

Molybdenum (Mo, TZM, ML)

Pure Molybdenum is used for example for high temperature heating elements, shielding, filaments, evaporation crucibles, rocket propulsions, radiation shields, X-ray anodes, welding electrodes, thermodes, coatings for wear protection, components and melting electrodes for glass fabrication, sputtering targets and others.

Significant Characteristics and Applications

High melting point, low vapor pressure
Good resistance and mechanical stability at high temperatures
Thermal shock resistant
Low thermal expansion
Application under vacuum or reducing atmosphere
Good corrosion resistance in liquid metals and glass melting

Titanium-Zirconium-Molybdenum (TZM)

TZM is a micro-alloyed Molybdenum with Titanium-Zirconium-Carbides (0.4-0.55 % Ti, 0.06-0.12 % Zr, 0.01-0.03 % C). By means of solid-solution and carbide-strengthening TZM features improved high temperature strength up to 1400 °C and a higher recrystallization temperature, compared to pure Molybdenum.

Typical Applications of TZM

Components for heat treatment equipment, supports, fixtures, carriers, hot runner nozzles, casting moulds, forging dies, welding electrodes and others.

Molybdenum-Lanthanum (ML)

Through doping with Lanthanum-oxide (typ. 0.2-0.7 weight-% La₂O₃) and a suitable production process an elongated grain structure with fine disperse La₂O₃-particles occurs. This structure has a higher recrystallization temperature and a good creep resistance. Depending on the semi-finished product, lanthanated Molybdenum components can be used for temperatures up to 1800 °C.

Typical Applications of ML

Heating elements, wires for lighting technology, sintering trays, hot-zone-components and others.

Physical Properties

Element Symbol	Mo
Atomic Number	42
Atomic Mass	95.94
Valency	2, 3, 4, 5, 6
Density (20 °C)	10.28 g/cm ³
Crystal Structure	body-centered cubic (bcc)
Melting Point	2623 °C
Boiling Point	4800 °C
Vapor Pressure	1 · 10 ⁻⁸ hPa (~1500 °C)
	1 · 10 ⁻⁵ hPa (~2000 °C)
Specific Electrical Resistivity	0.056 · 10 ⁻⁶ Ω · m (20 °C)
	0.301 · 10 ⁻⁶ Ω · m (1000 °C)
	0.452 · 10 ⁻⁶ Ω · m (1500 °C)
Coefficient of Thermal Expansion	5.2 · 10 ⁻⁶ K ⁻¹ (20 °C)
	5.8 · 10 ⁻⁶ K ⁻¹ (1000 °C)
Thermal Conductivity	142 W/m · K ⁻¹ (20 °C)
	105 W/m · K ⁻¹ (1000 °C)

Mechanical Properties

Hardness	200-400 HV (typ.)
E-Modulus	330 GPa (20 °C)
	280 GPa (800 °C)
G-Modulus	138 GPa (20 °C)
Yield Strength R _m	500-900 MPa (typ.)
Yield Strength R _{p0.2}	400-700 MPa (typ.)
Elongation A	5-20 % (typ.)

Material Types and Alloys

Mo 99.95 % (Type 360 – Unalloyed vacuum arc-cast)
Mo 99.96 % (Type 365 – Unalloyed vacuum arc-cast)
Mo 99.95 % (Type 361 – Unalloyed powder-metallurgical)
Titanium-Zirconium-Molybdenum (Type 363 Ti,Zr,C-alloyed vacuum arc-cast)
Titanium-Zirconium-Molybdenum (Type 364 Ti,Zr,C-alloyed powder-metallurgical)
MoW 30 (Type 366 vacuum arc-cast)
ML Molybdenum-Lanthanum (Lanthanum oxide doped)
MoRe 47.5, MoRe 44.5, MoRe 41
MoCu (Molybdenum-Copper)