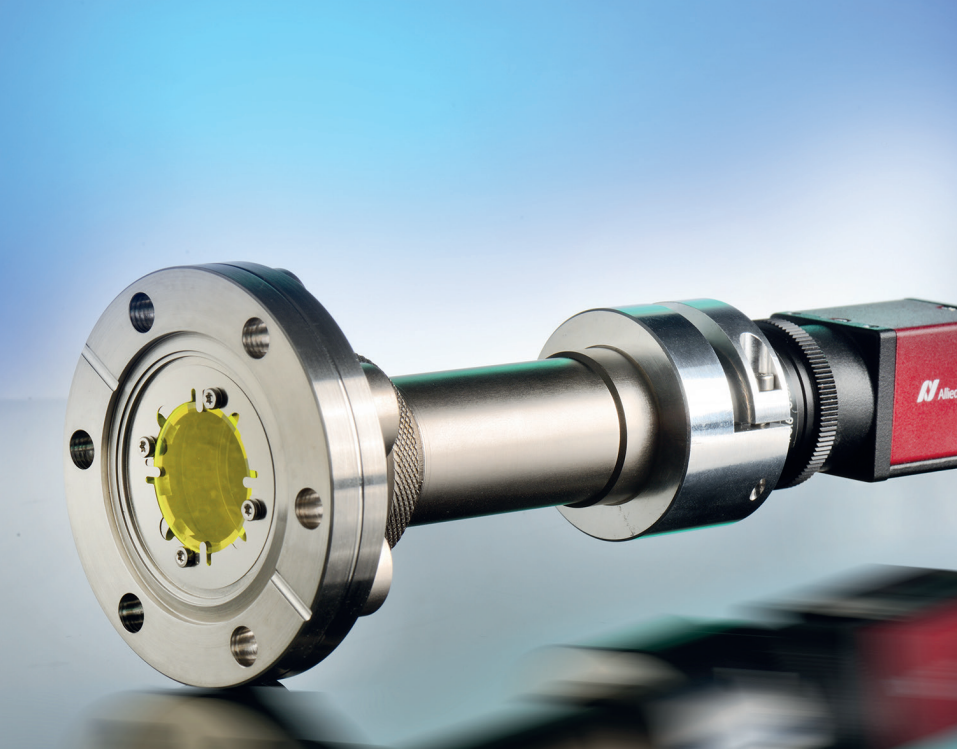

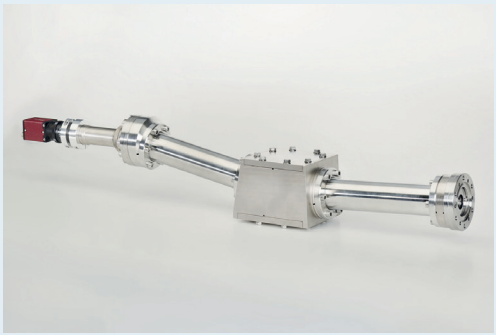

1 EUV detector with converter crystal.
2 EUV spectrograph for the spectral range of 10–20 nm.

Inline EUV diagnostics

EUV systems equipped with plasma-based radiation sources are commonly used to irradiate samples or to analyze defects on EUV masks for semiconductor lithography. Pulsed plasma radiation sources, both laser and discharge-based sources, fundamentally exhibit variations in spectral distribution and total emission that affect the outcome of each application. By implementing an industry-grade metrology that accurately monitors the emission characteristics, an inline control system can improve the quality of the obtained results significantly.

Cost effective alternative using a converter crystal

In the present case, Fraunhofer ILT set up an EUV camera and an EUV spectrograph to monitor a xenon-based pinch plasma source for use in an irradiation system. Both diagnostic devices are equipped with a detector in which the EUV light is converted to visible light with a converter crystal and then recorded using a commercially available camera. The use of the converter crystal is a particularly cost-effective alternative compared to a back-thinned CCD or a chip directly coated with a luminescent material that would otherwise be used.

Results and applications

The EUV detector is shown in Figure 1. A Ce:YAG disk is used as the converter. The optical system for recording the fluorescence light consists of lenses with a magnification of either 1:1 for the EUV camera or 1:2 for the spectrograph and a camera with a pixel size of 3.45 micrometers. Figure 2 shows the EUV spectrograph with a grating reflecting in grazing incidence. The total length is approximately 68 cm. The detected spectral range is between 10 and 20 nm. The spectral resolution $\lambda/\Delta\lambda$ is about 800. In the EUV camera, a system of a spherical and a flat multilayer mirror is used to image the source at a wavelength around 13.5 nm. The spatial resolution is approx. 10 µm.

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