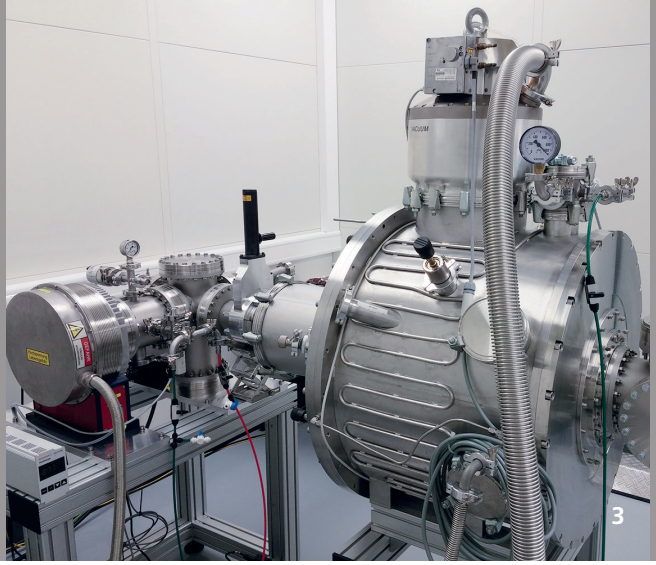

TEST STAND FOR IRRADIATION EXPERIMENTS IN THE EUV SPECTRAL RANGE

Task

For a number of scientific issues on the interaction of short wavelength radiation with matter, the availability of high, medium as well as pulsed irradiation intensities in the extreme ultraviolet is of particular interest. The spectral range around 13.5 nm plays a special role since semiconductor production has demand for it and optical systems based on multilayer mirrors are generally available.

Method

In cooperation with the chairs »Technology of Optical Systems TOS« and »Experimental Physics of Extreme Ultraviolet EUV« of RWTH Aachen University, Fraunhofer ILT has set up a test stand with which high irradiation intensities in the extreme ultraviolet can be exposed to a sample. The test stand consists of a xenon-based gas discharge source as an emitter for 13 nm wavelength radiation, a 45° multilayer mirror for monochromatization, and a Wolter-type collector, with the source and sample placed in each of the focal points. The collector reduces the beam profile of the source to the sample, resulting in an illumination spot with a diameter of approximately 50 µm (FWHM).

Results

For a 50-Hertz discharge source with a 13.5 nm emission of 0.6 mJ/sr in a spectral bandwidth of two percent per pulse, average intensities of up to about 1 W/cm² on the sample were achieved at maximum focus. By defocusing, a tophead profile can be set in approximation, with a diameter of about 140 µm and an intensity of about 200 mW/cm². The peak intensity during the pulse is up to 4 x 10^7 W/cm² at maximum focus. When the bench is combined with the more powerful EUV radiation sources developed at Fraunhofer ILT, the average intensity can be increased by about two orders of magnitude and peak intensity by about one.

Applications

This test stand can be used for basic studies on the degradation of optical components under EUV irradiation and tests for scintillator materials. Moreover, it can be applied to process and structure materials (biomaterials) in EUV-induced ablation to selectively modify surfaces, which would not be possible by mechanical or laser material processing.

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3 Test stand for high irradiation intensities in the EUV spectral range.
4 Wolter-type collector for focusing the EUV radiation.