Fraunhofer IOF

Fraunhofer Institute for Applied Optics and Precision Engineering IOF

Dielectric PEALD mirrors for high-power laser applications

Strongly curved dielectric mirrors

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Cover: Strongly curved aspheric lens functionalized by ALD.

Top: High-reflective dielectric mirrors conformally coated on various optics.

Motivation

Our aim is to provide conformal dielectric mirrors on strongly curved optics to meet the increasing demand for these in high-power laser applications.

Technology

Atomic layer deposition (ALD) enables precise thickness control as well as conformal coatings on 3D substrates. Plasma-enhanced atomic layer deposition applies energetic plasma species to deposit coatings at low deposition temperature. We apply substrate biasing technique to tailor ion energies in the plasma and thus thin film properties like refractive index, mass density, mechanical stress, and elemental composition.

Highlights

Dielectric mirrors for 355 nm and 532 nm laser wavelengths with high reflectance R > 99.93 % at the design wavelengths.

Characteristics

Low absorption:

measured by laser-induced deflection (LID)

- λ = 355nm: ~ 87 ppm
- λ = 532nm: ~ 6 ppm
- Residual transmittance of ~ 530 ppm at 532 nm

Low scattering:

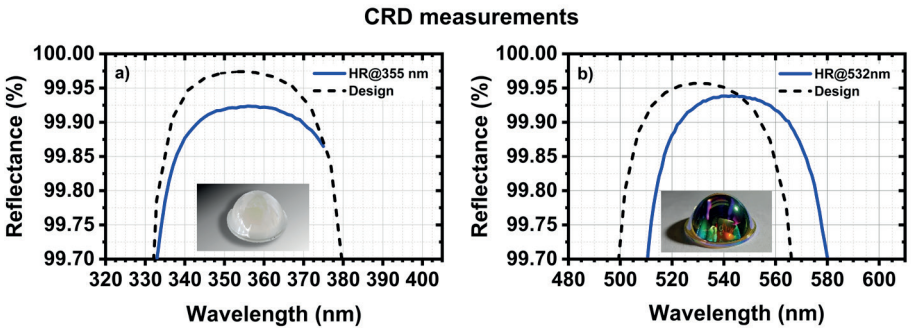
- Total scattering approx. 4 ppm for mirror at 532 nm wavelength

High mechanical and environmental stability:

- Tensile stress lower than 120 MPa with thickness up to 2.33 µm
- No delamination or cracks observed after humidity test

High laser-induced damage threshold (LIDT):

- LIDT values comparable to those deposited by PVD techniques: defect free LIDT of 60 to 80 J/cm²; defect driven LIDT values from 19 to 25 J/cm² (R on 1 method; 10 pulses and 10000 pulses per fluence)



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