



**STARDUST**



**Stardust Technology (Guangdong) Co., Ltd.**

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[www.stardustpowder.com](http://www.stardustpowder.com)



**星尘科技（广东）有限公司**

# 公司简介

PROFILE COMPANY

Stardust Technology (Guangdong) Co., Ltd. is a national high-tech enterprise specializing in the research, development, production and sales of high-end spherical powder materials used in additive manufacturing, powder metallurgy, surface engineering and other fields. Stardust adheres to the core of radio frequency plasma spheroidization powdering technology and provides internationally advanced powder products and application solutions.

Stardust was jointly established by the Institute of New Materials of the Guangdong Academy of Sciences, Foshan Stardust Information Consulting Partnership (Limited Partnership), and Foshan Industrial Technology Research Institute Co., Ltd. of the Guangdong Academy of Sciences. There is a powerful R&D center and a complete technical support team.

Stardust's R&D team comes from the New Materials Research Institute of the Guangdong Academy of Sciences. The institute has been committed to the powder preparation modification, application research and promotion. Research centers have been established, such as "National Titanium and Rare Metal Powder Metallurgy Engineering Technology Research Center", "Guangdong Metal Powder Materials Engineering Technology Research Center" and "Guangzhou Powder Materials and Precision Parts Manufacturing Engineering Technology Research Center". Currently, there are 13 technical staff (8 with doctor degrees and 5 with master degrees). There are internationally leading high-end powder preparation and forming equipments such as Canadian TEKNA radio frequency plasma spheroidization equipment, Ukrainian plasma rotating electrode atomization equipment, Swedish Quintus hot isostatic pressing equipment, and German EOS 3D printing equipment.

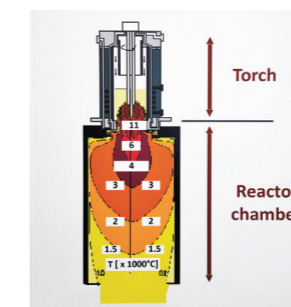
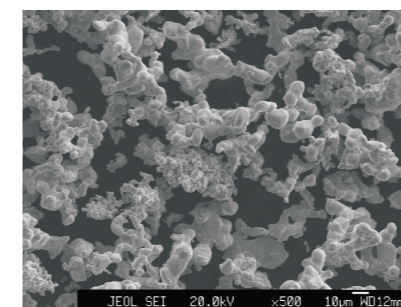
Stardust's main products are high-end spherical rare refractory metal powders, alloys powders and compound powders, including spherical tungsten powder, spherical molybdenum powder, spherical tantalum powder, spherical niobium powder, spherical vanadium powder, spherical titanium powder, spherical zirconium powder, spherical hafnium powder, spherical rhenium powder, spherical chromium powder etc. Stardust also provides technical service such as radio frequency plasma spheroidization and plasma rotating electrodes atomization, 3D printing, hot isostatic pressing, injection molding, and powder metallurgy.



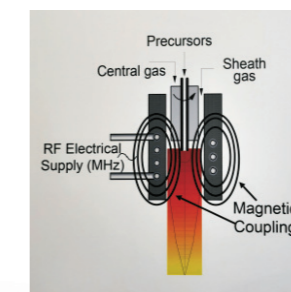
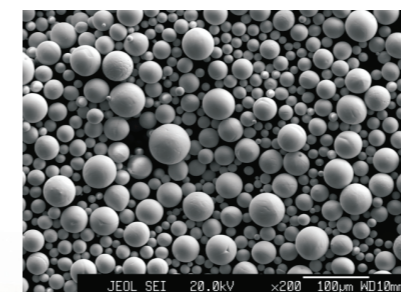
## World-class RF plasma spheroidization powder technology



- Power: 15/40KW
- Frequency: 1.5-4.0MHz
- Function: Micron spheroidization; Nano spheroidization
- Continuous working time: >8h
- Gas atmosphere: Inert; Oxidation; Reduction
- Particle size: 0-250 um
- Material category: elementary substance; alloy; compound
- Low oxygen: ≤ 300ppm

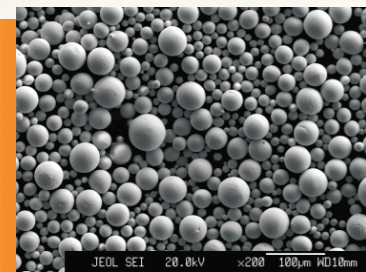


- ◆ High plasma temperature ( $\geq 8000^{\circ}\text{C}$ )
- ◆ No electrode corrosion, with purifying effect
- ◆ Big plasma torch
- ◆ Longer staying time for raw material
- ◆ Controllable plasma atmosphere

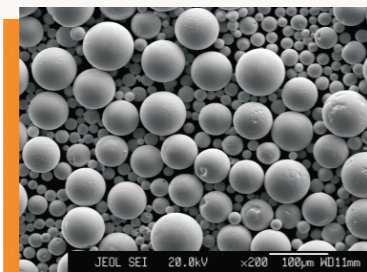


- ✓ High sphericity, less internal defects
- ✓ Controllable particle size distribution
- ✓ various raw materials, low prices
- ✓ Low energy consumption, high capacity

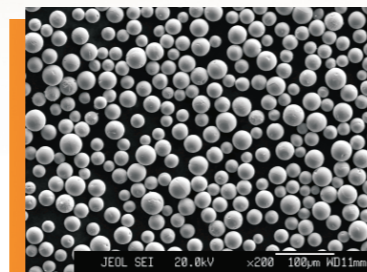
## Spherical powders of high-end metals and compounds



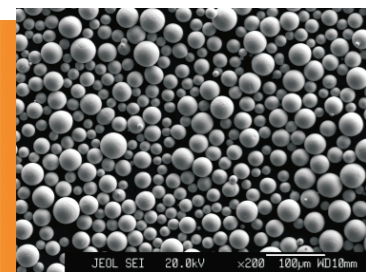
• Spherical tantalum powder



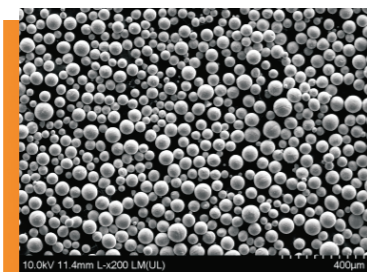
• Spherical tungsten powder



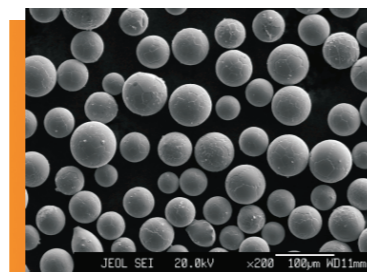
• Spherical molybdenum powder



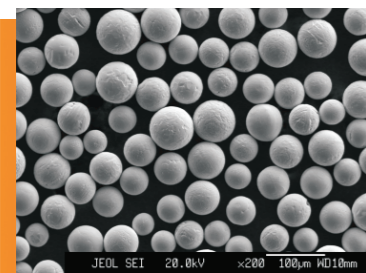
• Spherical niobium powder



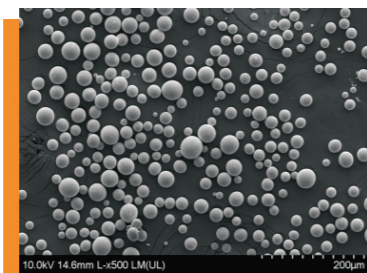
• Spherical titanium powder



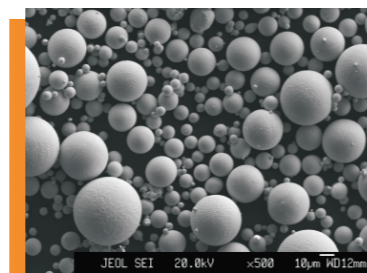
• Spherical chrome powder



• Spherical Cast tungsten carbide powder



• Spherical W-Mo alloy powder



• Spherical W-Re alloy powder

	Ta	W	Mo	Nb	Ti	Cr	Cast WC	W-Mo	W-Re
Apparent density / (g/cm <sup>3</sup> )	≥ 9.5	≥ 10.0	≥ 6.0	≥ 4.5	≥ 2.1	≥ 4.2	≥ 10.0	≥ 6.5	≥ 9.5
Tap density / (g/cm <sup>3</sup> )	≥ 10.5	≥ 12.0	≥ 6.5	≥ 5.5	≥ 2.8	≥ 5.5	≥ 11.0	≥ 7.5	≥ 10.5
Hall flow rate / (s/50g)	≤ 6.5	≤ 6.5	≤ 12.0	≤ 15.0	≤ 25.0	≤ 15.0	≤ 6.0	≤ 8.0	≤ 10.0
Purity / (wt%)	≥ 99.95	≥ 99.9	≥ 99.95	≥ 99.9	≥ 99.8	≥ 99.9	≥ 99.9	≥ 99.9	≥ 99.9
Oxygen content / (ppm)	≤ 300	≤ 100	≤ 200	≤ 800	≤ 1200	≤ 400	≤ 200	≤ 300	≤ 600

## Spherical tungsten powder

### • Powder characteristics

Tungsten has excellent high temperature resistance and ray shielding properties, also widely used in defense industry, medical equipment and other fields. Spherical tungsten powder is suitable for laser/electron beam additive manufacturing, laser direct deposition, hot isostatic pressing, injection molding, laser cladding and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

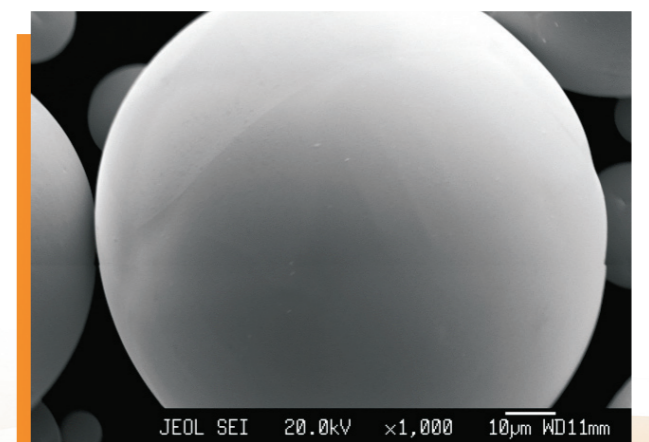
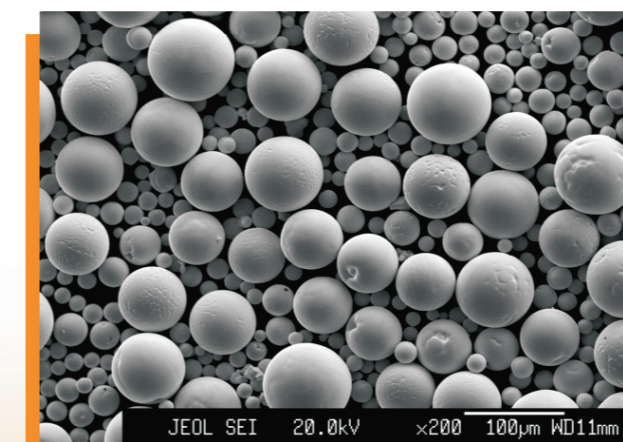
### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
W	≥ 99.98	—	Sn	< 0.001	ICP-AES
Al	< 0.001	ICP-AES	Mo	< 0.001	ICP-AES
Si	< 0.002	ICP-AES	Cu	< 0.001	ICP-AES
Ni	< 0.001	ICP-AES	Fe	< 0.005	ICP-AES
Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
C	≤ 0.005	GB/T 4324-2012	O	≤ 0.01	GB/T 4324-2012
N	≤ 0.003	GB/T 4324-2012	P	≤ 0.002	GB/T 4324-2012

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥ 10.0	≥ 12.0	GB/T 1479-1984 GB/T 5162-2006	≤ 6.5	GB/T 1482-2010

### • Powder appearance



## Spherical molybdenum powder

### • Powder characteristics

High purity, low oxygen, high sphericity, smooth surface, no satellite spheres, very few hollow particle, uniform particle size distribution, excellent flow properties, and high bulk density and tap density.

Widely used in contact materials, aerospace high temperature resistant components, target materials and other fields. Spherical molybdenum powder is suitable for laser/electron beam additive manufacturing, laser direct deposition, hot isostatic pressing, injection molding, laser cladding and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

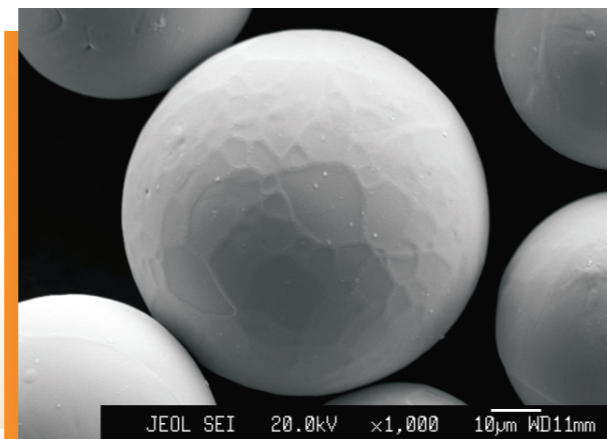
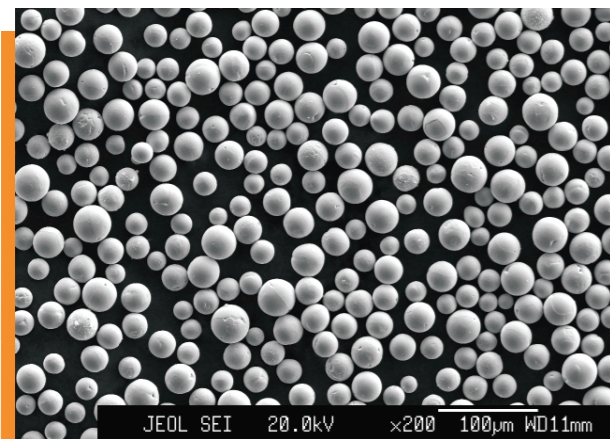
### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
Mo	≥99.95	—	Ni	<0.01	ICP-AES
Al	<0.001	ICP-AES	Si	<0.005	ICP-AES
Cr	<0.002	ICP-AES	Fe	<0.005	ICP-AES
Cu	<0.005	ICP-AES	Mg	<0.002	ICP-AES
Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
C	≤0.004	GB/T 4325-2013	O	≤0.02	GB/T 4325-2013
N	≤0.003	GB/T 4325-2013	P	≤0.005	GB/T 4325-2013

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥6.0	≥6.5	GB/T 1479-1984 GB/T 5162-2006	≤12.0	GB/T 1482-2010

### • Powder appearance



## Spherical tantalum powder

### • Powder characteristics

High purity, low oxygen, high sphericity, smooth surface, no satellite spheres, very few hollow particle, uniform particle size distribution, excellent flow properties, and high bulk density and tap density. Tantalum has excellent biocompatibility. The tantalum implant formed by 3D printing has the elastic modulus closest to human cartilage tissue, making it the most ideal orthopedic implant material. Spherical molybdenum powder is suitable for laser/electron beam additive manufacturing, hot isostatic pressing, laser cladding, hot/cold coating and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

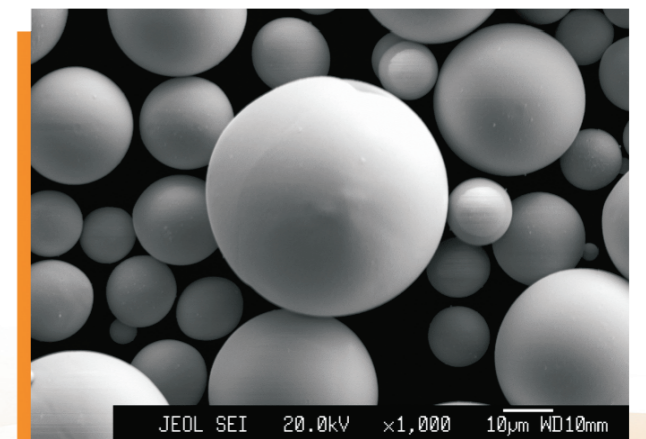
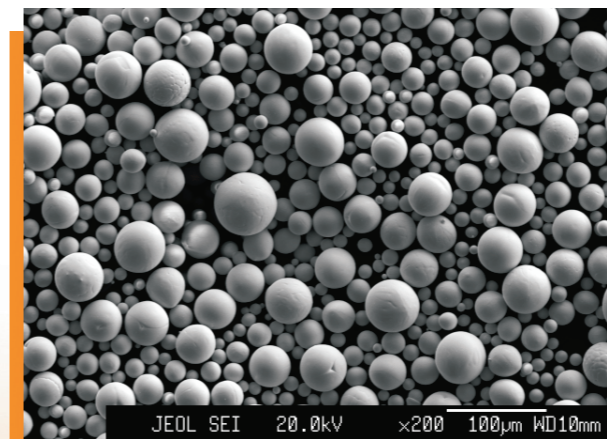
### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
Ta	≥99.95	—	Ti	<0.001	ICP-AES
Fe	<0.001	ICP-AES	Mo	<0.001	ICP-AES
Si	<0.005	ICP-AES	W	<0.01	ICP-AES
Ni	<0.002	ICP-AES	Nb	<0.01	ICP-AES
Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
C	≤0.003	GB/T 15076.8-2008	O	≤0.03	GB/T 15076.14-2008
H	≤0.0025	GB/T 15076.15-2008	N	≤0.004	GB/T 15076.13-2017

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥9.5	≥10.5	GB/T 1479-1984 GB/T 5162-2006	≤6.5	GB/T 1482-2010

### • Powder appearance



## Spherical niobium powder

### • Powder characteristics

High purity, low oxygen, high sphericity, smooth surface, no satellite spheres, uniform particle size distribution. As the lightest refractory metal, niobium has the characteristics of high melting point, high temperature strength and high specific strength, and no radioactivity. It's the perfect thermal protection material and structural material for aerospace engines. Spherical niobium powder is suitable for laser/electron beam additive manufacturing, hot isostatic pressing, laser cladding, hot/cold coating and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

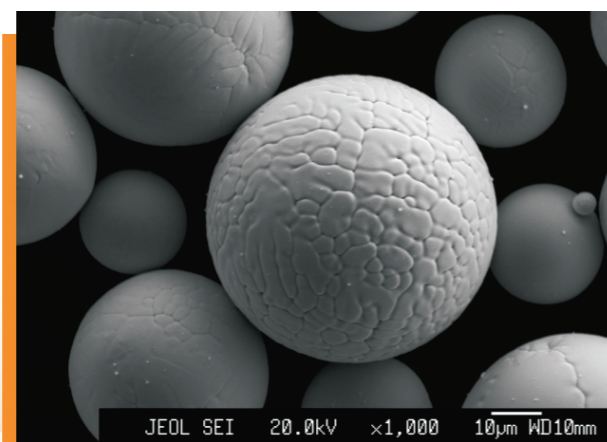
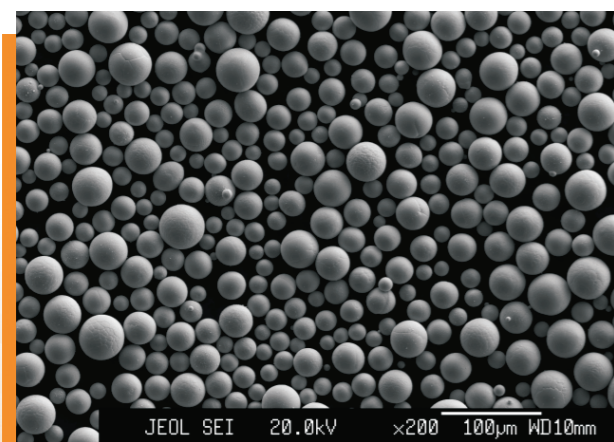
### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
Nb	≥99.95	—	Ta	<0.005	ICP-AES
Mo	<0.003	ICP-AES	Si	<0.002	ICP-AES
Fe	<0.005	ICP-AES	Cr	<0.002	ICP-AES
Ni	<0.001	ICP-AES	Ti	<0.002	ICP-AES
Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
C	≤0.01	GB/T 15076.8-2008	O	≤0.06	GB/T 15076.14-2008
N	≤0.003	GB/T 15076.13-2017	P	≤0.002	GB/T 4324-2012

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥4.5	≥5.5	GB/T 1479-1984 GB/T 5162-2006	≤15.0	GB/T 1482-2010

### • Powder appearance



## Spherical chrome powder

### • Powder characteristics

Radio-frequency plasma spheroidized chromium powder have high sphericity, high purity, excellent flow properties, and high bulk density, no hollow particle etc characteristics. It can be widely used in cemented carbide, diamond tools, welding materials, palladium and other fields. Spherical chrome powder is suitable for laser/electron beam additive manufacturing, hot isostatic pressing, laser cladding, vacuum coating, hot/cold coating and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

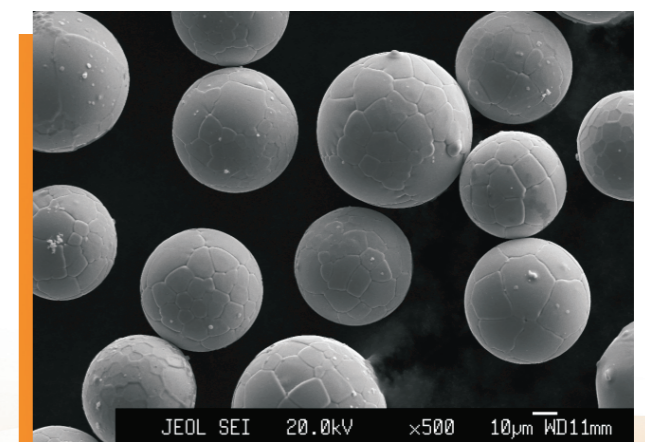
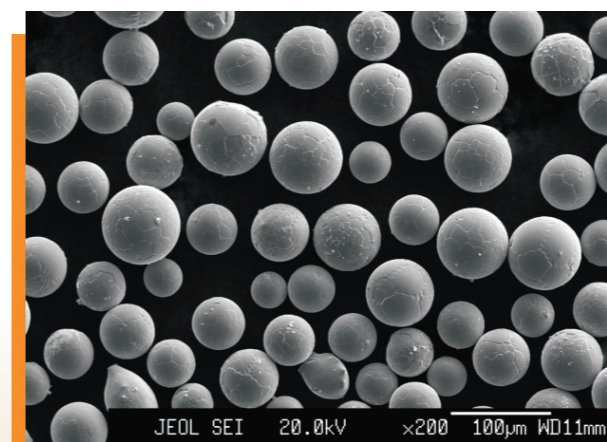
### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
Cr	≥99.95	—	Mo	<0.005	ICP-AES
Fe	<0.02	ICP-AES	Ti	<0.001	ICP-AES
Si	<0.01	ICP-AES	W	<0.001	ICP-AES
Al	<0.006	ICP-AES	Ni	<0.001	ICP-AES
Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
C	≤0.005	GB/T 4324-2012	O	≤0.050	GB/T 4324-2012
S	≤0.001	GB/T 4324-2012	N	≤0.004	GB/T 4324-2012

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥4.2	≥5.5	GB/T 1479-1984 GB/T 5162-2006	≤15.0	GB/T 1482-2010

### • Powder appearance



## Spherical titanium powder

### • Powder characteristics

Titanium has outstanding biocompatibility, high specific strength and excellent mechanical properties, and is widely used in biomedical, aerospace, 3C electronics and other fields. Radio-frequency plasma spherical titanium powder have high purity, high sphericity, no satellite spheres, excellent flow properties, and high bulk density, no hollow particle etc characteristics. Suitable for 3D printing, hot isostatic pressing, ejection molding, and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
Ti	≥99.8	—	Si	<0.02	ICP-AES
Fe	<0.003	ICP-AES	Mn	<0.01	ICP-AES
Cr	<0.001	ICP-AES	Mg	<0.01	ICP-AES
Mo	<0.001	ICP-AES	Others	<0.05	—

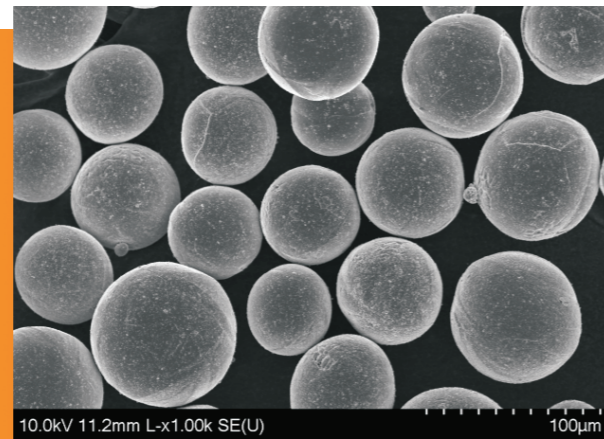
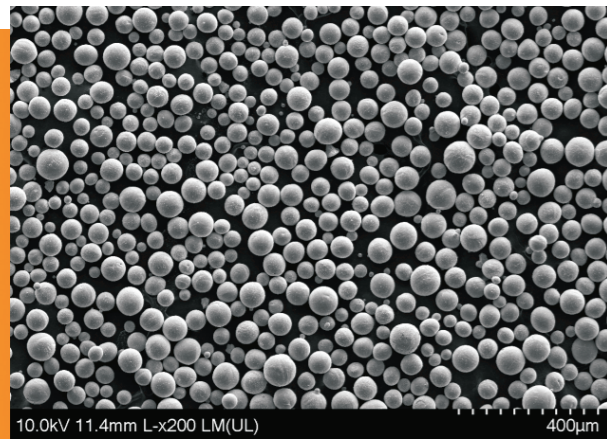
  

Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
C	≤0.005	GB/T 4698-2017	O	≤0.12	GB/T 4698-2017
H	≤0.015	GB/T 4698-2017	N	≤0.005	GB/T 4698-2017

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥2.1	≥2.8	GB/T 1479-1984 GB/T 5162-2006	≤25.0	GB/T 1482-2010

### • Powder appearance



## Spherical vanadium powder

### • Powder characteristics

Metal vanadium has good resistance to radiation induced expansion and damage, high thermal conductivity, low thermal expansion coefficient, low elastic modulus, good creep resistance and processing performance, and low activation characteristics under neutron irradiation conditions. It is known as the "metal vitamin" due to its excellent high-temperature strength properties and is widely used in magnetic materials, cemented carbide, superconducting materials, nuclear reactor materials and other fields. Spherical vanadium powder has the characteristics of high purity, good sphericity, no satellite balls, and very few hollow particles. It is suitable for 3D printing, hot isostatic pressing, laser cladding and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
V	≥99.8	—	Si	<0.005	ICP-AES
Al	<0.01	ICP-AES	Cr	<0.01	ICP-AES
Ca	<0.005	ICP-AES	Fe	<0.05	ICP-AES
Cu	<0.005	ICP-AES	others	<0.05	—

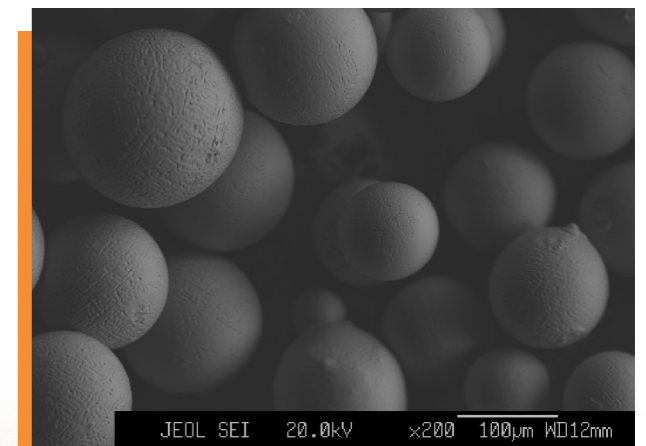
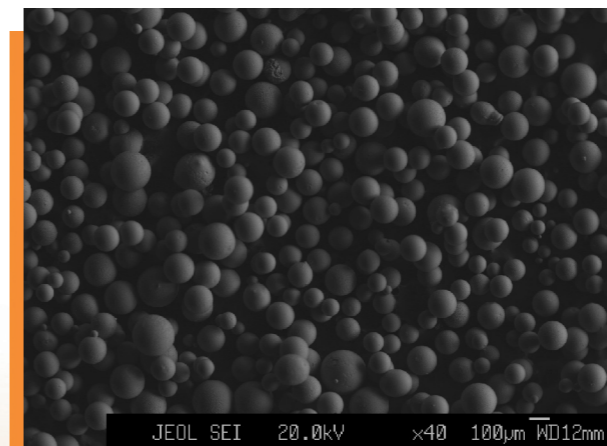
  

Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
O	<0.2	GB/T 4310-2016	N	<0.05	GB/T 4310-2016
C	<0.1	GB/T 4310-2016	—	—	—

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥3.5	≥4.2	GB/T 1479-1984 GB/T 5162-2006	≤15.0	GB/T 1482-2010

### • Powder appearance



## Spherical rhenium powder

### • Powder characteristics

Metal rhenium is silver-gray, hard, and has a melting point of 3180°C, which is only lower than the most difficult-to-melt tungsten. Rhenium has high resistance, good mechanical properties, high temperature resistance and corrosion resistance. It is used to make electric filaments, shells of artificial satellites and rockets, protective plates of atomic reactors, electrodes, thermocouples, etc., and is used as a catalyst in chemistry. Spherical rhenium powder has the characteristics of high purity, few satellite spheres, very few hollow particles, and excellent flow properties. It is suitable for 3D printing, hot isostatic pressing, laser cladding, hot/cold spraying and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

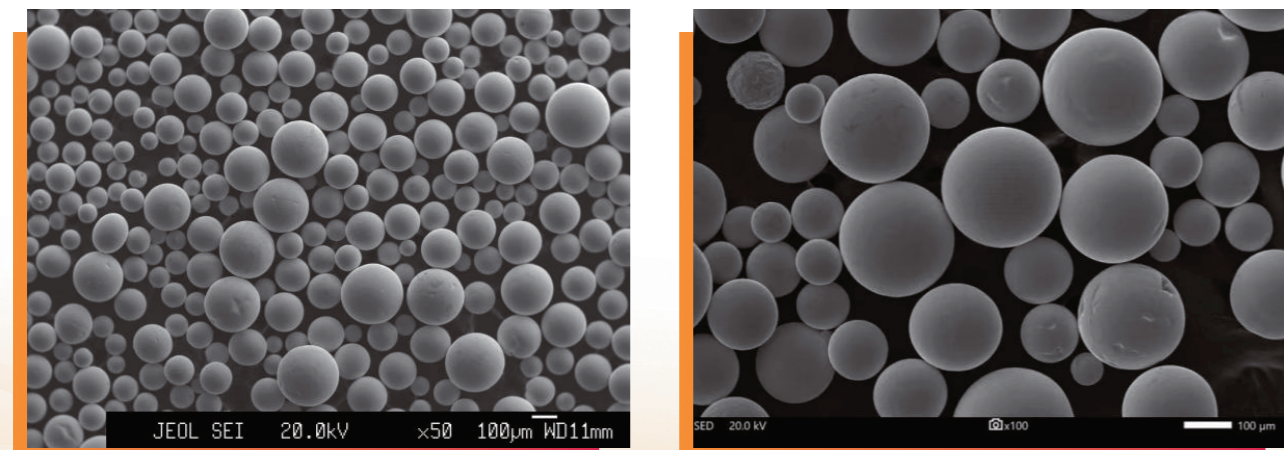
### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
Re	≥99.95	—	Si	<0.005	ICP-AES
Fe	<0.01	ICP-AES	Ca	<0.005	ICP-AES
Mo	<0.01	ICP-AES	Al	<0.005	ICP-AES
Cu	<0.005	ICP-AES	others	<0.05	—
Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
O	<0.1	YS/T 1017-2015	C	<0.004	YS/T 1017-2015

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥9.5	≥10.5	GB/T 1479-1984 GB/T 5162-2006	≤10.0	GB/T 1482-2010

### • Powder appearance



## Spherical zirconium powder

### • Powder characteristics

Zirconium metal is silver-white, has very low thermal neutron absorption cross-section, excellent corrosion resistance, good processing and welding properties, and outstanding biocompatibility. It is commonly used as materials such as structures, coatings and control rods in the field of nuclear reactors; in the corrosion-resistant field of reaction towers, pumps, heat exchangers, valves, nozzles and other heterogeneous components; in the biomedical field of orthopedics and dental implants, etc. Spherical zirconium powder has the characteristics of high purity, few satellite spheres, few hollow particles, and excellent flow properties, and is suitable for 3D printing, laser cladding and other processes.

Available conventional powder particle sizes: 45–106 μm, 53–150 μm, 53–250 μm.

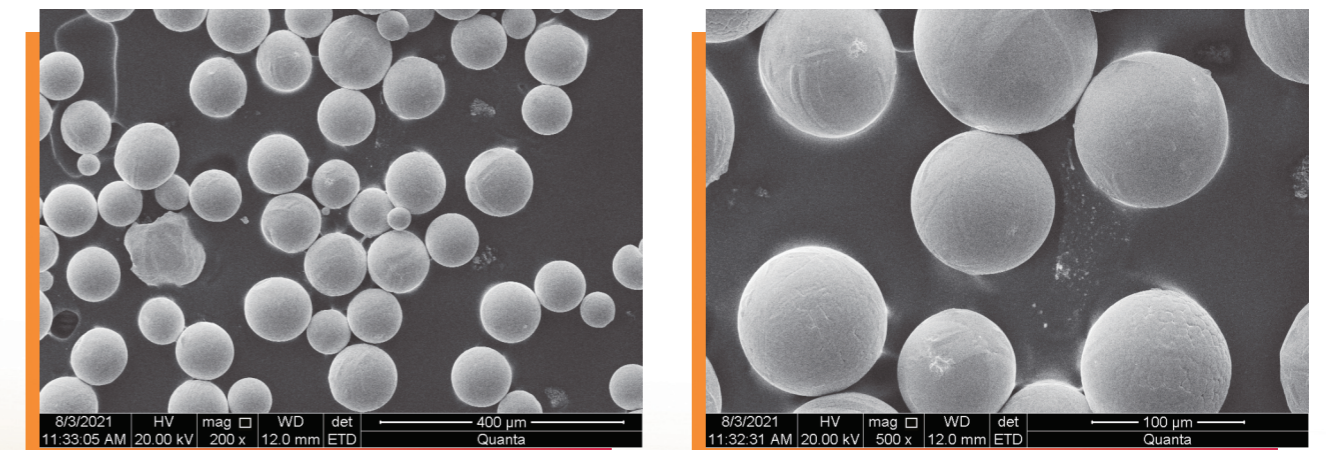
### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
Zr	≥99.8	—	Si	<0.02	ICP-AES
Fe+Cr	<0.05	ICP-AES	Ca	<0.005	ICP-AES
Mo	<0.01	ICP-AES	Al	<0.03	ICP-AES
Cu	<0.005	ICP-AES	others	<0.05	—
Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
O	<0.1	GB/T 13747-2020	C	<0.05	GB/T 13747-2020

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥3.5	≥4.5	GB/T 1479-1984 GB/T 5162-2006	≤15.0	GB/T 1482-2010

### • Powder appearance



## Spherical hafnium powder

### • Powder characteristics

Metal hafnium is silver-grey and has the characteristics of plasticity, easy processing, high temperature resistance and corrosion resistance. Pure hafnium is an important material in the atomic energy industry, and its main use is to make control rods for nuclear reactors. Spherical hafnium powder has the characteristics of high purity, good sphericity, no satellite balls, and very few hollow particles. It is suitable for 3D printing, hot isostatic pressing, laser cladding and other processes.

Available conventional powder particle sizes: 5–25 μm, 15–53 μm, 45–106 μm, 53–150 μm.

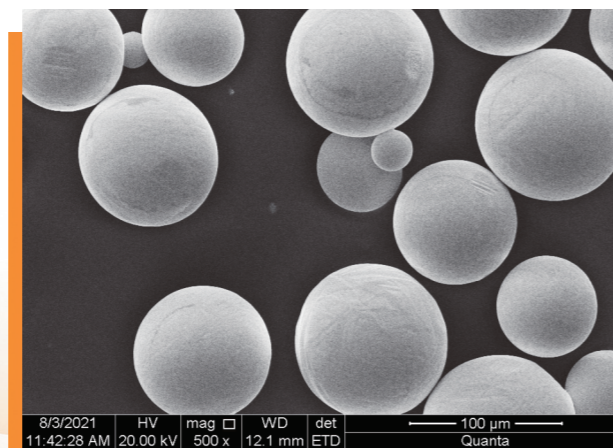
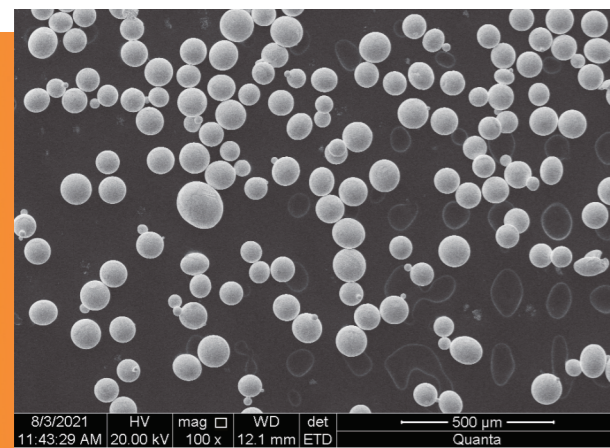
### • Chemical component

Chemical Composition					
Element	Value(wt%)	Test Method	Element	Value(wt%)	Test Method
Hf	≥99.8	—	Si	<0.005	ICP-AES
Al	<0.01	ICP-AES	Nb	<0.01	ICP-AES
W	<0.005	ICP-AES	Fe	<0.01	ICP-AES
Zr	<0.5	ICP-AES	others	<0.05	—
Gas Impurities					
Element	Value(wt%)	Test Standard	Element	Value(wt%)	Test Standard
O	<0.2	YS/T 1467.10-2021	N	<0.05	YS/T 1467.10-2021

### • Physical property

Density (g/cm <sup>3</sup> )			Hall Flow Rate (s/50g)	
Apparent Density	Tap Density	Test Standard	Value	Test Standard
≥6.5	≥7.5	GB/T 1479-1984 GB/T 5162-2006	≤10.0	GB/T 1482-2010

### • Powder appearance



## Spherical tungsten alloy powder

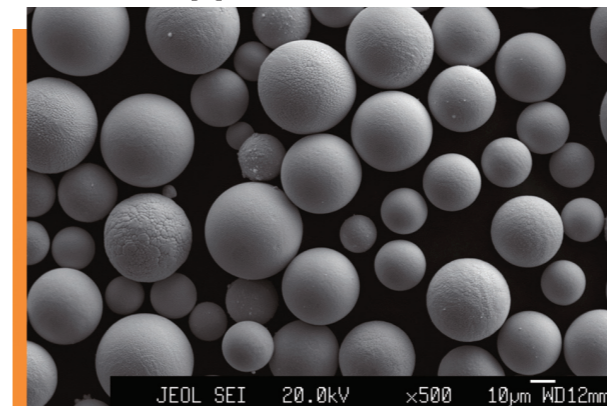
### • Chemical component

	W/(wt%)	Ni/(wt%)	Fe/(wt%)	Mo/(wt%)	Re/(wt%)	Nb(wt%)	C/(wt%)	O/(wt%)
W-Ni-Fe	90-98	1.0-9.0	1.0-9.0	≤0.01	≤0.001	≤0.005	<0.05	<0.05
W-Mo	1-99	≤0.01	≤0.01	1-99	≤0.001	≤0.005	<0.04	<0.03
W-Nb	2-98	≤0.01	≤0.01	≤0.01	≤0.001	2-98	<0.05	<0.10
W-Re	75-98	≤0.01	≤0.01	≤0.01	2-25	≤0.005	<0.05	<0.10

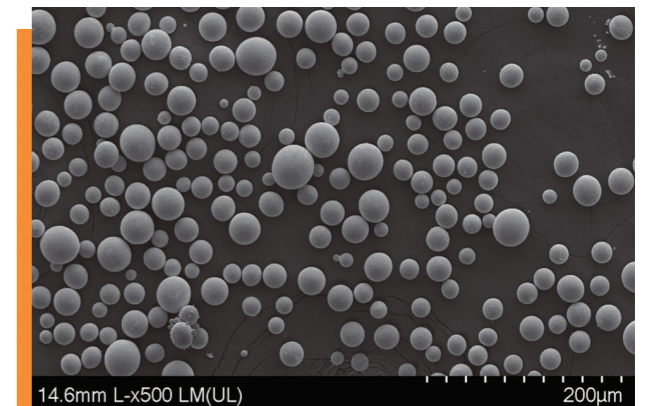
### • Physical property

	Particle size / (μm)	Apparent density / (g/cm <sup>3</sup> )	Tap density / (g/cm <sup>3</sup> )	Hall flow rate / (s/50g)	Sphericity / (%)
W-Ni-Fe	15-45/45-106/Others	≥8.5	≥9.5	≤10.0	≥98
W-Mo	15-45/45-106/Others	≥6.5	≥7.5	≤8.0	≥98
W-Nb	15-45/45-106/Others	≥4.5	≥5.5	≤8.0	≥98
W-Re	15-45/45-106/Others	≥9.5	≥10.5	≤10.0	≥98

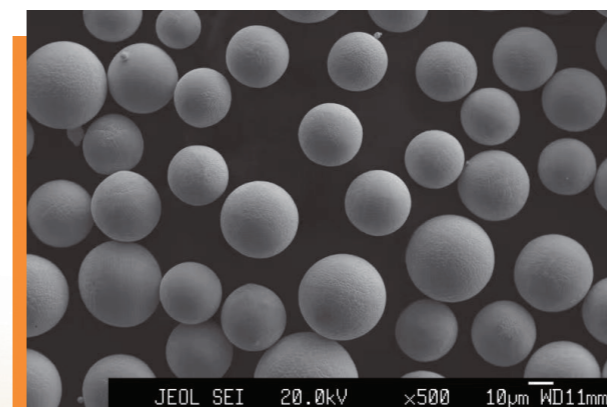
### • Powder appearance



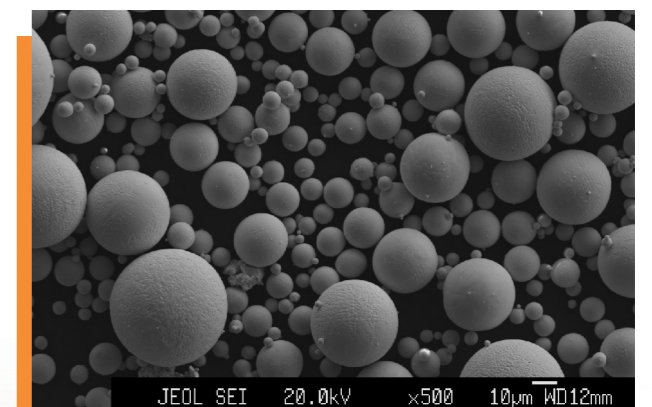
W-Ni-Fe



W-Mo



W-Nb



W-Re



## Spherical tantalum alloy powder

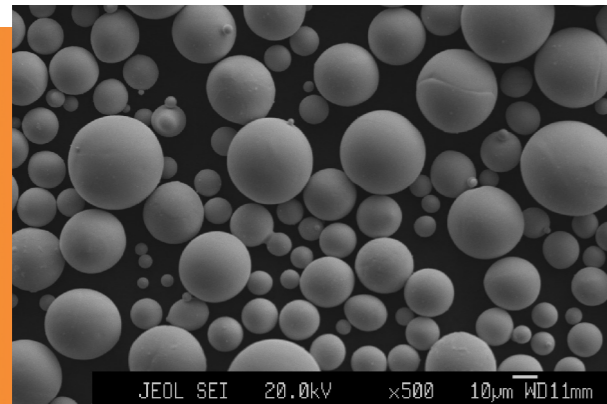
### • Chemical component

	Ta/(wt%)	Ti/(wt%)	Nb(wt%)	W/(wt%)	Mo/(wt%)	N/(wt%)	C/(wt%)	O/(wt%)
Ta-Ti	25-75	25-75	≤0.01	≤0.01	≤0.001	≤0.005	<0.05	<0.15
Ta-Nb	75-97	≤0.01	3-25	≤0.01	≤0.001	≤0.005	<0.01	<0.15
Ta-10.0W	Bal.	≤0.01	≤0.01	9.0-11.0	≤0.001	≤0.005	<0.01	<0.05
Ta-2.5W	Bal.	≤0.01	≤0.01	2.0-3.0	≤0.001	≤0.005	<0.01	<0.05

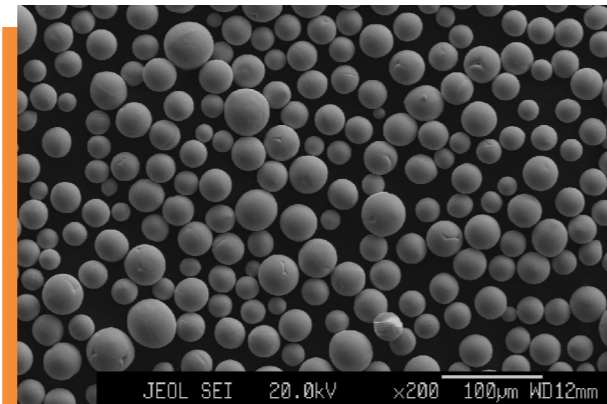
### • Physical property

	Particle size / (μm)	Apparent density / (g/cm <sup>3</sup> )	Tap density / (g/cm <sup>3</sup> )	Hall flow rate / (s/50g)	Sphericity / (%)
Ta-Ti	15-45/45-106/Others	≥4.0	≥5.5	≤15.0	≥98
Ta-Nb	15-45/45-106/Others	≥8.0	≥9.0	≤10.0	≥98
Ta-10W	15-45/45-106/Others	≥9.0	≥10.0	≤8.0	≥98
Ta-2.5W	15-45/45-106/Others	≥9.0	≥10.0	≤8.0	≥98

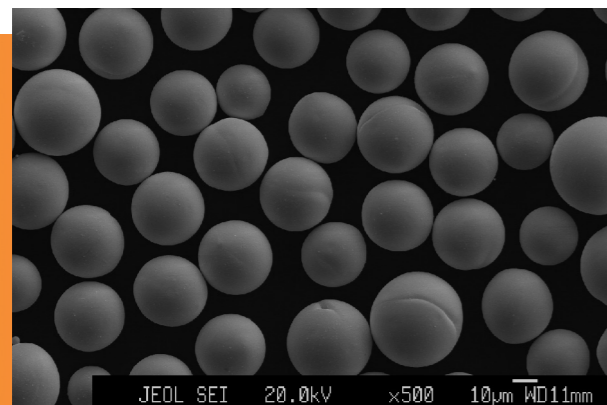
### • Powder appearance



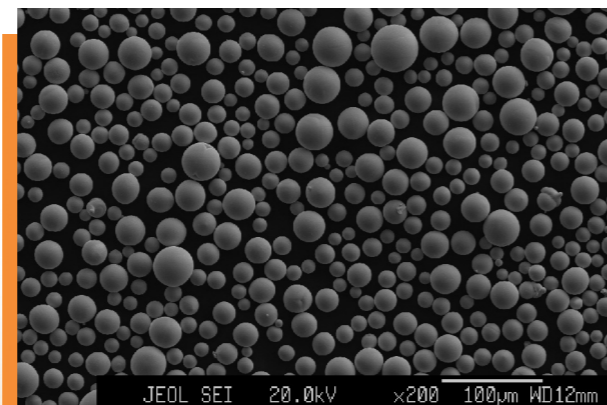
Ta-Ti



Ta-Nb



Ta-10W



Ta-2.5W

## Spherical niobium alloy powder

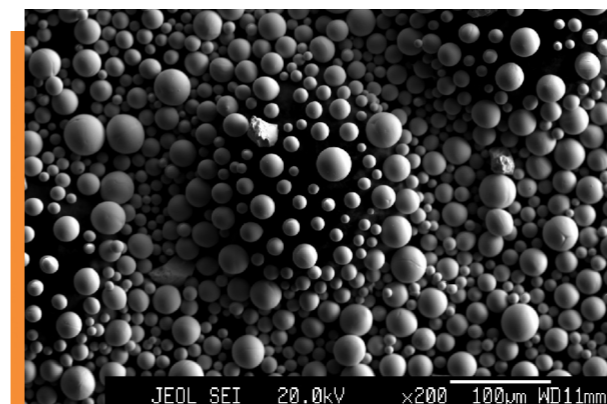
### • Chemical component

	Nb(wt%)	W/(wt%)	Mo/(wt%)	Zr/(wt%)	Hf/(wt%)	Ti/(wt%)	N/(wt%)	C/(wt%)	O/(wt%)
Nb521	Bal.	4.5-5.5	1.6-2.5	0.75-1.0	≤0.001	≤0.005	≤0.005	<0.15	<0.15
C103	Bal.	≤0.5	≤0.01	≤0.7	9-11	0.7-1.3	≤0.01	<0.01	<0.15
NbZr	Bal.	≤0.03	≤0.01	0.8-1.2	≤0.001	≤0.02	≤0.01	<0.01	<0.15
NbTiW	Bal.	20-30	≤0.01	20-30	≤0.001	≤0.005	≤0.005	<0.01	<0.10

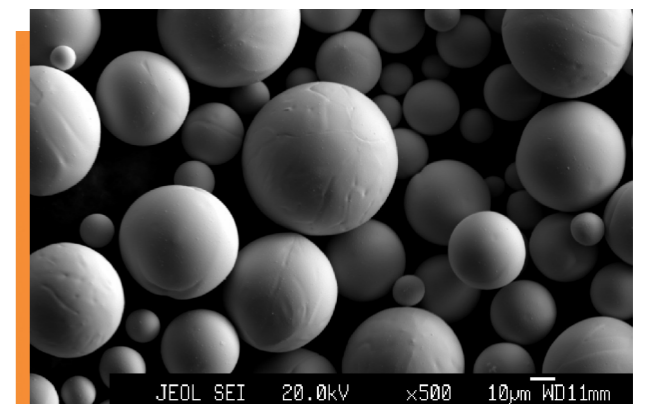
### • Physical property

	Particle size / (μm)	Apparent density / (g/cm <sup>3</sup> )	Tap density / (g/cm <sup>3</sup> )	Hall flow rate / (s/50g)	Sphericity / (%)
Nb521	15-45/45-106/Others	≥4.5	≥5.5	≤15.0	≥98
C103	15-45/45-106/Others	≥4.5	≥5.5	≤15.0	≥98
NbZr	15-45/45-106/Others	≥4.2	≥5.2	≤15.0	≥98
NbTiW	15-45/45-106/Others	≥5.0	≥6.5	≤10.0	≥98

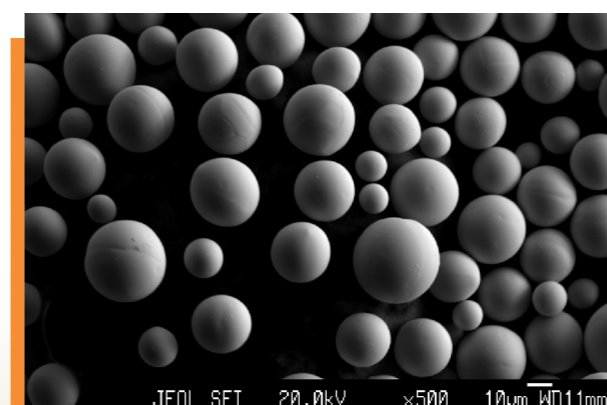
### • Powder appearance



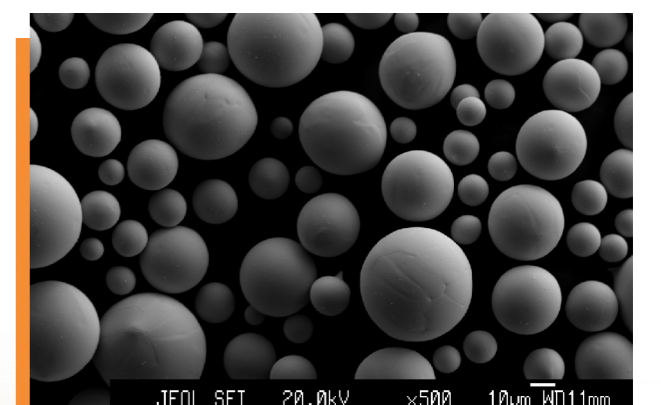
Nb521



C103



Nb-Zr



Nb-Ti-W

## Refractory high entropy alloy powder

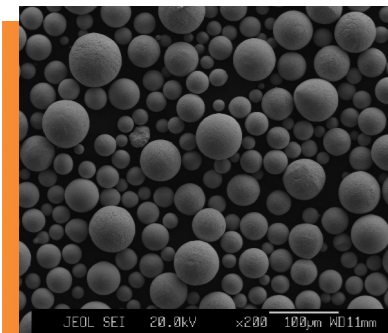
### • Chemical component

	W/(at%)	Mo/(at%)	Ta/(at%)	Nb/(at%)	V/(at%)	Ti/(at%)	Zr/(at%)	N/(wt%)	C/(wt%)	O/(wt%)
W-Mo-Ta-Nb	24-26	24-26	24-26	24-26	≤0.01	≤0.01	≤0.01	≤0.005	<0.15	<0.10
W-Mo-Ta-Nb-V	19-21	19-21	19-21	19-21	19-21	≤0.01	≤0.01	≤0.01	<0.01	<0.10
W-Mo-Ta-Nb-Zr	19-21	19-21	19-21	19-21	≤0.001	≤0.02	19-21	≤0.02	<0.01	<0.15
Ta-Nb-Zr-Ti	≤0.01	≤0.01	24-26	24-26	≤0.001	24-26	24-26	≤0.02	<0.01	<0.15
Ta-Nb-V-Ti	≤0.01	≤0.01	24-26	24-26	24-26	24-26	≤0.01	≤0.02	<0.01	<0.15

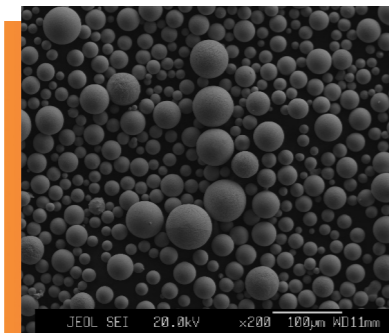
### • Physical property

	Particle size /( $\mu\text{m}$ )	Apparent density /( $\text{g}/\text{cm}^3$ )	Tap density /( $\text{g}/\text{cm}^3$ )	Hall flow rate /( $\text{s}/50\text{g}$ )	Sphericity / (%)
W-Mo-Ta-Nb	15-45/45-106/Others	≥7.5	≥8.5	≤10.0	≥98
W-Mo-Ta-Nb-V	15-45/45-106/Others	≥7.5	≥8.5	≤10.0	≥98
W-Mo-Ta-Nb-Zr	15-45/45-106/Others	≥7.5	≥8.5	≤10.0	≥98
Ta-Nb-Zr-Ti	15-45/45-106/Others	≥6.0	≥7.0	≤15.0	≥98
Ta-Nb-V-Ti	15-45/45-106/Others	≥6.0	≥7.0	≤15.0	≥98

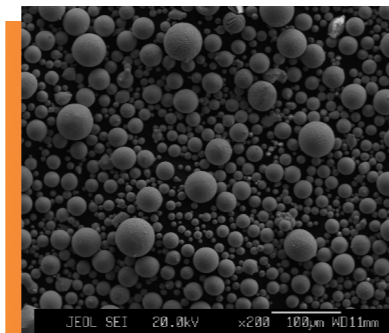
### • Powder appearance



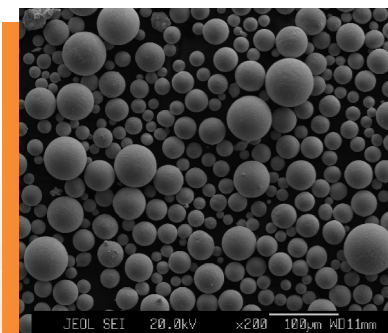
W-Mo-Ta-Nb



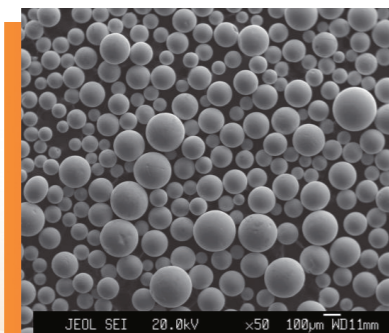
W-Mo-Ta-Nb-V



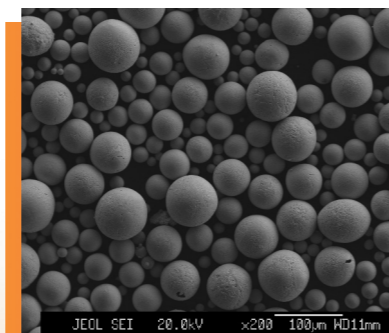
W-Mo-Ta-Nb-Zr



Ta-Nb-Zr-Ti



Ta-Nb-V-Ti



W-Mo-Ta-Nb-Ti

## 先进装备

ADVANCED EQUIPMENT



Radio frequency plasma powder manufacturing system TEKNA-40KW



Radio frequency plasma powder manufacturing system TEKNA-40KW



Radio frequency plasma powder manufacturing system TEKNA-15KW



Vacuum atomization powder manufacturing system



3D printing equipment



Hot isostatic pressing equipment

## 合作伙伴

ADVANCED EQUIPMENT



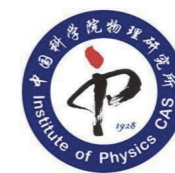
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Beijing Institute of Technology



东方钽业  
Orient Tantalum



湖南华翔  
Huanxing Meditech



中国科学院物理研究所  
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