NbN	99,95%	8,4	2573	-	**1,00	-	-	-	-	-	-	-	-	-	RF, RF-R	Reactive, Evaporates Nb in 10-3 Torr N2,
Niobium Telluride	NbTe2	99,95%	7,6	-	-	-	-	-	-	-	-	-	-	-	-	RF	Composition variable,
Niobium-Tin	Nb3Sn	99,95%	-	-	-	-	-	-	-	Excellent	-	-	-	-	-	DC	Co-evaporate from 2 sources,
Osmium	Os		22,48	3045	-	-	2170	2430	2760	Fair	-	-	-	-	-	DC	-
Osmium Oxide	Os2O3		-	-	D	-	-	-	-	-	-	-	-	-	-	-	Deposits Os in 10-3Torr O2,
Palladium	Pd	99,95%	12,02	1554	S	0,357	842	992	1192	**Excellent**	Fabmate®, Graphite, Tungsten	W***	W	W	Al2O3	DC	Alloys with refractory metals,
Palladium Oxide	PdO	99,95%	9,7	870	-	-	-	-	575	-	-	-	-	-	Al2O3	RF-R	Decomposes,
Parylene	C8H8		1,1	300–400	-	-	-	-	-	-	-	-	-	-	-	-	Vapor-depositable plastic,
Permalloy® †	Ni/Fe/Mo/Mn	99,90%	8,7	1395	-	**1,00	947	1047	1307	Good	Fabmate® ‡	W	-	-	Al2O3	DC	Film low in Ni,
Phosphorus	P		1,82	44,1	-	-	327	361	402	-	-	-	-	-	Al2O3	-	Material reacts violently in air,
Phosphorus Nitride	P3N5		2,51	-	-	-	-	-	-	-	-	-	-	-	-	RF, RF-R	-
Platinum	Pt	99,99%	21,45	1772	-	0,245	1292	1492	1747	**Excellent**	Fabmate®, Graphite	W	W	W	C	DC	Alloys with metals, Films soft, poor adhesion,
Platinum Oxide	PtO2	99,99%	10,2	450	-	-	-	-	-	-	-	-	-	-	-	RF-R	E-beam preferred for evaporation,
Plutonium	Pu		19,84	641	-	-	-	-	-	-	-	W	-	-	-	-	-
Polonium	Po		9,4	254	-	-	117	170	244	-	-	-	-	-	Q	-	-
Potassium	K		0,86	63	-	-	23	60	125	-	-	Mo	-	-	Q	-	Metal reacts rapidly in air, Preheat gently to outgas,
Potassium Bromide	KBr		2,75	734	-	-	-	-	≈450	-	-	Ta, Mo	-	-	Q	RF	Preheat gently to outgas,
Potassium Chloride	KCl		1,98	770	S	-	-	-	510	Good	Tantalum	Ta, Ni	-	-	-	RF	Preheat gently to outgas,
Potassium Fluoride	KF		2,48	858	-	-	-	-	≈500	-	-	-	-	-	Q	RF	Preheat gently to outgas,
Potassium Hydroxide	KOH		2,04	360	-	-	-	-	≈400	-	-	-	-	-	-	-	Preheat gently to outgas,
Potassium Iodide	KI		3,13	681	-	-	-	-	≈500	-	-	Ta	-	-	-	RF	Preheat gently to outgas,
Praseodymium	Pr	99,9%	6,77	931	-	**1,00	800	950	1150	Good	-	Ta	-	-	-	DC	-
Praseodymium Oxide	Pr2O3	99,9%	7,07	-	D	-	-	-	1400	Good	-	-	-	-	ThO2	RF, RF-R	Loses oxygen,
PTFE	PTFE		2,9	330	-	-	-	-	-	-	-	W	-	-	-	RF	Baffled source, Film structure doubtful,
Radium	Ra		5 (?)	700	-	-	246	320	416	-	-	-	-	-	-	-	-
Rhenium	Re	99,9%	20,53	3180	-	0,15	1928	2207	2571	Poor	-	-	-	-	-	DC	-
Rhenium Oxide	ReO3	99,9%	~7	-	D	-	-	-	-	-	-	-	-	-	-	RF	Evaporate Re in 10-3 Torr O2,
Rhodium	Rh	99,8%	12,4	1966	-	0,21	1277	1472	1707	Good	Fabmate®, Tungsten	W	W	W	ThO2, VitC	DC	E-beam gun preferred,
Rubidium	Rb	99,8%	1,48	39	-	-	-3	37	111	-	-	-	-	-	Q	-	-
Rubidium Chloride	RbCl	99,8%	2,09	718	-	-	-	-	≈550	-	-	-	-	-	Q	RF	-
Rubidium Iodide	RbI	99,8%	3,55	647	-	-	-	-	≈400	-	-	-	-	-	Q	RF	-
Ruthenium	Ru	99,9%	12,3	2310	-	0,182	1780	1990	2260	Poor	-	-	-	-	-	DC	-
Samarium	Sm	99,9%	7,52	1074	-	0,89	373	460	573	Good	-	Ta	-	-	Al2O3	DC	-
Samarium Oxide	Sm2O3	99,9%	8,35	2350	-	-	-	-	-	Good	-	-	-	-	ThO2	RF, RF-R	Loses oxygen, Films smooth, clear,
Samarium Sulfide	Sm2S3	99,9%	5,73	1900	-	-	-	-	-	Good	-	-	-	-	-	-	-
Scandium	Sc	99,9%	2,99	1541	-	0,91	714	837	1002	**Excellent**	Tungsten, Molybdenu	W	-	-	Al2O3	RF	Alloys with Ta,

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Termal evaporation accessories materials
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Q = quartz
VitC = vitreous carbon

S = sublimes D = decomposes

Effective Sputtering Techiques:

PDC = Pulsed DC sputtering		RF = RF sputtering	RF-R = reactive RF sputter	DC = DC sputtering	DC-R = reactive DC sputtering

Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible		
Scandium Oxide	Sc2O3	99,99%	3,86	2300	-	-	-	-	~400	Fair	-	-	-	-	-	RF, RF-R	-
Selenium	Se	99,99 - 99,999%	4,81	217	-	0,864	89	125	170	Good	Fabmate®, Tungsten, Molybdenum	W, Mo	W, Mo	W, Mo	Al2O3	-	Bad for vacuum systems, High V.P, Low Melting Point materials not ideal for sputtering,
Silicon	Si	99,999%	2,32	1410	-	0,712	992	1147	1337	Fair	Fabmate® ‡, Tantalum	-	-	-	-	RF	Alloys with W; use heavy W boat, SiO produced,
Silicon (II) Oxide	SiO	99,999%	2,13	>1702	S	0,87	-	-	850	Fair	Fabmate®, Tungsten, Tantalum	Ta	W	W	Ta	RF, RF-R	For resistance evaporation, use baffle box and low rate,
Silicon (IV) Oxide	SiO2	99,999%	~2,65	1610	-	**1,00	*	*	1025*	**Excellent**	Fabmate®, Graphite, Tantalum	-	-	-	Al2O3	RF	Quartz excellent in E-beam,
Silicon (N-type)	Si (N-type)	99,999%	2,32	1410	-	0,712	992	1147	1337	Fair	Fabmate® ‡, Tantalum	-	-	-	-	DC, RF	-
Silicon (P-type)	Si (P-type)	99,999%	2,32	1410	-	0,712	992	1147	1337	Fair	Fabmate® ‡, Tantalum	-	-	-	-	DC, RF	-
Silicon Boride	SiB6	99,999%	-	-	-	-	-	-	-	Poor	-	-	-	-	-	RF	-
Silicon Carbide	SiC	99,999%	3,22	≈2700	S, D	**1,00	-	-	1	-	-	-	-	-	-	RF	Sputtering preferred,
Silicon Nitride	Si3N4	99,999%	3,44	1900	-	**1,00	-	-	≈800	-	-	-	-	-	-	RF, RF-R	-
Silicon Selenide	SiSe	99,999%	-	-	-	-	-	-	550	-	-	-	-	-	Q	RF	-
Silicon Sulfide	SiS	99,999%	1,85	940	S	-	-	-	450	-	-	-	-	-	Q	RF	-
Silicon Telluride	SiTe2	99,999%	4,39	-	-	-	-	-	550	-	-	-	-	-	Q	RF	-
Silver	Ag	99,99%	10,5	962	-	0,529	847	958	1105	**Excellent**	Fabmate®, Tungsten, Molybdenum, Tantalum	W	Mo	Ta, Mo	Al2O3, W	DC	-
Silver Bromide	AgBr	99,99%	6,47	432	D	-	-	-	≈380	-	-	Ta	-	-	Q	RF	-
Silver Chloride	AgCl	99,99%	5,56	455	-	-	-	-	≈520	-	-	Mo	-	Mo	Q	RF	-
Sodium	Na	99,9%	0,97	98	-	-	74	124	192	-	-	Ta	-	-	Q	-	Preheat gently to outgas, Metal reacts quickly in air,
Sodium Bromide	NaBr	99,9%	3,2	747	-	-	-	-	≈400	-	-	-	-	-	Q	RF	Preheat gently to outgas,
Sodium Chloride	NaCl	99,9%	2,17	801	-	-	-	-	530	Good	-	Ta, W, Mo	-	-	Q	RF	Copper oven; little decomposition, Preheat gently to outgas,
Sodium Cyanide	NaCN	99,9%	-	564	-	-	-	-	≈550	-	-	-	-	-	-	RF	Preheat gently to outgas,
Sodium Fluoride	NaF	99,9%	2,56	993	-	-	-	-	≈1000	Good	Tungsten, Fabmate®	Mo, Ta, W	-	-	BeO	RF	Preheat gently to outgas, No decomposition,
Sodium Hydroxide	NaOH	99,9%	2,13	318	-	-	-	-	≈470	-	-	-	-	-	-	-	Preheat gently to outgas,
Spinel	MgAl2O4		8	-	-	-	-	-	-	Good	-	-	-	-	-	RF	-
Strontium	Sr	99,9%	2,6	769	-	**1,00	239	309	403	Poor	-	W, Ta, Mo	W	W	VitC	RF	Wets but does not alloy with W/Ta/Mo, May react in air,
Strontium Chloride	SrCl2	99,9%	3,05	875	-	-	-	-	-	-	-	-	-	-	-	-	-
Strontium Fluoride	SrF2	99,9%	4,24	1473	-	-	-	-	≈1000	-	-	-	-	-	Al2O3	RF	-
Strontium Oxide	SrO	99,9%	4,7	2430	S	-	-	-	1500	-	-	Mo	-	-	Al2O3	RF	Reacts with W/Mo,
Strontium Sulfide	SrS	99,9%	3,7	>2000	-	-	-	-	-	-	-	Mo	-	-	-	RF	Decomposes,
Strontium Titanate	SrTiO3	99,9%	-	-	-	0,31	-	-	-	-	-	-	-	-	-	-	-
Sulfur	S	99,999%	2,07	113	-	-	13	19	57	Poor	-	W	-	W	Q	-	Bad for vacuum systems,
Supermalloy® †	Ni/Fe/Mo		8,9	1410	-	-	-	-	-	Good	Fabmate® ‡,	-	-	-	-	DC	Sputtering preferred; or co-evaporate from 2 sources-Ni/Fe and Mo,
Tantalum	Ta	99,95%	16,6	2996	-	0,262	1960	2240	2590	**Excellent**	Fabmate®, Graphite	-	-	-	-	DC	Forms good films,
Tantalum Boride	TaB2	99,95%	11,15	>3000	-	-	-	-	-	-	-	-	-	-	-	RF	-
Tantalum Carbide	TaC	99,95%	13,9	3880	-	**1,00	-	-	≈2500	-	-	-	-	-	-	RF	-

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Effective Sputtering Techiques:

PDC = Pulsed DC sputtering		RF = RF sputtering	RF-R = reactive RF sputter	DC = DC sputtering	DC-R = reactive DC sputtering

Material Vacuum Deposition Techniques

Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible		
Tantalum Pentoxide	Ta2O5	99,95%	8,2	1872	-	0,3	1550	1780	1920	Good	Fabmate®, Tantalum	Ta	W	W	VitC	**RF, RF-R**	Slight decomposition, Evaporate Ta in 10-3 Torr O2,
Tantalum Sulfide	TaS2	99,95%	-	>1300	-	-	-	-	-	-	-	-	-	-	-	**RF**	-
Technetium	Tc		11,5	2200	-	-	1570	1800	2090	-	-	-	-	-	-	**-**	-
Tellurium	Te	99,999%	6,25	449	-	0,9	157	207	277	Poor	Fabmate®	W, Ta	W	W, Ta	Al2O3, Q	**RF**	Wets without alloying,
Terbium	Tb	99,9%	8,23	1356	-	0,66	800	950	1150	**Excellent**	Graphite, Fabmate®, Tantalum	Ta	-	-	Al2O3	**RF**	-
Terbium Fluoride	TbF3	100	-	1172	-	-	-	-	≈800	-	-	-	-	-	-	**RF**	-
Terbium Oxide	Tb2O3	100	7,87	2387	-	-	-	-	1300	-	-	-	-	-	-	**RF**	Partially decomposes,
Terbium Peroxide	Tb4O7	100	-	-	D	-	-	-	-	-	-	Ta	-	-	-	**RF**	Films TbO,
Thallium	Tl	99,9 - 99,999%	11,85	304	-	-	280	360	470	Poor	Fabmate®	W, Ta	-	W	Al2O3, Q	**DC**	Wets freely,
Thallium Bromide	TlBr	99,9 - 99,999%	7,56	480	S	-	-	-	≈250	-	-	Ta	-	-	Q	**RF**	-
Thallium Chloride	TlCl	99,9 - 99,999%	7	430	S	-	-	-	≈150	-	-	Ta	-	-	Q	**RF**	-
Thallium Iodide	TlI	99,9 - 99,999%	7,1	440	S	-	-	-	≈250	-	-	-	-	-	Q	**RF**	-
Thallium Oxide	Tl2O2	99,9 - 99,999%	10,19	717	-	-	-	-	350	-	-	-	-	-	-	**RF**	Disproportionates at 850°C to Tl2O,
Thorium	Th	99,9%	11,7	1,75	-	-	1430	1660	1925	**Excellent**	Molybdenum, Tantalum, Tungsten	W, Ta, Mo	W	W	-	**-**	-
Thorium Bromide	ThBr4	99,9%	5,67	610	S	-	-	-	-	-	-	Mo	-	-	-	**-**	-
Thorium Carbide	ThC2	99,9%	8,96	2655	-	-	-	-	≈2300	-	-	-	-	-	C	**RF**	-
Thorium Fluoride	ThF4	99,9%	6,32	>900	-	-	-	-	≈750	Fair	-	Mo	-	W	VitC	**RF**	-
Thorium Oxide	ThO2	99,9%	9,86	3220	-	-	-	-	≈2100	Good	Tungsten	-	-	-	-	**RF, RF-R**	-
Thorium Oxyfluoride	ThOF2	99,9%	9,1	900	-	-	-	-	-	-	-	Mo, Ta	-	-	-	**-**	-
Thorium Sulfide	ThS2	99,9%	7,3	1925	-	-	-	-	-	-	-	-	-	-	-	**RF**	Sputtering preferred; or co-evaporate
Thulium	Tm	99,9%	9,32	1545	S	-	461	554	680	Good	-	Ta	-	-	Al2O3	**DC**	-
Thulium Oxide	Tm2O3	99,9%	8,9	-	-	-	-	-	1500	-	-	-	-	-	-	**RF**	Decomposes,
Tin	Sn	99,99%	7,28	232	-	0,724	682	807	997	**Excellent**	Fabmate®, Tantalum	Mo	W	W	Al2O3	**DC**	Wets Mo low sputter power, Use Ta liner in E-beam guns, Low Melting Point materials not ideal for sputtering,
Tin Oxide	SnO2	99,99%	6,95	1630	S	**1,00	-	-	≈1000	**Excellent**	-	W	W	W	Q, Al2O3	**RF, RF-R**	Films from W are oxygen deficient; oxidize in air,
Tin Selenide	SnSe	99,99%	6,18	861	-	-	-	-	≈400	Good	-	-	-	-	Q	**RF**	-
Tin Sulfide	SnS	99,99%	5,22	882	-	-	-	-	≈450	-	-	-	-	-	Q	**RF**	-
Tin Telluride	SnTe	99,99%	6,48	780	D	-	-	-	≈450	-	-	-	-	-	Q	**RF**	-
Titanium	Ti	99,7 - 99,995%	4,5	1660	-	0,628	1067	1235	1453	**Excellent**	Fabmate®	W	-	-	TiC	**DC**	Alloys with W/Ta/Mo; evolves gas on first heating,
Titanium (II) Oxide	TiO	99,7 - 99,995%	4,93	1750	-	**1,00	-	-	≈1500	Good	Fabmate®, Tantalum	W, Mo	-	-	VitC	**RF**	Preheat gently to outgas,
Titanium (III) Oxide	Ti2O3	99,7 - 99,995%	4,6	2130	D	-	-	-	-	Good	Fabmate®, Tantalum	W	-	-	-	**RF**	Decomposes,
Titanium (IV) Oxide	TiO2	99,7 - 99,995%	4,26	1830	-	0,4	-	-	≈1300	Fair	Fabmate®, Tantalum	W, Mo	-	W	-	**RF, RF-R**	Suboxide, must be reoxidized to rutile, Ta reduces TiO2 to TiO and Ti,
Titanium Boride	TiB2	99,7 - 99,995%	4,5	2900	-	**1,00	-	-	-	Poor	-	-	-	-	-	**RF**	-
Titanium Carbide	TiC	99,7 - 99,995%	4,93	3140	-	**1,00	-	-	≈2300	-	-	-	-	-	-	**RF**	-
Titanium Nitride	TiN	99,7 - 99,995%	5,22	2930	-	**1,00	-	-	-	Good	Molybdenum	Mo	-	-	-	**RF, RF-R**	Sputtering preferred, Decomposes with thermal evaporation,
Tungsten	W	99,95%	19,35	3410	-	0,163	2117	2407	2757	Good	Direct in Hearth	-	-	-	-	**DC**	Forms volatile oxides, Films hard and adherent

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Material	Symbol	Purities	Density g/cm3	Melting Point (C°)	Sublimes / Decompose	Acoustic Impedance Z Ratio	Temp,(C°) for a given Vap, Press, (Torr)			E-Beam Evaporation		Thermal Evaporation				Sputter	Comments
							10-8	10-6	10-4	E-Beam Performance	Liner Material	Boat	Coil	Basket	Crucible		
Tungsten Boride	WB2	99,95%	10,77	≈2900	-	-	-	-	-	Poor	-	-	-	-	-	**RF**	-
Tungsten Carbide	WC	99,95%	17,15	2860	-	0,151	1480	1720	2120	**Excellent**	Graphite, Fabmate®	C	-	-	-	**RF**	-
Tungsten Disulfide	WS2	99,95%	7,5	1250	D	**1,00	-	-	-	-	-	-	-	-	-	**RF**	-
Tungsten Oxide	WO3	99,95%	7,16	1473	S	**1,00	-	-	980	Good	Tungsten	W	-	-	-	**RF-R**	Preheat gently to outgas, W reduces oxide slightly,
Tungsten Selenide	WSe2	99,95%	9	-	-	-	-	-	-	-	-	-	-	-	-	**RF**	-
Tungsten Silicide	WSi2	99,95%	9,4	>900	-	**1,00	-	-	-	-	-	-	-	-	-	**RF**	-
Tungsten Telluride	WTe2	99,95%	9,49	-	-	-	-	-	-	-	-	-	-	-	Q	**RF**	-
Uranium	U		19,05	1132	-	-	1132	1327	1582	Good	-	Mo, W	W	W	-	**-**	Films oxidize,
Uranium (II) Sulfide	US		10,87	>2000	-	-	-	-	-	-	-	-	-	-	-	**-**	-
Uranium (III) Oxide	U2O3		8,3	1300	D	-	-	-	-	-	-	W	-	W	-	**RF-R**	Disproportionates at 1,300°C to UO2,
Uranium (IV) Oxide	UO2		10,96	2878	-	-	-	-	-	-	-	W	-	W	-	**RF**	Ta causes decomposition,
Uranium (IV) Sulfide	US2		7,96	>1100	-	-	-	-	-	-	-	W	-	-	-	**RF**	Slight decomposition,
Uranium Carbide	UC2		11,28	2350	-	-	-	-	2100	-	-	-	-	-	C	**RF**	Decomposes,
Uranium Fluoride	UF4		6,7	960	-	-	-	-	300	-	-	Ni	-	-	-	**RF**	-
Uranium Phosphide	UP2		8,57	-	-	-	-	-	1200	-	-	Ta	-	-	-	**RF**	Decomposes,
Vanadium	V	99,9%	5,96	1890	-	0,53	1162	1332	1547	**Excellent**	Tungsten	W, Mo	-	-	-	**DC**	Wets Mo, E-beam-evaporated films preferred,
Vanadium (IV) Oxide	VO2	99,9%	4,34	1967	S	-	-	-	≈575	-	-	-	-	-	-	**RF, RF-R**	Sputtering preferred,
Vanadium (V) Oxide	V2O5	99,9%	3,36	690	D	**1,00	-	-	≈500	-	-	-	-	-	Q	**RF**	-
Vanadium Boride	VB2	99,9%	5,1	2400	-	-	-	-	-	-	-	-	-	-	-	**RF**	-
Vanadium Carbide	VC	99,9%	5,77	2810	-	**1,00	-	-	≈1800	-	-	-	-	-	-	**RF**	-
Vanadium Nitride	VN	99,9%	6,13	2320	-	-	-	-	-	-	-	-	-	-	-	**RF, RF-R**	-
Vanadium Silicide	VSi2	99,9%	4,42	1700	-	-	-	-	-	-	-	-	-	-	-	**RF**	-
Ytterbium Fluoride	YbF3	99,9%	-	1157	-	-	-	-	≈800	-	Tantalum, Molybdenum	Mo	-	-	-	**RF**	-
Ytterbium Oxide	Yb2O3	99,9%	9,17	2346	S	**1,00	-	-	≈1500	-	-	-	-	-	-	**RF, RF-R**	Loses oxygen,
Yttrium	Y	99,9%	4,47	1522	-	0,835	830	973	1157	**Excellent**	Tungsten	W, Ta	W	W	Al2O3	**RF, DC**	High Ta solubility,
Yttrium Aluminum Oxide	Y3Al5O12	99,9%	-	1990	-	-	-	-	-	Good	-	-	W	W	-	**RF**	Films not ferroelectric,
Yttrium Fluoride	YF3	99,9%	4,01	1387	-	-	-	-	-	-	Tantalum, Molybdenum	-	-	-	-	**RF**	-
Yttrium Oxide	Y2O3	99,9%	5,01	2410	-	**1,00	-	-	≈2000	Good	Fabmate®, Graphite, Tungsten	W	-	-	C	**RF, RF-R**	Loses oxygen; films smooth and clear,
Zinc	Zn	99,99 - 99,995%	7,14	420	-	0,514	127	177	250	**Excellent**	Fabmate®, Graphite, Tungsten	Mo, W, Ta	W	W	Al2O3, Q	**DC**	Evaporates well under wide range of conditions,
Zinc Antimonide	Zn3Sb2	99,99 - 99,995%	6,33	570	-	-	-	-	-	-	-	-	-	-	-	**RF**	-
Zinc Bromide	ZnBr2	99,99 - 99,995%	4,2	394	-	-	-	-	≈300	-	-	W	-	-	C	**RF**	Decomposes,
Zinc Fluoride	ZnF2	99,99 - 99,995%	4,95	872	-	-	-	-	≈800	-	-	Ta	-	-	Q	**RF**	-
Zinc Nitride	Zn3N2	99,99 - 99,995%	6,22	-	-	-	-	-	-	-	-	Mo	-	-	-	**RF**	Decomposes,
Zinc Oxide	ZnO	99,99 - 99,995%	5,61	1975	-	0,556	-	-	≈1800	Fair	-	-	-	-	-	**RF-R**	-
Zinc Selenide	ZnSe	99,99 - 99,995%	5,42	>1100	-	0,722	-	-	660	-	Tantalum, Molybdenum	Ta, W, Mo	W, Mo	W, Mo	Q	**RF**	Preheat gently to outgas, Evaporates well,
Zinc Sulfide	ZnS	99,99 - 99,995%	3,98	1700	S	0,775	-	-	≈800	Good	Tantalum, Molybdenum	Ta, Mo	-	-	-	**RF**	Preheat gently to outgas, Films partially decompose, n=2,356,
Zinc Telluride	ZnTe	99,99 - 99,995%	6,34	1239	-	0,77	-	-	~600	-	-	Mo, Ta	-	-	-	**RF**	Preheat gently to outgas,
Zirconium	Zr	99,7%	6,49	1852	-	0,6	1477	1702	1987	**Excellent**	-	W	-	-	-	**DC**	Alloys with W, Films oxidize readily,
Zirconium Boride	ZrB2	99,7%	6,09	≈3200	-	-	-	-	-	Good	-	-	-	-	-	**RF**	-
Zirconium Carbide	ZrC	99,7%	6,73	3540	-	0,264	-	-	≈2500	-	-	-	-	-	-	**RF**	-

Symbols legend
† Magnetic material (requires special sputter source)
‡ One run only
* Influenced by composition
** The z-ratio is unknown, Therefore, we recommend using 1,00 or an experimentally determined value, Please click here for instructions on how to determine this value,
*** All metals alumina coated

Termal evaporation accessories materials
C = carbon
Gr = graphite
Q = quartz
VitC = vitreous carbon

S = sublimes D = decomposes

Effective Sputtering Techiques:

PDC = Pulsed DC sputtering		**RF = RF sputtering**	**RF-R = reactive RF sputter**	**DC = DC sputtering**	**DC-R = reactive DC sputtering**

EVAPORATION SOURCES
FILAMENTS, BOATS & CRUCIBLES

- Point & Loop Heaters
- Coil Heaters
- Baskets Heaters
- Spiral Heaters
- Boat Heaters
- Alumina -Coated Boat Heaters
- Boat Heaters for Microelectronics
- SiO Baffled Box Baffles Box Heaters
- Tantalum Box Heaters
- Tantalum Box Heaters For Microelectronics
- Baffles Box Heaters (Al203 Coated)
- Chrome - Plated Tungsten Rods
- Tungsten Rods
- Crucibles Liners for E-Beam
- Sources Crucibles for Thermal Sources
- Fabmate (R)

Typical materials are: Graphite, Tungsten, Molybdenum, Tantalum, Aluminum Oxide, Quartz, Borom Nitride et Carbon.

PHOTONEXPORT CAN PROVIDE YOUR CUSTOM EVAPORATION SOURCE ACCORDING TO YOUR SPECIFICATIONS. BUT ALSO STANDARD SOURCES ACCORDING TO THE FOLLOWING BRANDS: TELEMARK/TEMESCAL, EDWARDS, EB3, BALZERS, KURT J. LESKER, FERROTEC, VARIAN, MDC ET THERMIONICS

Custom made Evaporation Sources
send us your specification **info@photonexport.com**
quote in less than 24

EVAPORATION MATERIALS

Evaporation materials are available in stock or made to order in the following shapes:

Chunk - Foil - Pellet - Wire - Rod - Shot - Slug - Starter Sources &Cones
Evaporation boats - Crucibles liners

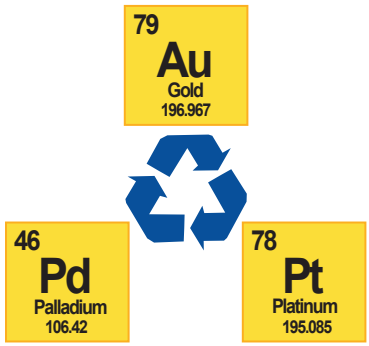
Quality:
Manufacture process undergoes quality inspections in all stages. 100% of our **targets & Evaporation Materials** go through a final composition, shape and size Lab analysis. The Inspection & Analysis Certificate is shipped with the targets.

Send us your material specification to get a quote and we will come back you in less than 24 hours.

BONDING SERVICES:
To avoid cracking or warping of the sputtering target caused bye inadequate cooling it is recommended to bond the target to an adequate backing plate. Thermal and mechanical integrity of the bond between the backing plate and the sputtering target is critical in order to provide optimal sputtering performance. PhotonExport offers both metallic bonding and elastomer bonding services.

RECYCLING SPUTTERING TARGETS SERVICES:
We recycle, process, refine & reclaim mostly all kinds of Sputtering Targets in all grades & shapes, used, unused, spent or full.

Most common are Precious metal like Gold, Platinum, Palladium.
We also recycle your used back panels and subtrate tube.
Au, Pt, Pd,Au/Pd target recycling special offer.
Zn, Pt, W, Tªare, commun materials that can be recovered.



PhotonExport

Specialist in thin films and nano-technology supplies

www.photonexport.com

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Certification

PhotonExport
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