Institute of Technical Physics

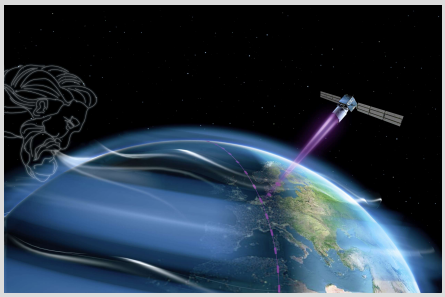
# Laser-induced damage and contamination testing for the next generation of LIDAR space optics

Nils Bartels[a], Paul Allenspacher[a], Thimotheus Alig[b], Istvan Balasa[b], Helmut Schröder[a], Gabriele Taube[a] and Wolfgang Riede[a]

[a]German Aerospace Center (DLR),Institute of Technical Physics, Pfaffenwaldring 38-40, 70569 Stuttgart, Germany
[b]Laser Zentrum Hannover e.V., Hollerithallee 8, 30419 Hannover, Germany

## Introduction:

„Sometimes there is no next time“ - LIDAR laser optics for applications in space need to be carefully tested. We supported LZH to improve the damage resistance of ion beam sputtered (IBS), UV-antireflective optical coatings. This achievement was only possible due to further improvements of our test methodology (algorithm based counting of damages in large area raster scans) that can help manufacturing the best laser optics in the world.



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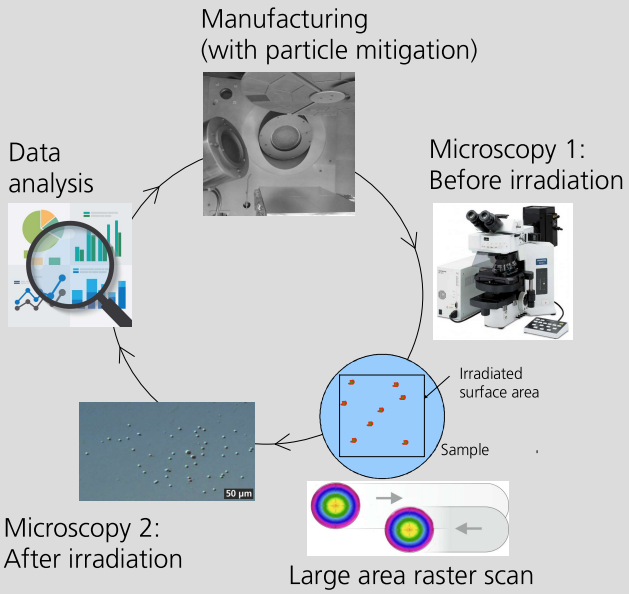
ESA Aeolus observation satellite (launched in August 2018). We qualified all laser optics for the Atmospheric Laser Doppler LIDAR Instrument (ALADIN). Follow-up missions are being planned.

## Damage resistance of LIDAR laser optics:

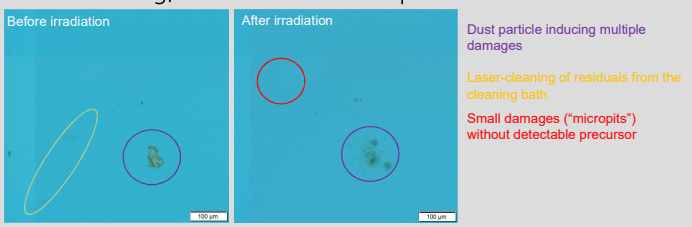
Laser-induced damage for nanosecond-pulsed lasers (typical for LIDAR lasers) is initiated by nano-sized particles (introduced e.g. during polishing or coating). Thus, particles need to be mitigated via ion or laser etching.

## Optimization cycle:

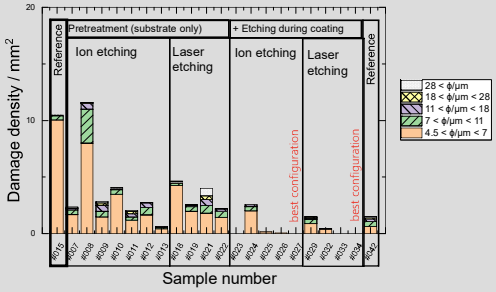



## Overcoming real-life challenges for counting and classifying damages:

-Large data set (~150 stitched image files per raster scan)
-Laser cleaning, sometimes: surface particles

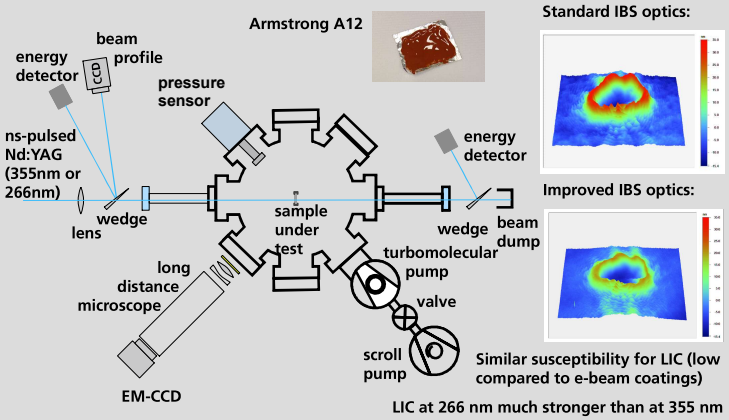



Python-script:
-Precise overlap of micrographs before and after test
-automized determination of size + number of damages




Successful coating optimization: no damages >4.5µm in 60mm² area raster scan at 25 J/cm²

## Laser-induced contamination (LIC) testing:

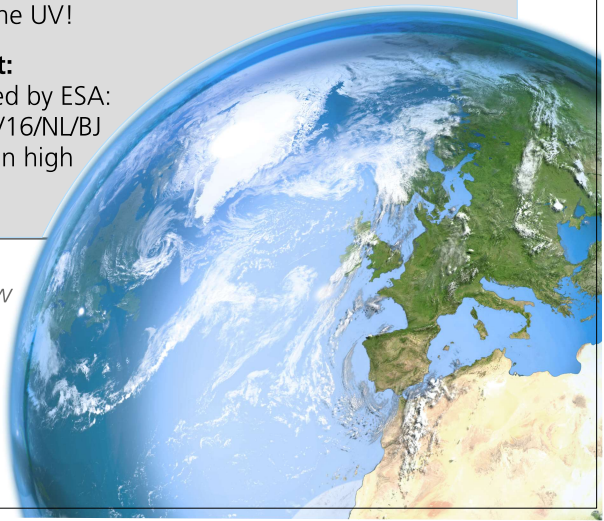



## Conclusions:

- Raster scans with image analysis help coating manufacturers to produce high quality laser optics
- Mitigation of LIC remains a very important topic for space lasers, especially in the UV!

## Acknowledgement:

This work was funded by ESA: contract AO 1-8683/16/NL/BJ “Particle mitigation in high power laser optics”



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