AMAZEMET

FREEDOM IN MATERIALS DESIGN

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ULTRASONIC ATOMIZATION – PRINCIPLE

PROBLEM

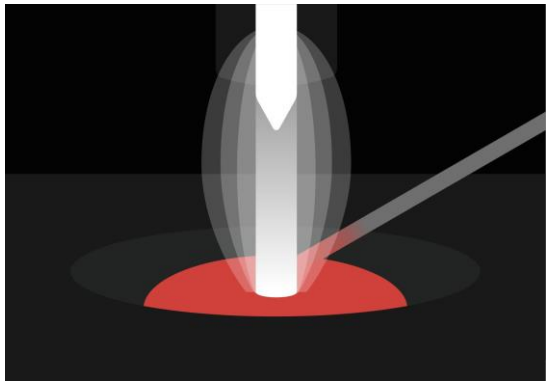
Gas atomizers are big and hard to use for R&D, other technologies require wire as a feedstock.

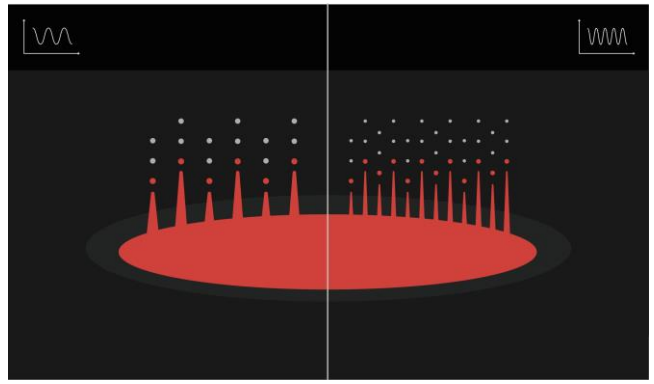
SOLUTION

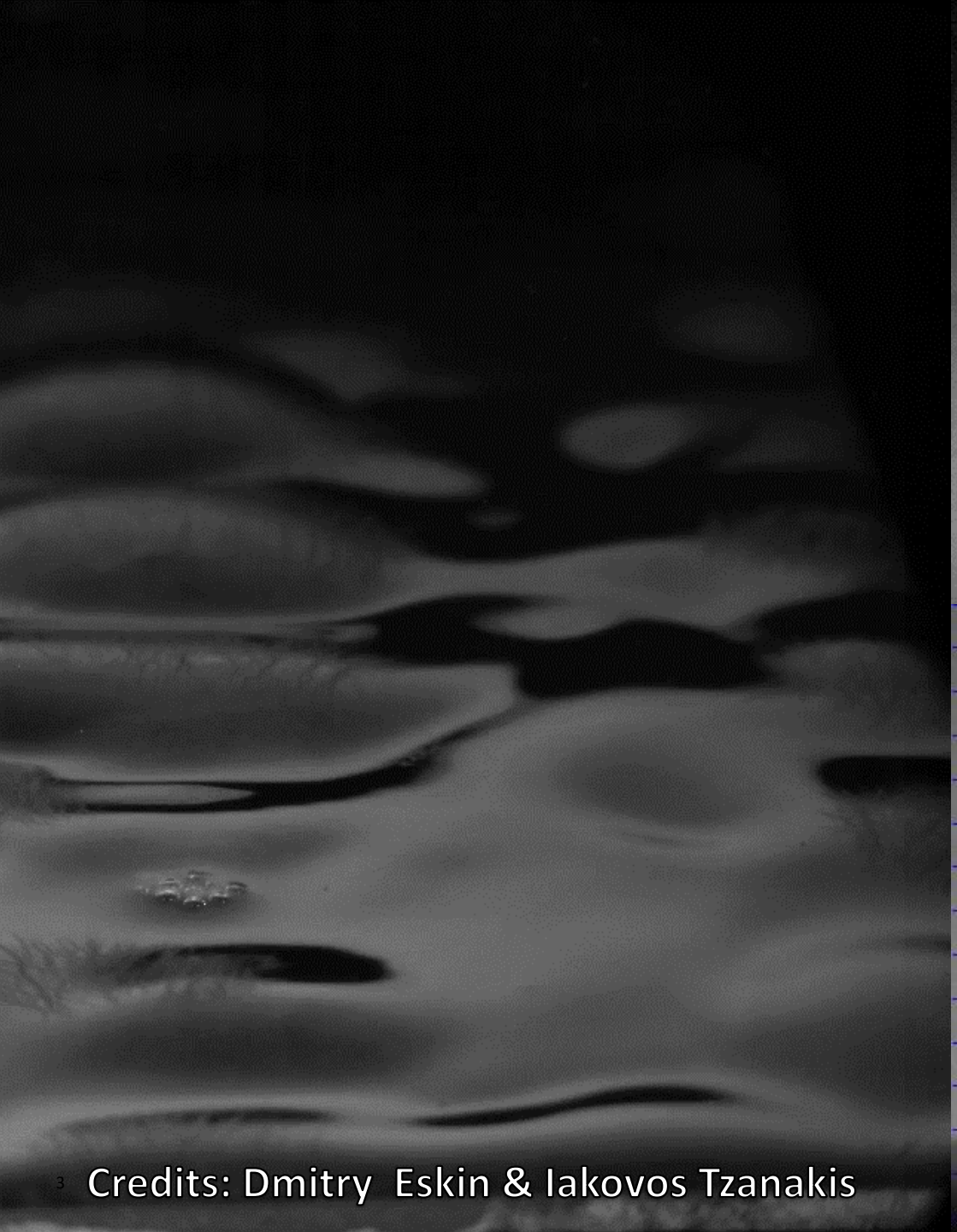
Ultrasonic atomization device allows the user to produce high-quality powder regardless of the initial form of the feed material.

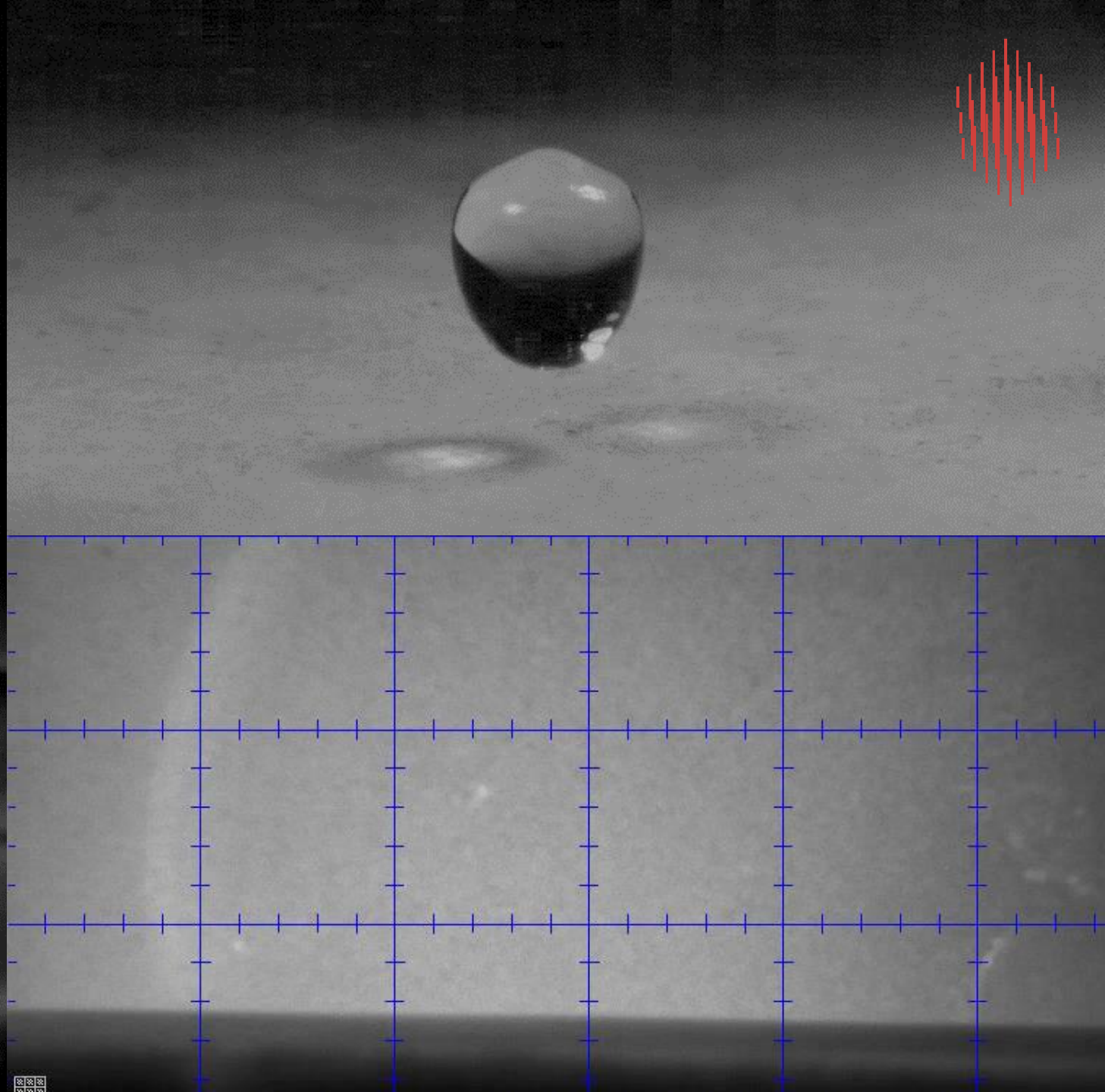
PHYSICS

Instead of high-velocity gas we use ultrasonic vibration to create AM-grade powder. Depending on material processed it is melted in the crucible and poured at vibrating element or melted directly at the sonotrode. Lack of pressurized gas allows for system miniaturization.



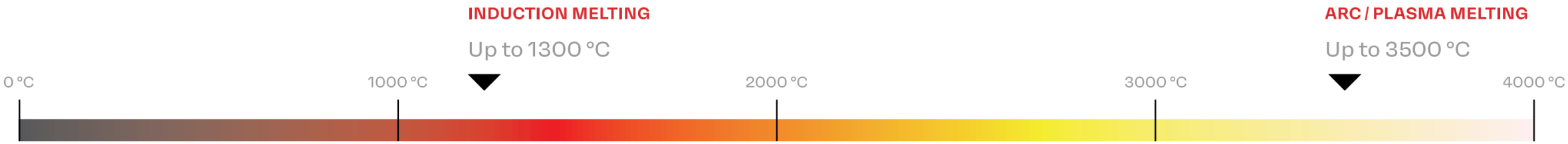


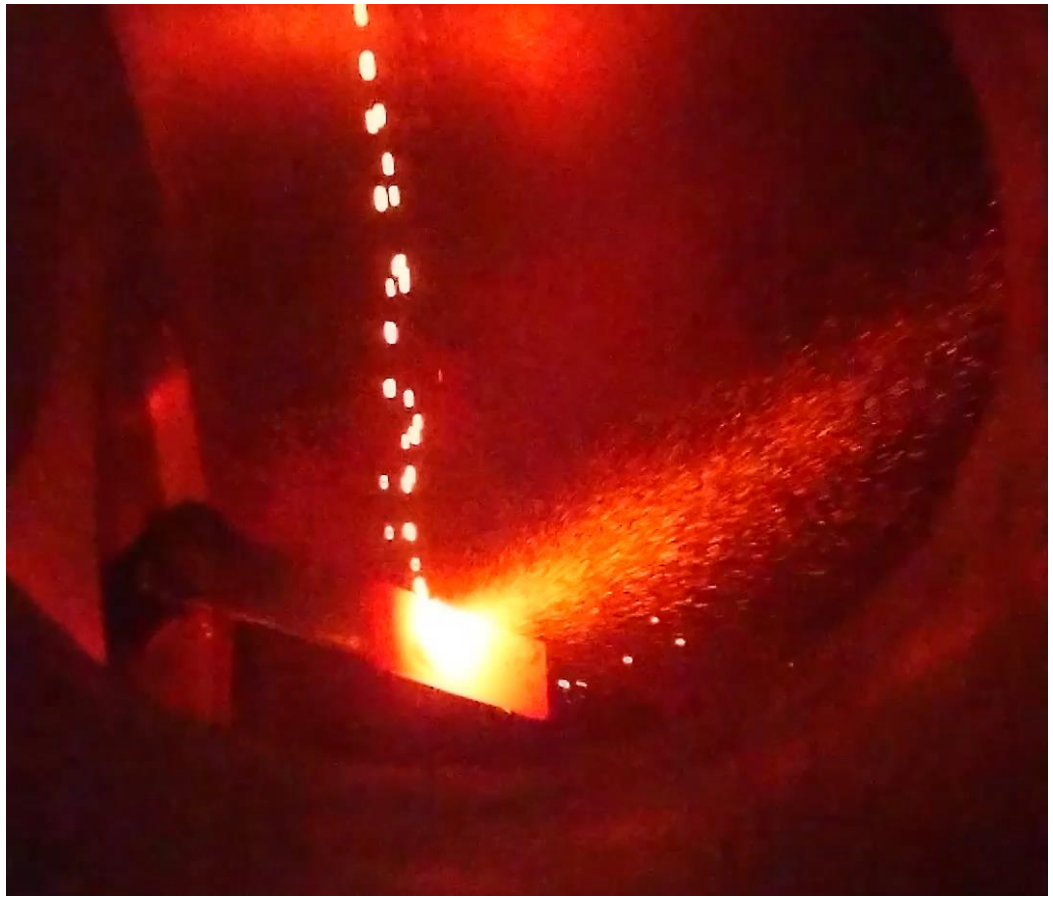


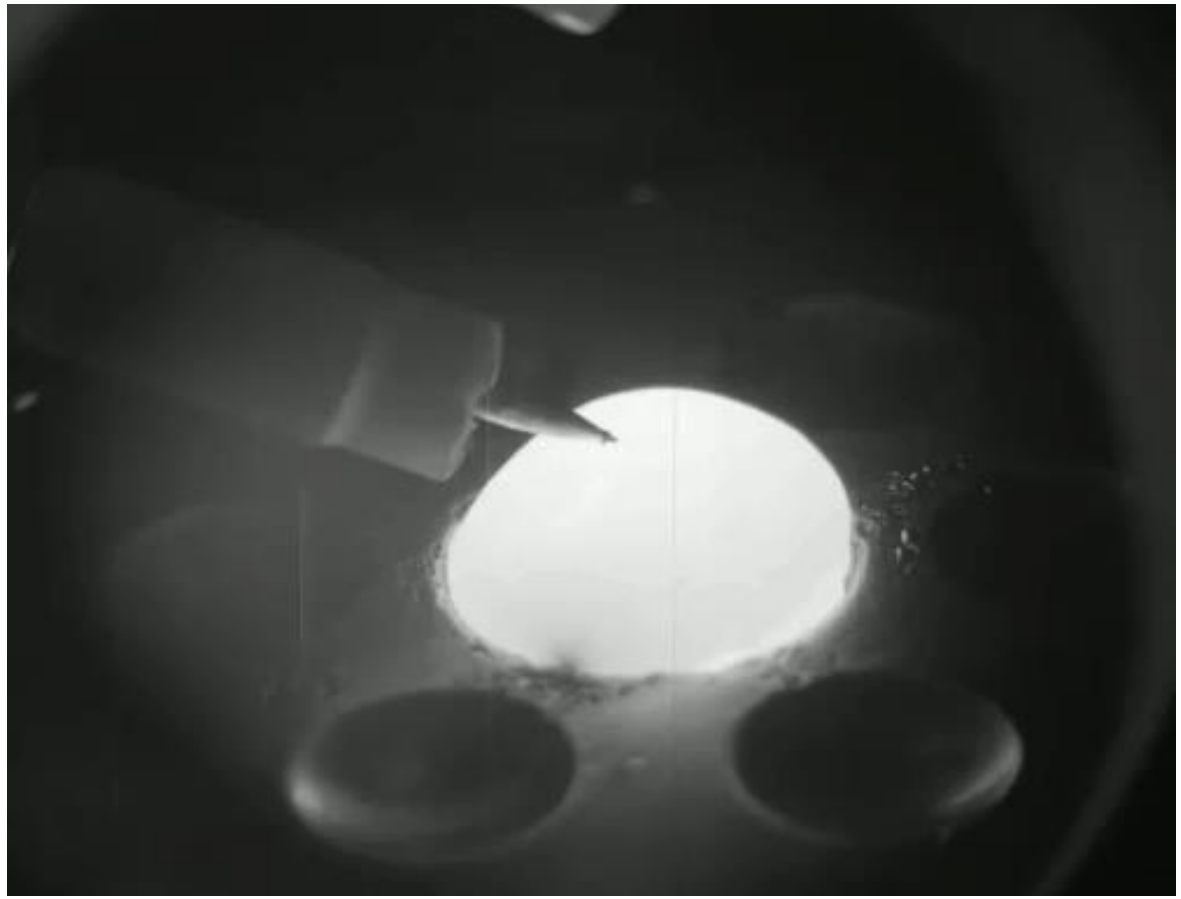


Credits: Dmitry Eskin & Iakovos Tzanakis

ULTRASONIC ATOMIZATION

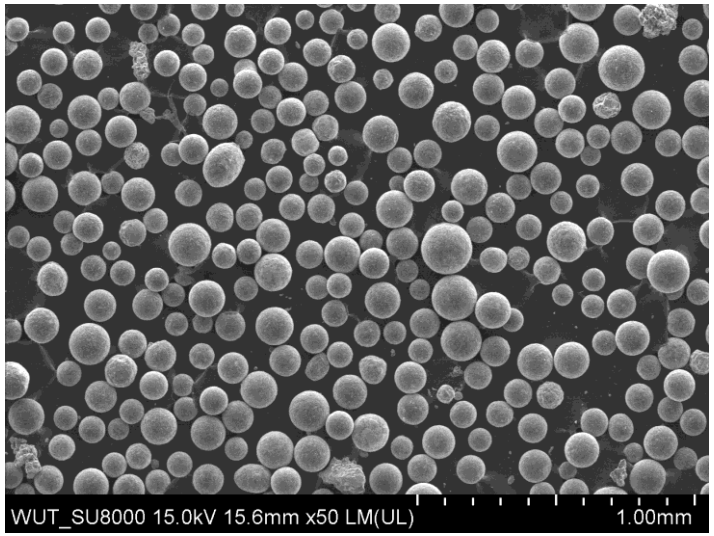




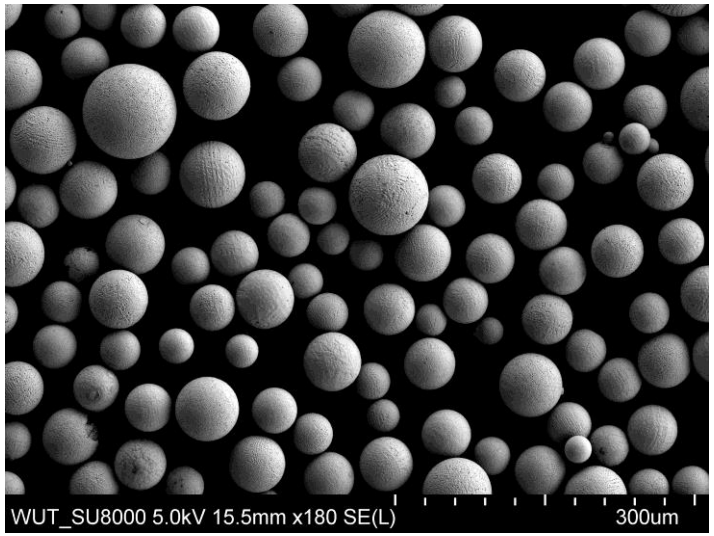


POWDER – ALWAYS SPHERICAL

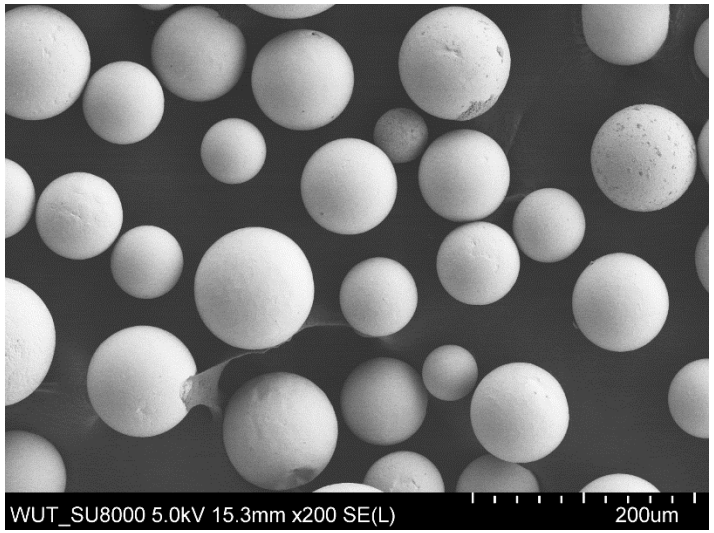
Powder atomization within 3000 K melting point range!



Mg-Li

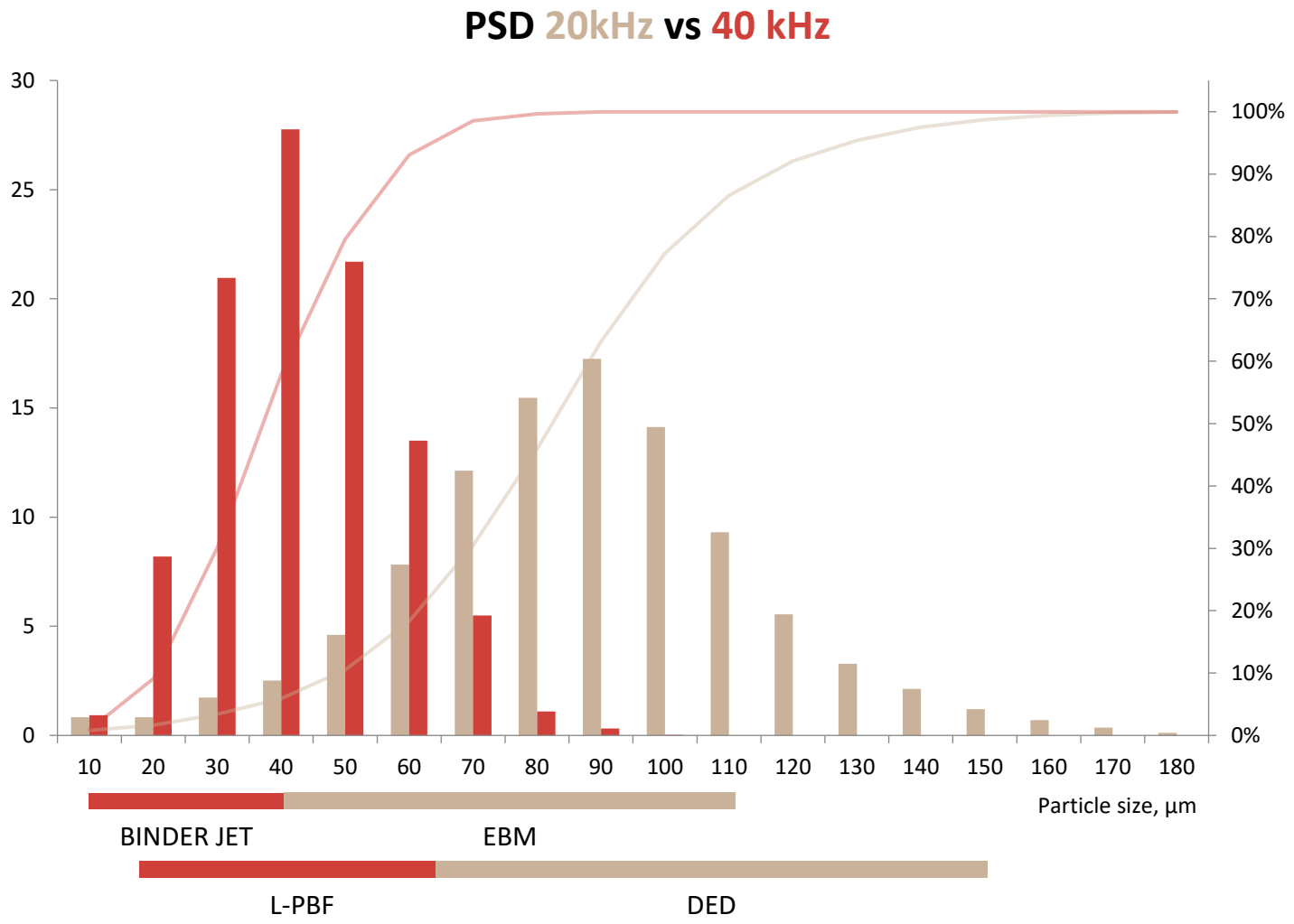


CuSn6



WTaVTi

FREQEUNCY VS PARTICLE SIZE



- **20 kHz** is most suitable for Electron Beam Melting (EBM) and Directed Energy Deposition (DED). The PSD of powders manufactured using this frequency has a d50 of 60–100 µm, depending on the atomized material.

- **40 kHz** is most suitable for laser based (L-PBF). The PSD of powders manufactured using this frequency has a d50 of 45–60 µm, depending on the atomized material

POWDER CHARACTERISTICS – SOFT MAGNETIC ALLOY

C. I.	Flow character	Hausner ratio
<10	Excellent	1.00-1.11
11-15	Good	1.12-1.18
16-20	Fair	1.19-1.25
21-25	Passable	1.26-1.34
26-31	Poor	1.35-1.45
32-37	Very poor	1.46-1.59
>38	Very, very poor	>1.60

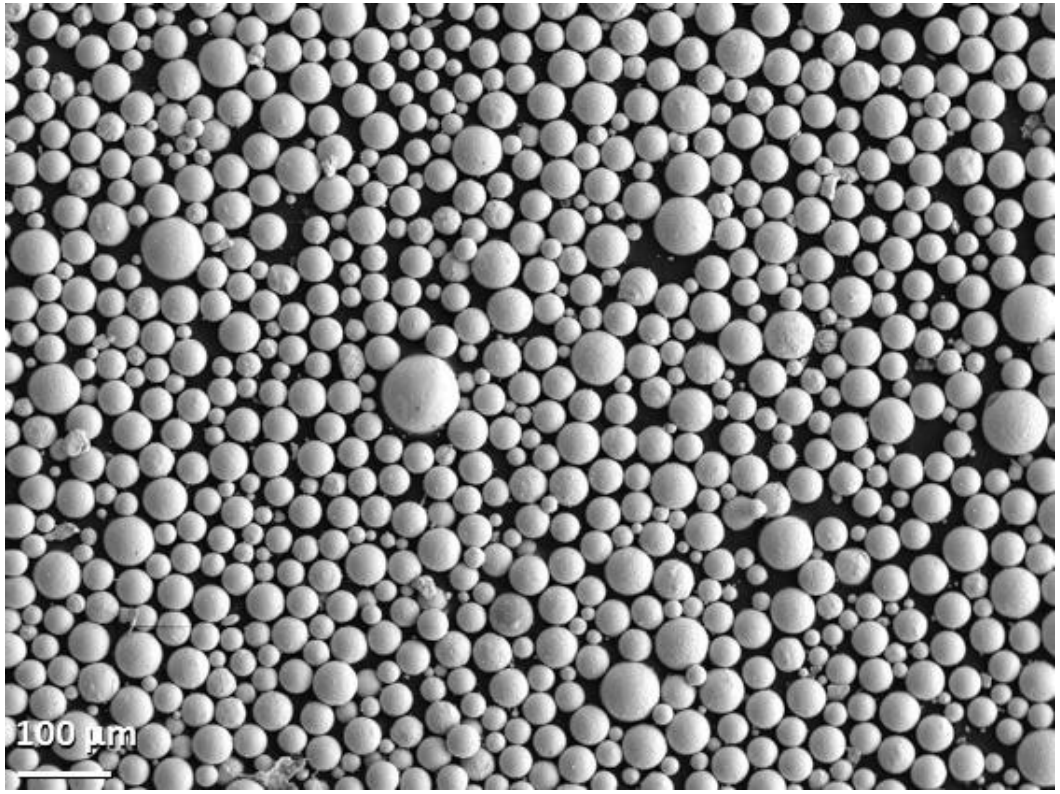
$$\text{Hausner ratio} = \frac{D_t}{D_a}$$

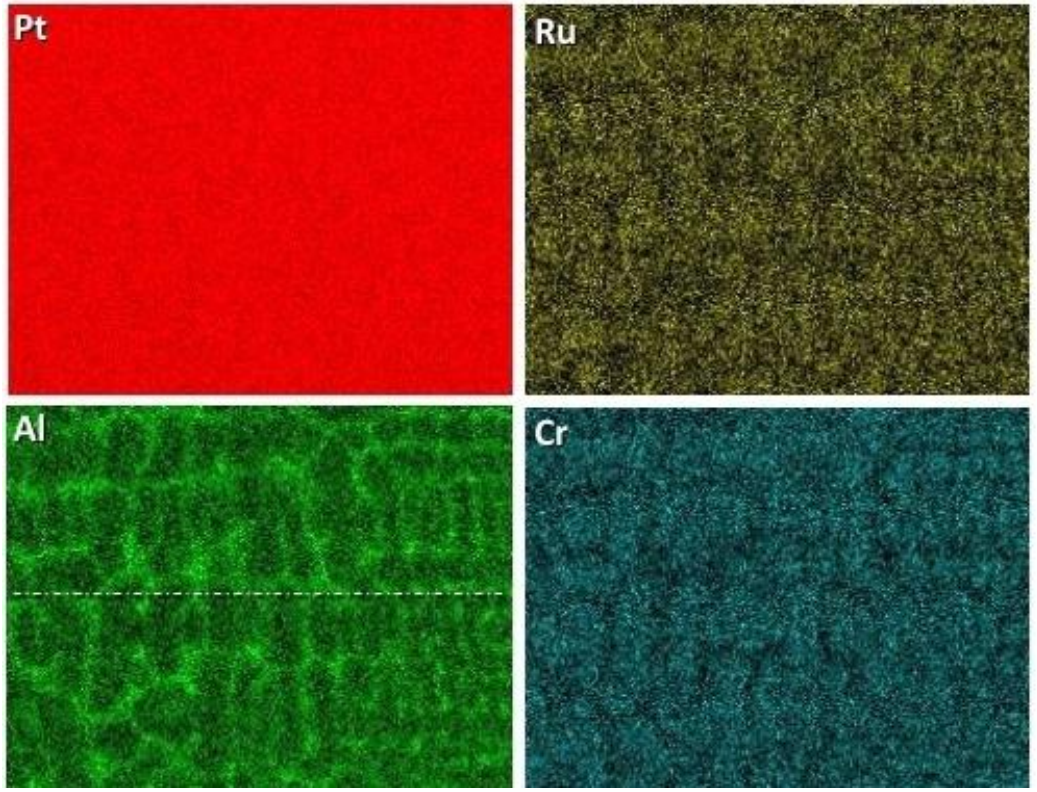
$$\text{C. I.} = \frac{D_t - D_a}{D_t}$$

Powder flowability (g/s)	Tapped density (g/cm3)	Hausner ratio	C. I
2.98	4.2	1.02	2.45

*Apparent density = 4.09 g/cm3

APPLICATION: Pt84-Al11-Cr3-Ru2 SUPERALLOY

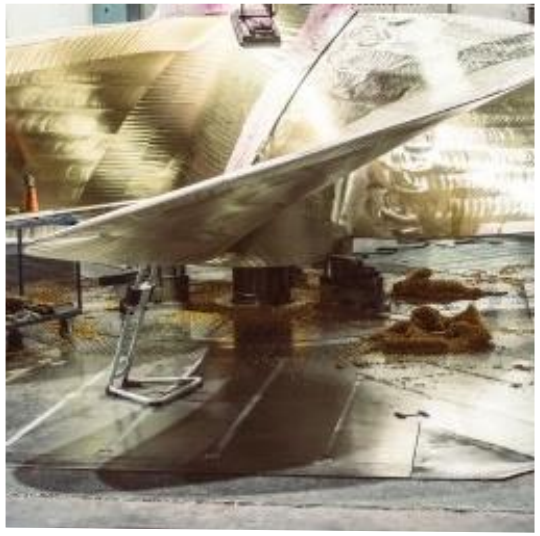




Dv (10)	23.0
Dv (50)	54.2
Dv (90)	475

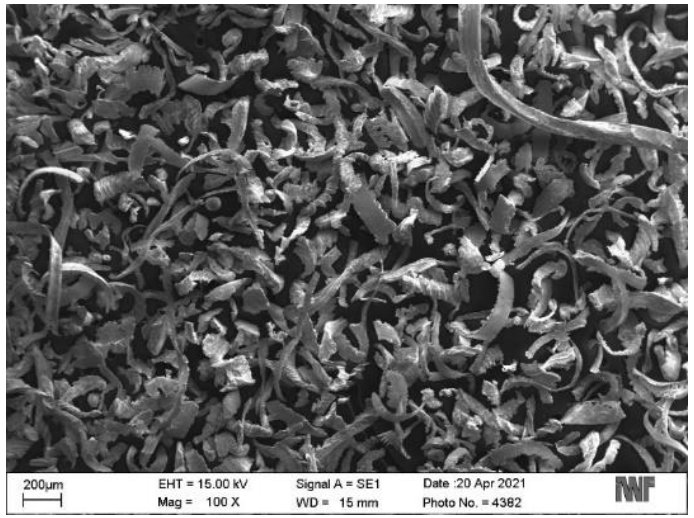
In cooperation with Advanced Materials Division, Mintek, Randburg, South Africa, and Department of Materials Science and Metallurgical Engineering, University of Pretoria, South Africa.

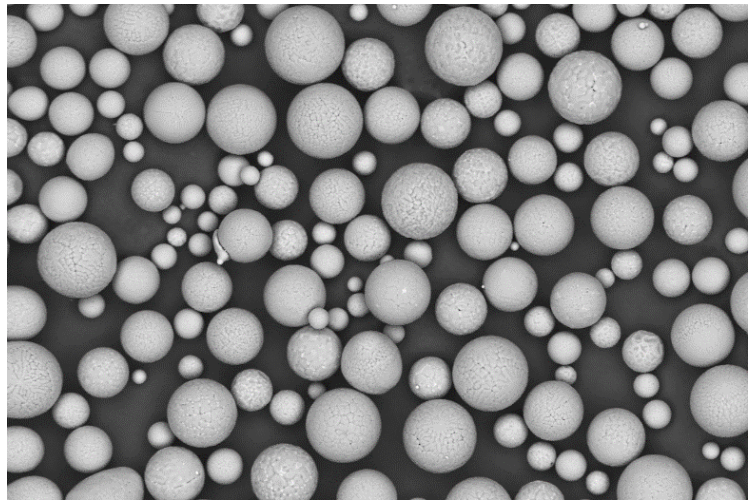
APPLICATION: CuAlFe ALLOY RECYCLING



In cooperation with Mecklenburger Metalguss GmbH (MMG propellers), Germany and Fraunhofer IPK, Berlin, Germany

APPLICATION: CuAlFe ALLOY RECYCLING

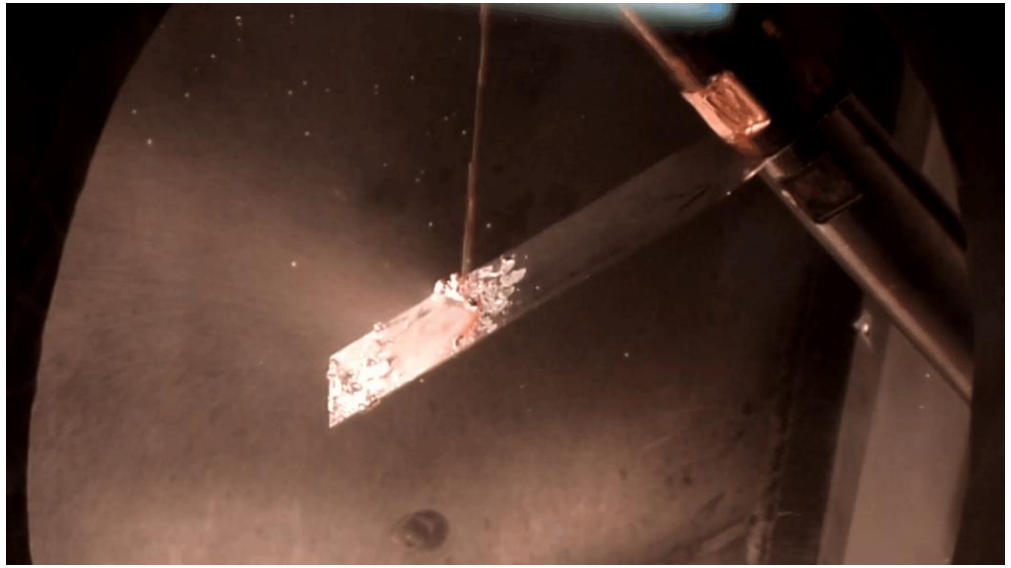




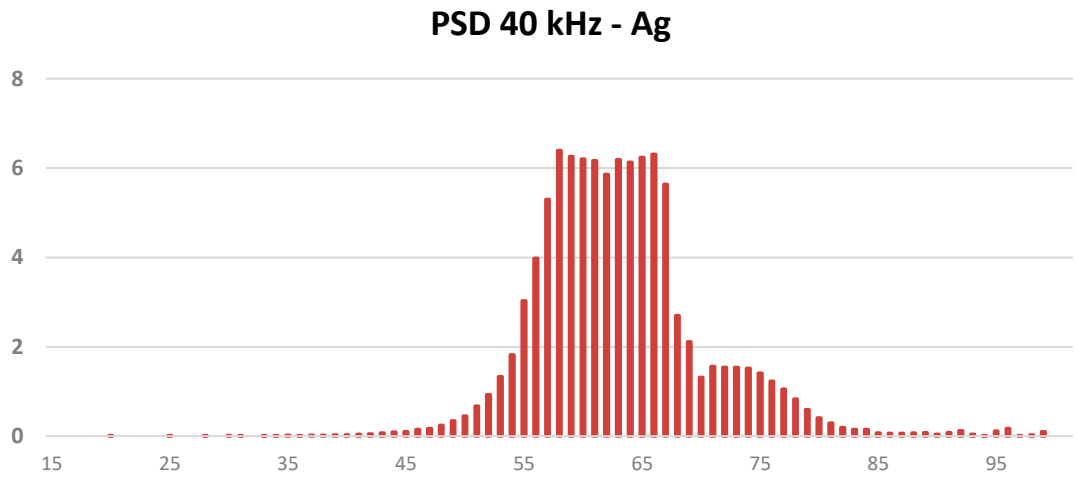
	d_{10}	d_{50}	d_{90}	$b/l\ mean$	$b/l \geq 0.9$	Carney flow rate	Bulk density	Tap density	Hausner ratio	Oxygen content
	[µm]	[µm]	[µm]	[-]	[%]	[s/150g]	[g/cm3]	[g/cm3]	[-]	[%]
Ultrasonic	45	96	179	0.92	82	8.6	4.67	4.90	1.05	0.0125
Reference	44	92	133	0.84	43	10.5	3.97	4.44	1.12	0.0196

In cooperation with Mecklenburger Metalguss GmbH (MMG propellers), Germany and Fraunhofer IPK, Berlin, Germany

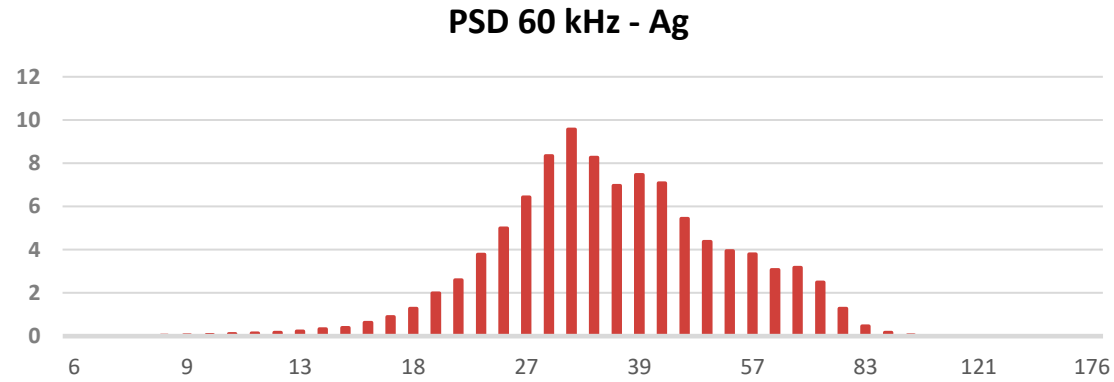
SILVER ATOMIZATION



In cooperation with Indutherm and KAMI

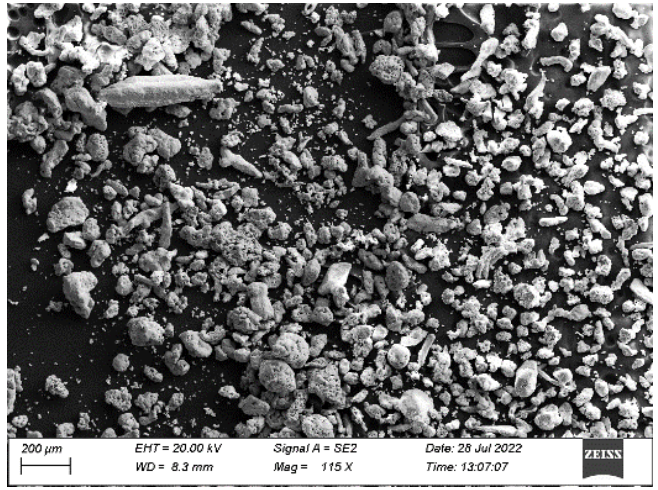


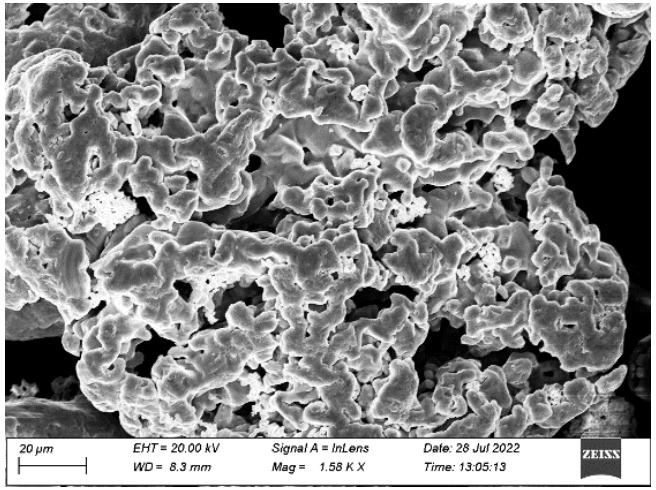
d10 = 33,74 µm; d50 = 56,91 µm; d90 = 123,23 µm, sphericity 0,9693



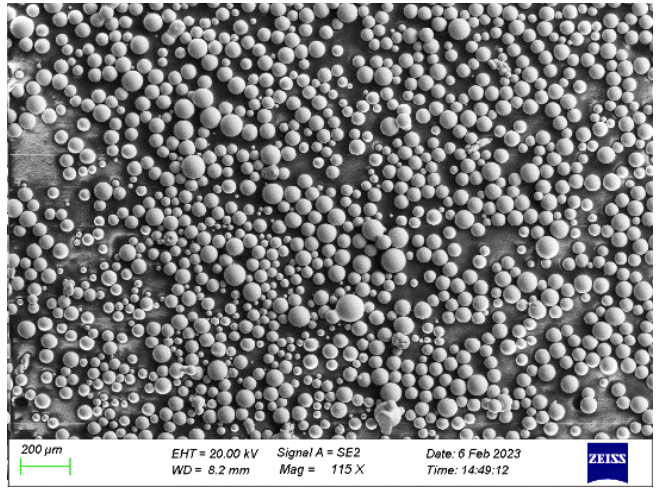
d10 = 23,46 µm; d50 = 36 µm; d90 = 62,12 µm, sphericity 0,9705

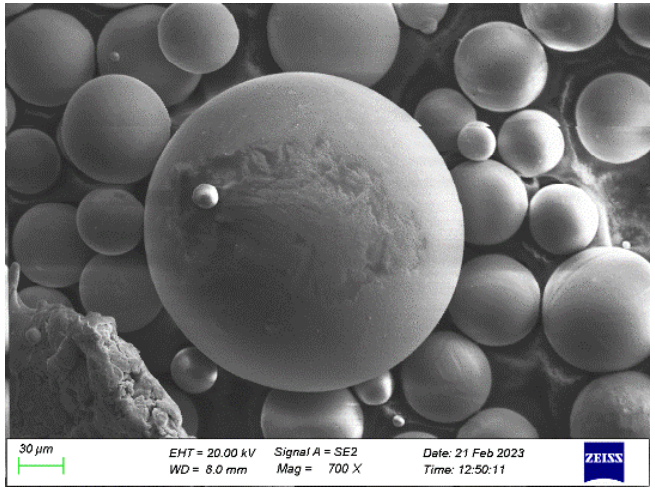
ATOMIZATION OF TI-6TA-1.5ZR-0.2RU-5CU





BLEND OF ELEMENTAL POWDERS

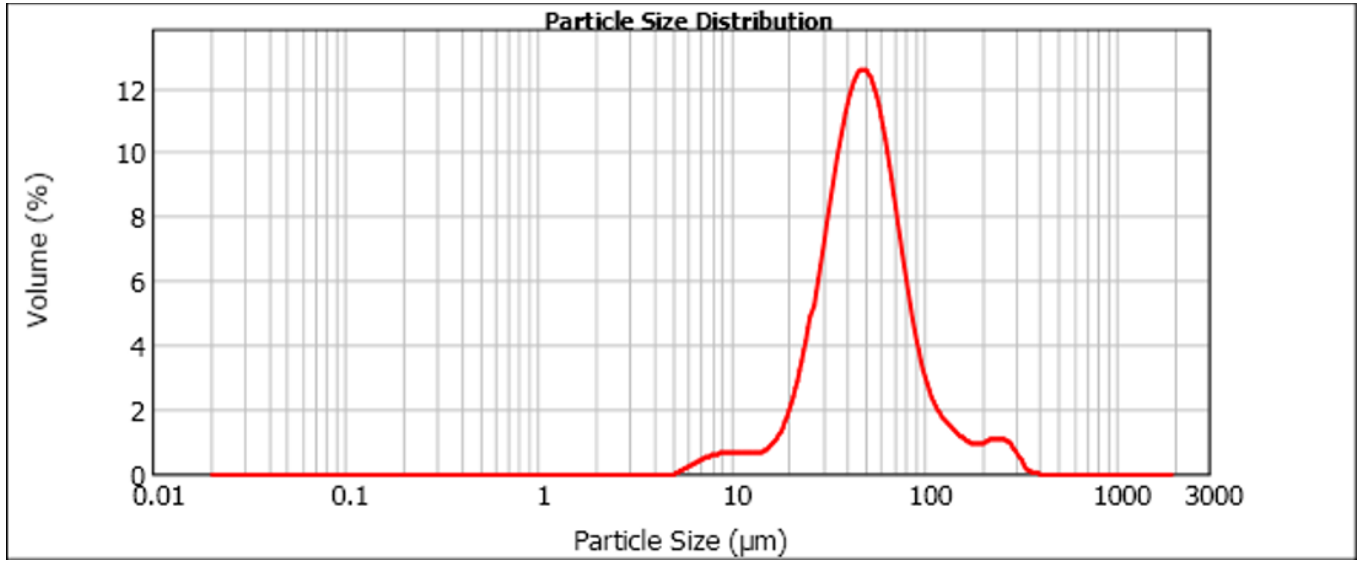




ALLOYED POWDER AFTER US

In cooperation with School of Chemical and Metallurgical Engineering and DSI-NRF CoE in Strong Materials, University of the Witwatersrand, South Africa

ATOMIZATION OF TI-6TA-1.5ZR-0.2RU-5CU



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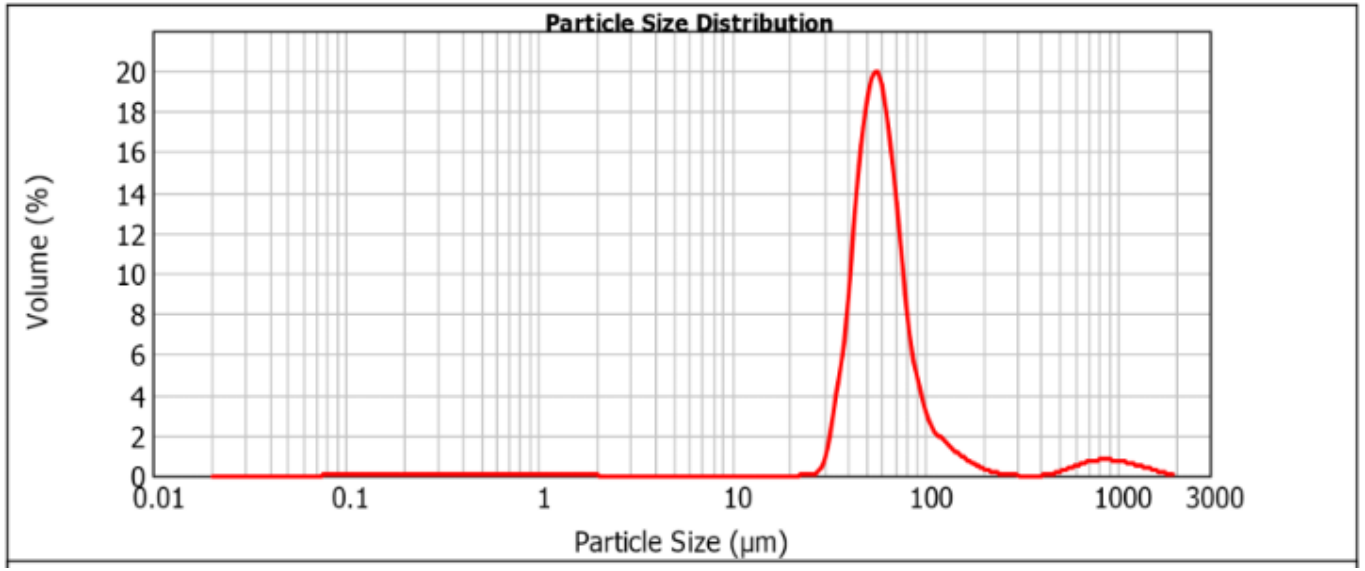

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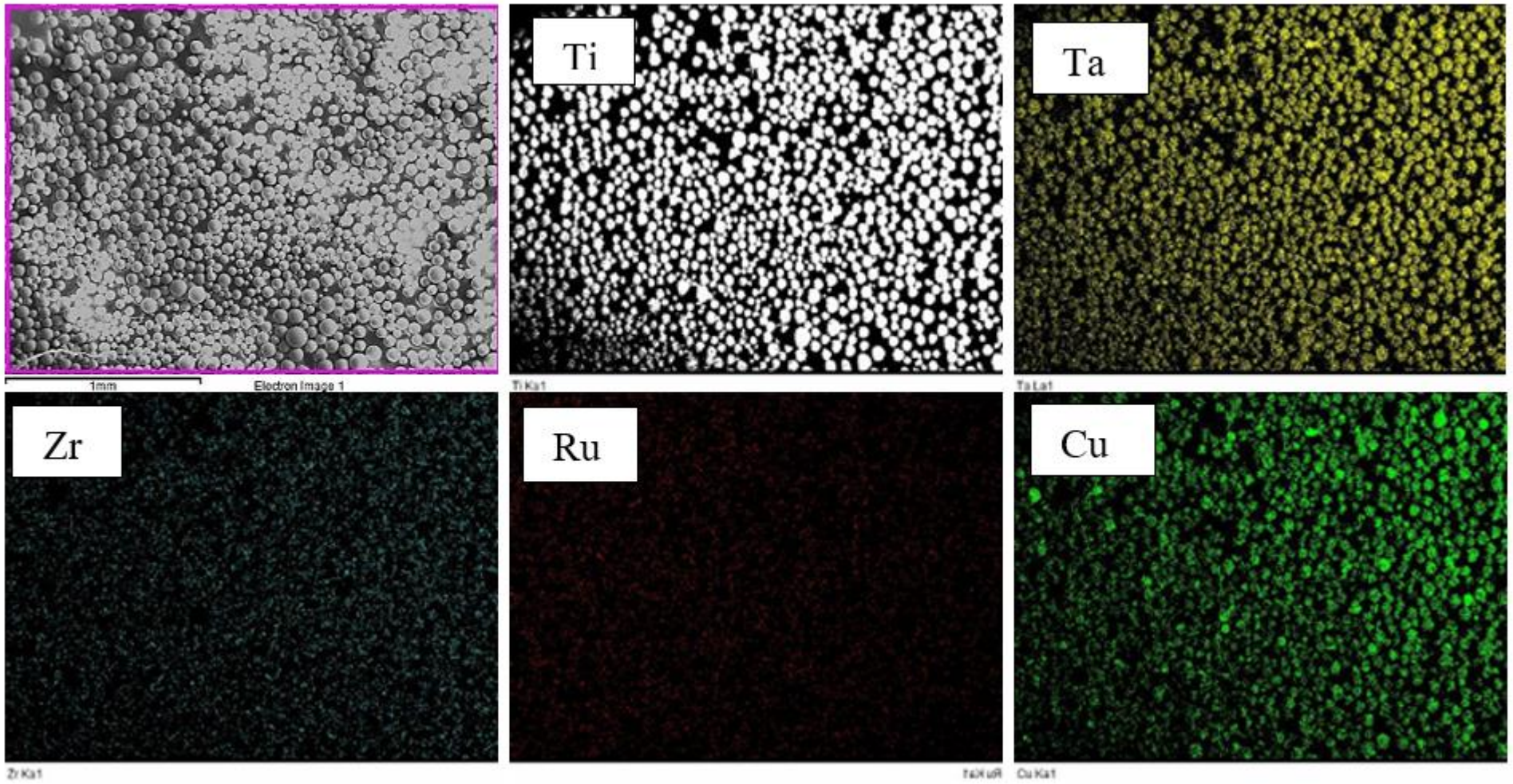

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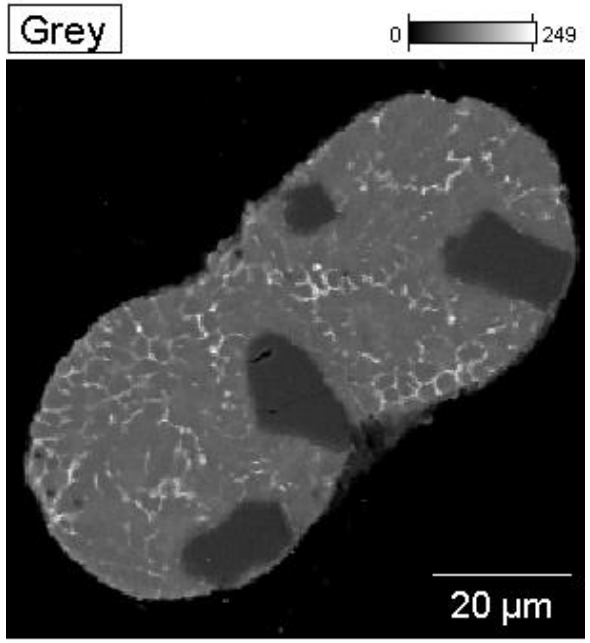
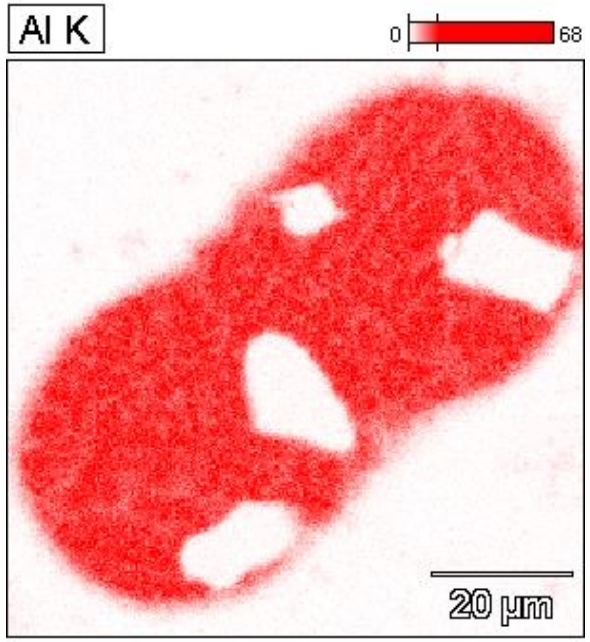
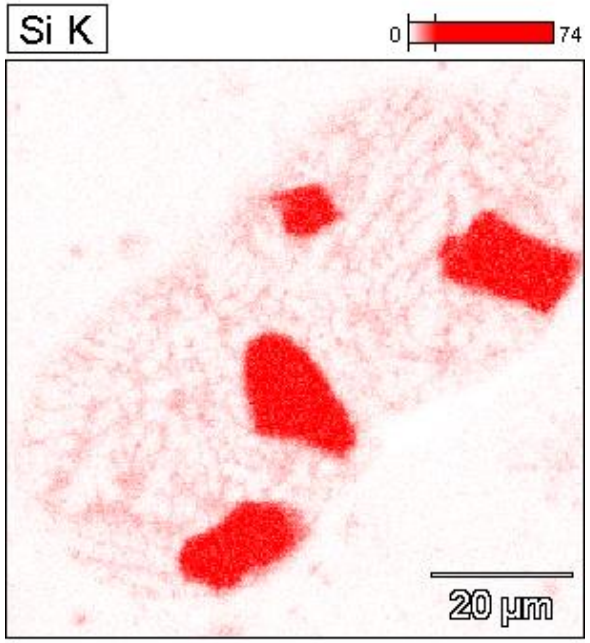
METAL MATRIX COMPOSITE POWDER

Materials:

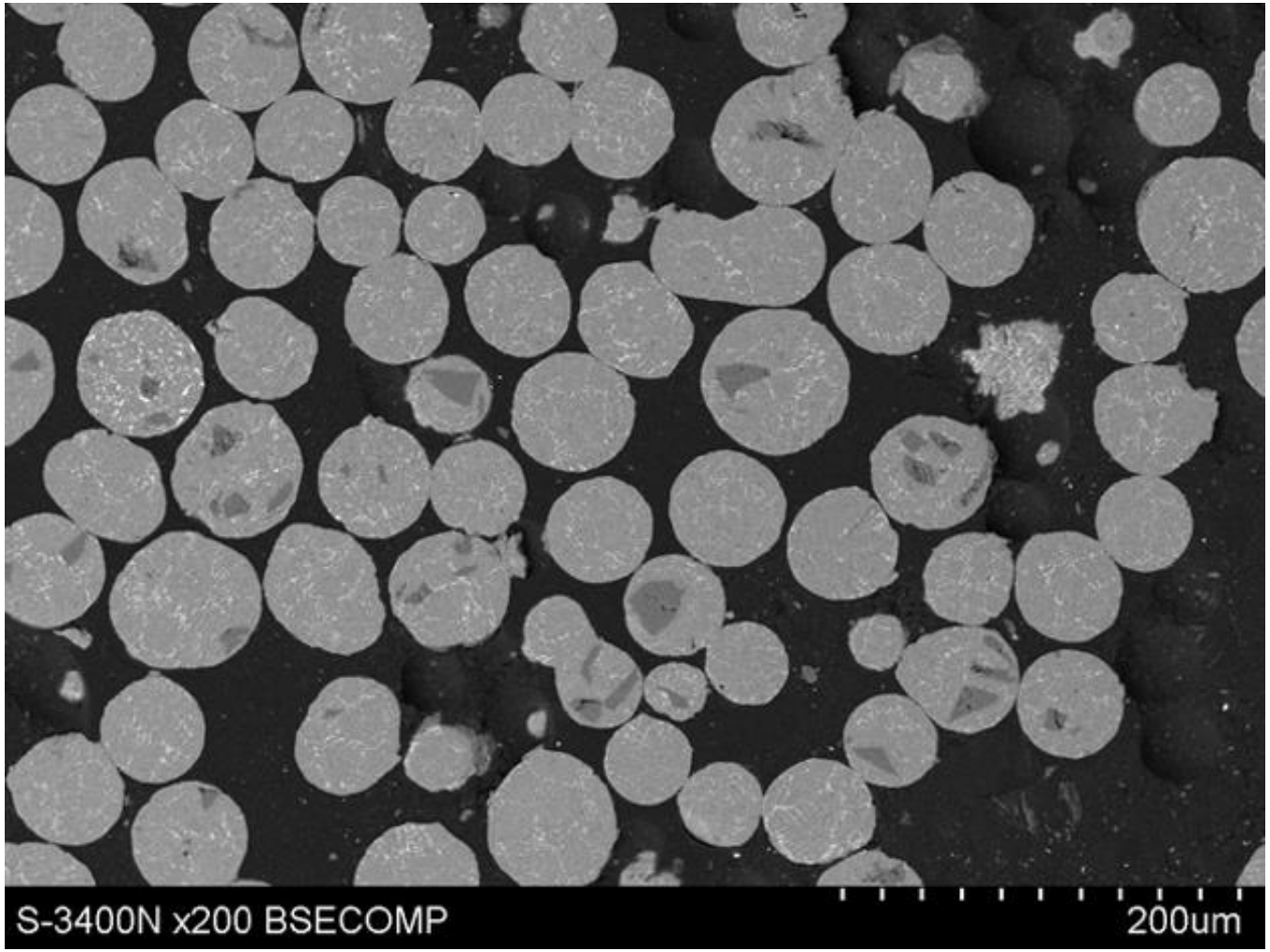
- Ak12/SiC
- Ti gr 2/TiC
- Ti gr 2/Al4C3



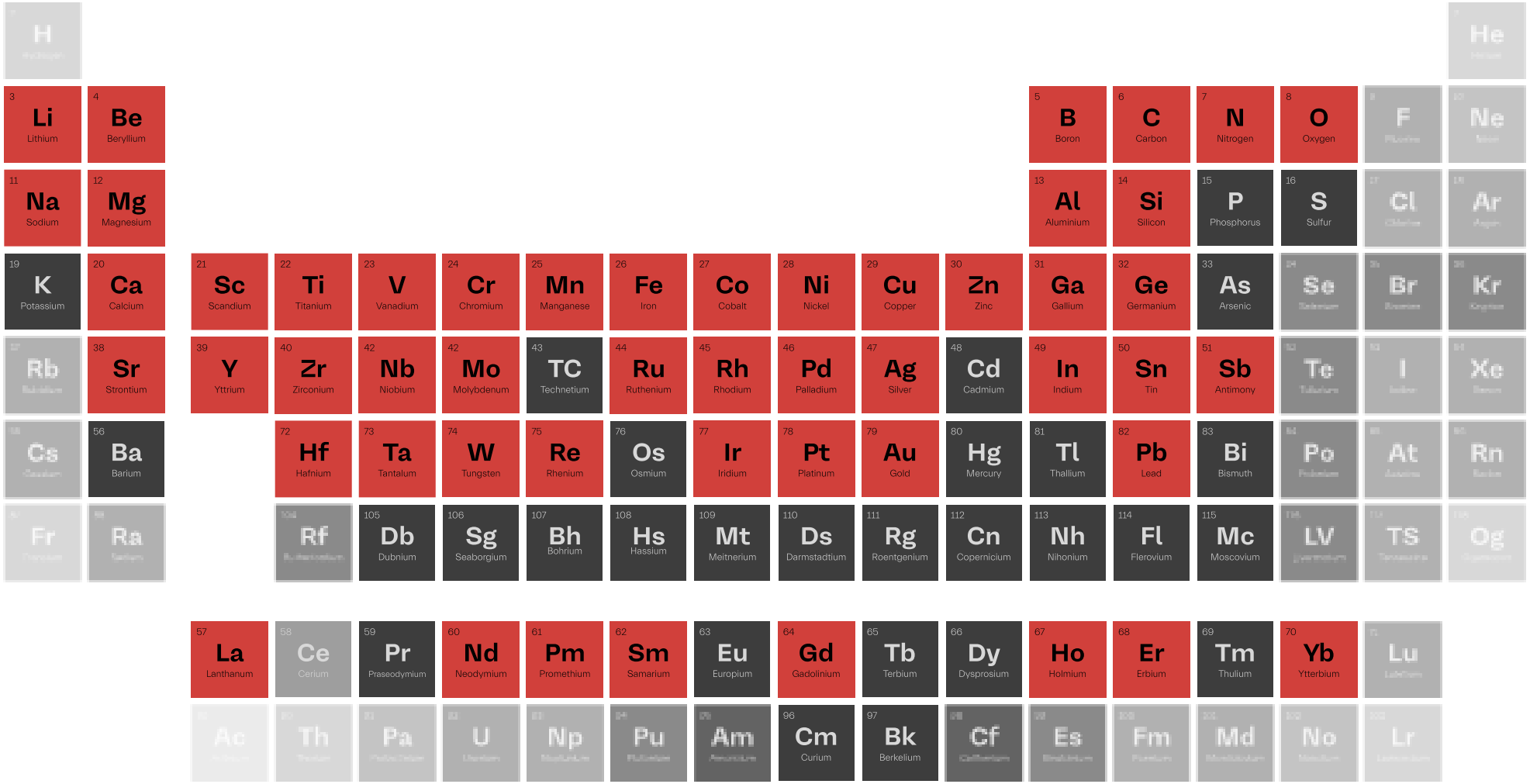




METAL MATRIX COMPOSITE POWDER

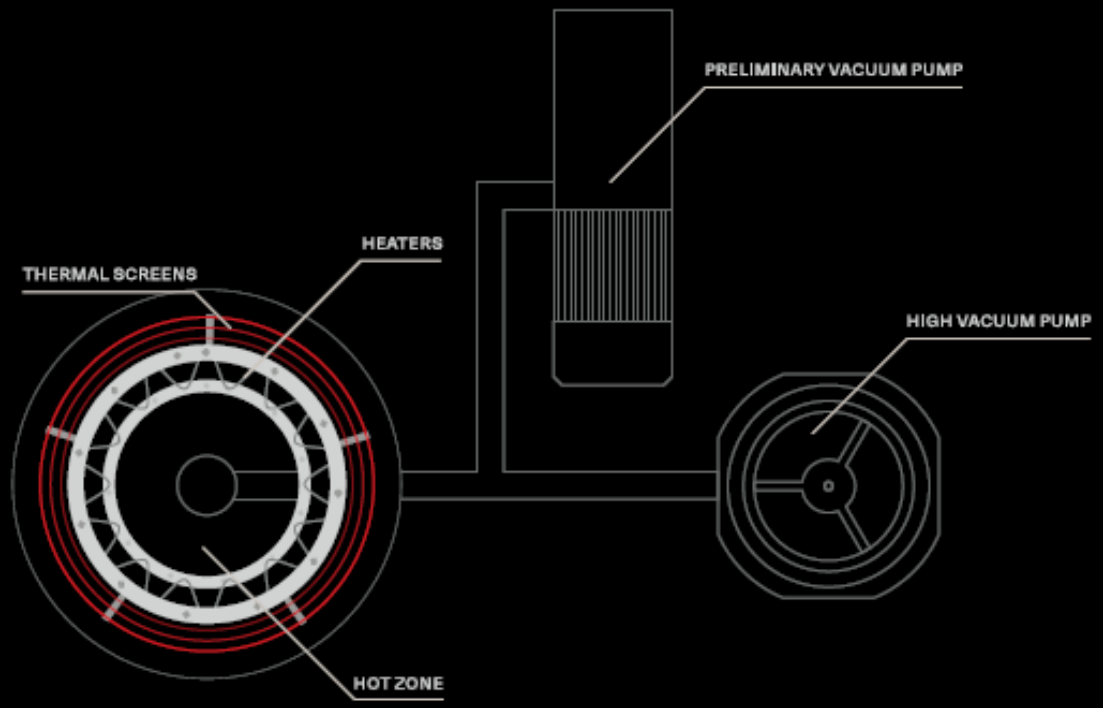


ELEMENTS PROCESSED WITH REPOWDER



|rePOWDER| - PRICE INFORMATION

|inFURNER| - COMPACT HIGH VACUUM FURNACE



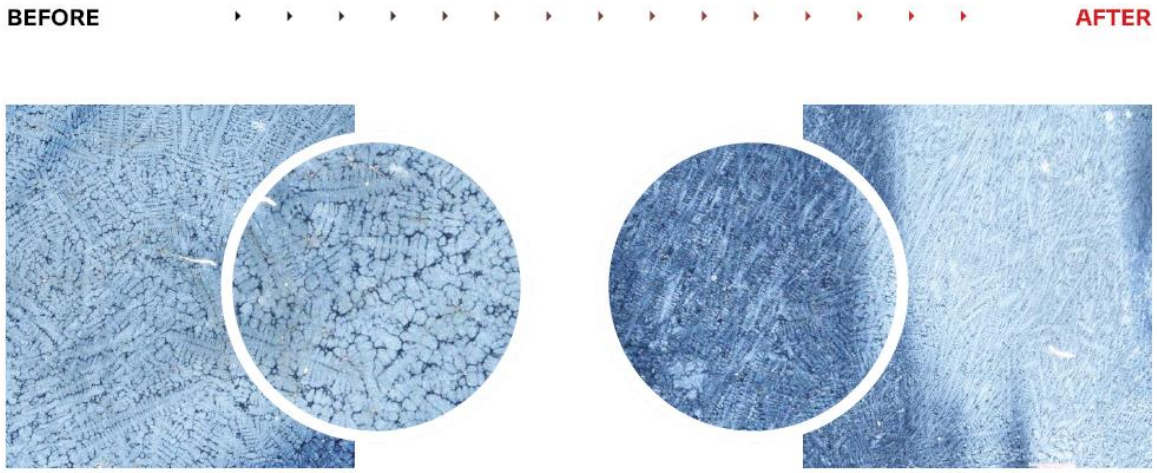
|inFURNER| - PRICE INFORMATION

Heaters and thermal screen materials vary depending on the maximum temperature requirements:

- 1200 °C: molybdenum heaters and thermal screens. Processing example: stress relief in Ti-based alloys
- 1600 °C: tantalum heaters and tungsten thermal screens. Processing example: sintering of refractory alloys

For both of these temperature options, there are two hot zone sizes available:

- Φ120 mm × 100 mm height – compatible with small build plate 3D printers
- Φ200 mm × 200 mm height – compatible with popular medium-sized build plate 3D printers



PROJECTS AND PARTNERS

6 GRANTED PROJECTS

- EIC Pathfinder AM2SoftMag - Additive Manufacturing of Amorphous Metals for Soft Magnetics
- HORIZON-CL4-2023-TWIN-TRANSITION-01 - Enabling Laser Powder Bed Fusion for Large Scale Production of Multi-Material Components
- POLTUR - Development of additively manufactured magnesium-based biodegradable scaffolds and implants for orthopaedic applications
- M-ERA.NET -IronWorkCoat - High-manganese steels to develop gradable coating systems by work hardening for sustainable wear protection applications

PROPOSALS SUBMISSION

- Over 25 project proposals submitted over last 2 years.
- Over 60 consortium members and partners (Universities and Research Institutes) around the World

Fraunhofer IKTS

Fraunhofer IFAM

institute IMDEA

Warsaw University of Technology

Medizinische Universität Innsbruck

Universität des Saarlandes

am2 softmag

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Politehnica din Bucuresti 1818

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THANK YOU!

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