Determination of optical constants in the VUV by combining reflectometry and ellipsometry

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For wavelengths in the spectral range of the vacuum- and extreme ultraviolet (VUV, EUV), i.e. from below 200 nm down to 5 nm, the existing data base for optical constants of relevant materials is rather short and/or were not generated in a metrological manner, i.e. with solid uncertainty budgets. Thus, it is also not possible to reasonably compare different data sets regarding their validity. We use reflectometry (i.e. change of the amplitude upon surface reflection) and ellipsometry (i.e. change of the phase) to reliably determine and validate optical constants n (refractive index) and k (extinction coefficient) provided with a solid uncertainty budget. The complexity in creating experimental data arise from the combination of high demanding surface preparation and measurement conditions from ultra-clean vacuum surrounding to the need for a tunable VUV radiation source. The measurement conditions are met at PTB's Metrology Light Source synchrotron. A numerical method is developed to extract the optical constants from experimental data. The method is aimed to be applicable to a wide range of problems from bulk to multilayer systems and to allow a flexible modelling of the system, e.g. introduction of roughness or arbitrary polarization.