Contamination of EUV optics

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The drive for smaller feature sizes in semiconductor industry has led ASML to develop lithography tools using 13.5 nm Extreme Ultraviolet (EUV) light. This departure from the now-standard 193 nm ArF wavelength poses a number of challenges, among which the lifetime of EUV optics. EUV mirrors are exposed to a harsh environment. They receive large doses of ionizing EUV radiation, with only a nanometer-thin cap layer separating the reflective multilayer from the tool environment. Moreover, they are sensitive to contamination due to the strong absorption of EUV light by all materials. Combined with stringent optical specifications, this leads to a near zero tolerance (sub-nanonometer thicknesses) for contamination.

In this talk I will discuss two mirror degradation mechanisms: carbon growth and oxidation. EUV-driven decomposition of hydrocarbons on the mirror surface leads to the growth of an a-C:H on the mirror. It will be shown that in limiting regimes the experimental data is in accordance with a simple model. The exposure of mirrors with a metallic cap to EUV in a clean, but non-baked vacuum environment can lead to oxidation by the remaining water vapour. To prevent reflectivity loss, mitigation and/or cleaning strategies are needed. These will be discussed in the end of the talk.