

# Materials

## Molybdenum and TZM Alloy

Molybdenum, from the Greek Molybdaena, is provided in two basic forms, pure and TZM (Titanium Zirconium, Molybdenum). Both forms have high melting points (~2610 degrees C) and characteristics desirable for application to the semiconductor industry. Notably, both materials have good strength at high temperatures and, in controlled environments, can be conventionally machined at modest prices.

In selected applications, TZM will outperform pure molybdenum due to its higher recrystallization temperature—providing a harder surface at typical plasma source operating temperatures.

The chemical difference between TZM and pure molybdenum (>99.95%) is found in the percentage of its two alloying elements. Listed below are typical alloying values for TZM.

<u>Element</u>	<u>min</u>	<u>max</u>
Titanium	4000ppm	5500ppm
Zirconium	600ppm	1200ppm
Carbon	100ppm	400ppm
Molybdenum	99.25%	99.20%

Hydrogen, oxygen, and nitrogen are also considered to be dopants, but the alloying percentages are less important.

Although the ASTM specifications for TZM and molybdenum chemistries are generally met, each raw material supplier may have slightly different conformance rules and quality level. All TZM material should have approximately 0.5% Ti, 0.08% Zr, 0.025% C, and 99.25% Mo. Contact the [Electro-Graph Engineering Department](#) for a more detailed review of individual needs.

<u>Element</u>	<u>Pure Molybdenum</u>	<u>TZM</u>
Carbon	100ppm max	400ppm max
Oxygen	70ppm max	300ppm max
Nitrogen	20ppm max	20ppm max
Iron	10ppm max	10ppm max
Nickel	5ppm max	5ppm max
Titanium	...	5500ppm max
Tungsten	300ppm max	300ppm max
Zirconium	...	1200ppm max
Molybdenum	balance	balance

Typical applications: Pure molybdenum – General purpose arc chamber components; TZM – Select high arc current apertures

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