PLASMA PROCESSES

FOR ADDITIONAL INFORMATION,
CONTACT SALES AT (256) 851-7653
OR SALES@PLASMAPROS.COM

POWDER ALLOYING & SPHEROIDIZATION

Powder Alloying & Spheroidization (PAS) transforms flaky and angular powder particles into spheres, resulting in free flowing powder feedstock with enhanced physical characteristics such as:

- Spherical Particle Shapes
- High Density
- Improved Flow
- Low Oxygen Content
- Controlled Particle Size Distribution

POWDER SPHEROIDIZATION SCHEMATIC:

PARTICLE BEFORE SPHERIODIZATION

PARTICLE AFTER SPHERIODIZATION

PAS creates alloys by combining powder particles in the molten state, forming spherical, metallurgically alloyed particles upon solidification. Each PAS sphere contains some of each element as illustrated below:

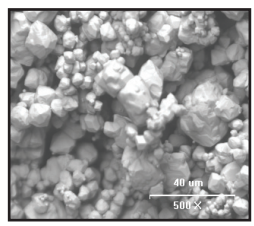
COMPARISON OF DIFFERENT POWDER ALLOY TECHNIQUES:

BLEND

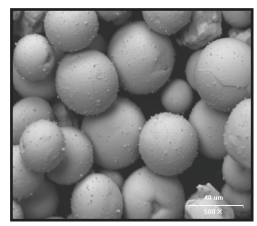
COMPOSITE

BEFORE AND AFTER COMPARISONS

TUNGSTEN POWDER

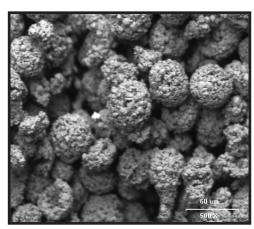


SEM backscattered image of tungsten crystalline powder with blocky, faceted powder particles.

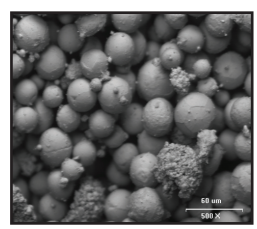


SEM backscattered image of PAS tungsten. Highly spherical particles are produced.

MOLYBDENUM POWDER

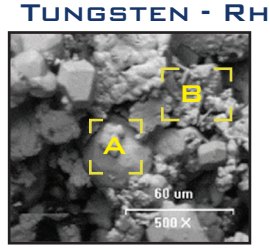


SEM backscattered image of spray-dried Mo powder. Each particle is comprised of smaller (<10 μ diameter) agglomerated particles.

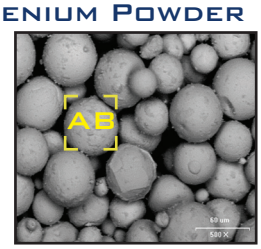


SEM backscattered image of PAS Mo powder. The agglomerated particles of feedstock have been converted to solid Mo particles, reducing overall surface area and O_2 concentration.

TUNGSTEN - RHENIUM POWDER



W-Re Blended Powder



W-Re PAS Powder

ENHANCED FLOW CHARACTERISTICS

PAS increases flow as evidenced by Hall Flow Test results on non-PAS and PAS powders per ASTM B 213. This test measures the time necessary for a given amount of powder to pass through an orifice as a result of gravity.

HALL FLOW TEST RESULTS		
COMPOSITION	FLOW (G/S)	
	BEFORE PAS	AFTER PAS
W	NO FLOW	100G/10S
W-25RE	NO FLOW	100G/10S
W-2RE	NO FLOW	100G/11S
MO	NO FLOW	50G/20S
MO-40RE	NO FLOW	100G/15S
TA	NO FLOW	110G/10S

4914 MOORES MILL ROAD • HUNTSVILLE, AL 35811 USA • (256)-851-7653 • FAX (256)-859-4134 • WWW.PLASMAPROS.COM

Powder Alloying & Spheroidization

PAS Material Feedstock

Virtually any powder or powder alloy that melts can be processed through PAS. Feedstock can include crystalline, spray-dried, blended, agglomerated and composite powders. All PAS powders typically have spherical / dense particles with good flow characteristics and a reduction in trace elements, as compared to feedstock.

Chemical Analysis

Glow discharge mass spectroscopy and Leco carbon/oxygen analysis confirm decreases in trace elements for PAS powders in comparison to feedstock. Of particular note is the two-order magnitude decrease in oxygen content after PAS.

Trace Element Chemical Analysis of Mo-40Re Powder

Element	Before PAS	After PAS
C	82	53
O	13,000	400
Al	100.0	35.0
Si	145.0	42.0
P	13.0	6.2
Ca	124.0	27.0
Ti	34.0	6.8
Cr	70.0	19.0
Fe	490.0	265.0
Ni	50.0	24.0
Ta	600.0	<5
Mg	9.3	<5
Mn	11	<5
Cu	12	<5
Zr	5.9	<5
Ba	<10	<5
All values expressed in ppmw.		

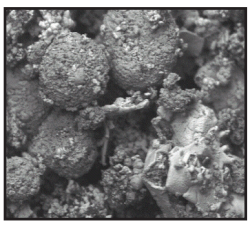
PAS Refractory Metal Alloying

The degree of PAS alloying depends upon the type of starting material. Composite powders processed by PAS can result in complete alloying of individual particles. Blended and agglomerated powders can result in partial alloying.

Before and after Comparisons of Refractory Metal Alloy Powders

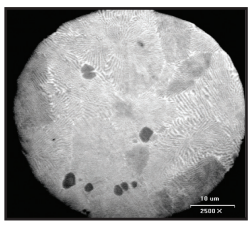
Mo-40Re Agglomerated Powder

Before PAS

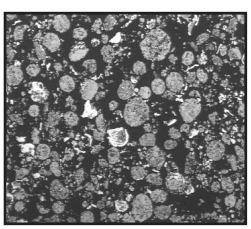


Before: SEM images of agglomerated Mo-40Re powder illustrating porosity of Mo particles.

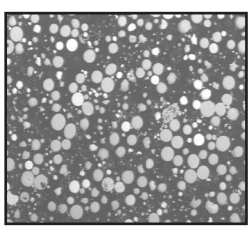
After PAS



After: High magnification image (2500x) of PAS Mo-40Re particle containing both Mo & Re.



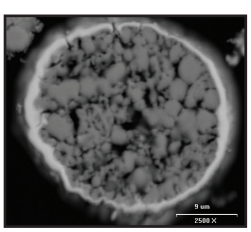
Before: Cross sectional view shows non-uniform contact of Re flakes with spray dried Mo particles.



After: Cross sectional view exhibits highly spherical, dense particles with uniform distribution.

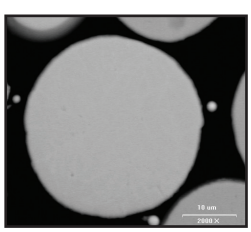
Mo-40Re Composite Powder

Before PAS



Before: SEM backscattered cross-sectional view of an unalloyed Mo particle (dark gray middle region) coated with Re (bright outer layer).

After PAS



After: SEM backscattered cross-sectional view showing the same material after PAS processing. The lack of color contrast denotes complete alloying of the Re coating with the Mo center to form a true Mo-Re alloy.

4914 Moores Mill Road • Huntsville, AL 35811 USA • (256)-851-7653 • fax (256)-859-4134 • www.plasmapros.com