Test Station for Reflectance Measurements in the Deep Ultraviolet Region

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This note presents the development of the test station for measuring reflectance R of mirrors for wavelengths λ in the deep ultraviolet (UV) region (≤ 300 nm).

The test station developed for R measurements in the deep UV region is instrumented with Thorlabs and Edmund Optics components—collimator, collector, compact CCD spectrometer, tungsten lamp for visible light and deuterium lamp for deep UV light, optical fibers to route light from lamp to the collimator and light from the collector to the compact CCD spectrometer—and 3D printed fixtures—configured with grips to hold the collimator and collector in the required orientation—designed in Siemen's Next Generation Design Platform NX 12 and printed with an Ultimaker S7 3D printer.

For reference measurements, the 3D printed fixture holds the collimator and collector such that light from the collimator directly enters the collector, Fig. 1.

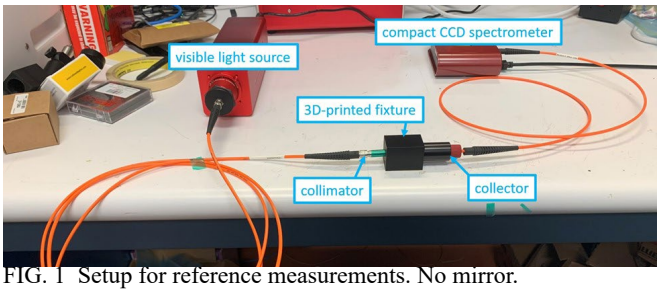

FIG. 1 Setup for reference measurements. No mirror.

For R measurements of the mirror, the fixture holds the collimator and collector at an incident angle ϑi and reflected angle ϑr of 45°, Fig. 2.

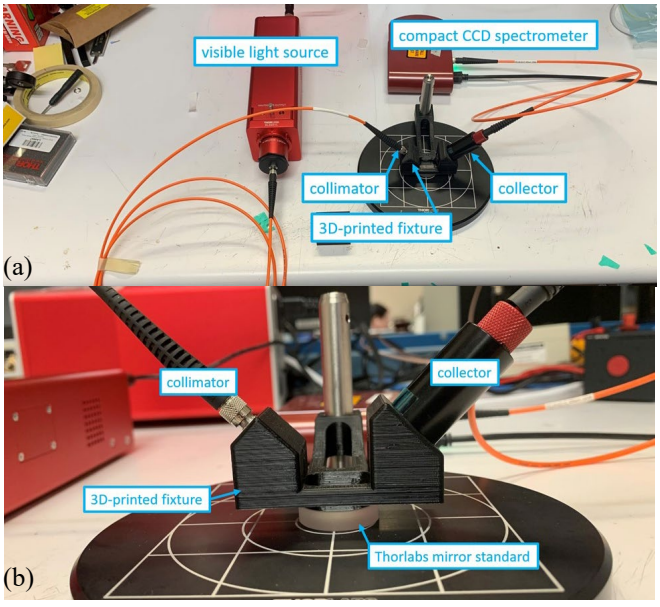

FIG. 2 (a) R measurement setup, (b) 3D printed fixture.

To check whether the test station works and to improve the positioning capability of the 3D printed fixtures, measurements were performed with a Thorlabs BB1-EO2 dielectric-coated standard mirror and the Thorlabs SLS201L stabilized tungsten lamp, whose visible light intensity I, for lambda between 300 nm and 900 nm, facilitates aligning and positioning.

Thorlabs' Optical Spectrum Analysis program measured the light intensity with the compact CCD spectrometer.

Plots of the raw data from the reference and R measurements, Fig. 3(a), show that the curves start to diverge for λ ≥ 550 nm.

The spectral reflectance curve, Fig. 3(b), is given by

$$R(\lambda) = (I_r(\lambda))/(I_{ref}(\lambda) \times 100$$

where I = intensity, and r and ref indicate reflected and reference light beams.

Figure 3(b) shows that the developed test station can measure R of the mirror standard close to Thorlabs specifications (for lambda between 300 nm and 550 nm), however beyond 550 nm the measured R (green line) is less than the specified R (purple line), most likely due to variation of the mirror's dielectric surface or dirt and smudges on the mirror standard.

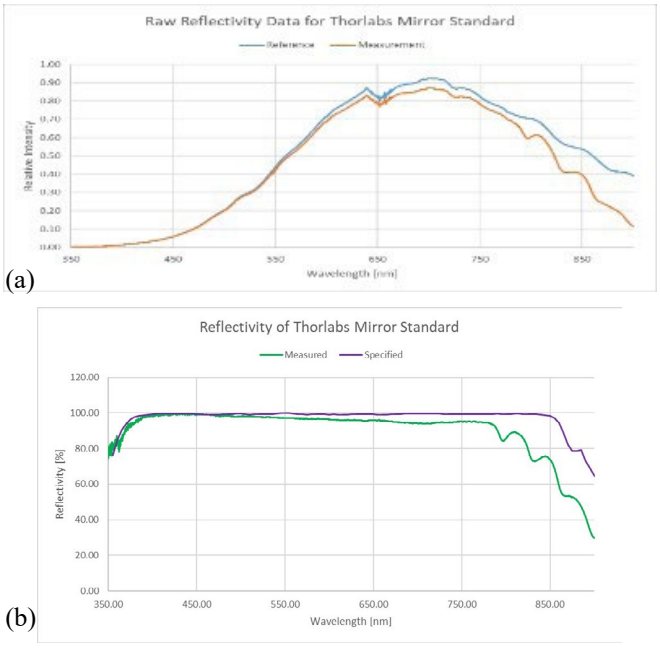

FIG. 3 (a) Raw data plot. Blue line is reference, orange line measurement, (b) Measured spectral reflectance curve (green line) and Thorlabs mirror standard's specified reflectance (purple line).

To conclude, the next step after this successful test is to use the Thorlabs SLS204 stabilized deuterium lamp for deep UV light and repeat the *R* measurements.