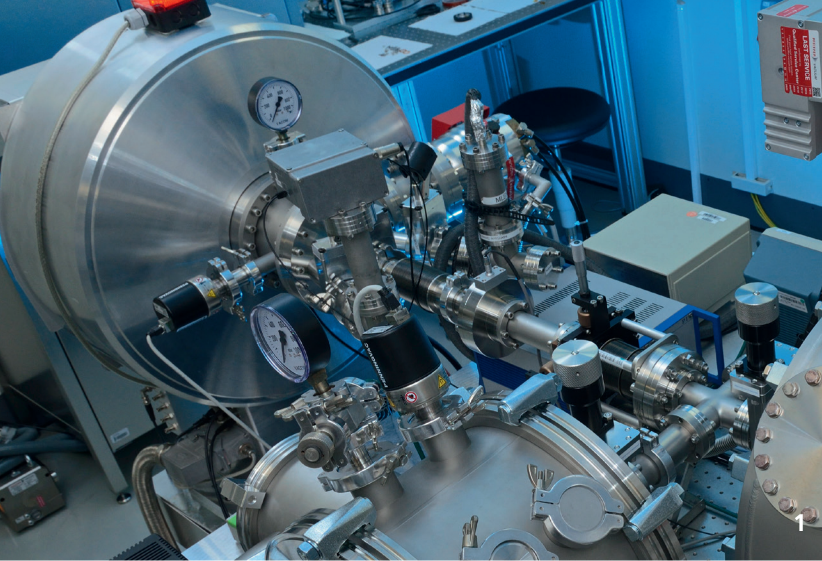

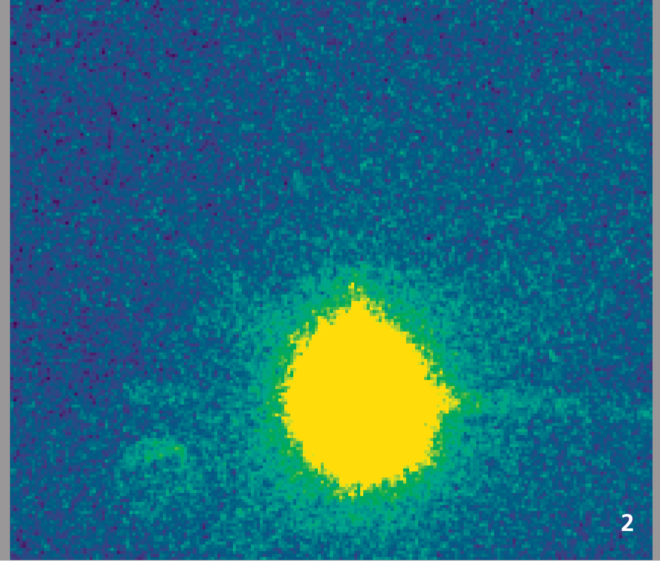

Subject to alterations in specifications and other technical information. 06/2022.

LABORATORY-BASED CHARACTERIZATION OF THE SCATTERING BEHAVIOR OF EUV-PELLICLES

Task

Used in industrial semiconductor manufacturing, pellicles are membranes with thicknesses in the nanometer range. They serve to protect the nanostructured mask from particles in the lithography process. To ensure high imaging quality and throughput, the industry must carefully optimize the transmission and scattering behavior of pellicles. Especially for modern lithography processes in the extreme ultraviolet (EUV) radiation range, this optimization places high demands on the fabrication and analysis of the pellicles.

Method

Fraunhofer ILT uses the broadband EUV radiation of a discharge produced plasma source to characterize the scattering behavior of nanoscale pellicles at the wavelength mainly used by industry, 13.5 nm. With suitable thin-film filters and a multilayer mirror, the radiation is spectrally filtered so that a main wavelength of 13.5 nm with a relative spectral bandwidth of 4 percent is available for the measurements. The pulse energy of the source is continuously measured with a dose monitor during the measurements to ensure their results can be reproduced. An aperture is used to illuminate a portion of the pellicle, and the transmitted and scattered light is measured with a CCD camera (charge-coupled device). To increase the number of photons available within a measurement, a beam blocker can be introduced into the beam path to shield the directly transmitted part of the radiation.

Results

Using this laboratory setup, Fraunhofer ILT was able to characterize different EUV pellicles of the latest generation with respect to the scattering behavior at a wavelength of 13.5 nm. Different material compositions and coatings were flexibly tested for their suitability for use in modern lithography processes. The measured results show high agreement with reference measurements and simulation results.

Applications

The setup and the developed measurement method can be used to characterize nanoscale membranes (pellicles) for use in lithography with extreme ultraviolet radiation.

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1 The experimental setup.

2 Scattered light image of a CCD camera.

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