

# ***Comments on Application of CFRP Technology***

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Large Submillimeter Atacama

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## ***Motivation***

- low total weight
- low CTE
- high strength-to-weight
- Custom design of isotropy

# Application areas

- Reflector surface panels
- Backup structure
- Measuring tools and reference

## SMTO CFRP Reflector

- CFRP Tubes
- Invar node
- Panels
  - CFRP
  - Al core



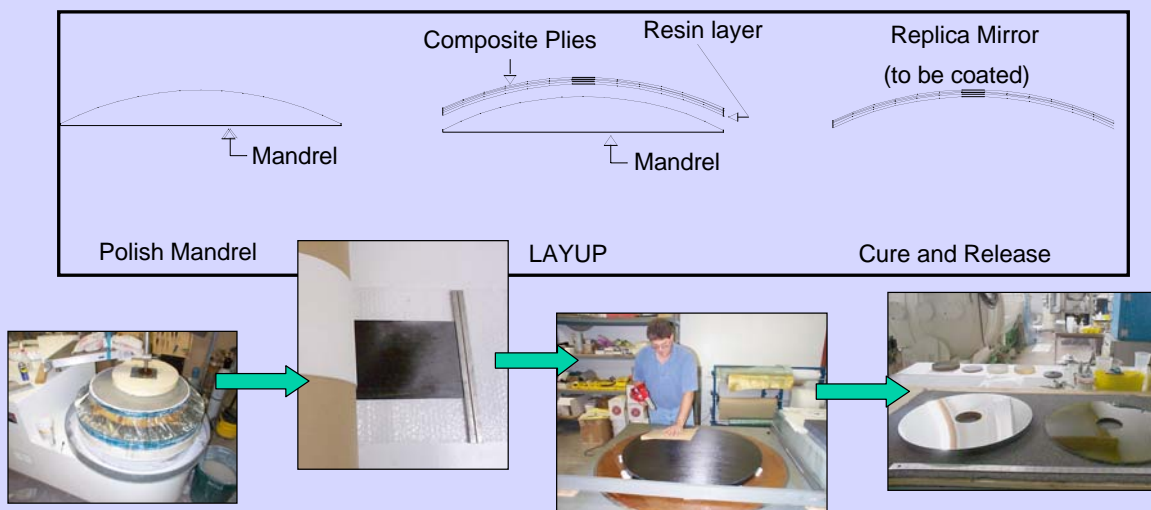
# CFRP OPTICS

- Used for 20 years now at mm and submm for panels.
- Accurate replication now moving into optical wavelengths. Problems encountered are print-through surface errors at the 100nm level.
- Ideal technology now for IR and radio wavelengths.
- Areal density of panels at 10-15 Kg/m<sup>2</sup>

## Mirror Fabrication Surface Transfer

- What are Composite Mirrors?

Carbon Fiber Reinforced Plastic Composite material  
Molded over an Optical Quality Mold



# *APEX Chopping Secondary*

- Aluminum tooling
- 6 micron molds; 7 micron final surfaces
- Mostly CFRP structure.



# *Example of Submm optics*

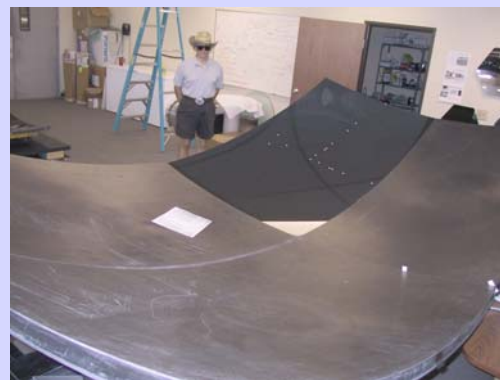
- Aluminum mold
- 1 micron rms
- all CFRP design



# 0.4m prototype OTA for ULTRA



# Example of Flight Simulator Mirrors



## ***COSTS***

- Wide range in CFRP material cost. \$10 to over \$500 per pound.
- CFRP has come down in cost.
- Price of steel, concrete and other building materials has escalated considerably in recent years.
- Labor and hand work are cost driver? But that is also true of custom metal work.

## ***DESIGNING WITH CFRP***

- Various forms of pre-preg. Woven vs. uni-directional.
- Flexibility in tailoring lay-up to use.
- Don't just use CFRP as a "black material" substitute for metal.
- Flexible in structural forms – sandwich panels, for example.
- Tooling/molds important in the design.
- Can tailor the CTE of uni-directional fiber layups.

# ***CFRP ADVANTAGES***

for surfaces and structures

- High strength-to-weight ratio
- High thermal conductivity
- Low CTE
- Low total mass and thus low thermal mass.

# ***CFRP DISADVANTAGES***

- Custom design work.
- Hand/craftmanship work.
- Experience valuable for success.
- Not yet a technology for blind bidding and purchasing.