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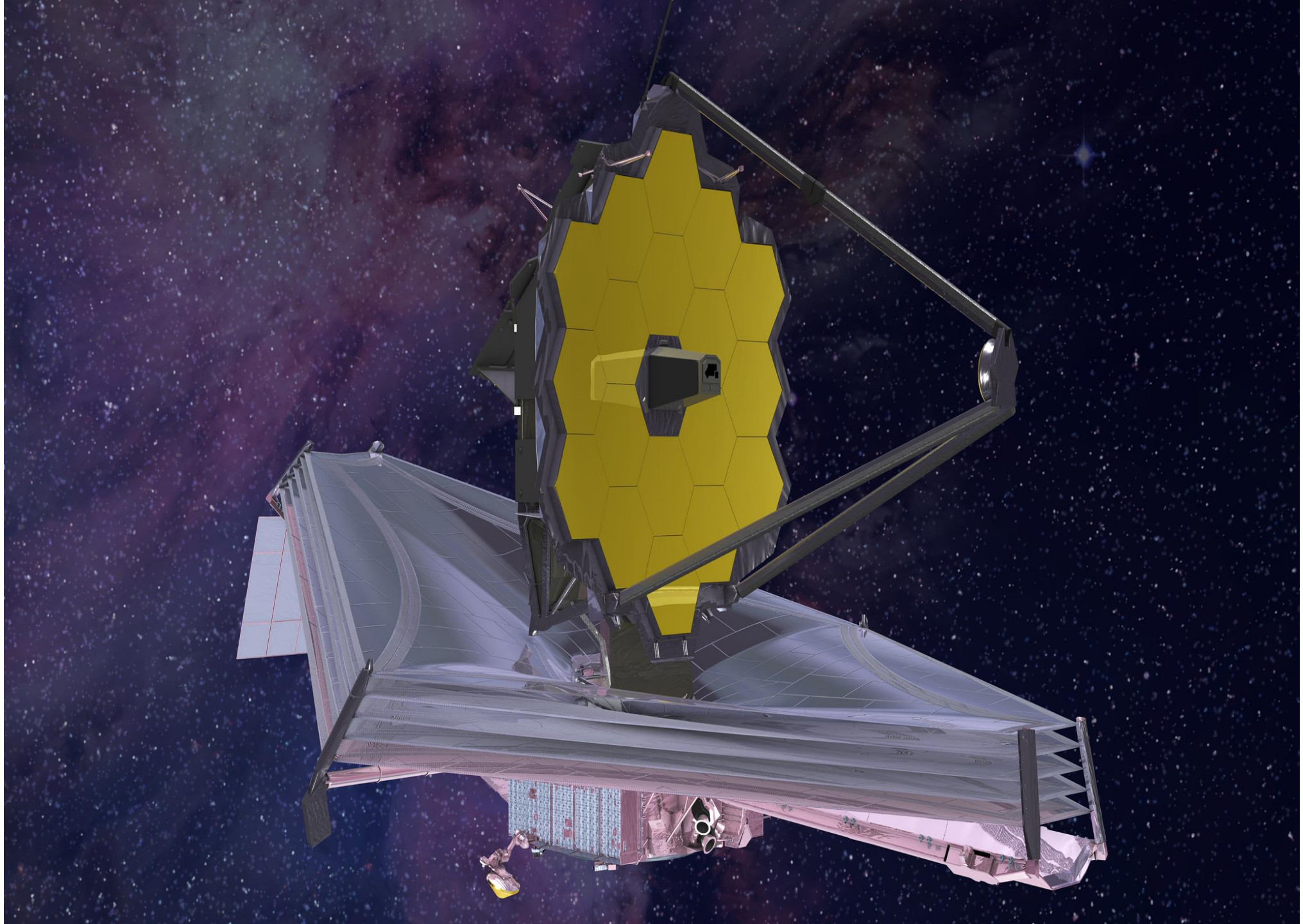
AOA Xinetics
Toxic Use Reduction Efforts

Jack Flynn
EHS Manager



James Webb Space Telescope

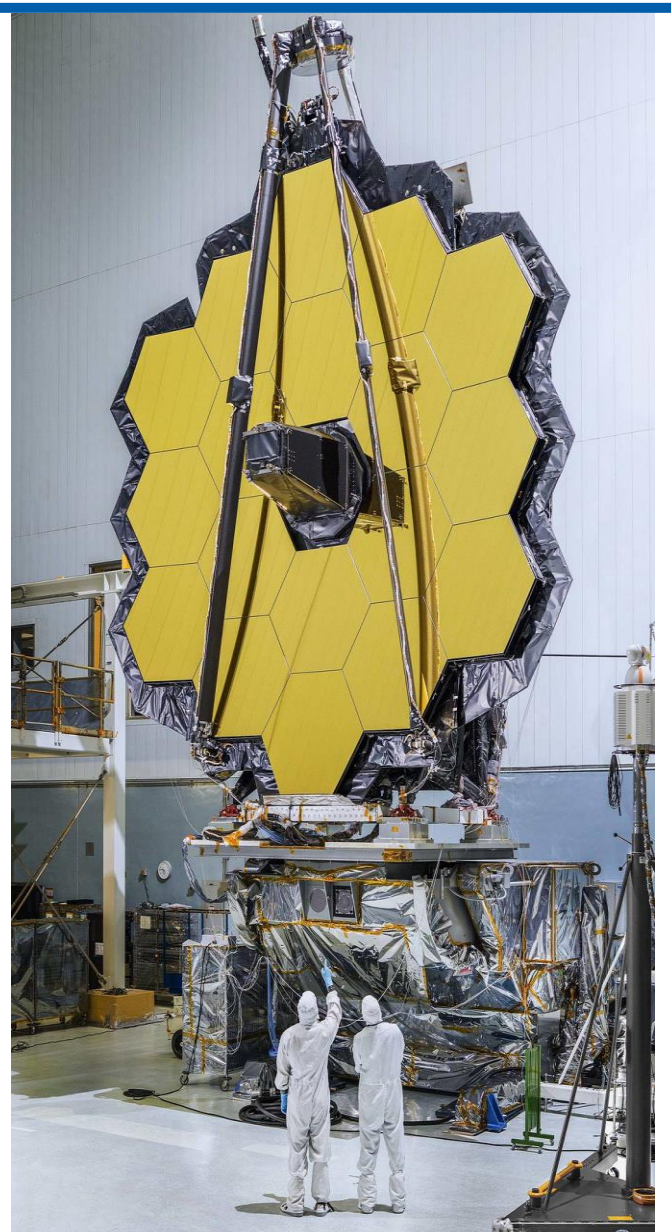
The James Webb Space Telescope is a large infrared telescope with a 6.5-meter primary mirror. The telescope was launched on December 25, 2021.

The James Webb Space Telescope will be the premier observatory of the next decade, serving thousands of astronomers worldwide. It will study every phase in the history of our Universe, ranging from the first luminous glows after the Big Bang, to the formation of solar systems capable of supporting life on planets like Earth, to the evolution of our own Solar System.

James Webb Space Telescope

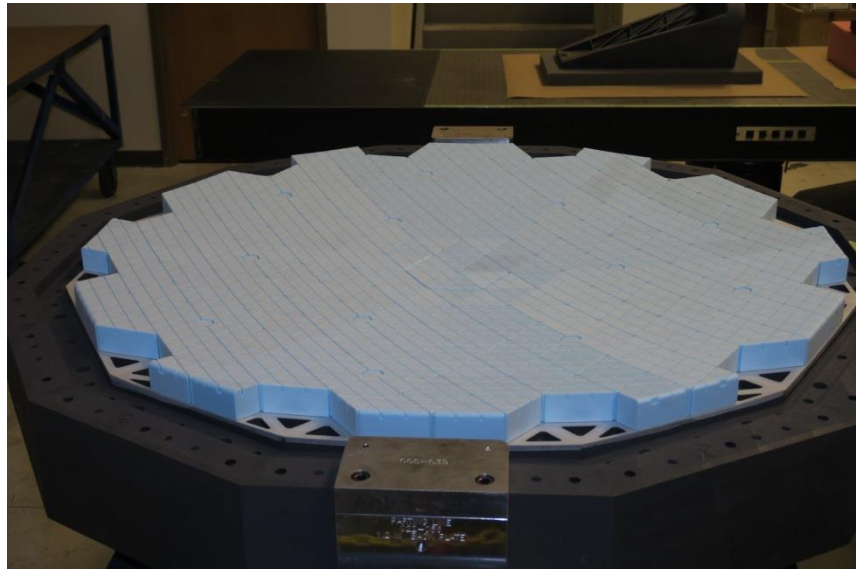
- Primary Mirror is made of Beryllium
- 6.5 meters (21 feet 4 inches) across
- Comprised of 18 hexagonal-shaped mirror segments 1.32 meters (4.3 feet) in diameter
- Manufacturing took nine years and involved the segments being transported to 11 different locations to complete
- Special care has to be taken when working with beryllium due to its toxicity

A need to research other materials and methods of manufacturing mirrors to reduce the cost of future missions was identified. AOA Xinetics was researching light weight Silicon Carbide mirrors for aerospace applications and was contracted to continue this research.



CERAFORM Silicon Carbide Process

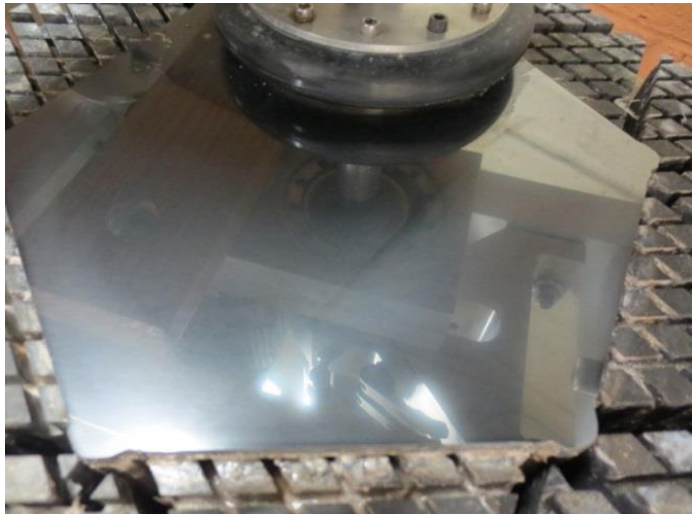
- AOA Xinetics manufactures our Silicon Carbide mirrors by a lost mold casting process.
- A mold is CNC machined from graphite and foam
- A proprietary Silicon Carbide slip is dispensed into the mold.
- The mold is placed in a -80C freezer for freeze drying
- Methylene Chloride is used to dissolve the foam core

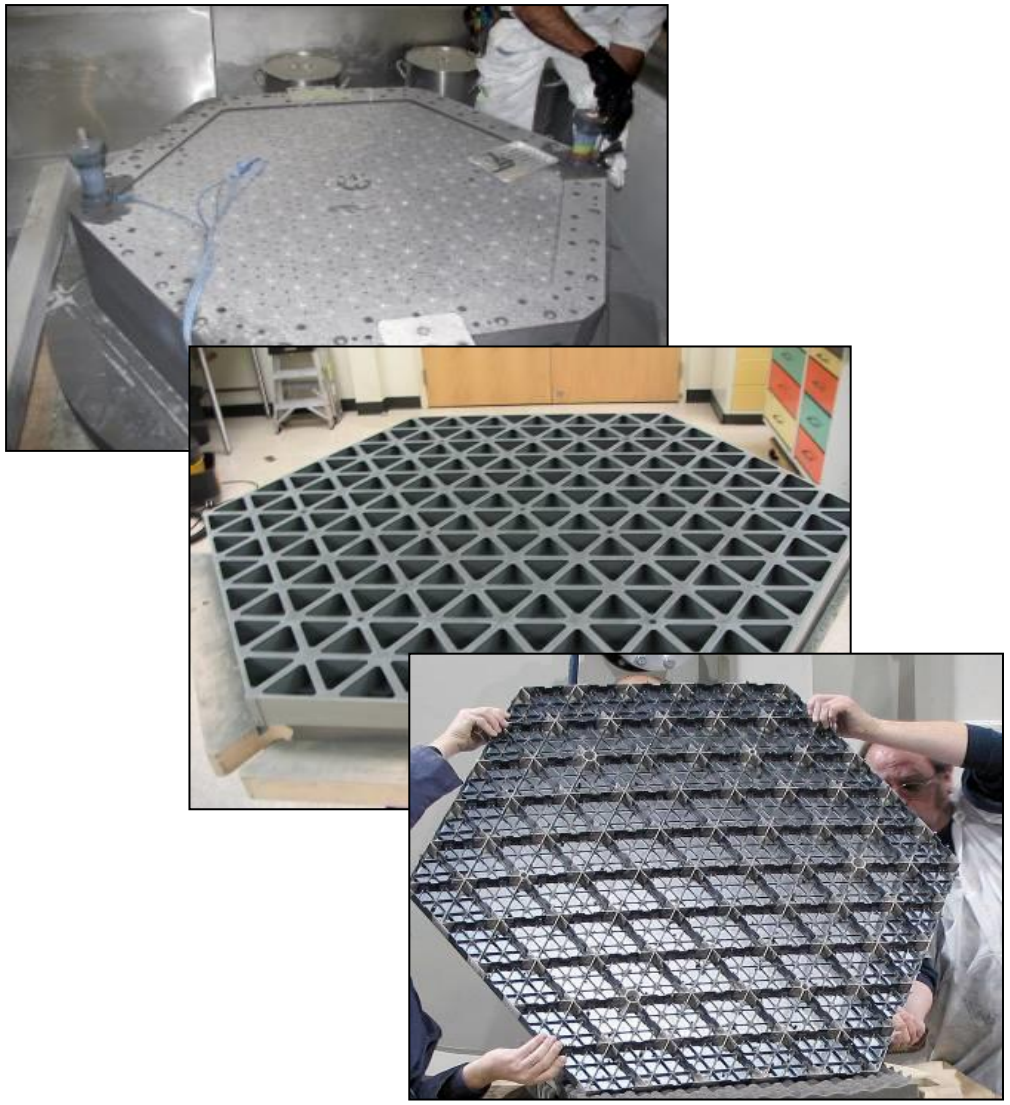


During the project to research large mirror segments, 4-6 mirror segments were manufactured each year. Methylene chloride would be used for one day per mirror segment. Annual usage of methylene chloride averaged 5,000 pounds per year. This was before methylene chloride was designated as a higher hazard substance. The last few years AOX has been focused on constructing smaller mirrors. Annual usage has been below the 1,000-pound threshold.

Construction of large mirrors may resume in the future based on customer requirements.

Large, Lightweight Mirror Manufacturing at AOX





Methylene Chloride is poured into mold to dissolve foam mold

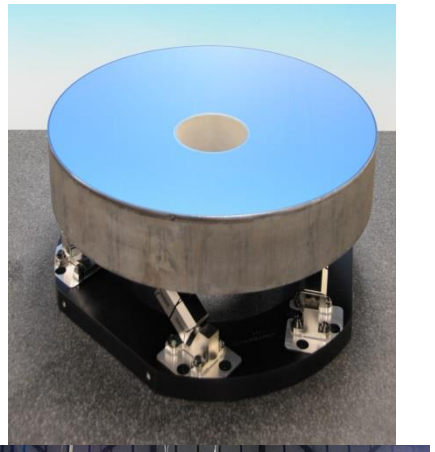
UMass Lowell's PICTURE-B Project

- PICTURE-B (Planet Imaging Coronagraphic Technology Using a Reconfigurable Experimental Base) mission of the Lowell Center for Space Science and Technology at the University of Massachusetts Lowell successfully launched and returned to Earth on Nov. 25, 2015 from NASA's White Sands, New Mexico Test Facility.

- Mission was designed to measure light reflected by dust in debris disks around nearby stars.

- 58 cm diameter silicon carbide mirror successfully withstood launch and impact on landing, and will be used for future missions

- Mirror survived an estimated 100g's during landing – well above design criteria



AOA Xinetics Toxic Use Reduction Efforts

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Input substitution

- Substitutes for methylene chloride must:
  - have a freezing point below -80° C
  - dissolve foam rapidly
  - not flammable
  - be less toxic than methylene chloride
- The large freezers that are currently used are not rated for use with flammable liquids.

Expanding SiC Capability – Additive Manufacturing
3D Printing

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- Have demonstrated equivalent material properties as compared to the current state of the art Ceraform Fugitive Core Casting
- Final Component Design to Forming time reduced from 6 to 8 weeks to 1 day
- Green forming time reduced from 2 weeks to 2 days
- Reduction in number of operators required to produce green formed component’
- Multiple parts can be printed concurrently
- Larger flexibility in geometric features

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