

# ULTRAMET

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## CORE COMPETENCY

Chemical vapor deposition of refractory and platinum group metals and ceramics for use in extreme thermal, chemical, and mechanical environments

2745 1500																	4275 1500
Be Beryllium																	B Boron
12 24																	13 27
Mg Magnesium																	Al Aluminum
20 40	21 45	22 48	23 51	24 52	25 55	26 56	27 59	28 59	29 64	30 65	31 70						
Ca Calcium	Sc Scandium	Ti Titanium	V Vanadium	Cr Chromium	Mn Manganese	Fe Iron	Co Cobalt	Ni Nickel	Cu Copper	Zn Zinc	Ga Gallium						
38 88	39 89	40 91	41 93	42 98	43 98	44 101	45 103	46 106	47 108	48 112	49 115						
Sr Strontium	Y Yttrium	Zr Zirconium	Nb Niobium	Mo Molybdenum	Tc Technetium	Ru Ruthenium	Rh Rhodium	Pd Palladium	Ag Silver	Cd Cadmium	In Indium						
56 137	57 139	72 178	73 181	74 184	75 187	76 190	77 192	78 195	79 197	80 201	81 204						
Ba Barium	La Lanthanum	Hf Hafnium	Ta Tantalum	W Tungsten	Re Rhenium	Os Osmium	Ir Iridium	Pt Platinum	Au Gold	Hg Mercury	Tl Thallium						
88 226	89 227																
Ra Radium	Ac Actinium																



Refractory Metals    Platinum Group Metals

## KEY POINTS OF CONTACT

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## KEY PROJECTS OR PRODUCTS

- Freestanding refractory metal components
- Open-cell refractory metal and ceramic foams
- Ceramic and metal matrix composites
- Protective coatings
- Hypersonic materials

### Key markets

Aerospace | Defense | Orthopedic implants | Energy

### Applications

- Propulsion
- Thermal management at ultrahigh temperatures
- Structural thermal protection systems
- Heat sinks
- Ablators
- Insulators
- Cryogenic insulation and heat exchangers

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**NASA Parker Solar Probe**

**2500 °F**

**85 °F**  
HEAT SHIELD

YES, THIS THIN!

Parker Solar Probe facing the Sun

Sun side: 2500 °F

4 1/2"

STRUCTURAL CARBON FOAM

~8' diameter x 4 1/2"

97% void space ("air")

Payload side: 85 °F

ULTRAMET  
ADVANCED MATERIALS SOLUTIONS

*In space now—launched August 2018*

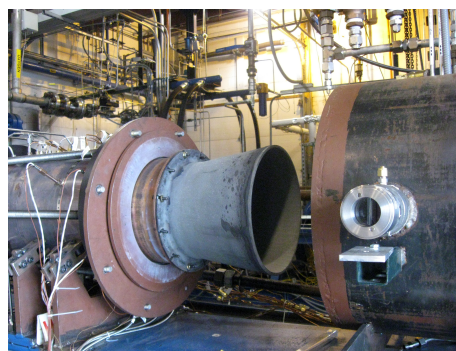
*“... the heat shield works so well that we had to put some of the heaters on for the instruments, even at closest approach.”*

—NASA spokesperson briefing on performance of Parker Solar Probe in its first fly-by of the Sun, Nov 2018.



>120 IN SPACE!

Iridium-lined rhenium combustion chambers for high-performance liquid rocket engines



Hot-fire test of CMC-lined C/C nozzle extension at ATK; maximum ID 11.36"

Ultramet carbon foam forms the core of the heat shield on the Parker Solar Probe.