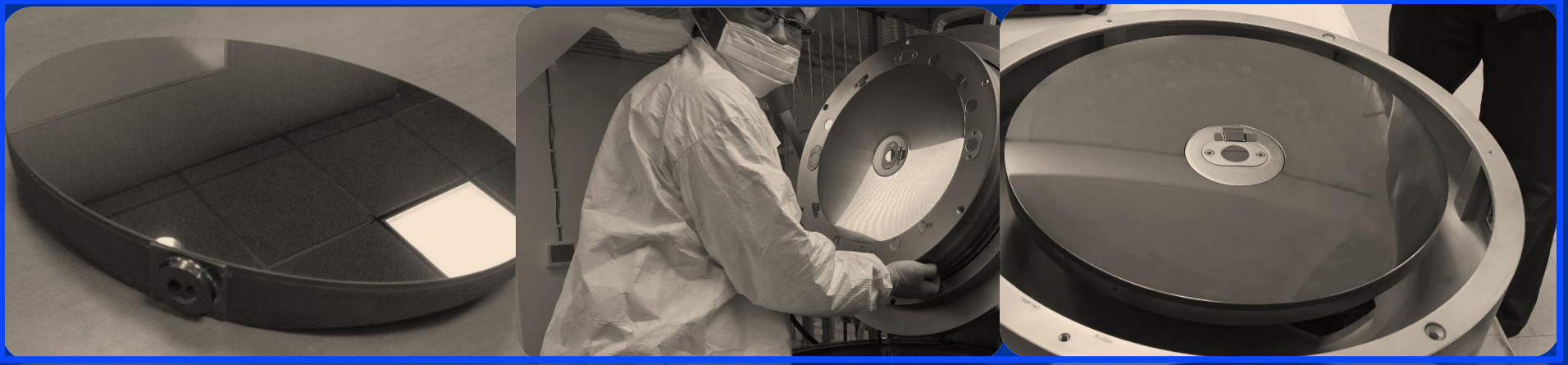
Surmet Corporation

Commercialization of Si Cladding Technology that Enables Precision Finishing of SiC Mirrors



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Engineering Better Material Solutions™

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Outline

About us

Capabilities

Amorphous Si Claddings for SiC Mirrors

Accomplishments in the Field

Q&A

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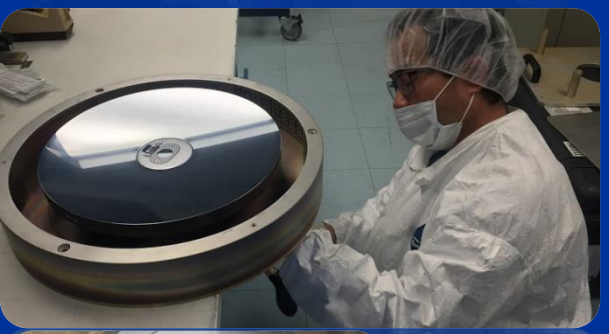
Ultrahigh Purity Amorphous Silicon Cladding - enable precision finishing of SiC mirrors



Low temperature Plasma Assisted process:

- Cladding thickness up to 100 microns
- Multiple coating chambers in place
- Applied at very low temperatures, <150°F
- Conformal coating, can coat 3-D non-flat shapes including lenses, and domes
- Current size capability is 40-in diameter but can be scaled up to even larger sizes
- Cladding applied onto variety of SiC substrates
- Cladding finished to tight optical specifications – 0.012 waves TWFE achieved

Surmet is reliably supplying such Si-claddings to Space Telescope Systems Integrators

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About us

Globally Recognized Technology Based

US Small Business Enterprise

Founded 35 years ago on a Simple Principle:

Today's Materials Aren't Adequate to Meet The Challenges Of Tomorrow's Machines, Devices and Systems

Our Focus: Take Laboratory Inventions to The Production Floor

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About us

Recipient of Multiple Prestigious Awards

2013 - ACerS Corporate Technical Achievement Award

Successful scale-up and commercialization of ALON® Transparent Ceramics

2016 - The Defense Manufacturing Technology Achievement Award

For ALON® Transparent Ceramic Scale-up Efforts

2017 - ACerS Medal for Leadership in Advancement of Ceramic Technology

Surmet's Founder Dr. Suri Sastri was recognized for his vision, leadership and entrepreneurship in successfully developing and commercializing transparent polycrystalline ceramics

About us - Facilities

- **Burlington, MA:**
  - Surmet Headquarters (6,500 sq ft)
  - R&D Facility (7,000 sq ft)
  - Manufacturing Facility (8,000 sq ft)
- **Buffalo, NY (75,000 sq ft) Powder production and Advanced Ceramics Manufacturing**
- **Murrieta, CA (6,250 sq ft) For Fabrication of Precision Optics Components**

ISO-9001 Certified Quality System

ITAR Compliance Implemented

SECRET Level Facility Clearance

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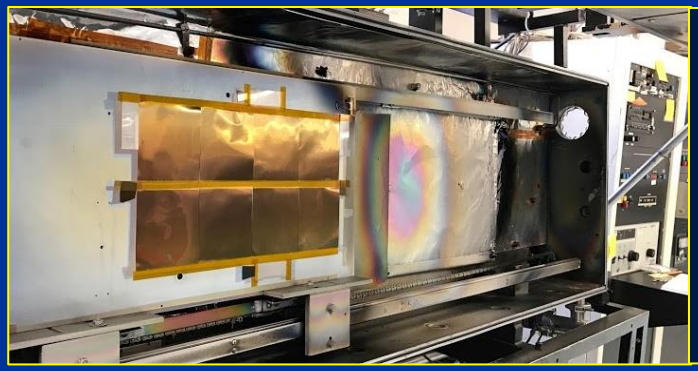
Vertically Integrated Optics Manufacturer

Capabilities

Advanced Coating Technologies

PA-CVD Technologies:

- Mirror tech - **UHP Amorphous Silicon**
- Wear-resistant hard protective coatings
- Anti-Reflection Coatings
- Hard, Scratch-resistant Transparent Coatings



PVD Technologies:

Metals, Amorphous Oxides, Nitrides and Oxy-nitrides

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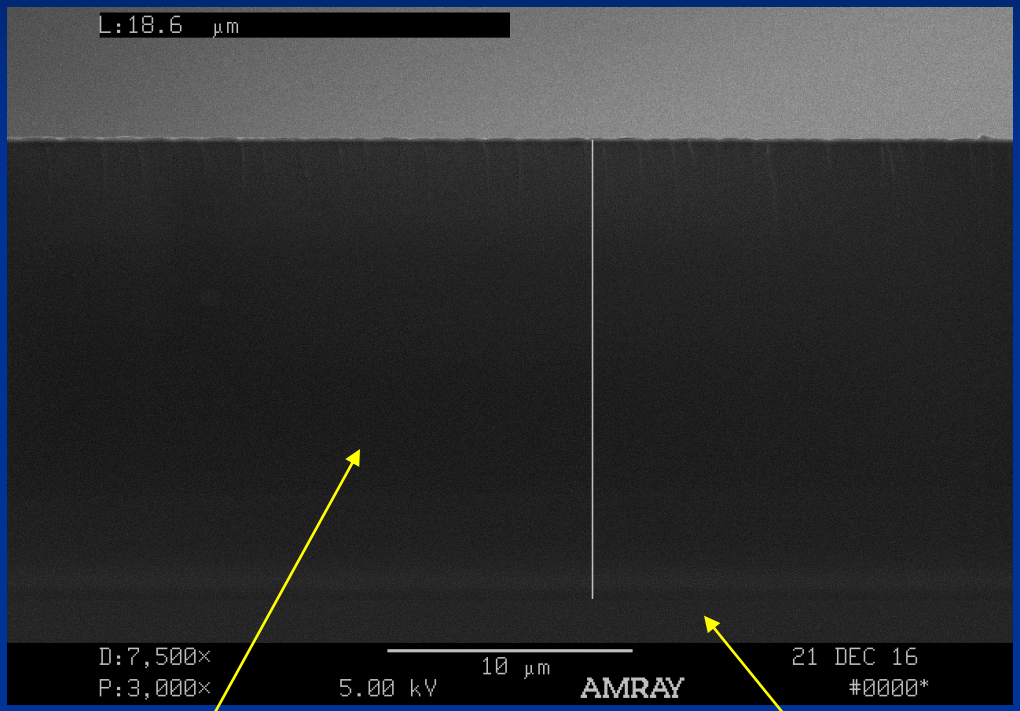
Capabilities

Advanced Coating Technologies



Cross section of Surmet's 18.6 µm Amorphous Silicon

Si Substrate

- **UHP Amorphous Silicon**
  - Featureless, Amorphous
  - Strongly Adherent
  - Ultra-homogeneous
  - Applicable onto variety of substrates
  - High Purity
  - Very Low Deposition Temperatures
  - Diamond-turnable and Polishable via Magneto-Rheological Finishing
  - Achieved wave-front error as low as **0.015 λ RMS**

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Capabilities - UHP Amorphous Silicon

Enables Finishing of SiC Mirror Substrates*

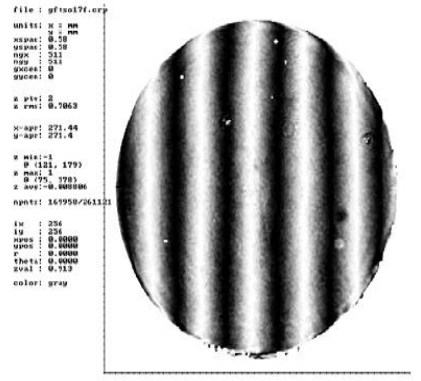
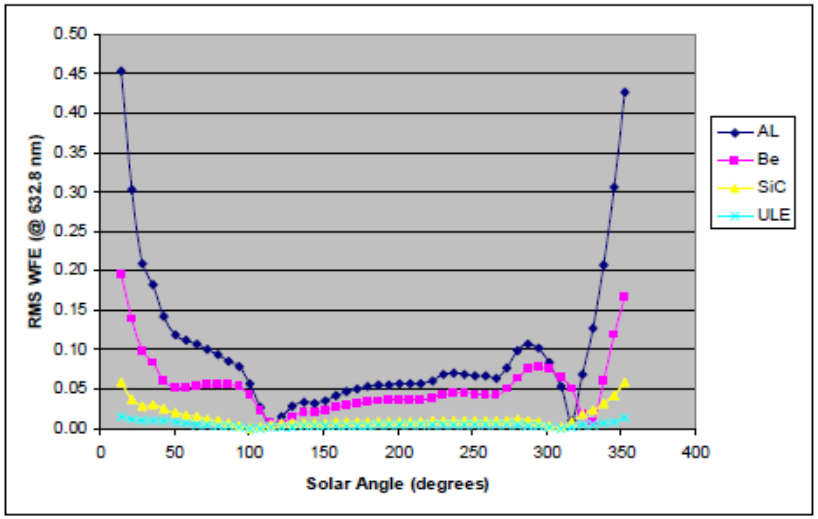


Fig 6. Interferogram from Silicon Coated SiC Aspheric Optic (0.012 λ RMS)

Fig 7. Photo of Silicon Coated SiC Aspl Finished Optic



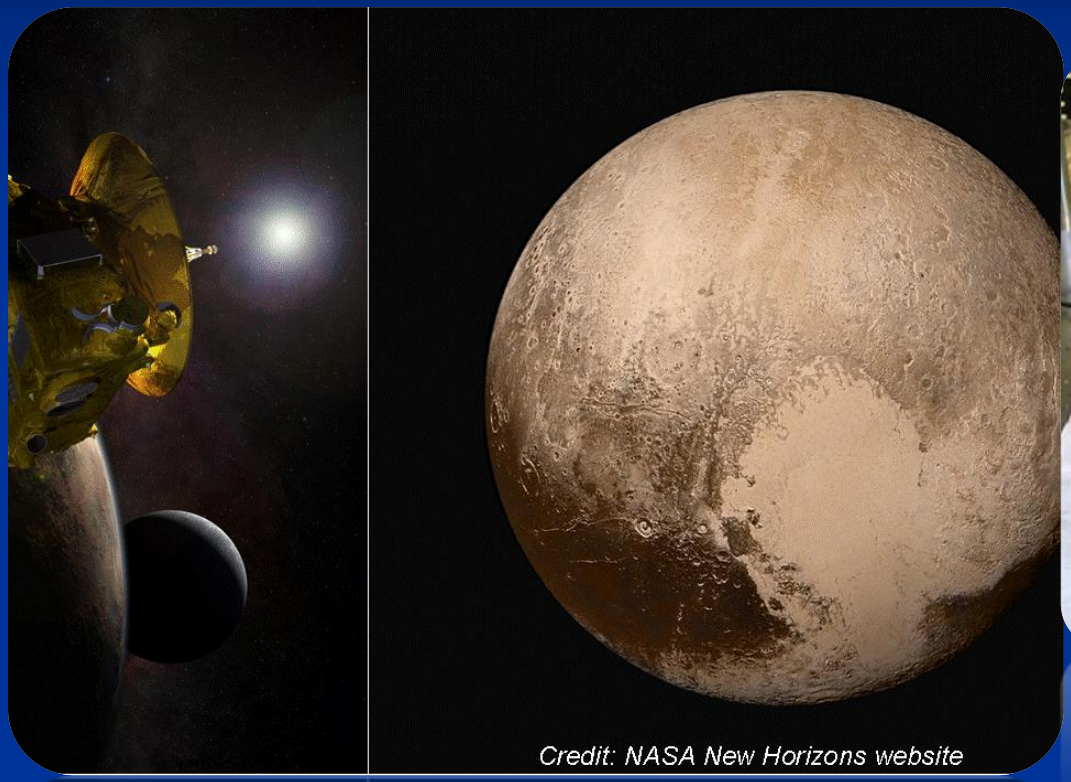
RMS Wavefront Errors (primary mirror only) as a function of solar loading angle for different primary mirror materials

- SiC appears to be material of choice for Polishing of SiC optics has been a challenge, primarily due to the material's slow removal rate.
- Thin Silicon cladding to the SiC optical component solves this issue. The cladding allows for optical finishing, being ductile enough to be diamond turned, and readily post-polished.
- Above Figures shows an interferogram obtained from an off-axis parabolic optical surface (Mirror shown in the above figure as well). This piece has been Si clad, diamond turned, and subsequently post-polished to 0.012 waves.

**Robichaud, et. al; "SiC Optics of SSA and Responsive Space Needs", 2008*

Accomplishments

Surmet Si Cladding Enabled Precision Finishing of SiC Mirrors in LORRI Telescope for NASA's New Horizon Pluto Mission



Surmet's coating technology enabled the precise surfaces to be machined onto the imaging surfaces of New Horizon's Probe that photographed Pluto

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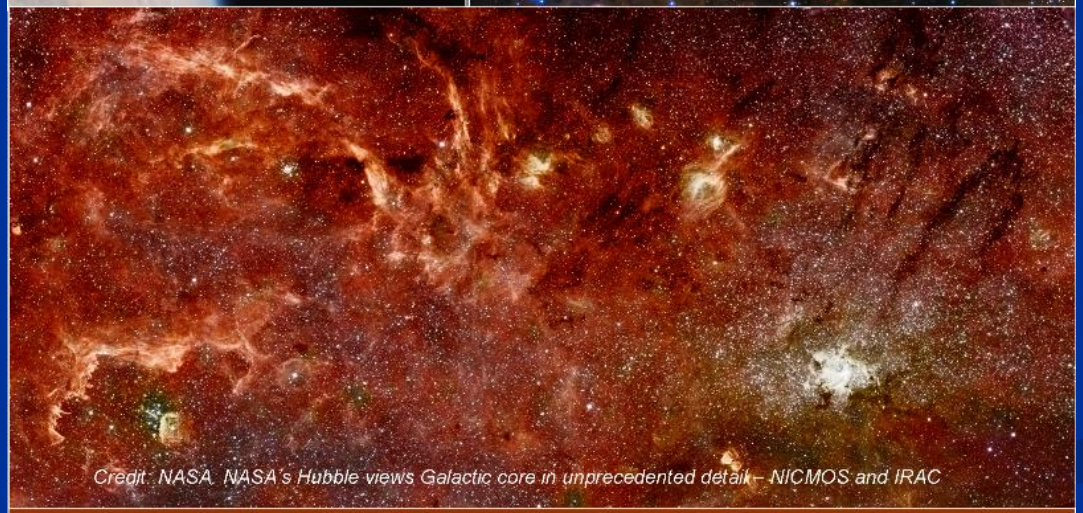
Accomplishments

NASA's Hubble

- In 2003, Surmet provided the enabling UltraC diamond-like carbon (DLC) coating technology for the Titanium Cryo-cooler component of the Infrared imaging sensors (NICMOS) in the Hubble Telescope.
- The coating made possible near frictionless performance by the Cryo-cooler, at a super high 6000 to 8000 rpm, for years on end helping to bring in astounding images from the edge of the observable Universe

Credit: Hubble_telescope_2009_By NASA Public domain, via Wikimedia Commons

NASA's Hubble 25th anniversary photo, credit: NASA



Credit: NASA, NASA's Hubble views Galactic core in unprecedented detail – NICMOS and IRAC

Surmet provided ultraC coated components for the Cryocooler, which was installed on ***Hubble***'s *NICMOS* (that took some of these unprecedented images of *Galactic Core*)

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Vertically Integrated Manufacturer of

ALON® and Spinel Vis-MWIR Precision Optics

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How can we help?

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