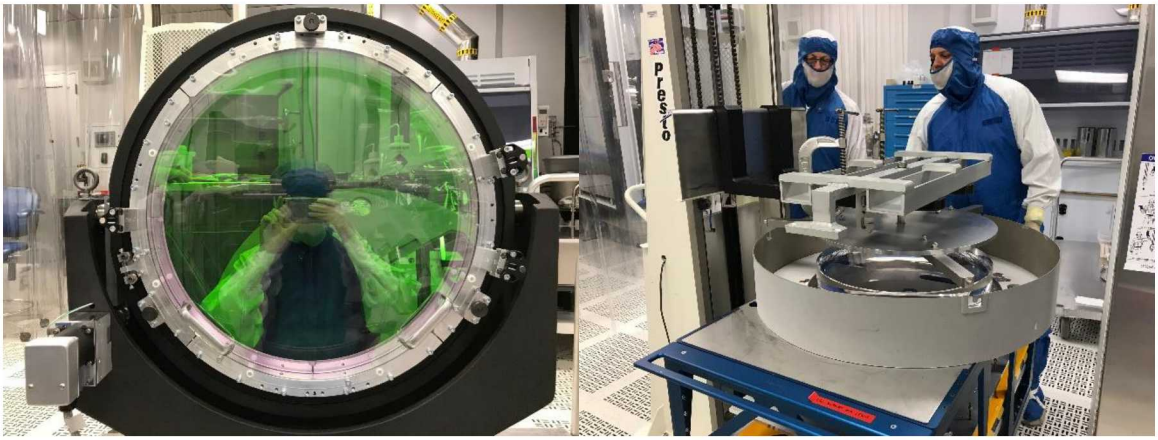
SAND2020-0246R

# CY2019 Annual Summary of Optical Coating Activities in Org 1682

Prepared by: Ella Field, efield@sandia.gov, 505-284-3091

## The Coating Team:




Ella Field (Team Lead), Damon Kletecka (Lead Technician), Robert Speas (Technician), and Anthony Smith (Student Intern, not pictured).

## CY2019 Accomplishments:

**Off-Axis Parabola:** Developed a new mirror coating for the off-axis parabola for mirror-based focusing. The laser damage threshold of the coating exceeded the power of the test laser at 7 picoseconds.

**Coinjection:** A new dichroic coating with higher laser damage threshold (12.5 J/cm$^2$ at 3.5 ns, 532 nm, 22.5$^o$ Spol) was coated on 2 optics for maintaining occasional 4 kJ coinjection operations (one dichroic is in the beam train, while the other is a spare). The laser damage threshold of the original coating was 7 J/cm$^2$. Later on, a dual-wavelength laser damage test was conducted at 532 nm and 1064 nm simultaneously. The dual-wavelength laser damage threshold is 10.5 J/cm$^2$ and is a more realistic measurement of the performance of the coating. This was the first time we have used a dual-wavelength laser damage test to characterize the current coinjection setup.

**Coinjection (Future):** New dichroic coating with higher laser damage threshold (23.2 J/cm$^2$ at 3.5 ns, 532 nm, 22.5$^o$ Spol) was developed to use in a new system layout for potential 10 kJ coinjection operations in the future. Patrick Rambo and Jeff Kellogg designed the new system layout.

**Z-Petawatt:** The 4 large Z-Petawatt gratings were installed into custom mounts that were designed by Daniel Headley. The M6 mirror, a negative asphere lens, and 8 small mirrors were also coated to support this.

**Contamination:** We have begun to work with Hall Environmental to use gas chromatography to diagnose the contamination in the beam train. Results expected in 2020. Two optics (Conchas Lens and Chama mirror) were removed from the beam train due to oil contamination, and were cleaned.

## Completed Optical Coatings:

Coatings completed: 9 large optics, 54 debris shields and vacuum windows, 9 small optics.

Detailed List:

- ZBL L3 lens
- ZBL L3 lens
- ZBL L4 lens
- ZPW M6 mirror
- 2 Dichroic beam-combiner mirrors for coinjection
- 2 Phase plates
- 1 Off-axis parabola mirror
- 47 debris shields
- 7 vacuum windows
- 8 small mirrors for ZPW (4" diameter and smaller)
- 1 small negative asphere lens for ZPW (12 cm diameter)

Note: the demand for debris shields and vacuum widows was lower in CY19, which enabled us to schedule downtime for major upgrades (new roughing pump, refurbished 22" gate valve), and also develop new coatings for coinjection and the off-axis parabola.

## Publications:

Journal Optical Engineering:

- Ella S. Field, Damon E. Kletecka, "Impact of contamination and aging effects on the long-term laser damage resistance of $SiO_2/HfO_2/TiO_2$ high reflection coatings for 1054 nm," Optical Engineering, vol. 58, no. 10, (2019).

SPIE Laser Damage Symposium (Conference Proceedings):

- Ella S. Field, Benjamin R. Galloway, Damon E. Kletecka, Patrick K. Rambo, Ian C. Smith, "Dual-wavelength laser-induced damage threshold of a $HfO_2/SiO_2$ dichroic coating developed for high transmission at 527 nm and high reflection at 1054 nm" in Proc. SPIE, vol. 11173 (2019).

## Plans for CY2020:

- Continue testing new dichroic coating designs for coinjection.
- Continue to study contamination issues in the beam train and help Org 1682 with a solution.
- Produce all coatings required for Z/ZBL operations.
- Conduct laser damage tests in-house, which is especially important for dual-wavelength laser damage testing (coinjection), and testing of coatings in a vacuum environment instead of ambient (many of our coatings operate in vacuum in the beam train).

## Acknowledgements

Big Thanks to Patrick Rambo and Ben Galloway for handling optics in the class 100 clean room, and Jeff Kellogg and Daniel Headley for engineering support. Also, many thanks to Org 1682 and 1680.

Follow us on Confluence: https://snl-wiki.sandia.gov/display/1682/Optical+Coating+Blog

*Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.*

## More Pictures!

Before installing the large gratings into the custom mounts, we practiced with an aluminum mock-up:

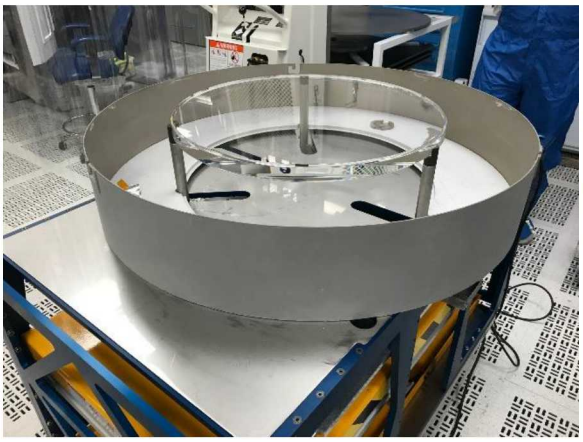
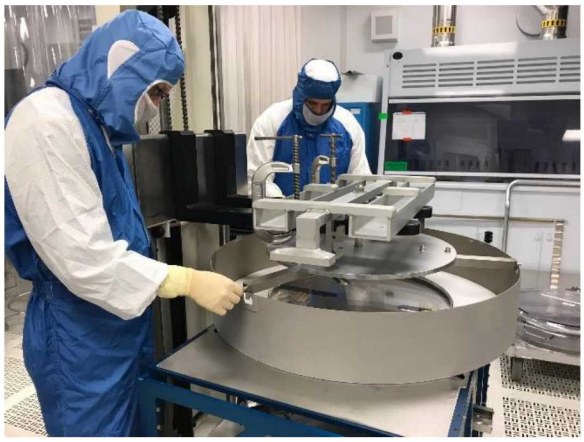
Installation of one of four of the large gratings into custom mount:


Sandia National Laboratories

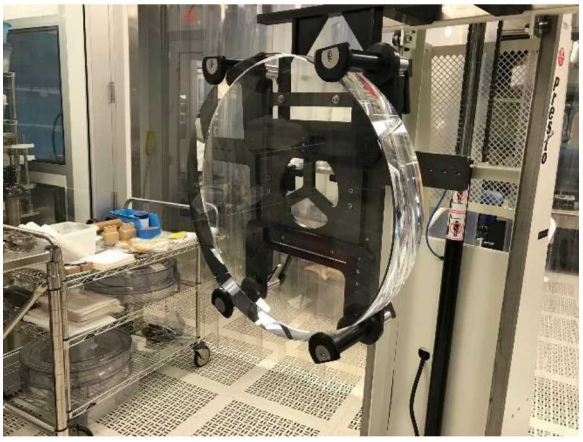
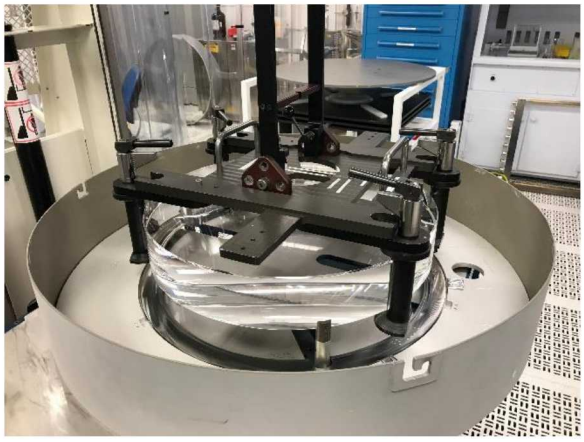
U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration


Dichroic beam combiner for coinjection (one of two):

Off-axis parabola:

Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration