Reflection-mode Coherent Diffraction Imaging using Laboratory Light Sources

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Coherent diffraction imaging (CDI), also called lens-less imaging, is these days a popular tool for X-ray metrology. The CDI method can avoid limitations of imperfect optics in the extreme ultraviolet (EUV) and X-ray regions and hence reach diffraction limited nm-scale resolution. Moreover, lens-less methods allow to extract full information about the exit-wave after interaction with the sample, thus amplitude and relative phase shift can be recovered. Reflection-mode CDI is attractive method for characterizing surface structures especially when samples are opaque.

In recent years, CDI is getting to be used also with the laboratory EUV sources. Table-top CDI with EUV light source is more challenging due to lower signal, worse coherence properties and generally lower temporal stability of the illumination when compared to synchrotron-based systems. Nevertheless, it is attractive due to its compact size, versatility, low price, and wide spectrum of applications in applied science and semiconductor metrology.

In this contribution, we will demonstrate the progress in the development of compact reflection-mode CDI tool. Results of reflection-mode scanning CDI (ptychography) method using plasma gas discharge EUV source operating with xenon at 13.5 nm wavelength are addressed. The advantages of the plasma gas discharge EUV sources for CDI compared to, e.g., laser-based high-harmonic sources are simplicity and robustness, so, these may be easily operated in university-lab settings by student-users. In this report we demonstrate the CDI method with Mo/Si multilayer mirrors with buried programmed defect arrays. We also show that the reflection-mode ptychography can be used for reconstructing distortions caused by buried defects in the multilayer.