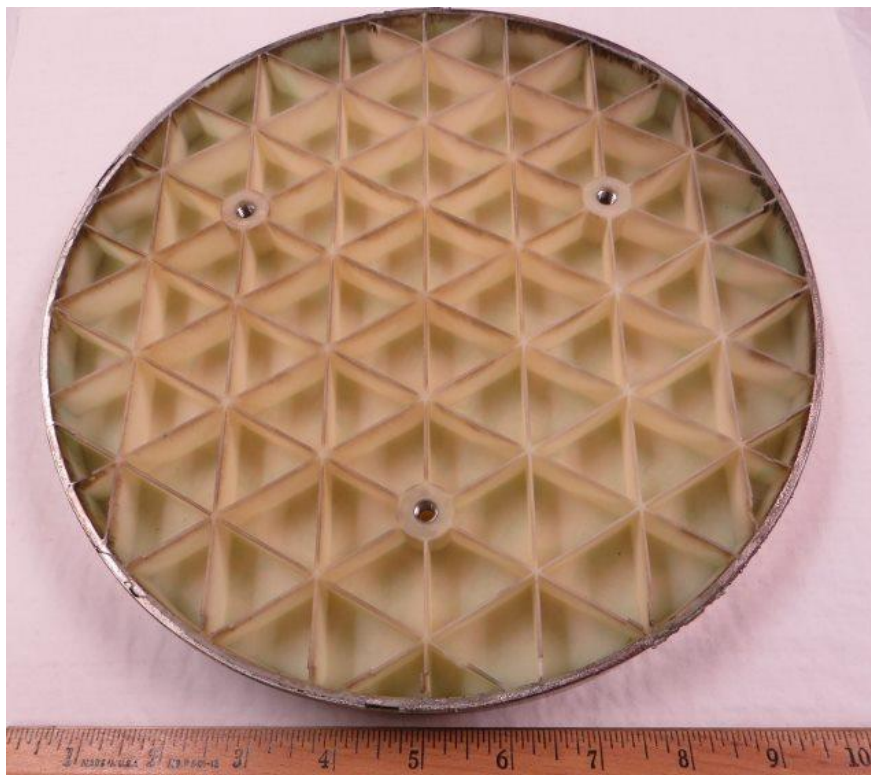


Additive manufacturing of lightweighted mirrors



Ron Eng

Mirror Tech Days

Nov 2015

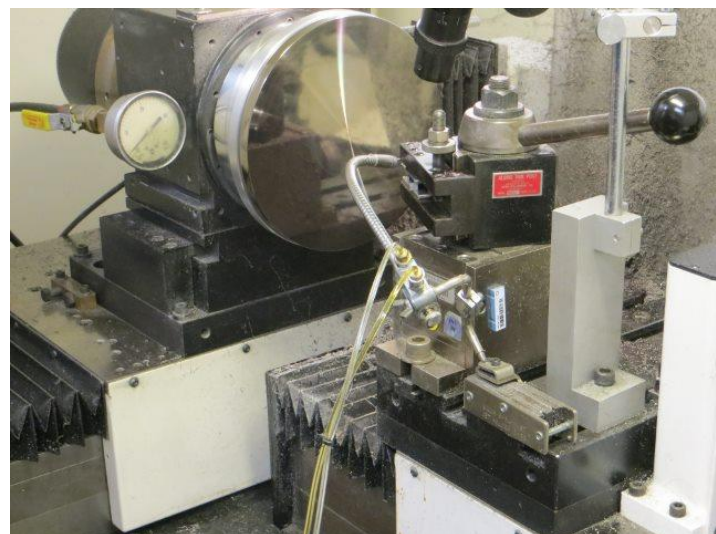
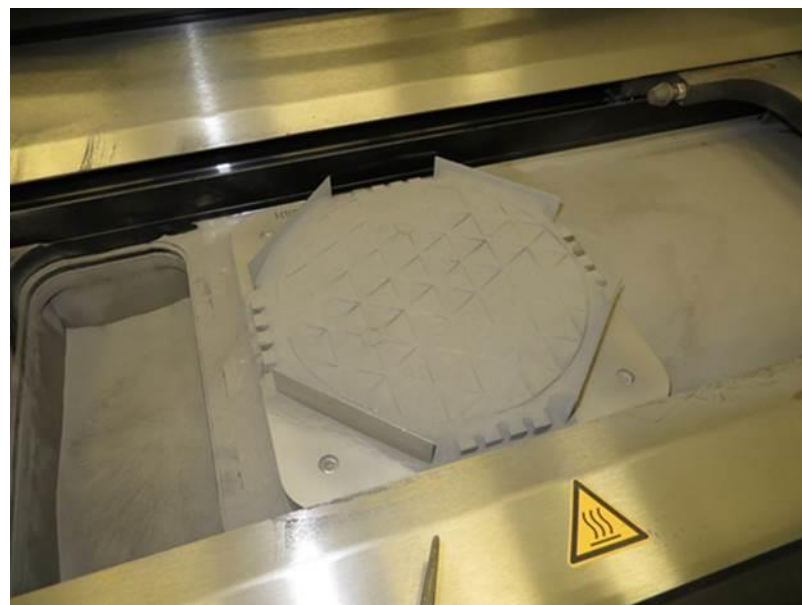
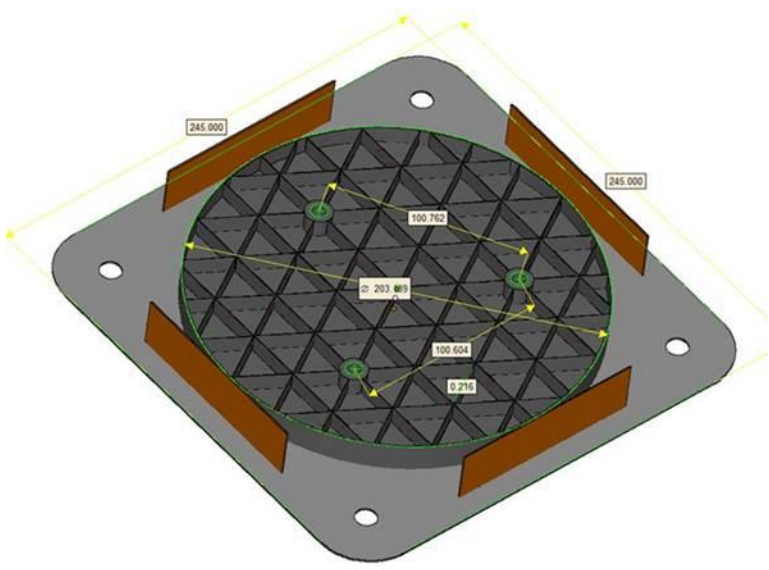


Motivation

- 3D printers for metal alloys and thermoplastics
- Enables complex shapes and freeform fabrication
- Electrolytic Nickel Phosphorus (NiP) deposition
- Single-point diamond turning (SPDT) capability
- Low cost prototype and engineering model



200mm Inconel 716 mirror

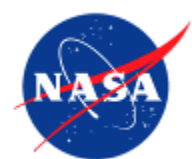




Concept Laser Xline 1000R printer



Selective laser sintering
630 x 400 x 500 mm
Nickel based alloy (Inconel 718)
Aluminum alloy (AlSi10Mg)
Titanium alloy (TiAl6V4 ELI)



Stratasys 3D thermoplastic printers



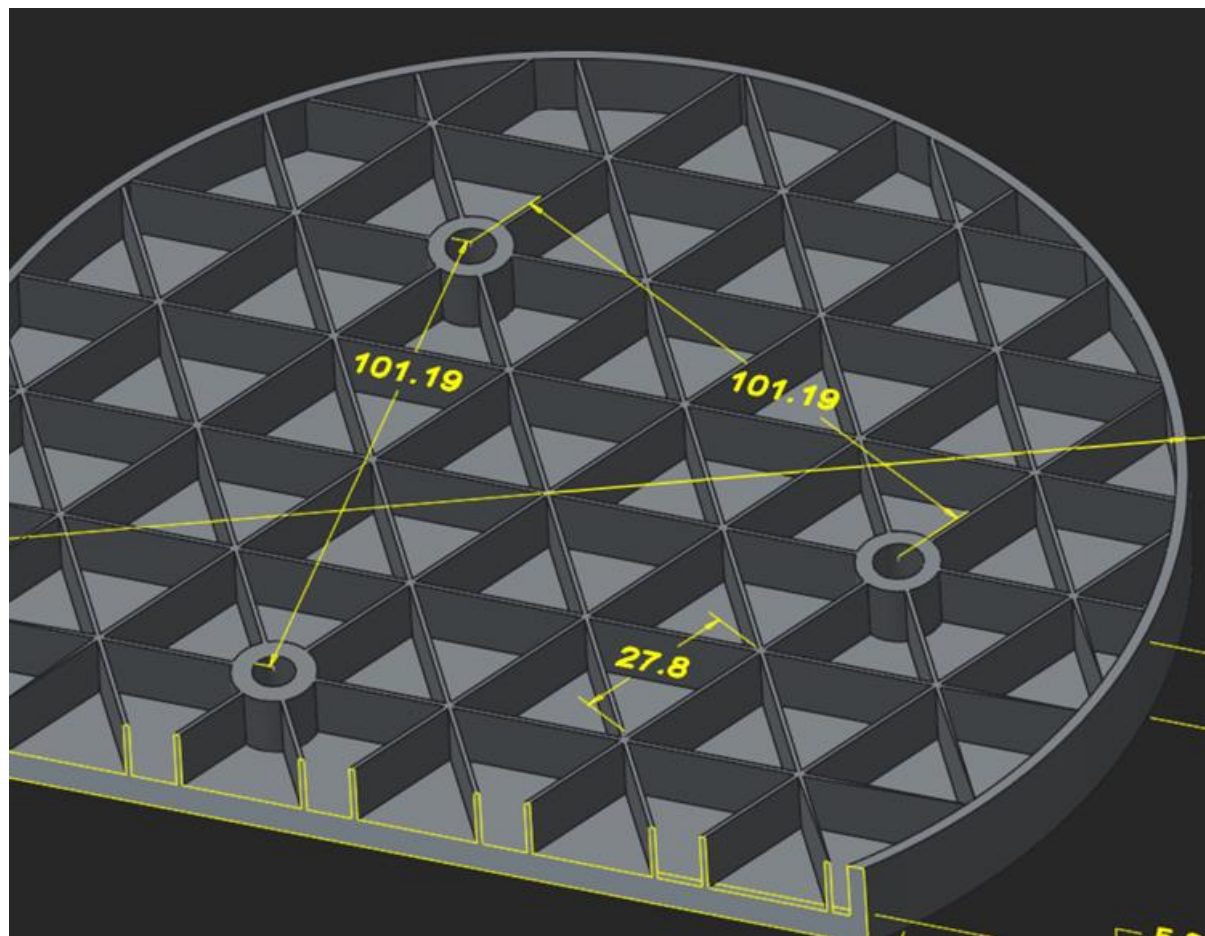
Fortus 360mc
355 x 254 x 254 mm



Fortus 900mc
914 x 610 x 914 mm



250 mm lightweight mirror design



250 mm diameter

25 mm thick

6.35 mm facesheet

4064 mm ROC

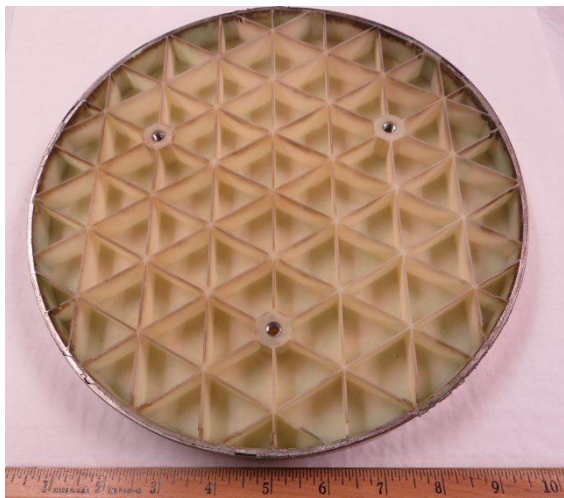
64% lightweighted

< 0.5 kg

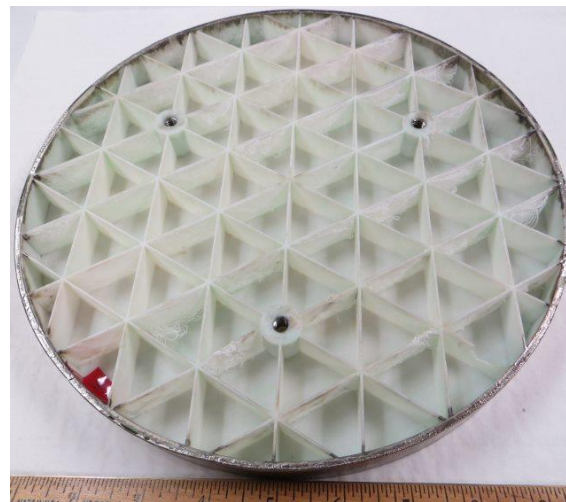
3 helicoil inserts for
SPDT



250mm 3D printed mirrors



ABS



polycarbonate

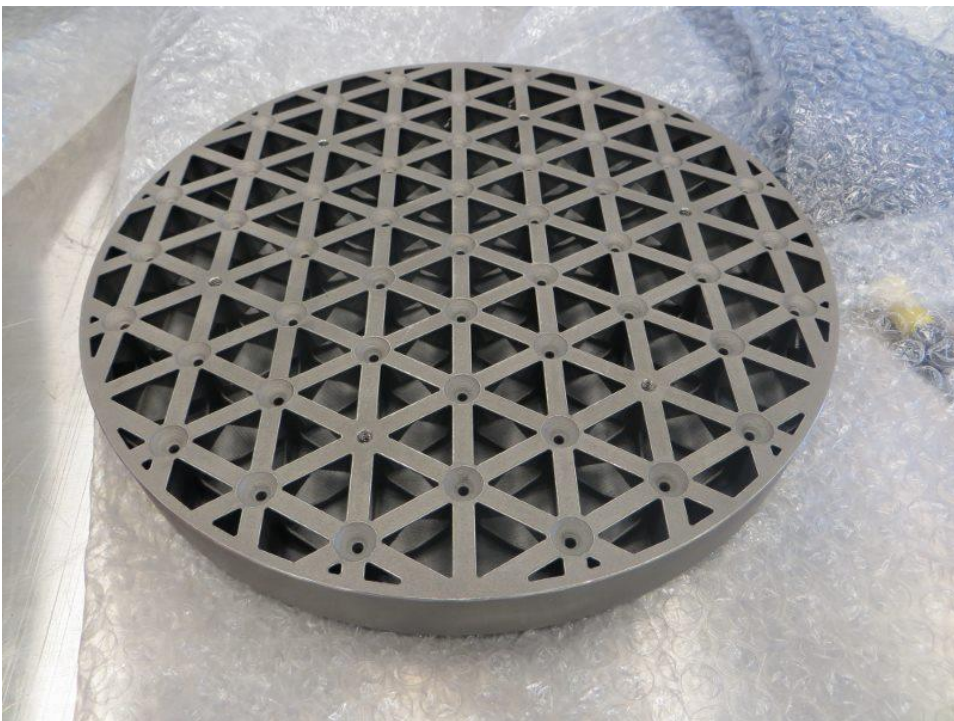


Printed with Fortus 360mc
~0.5 mm NiP
Ready for SPDT



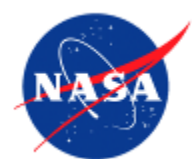
SBIR funded work

- Additive manufacturing was added to SBIR subtopic S2.03 – Advanced Optical Systems and Fabrication/Testing/Control Technologies for EUV/Optical and IR Telescope
- 4 out of 10 phase 1 proposals involve 3D printed optics
- 3 out of 5 phase 1 awards



12" dia. Inconel 718 mirror

Dallas Optical Systems, Inc.



Future plan

Low cost engineering model for a balloon borne UVOIR telescope

- >500 mm diameter thermoplastic primary mirror
- Secondary mirror
- NiP/SPDT for mirror surfaces
- Metal components for truss fittings and telescope mount
- Off-the-shelf carbon fiber composite tubes

Engineering evaluation for:

- Stray light suppression
- Assembly procedures at launch site
- Disassembly after landing
- Transportation to launch/from landing site