Actinic EUV Metrology and Materials Characterization for the EUV Era in imec's AttoLab

Kevin M. Dorney[1]

kevin.dorney@imec.be

[1]imec vzw, Kapeldreef 75, 3001 Leuven, Be

The introduction of extreme ultraviolet (EUV) lithography into high-volume manufacturing in advanced logic foundries in 2019, and later by memory foundries in 2021, has ensured the continual scaling of features in modern micro- and nano-electronics, thus enabling faster, smaller, and more efficient computing architectures. To harness the power of EUV lithography, a concomitant evolution in the design of EUV materials (photoresists, mask materials, etc.) has taken place, resulting in novel material systems that possess non-trivial properties and chemistries. The increased heterogeneity, low-dimensionality, and nanoscale size of EUV material systems presents a significant characterization challenge, as collective effects from subcomponents often determine the emergent behavior of the system and confinement effects result in fundamental properties differing from their bulk counterparts. Moreover, the direct interaction of EUV light with material systems is often critical for their performance in lithographic applications, yet many unresolved questions in the EUV light-matter interaction remain today.

In order to address these material characterization challenges, a similar evolution in metrology and inspection has taken place, where EUV light sources are increasing being used to deepen our understanding of complex systems. For instance, the short wavelength of EUV light is well suited for nanoscale imaging, while the presence of many absorption edges in the EUV range can be used to disentangle contributions from different constituents in heterogenous systems. Additionally, actinic EUV light at 13.5 nm can be used to characterize the optical response of materials, providing critical data needed to optimize their performance in lithography, imaging, and spectroscopic applications. At imec's AttoLab, we deploy ultrafast, table-top EUV light sources based on high-harmonic generation to enable cutting-edge spectromicroscopies to realize an advanced toolbox for interrogating the properties of novel EUV material systems. In this talk, we'll provide an overview of current and future activities aimed at advanced material characterization via in-situ EUV spectromicroscopies, particularly focusing on developments and application of actinic EUV metrology, imaging, and photoelectron spectroscopy.