Beam diagnostics at EUV wavelengths

T. Mey, B. Schäfer, K. Mann

Laser-Laboratorium Göttingen e.V., D-37077 Göttingen, Germany

In recent years, numerous applications of EUV radiation have evolved in science and industry, each posing individual demands on the properties of the employed beam. Accordingly, many different types of EUV beam sources have been developed, ranging from synchrotron and free-electron laser facilities down to lab-scale high-harmonic or plasma based sources. Here, three diagnostic tools are presented that recover wavefront and spatial coherence information of EUV beams. The application of a *Hartmann type wavefront sensor* is demonstrated at FEL and high-harmonic beams. This device measures fundamental beam parameters in a single shot (Rayleigh length, waist diameter/position, M^2) and it is used for highly precise online adjustments of the optical beamline components. The system is very reliable, but provides a rather low resolution and requires a reference measurement. These drawbacks can be overcome by the *wavefront curvature sensor*, which is based on a CCD detector that captures two intensity profiles closely behind each other. This information allows solving the transport of intensity equation which results in the wavefront at the native CCD resolution. Beyond these wavefront sensing techniques, the *Wigner distribution formalism* is reviewed which provides access to the entire spatial coherence distribution of the beam. Experimentally, a set of 150 intensity profiles suffices to reconstruct the mutual coherence function from which coherence lengths and the global degree of coherence are derived. This approach is demonstrated with the latest results from the free-electron laser FLASH.