PLANSEE

Engineering the future of fusion:
The crucial role of refractory metals

2025 Industry Day at DIII-D National Fusion Facility, Nov. 14, 2025

Dr. Arno Plankensteiner, Director Corporate Research Plansee HPM

Plansee SE, Reutte, Austria

“Our metals drive machines, bring light into our homes, transmit words and images over long distances and perform thousands of other useful and important services.”

Paul Schwarzkopf

Founder of Metallwerk Plansee Ges.m.b.H.

Key facts about Plansee

Plansee is the world's leading manufacturer of tungsten and molybdenum components.

Held since 1952, the **Plansee Seminar** brings together experts from the refractory metals and carbides industry every four years

Over **150 international R&D experts** develop customized solutions in close collaboration with customers and academic partners

Our **accredited laboratories** ensure top quality through advanced analytics, from raw materials to finished products.

We source **100% of 3TG** (tin, tungsten, tantalum and gold) materials from **certified conflict-free smelters**

3

Production sites in the US

PLANSEE

Mi Tech TUNGSTEN Metals LLC

GTP

Strong Materials

42	95.94
Mo	
Molybdenum	

74	183.84
W	
Tungsten	

Heat resistance, dimensional stability, and high strength

Good electrical and thermal conductivity

Low coefficient of thermal expansion

High corrosion resistance

Shielding of X-ray- and gamma radiation

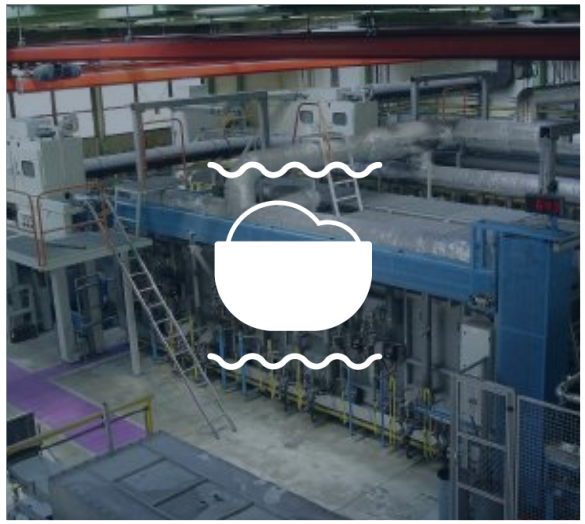
Tungsten – Properties, Grades

	42 95.94 Mo Molybdenum	74 183.84 W Tungsten
Melting point [°C]	2620	3420
Boiling point [°C]	4639	5555
Density [g/cm³]	10.22	19.25
Coefficient of thermal expansion [10^{-6}/K]	5.2	4.4
Thermal conductivity [W/(m K)]	142.0	164.0
Electrical conductivity [m/(Ω mm²)]	17.9	18.2
Specific heat [J/(g K)]	0.25	0.13
Sonic speed [m/s]	Long: 6250 Trans: 3350	Long: 5180 Trans: 2870
Young´s-modulus(1) [GPa]	320	405
Magnetic permeability	Paramagnetic material (μ ≈ 1)	

Material designation		**Chemical composition** (percent by weight)
W (pure)		> 99.97% W
W-UHP (ultra-pure)		> 99.999% W
WVM		30–70 µg/g K
WVMW		15–40 µg/g K
WL	WL05 WL10	0.5% La_2O_3 1.0% La_2O_3
WC20		2.0% CeO_2
WRe	WRe05 WRe26	5.0% Re 26.0% Re
WCu*		10–40% Cu
W heavy metal* alloy with a high density	Densimet® Inermet® Denal®	1.5%–10% Ni, Fe, Mo 5%–10% Ni, Cu 2.5%–10% Ni, Fe, Co

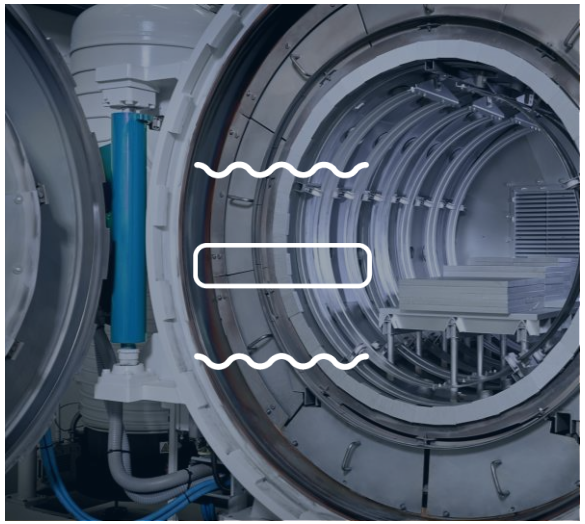
From raw material to the finished product

Our production process – *Excerpt* in view of fusion



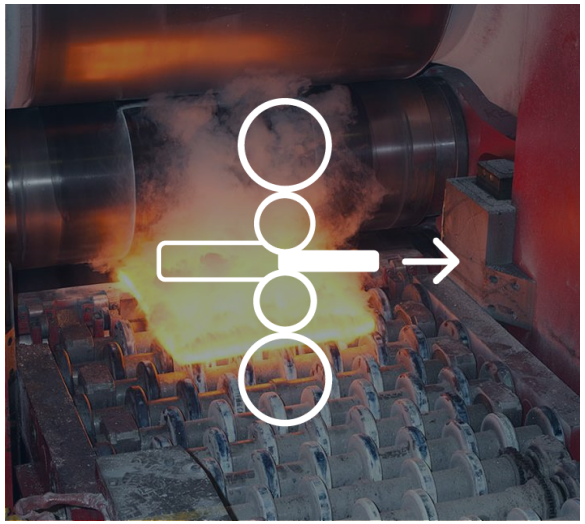
Powder production

- Starting w/ ore concentrates and oxidic powders
- Reduction to metal powders
- Homogenization, blending
- Powder compaction (up to ingot sizes of Ø1.5m x 2.0m)



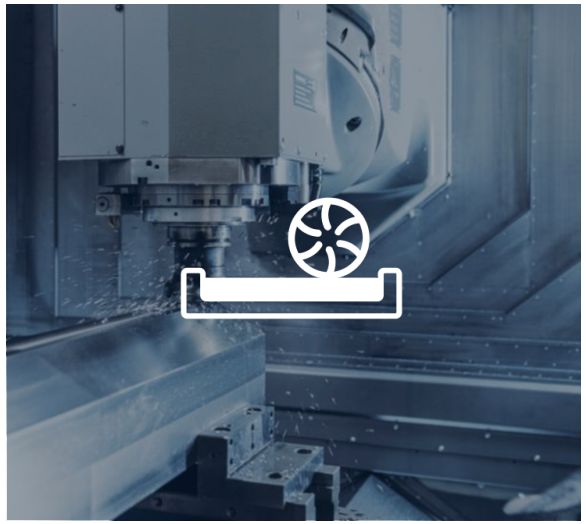
Sintering

- Sintering in H_2 or vacuum
- Ingot masses up to 3.5to (Mo) or 2.0to (W)
- H_2 production via steam reforming and electrolysis
- Alternatives: SPS, HP, HIP



Forming

- Rolling mills (F_{max} < 50000kN)
- Radial forgers (F_{max} < 6000kN)
- Screw presses (F_{max} < 30000kN)
- Wire drawing
- Cold rolling mills



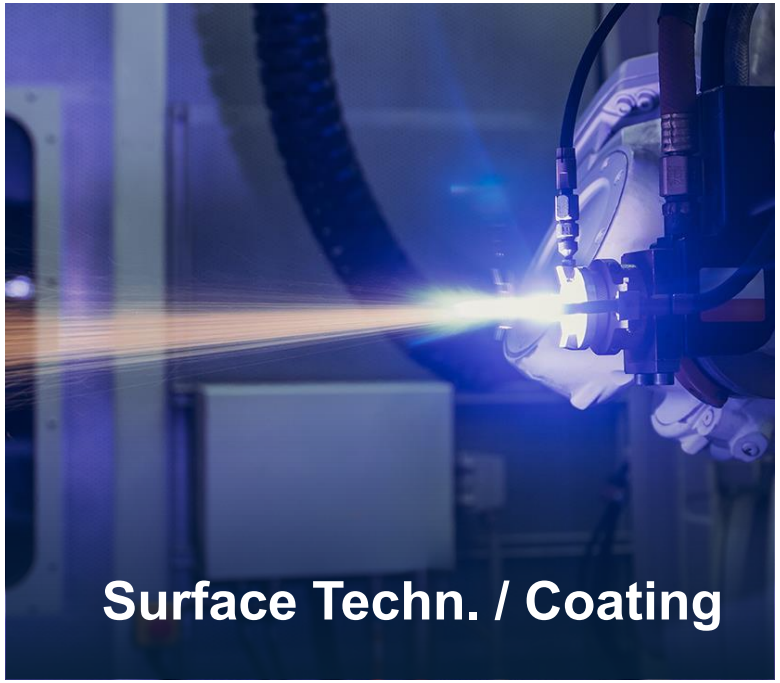
Machining / Surface techn.

- CNC milling and turning centers (< 2.0 x 2.0 x 1.0 m^3, < Ø0.5m x 1.7m)
- EDM, die sinking
- Deep drawing
- Lapping, e-polishing, pickling

Strong on expertise, strong on technologies

Joining

- Welding – under protective atmosphere via LBW and TIG
- Welding – filler assisted welding with TZM-, MoRe-, MoC-fillers
- Brazing (800°C-2000°C) with Al-, Cu-, Ni-, Ag-, Au-, Pd-, Pt-brazing alloys



Surface Techn. / Coating

- PVD (magnetron sputtering, Arc-PVD)
- Galvanic coatings
- CGS for consolidation of multiphase-materials and thick coatings
- APS, VPS

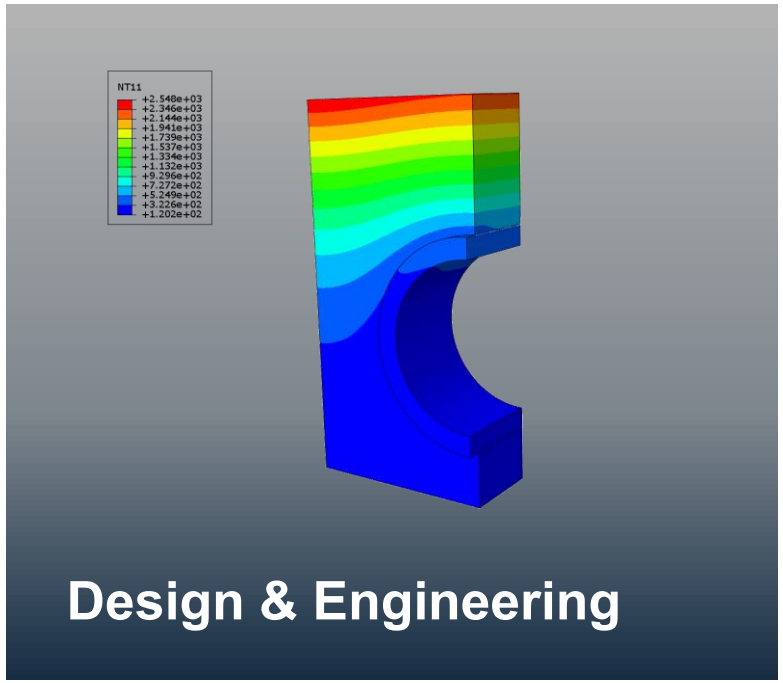
Additive Manufacturing

- Mo and W: Beam-based (LPBF, micro-doping for >99% density)
- WHA: Sinter-based methods (div. methods, fully dense, properties of sintered materials)
- AM-specific design process and QA

Strong on expertise, strong on quality and innovation

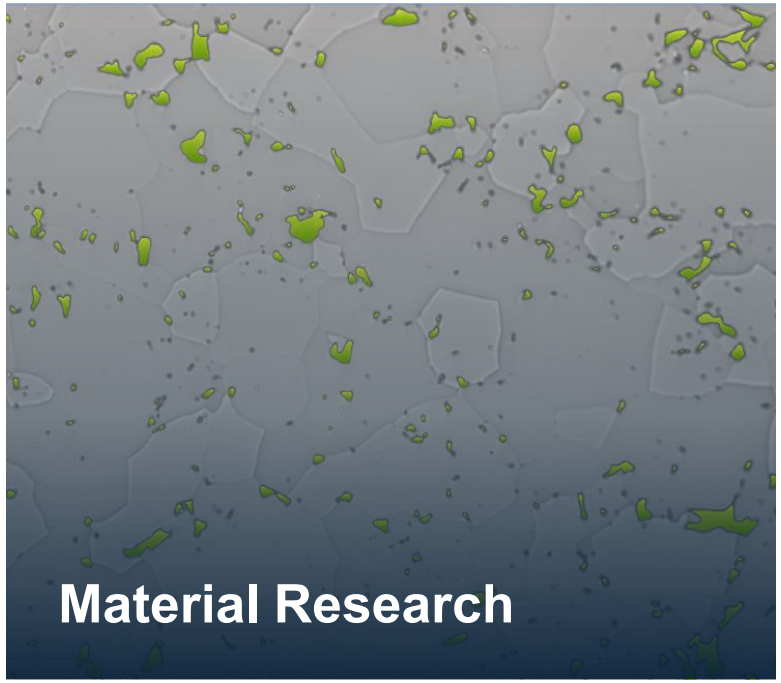
Laboratory

- Fully equipped labs. on latest stage of technology:
- EN ISO/IEC 17025 and 17020 certif.
- Chemical analysis
- Powder competence center
- Metal-physical lab.
- Mechanical-techn. lab.
- Non-destructive testing lab.



Design & Engineering

- Department for computational methods:
- FEM, CFD, DEM, MD
- Multi-physics simulations
- Machine learning
- APP programing



Material Research

- Research aiming at improving properties of RM bridging length scales from µm (microstructure) to m (manufacturing, applications), e.g.:
- Micro-doping for RT-ductility
- Alloying (with Re, Ta, …) for strength
- RM-based High Entropy Alloys (HEA) with superior properties

PLANSEE

Strong Metals. Strong Goals.

www.plansee.com

Let´s cooperate!

DI Dr. Arno Plankensteiner
Director Corporate Research Plansee
6600 Reutte, Austria
Tel.: +43 5627 600 2229
Mobile: +43 664 8152563
ap@plansee.com