

元素週期表 Periodic Table of Elements

1 H Hydrogen 1.008																	2 He Helium 4.003	
3 Li Lithium 6.941	4 Be Beryllium 9.012																	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305																	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80	
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.24	41 Nb Niobium 92.906	42 Mo Molybdenum 95.54	43 Tc Technetium 98	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29	
55 Cs Cesium 132.91	56 Ba Barium 137.33	71 Lu Lutetium 174.97	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222	
87 Fr Francium 1.008	88 Ra Radium 226	103 Lr Lawrencium 262	104 Rf Rutherfordium 261	105 Db Dubnium 262	106 Sg Seaborgium 266	107 Bh Bohrium 264	108 Hs Hassium 269	109 Mt Meitnerium 268	110 Ds Darmstadtium 281	111 Rg Roentgenium 272	112 Cn Copernicium 285.18	113 Nh Nihonium 286.18	114 Fl Flerovium 289.19	115 Mc Moscovium 290.20	116 Lv Livermorium 293.20	117 Ts Tennessine 293.21	118 Og Oganesson 294.21	

元素編號 — 符號 — 原子量

1 **H** 氫
Hydrogen
1.008

中文 — 英文

金屬

- 鹼金屬
- 鹼土金屬
- 過渡金屬
- 錒系元素
- 錒系元素
- 其他金屬

非金屬

- 氫氣
- 半金屬
- 非金屬
- 鹵素
- 惰性氣體

HIGH QUALITY PVD MATERIALS

- Sputtering Targets
- Target Bonding
- Crucible Liners
- Backing Plates
- Evaporation Materials

57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium 145	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04
89 Ac Actinium 227	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 251	99 Es Einsteinium 252	100 Fm Fermium 257	101 Md Mendelevium 258	102 No Nobelium 259

薄膜蒸鍍參考指南

Thin Film Evaporation Guide

Material	Sym.	Melt. Point °C	Density (bulk, g/cm ³)	Z-ratio	Temperature °C @ Vapor Pressure (Torr)			Evaporation Method	Crucible Liner	Remarks
					10 ⁸	10 ⁶	10 ⁴			
Aluminum	Al	660	2.7	1.08	677	821	1010	eBeam (XInt)	TiB ₂ -TiC, TiB ₂ -BN, graphite, BN	High deposition rates possible. Al wets IMCS.
Copper	Cu	1083	8.92	0.437	727	857	1017	eBeam (XInt)	Al ₂ O ₃ , Mo Ta, graphite	Poor adhesion on most substrates. Use thin adhesion layer of Cr/Ti.
Germanium	Ge	937	5.35	0.516	812	957	1167	eBeam (XInt)	Al ₂ O ₃ , quartz, graphite, Ni	Uniform films achieved with slow power ramp and swept beam.
Gold	Au	1062	19.32	0.381	807	947	1132	eBeam (XInt)	W, Al ₂ O ₃ , graphite, BN	Metal spitting can be an issue. Mitigate by slow power ramp with swept beam and low carbon content in source material.
Hafnium Oxide	HfO ₂	2812	9.68	—	—	—	~2500	eBeam (fair)	graphite, W	Can be fabricated by reactive evaporation in O ₂ or using bulk source material. Post process annealing at 500°C improves film quality.
Indium Tin Oxide/ ITO	In ₂ O ₃ -SnO ₂	1800	6.43-7.14	—	—	—	—	eBeam (good)	graphite	Thin films have been produced from 90% In ₂ O ₃ -10%SnO ₂ powder in O ₂ partial pressure. Substrate temperature of 250°C improves electrical conductivity of resulting films.
Iron	Fe	1535	7.86	0.349	858	998	1180	eBeam (XInt)	Al ₂ O ₃ , BeO, graphite	Molten Fe will attack and adhere to graphite, severely limiting crucible liner life.
Magnesium	Mg	651	1.74	—	185	247	327	eBeam (good)	W, graphite, Al ₂ O ₃	Powder is flammable. High deposition rates are possible.
Molybdenum	Mo	2610	10.22	—	1592	1822	2117	eBeam (XInt)	graphite, W	Films are smooth, hard and adherent.
Nickel	Ni	1453	8.91	0.331	927	1072	1262	eBeam (XInt)	Al ₂ O ₃ , BeO, W, graphite	Differential thermal expansion between Ni and graphite can cause graphite crucible liners to crack on cooling.
Niobium	Nb	2468	8.55	—	1728	1977	2287	eBeam (XInt)	Graphite	Ion assisted eBeam evaporation modifies Nb film stress from tensile to compressive at a substrate temperature of 400°C.
Palladium	Pd	1550	12.4	—	—	—	1192	eBeam (XInt)	W, Al ₂ O ₃ , graphite	Susceptible to metal spitting. Mitigate with slow power ramp and longer soak before deposition.
Platinum	Pt	1769	21.45	0.245	1292	1492	1747	eBeam (XInt)	W, Al ₂ O ₃ , graphite	Low deposition rates (< 5 Å/sec) preferred for film uniformity. Carbon contamination with graphite liners is possible at high power.
Silicon	Si	1410	2.42	0.712	992	1147	1337	eBeam (fair)	Ta, graphite, BeO	High deposition rates possible. Molten Si can attack graphite liners limiting crucible liner life.
Silver	Ag	961	10.49	0.529	847	958	1105	eBeam (XInt)	W, Al ₂ O ₃ , Ta, Mo, graphite	Swept beam during melt and focused beam during deposition is recommended for higher deposition rates.
Titanium	Ti	1675	4.5	0.628	1067	1235	1453	eBeam (XInt)	W, graphite, TiC	Films are very adherent to almost any substrate.
Yttrium	Y	1509	4.48	—	830	973	1157	eBeam (XInt)	W, Al ₂ O ₃	Substrate heating at 300°C improves adhesion and film smoothness.
Zinc	Zn	419	7.14	0.514	127	177	250	eBeam (XInt)	W, Al ₂ O ₃ , quartz, graphite	Evaporates well under a wide range of conditions.
Zirconium	Zr	1852	6.4	—	1477	1702	1987	eBeam (XInt)	W, quartz	Alloys with W. Thin films oxidize readily.

