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EXTREME UV IMAGING WITH HIGH HARMONICS

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Abstract. I will discuss cross-sectional nanoscale imaging in the extreme ultraviolet (XUV) spectral region using high-harmonics produced by intense femtosecond laser radiation. The imaging method to be discussed is the XUV incarnation of optical coherence tomography (OCT). In recent years, OCT has become a major diagnostic method, especially in ophthalmology, where it allows cross-sectional imaging of the retina. The axial resolution is a few micrometers. XCT, in contrast, reaches resolutions of 20 nm and better. OCT and XCT alike are based on white-light interferometry. Nevertheless, due to the challenges of XUV optics, XUV coherence tomography (XCT) has to be implemented in a very different way — but it also offers special capabilities.

Most of these rely on the fact that it is possible to reconstruct the phase of the XUV radiation reflected at the sample. This in turn allows to determine the spectral *field* reflectivity, which can be used to determine various physical properties of the interfaces. These include the material composition, the thickness of layers even far below the nominal resolution, and the roughness of the boundary layers.

A particularly relevant application of XCT for the spectral range up to 100 eV are silicon-based samples. We have demonstrated depth resolutions of 20 nm and very high sensitivities. Buried oxide layers of a thickness of a few nanometers could be detected as well as buried monolayers of graphene. It is even possible to identify the material encapsulated in silicon and determine properties like layer roughness without destroying the sample. A unique perspective is ultrafast imaging.

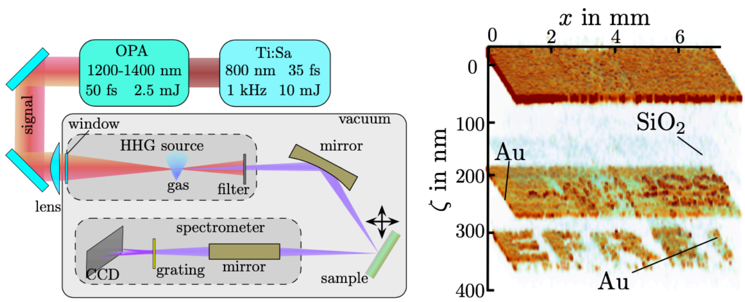

Figure 1: (left) Experimental setup of lab-based XCT; (right) Reconstructed 3D XCT measurement a structured sample consisting of two gold layers and an additional thin silicon dioxid layer buried in silicon. The axial resolution is 24 nm.

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