



# SPECTROSCOPIC EUV REFLECTOMETRY FOR THE CHARACTERIZATION OF NANOSTRUCTURES

## Task

Extreme ultraviolet (EUV) radiation is a promising alternative to spectral ranges previously used for photon-based metrology applications. In contrast to the surrounding spectral ranges from infrared to the X-ray range, EUV radiation has a much stronger interaction with matter. In addition, the short wavelengths – of the same order of magnitude as current structure sizes (~ 10 nm) of semiconductor and nanotechnology – are advantageous.

## Method

In a EUV spectroscopy system developed and built for the spectral range from 9 nm to 17 nm, nanostructures were measured for their spectroscopic reflectance at various angles in grazing incidence. With sufficiently thin samples (< 100 nm) the spectroscopic transmittance can be determined. This model-based procedure can be used to reconstruct the sample geometry – such as lateral distances and sizes of periodic structures as well as vertical thicknesses of complex multilayer systems – from the determined radiometric quantities. In addition, samples with unknown material properties can be characterized in terms of their stoichiometry and density.

## Results

The system was able to characterize ultrathin membranes with thicknesses of about 20 nm, multilayer systems with single-layer thicknesses of less than 1 nm and periodic grating structures with respect to their geometry down to the subnanometer range. In addition, the stoichiometry of membrane samples and multilayer systems could be successfully determined.

## Applications

The described metrology process can be applied in the field of semiconductor measurement technology since measurement methods with high sensitivity for small structural dimensions are in great demand there. In addition, the developed process can characterize nanostructures and materials from other technological areas.

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- 3 Ultrathin silicon nitride membrane in vacuum sample holder.
- 4 Line gratings (period = 150 nm, SEM image).
- 5 EUV spectroscopy system.