Estimating out-of-band radiation flare levels extreme ultraviolet lithography

Simi George and Patrick Naulleau

Center for X-ray Optics, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, California 94720

Multilayer EUV optics reflects OOB radiation emitted by the plasma EUV sources onto the wafer plane. This results in unwanted background exposure of the resist (flare) and reduced image contrast. The reflectivity of multilayer optics at the target wavelength of 13.5 nm is comparable to that of their reflectivity in the deep ultraviolet (DUV) and UV regions from 100-350 nm. Many of the resists used for EUV are highly absorptive at specific DUV wavelengths contributing to the problem. Since the projection optics work equally well as imaging optics at DUV wavelengths, the OOB radiation cannot be treated simply as uniform background or DC flare.

For this paper, we will present a more detailed analysis of the potential impact of OOB radiation based on known resist, mask, and multilayer conditions. We expect that OOB can be treated as a pure reflectivity problem until the mask, beyond that mask absorber reflectivity and scattering will need to be accounted for. The simulation-based imaging results for predicting the effective flare as a function of mask feature types and sizes will be presented. In order to study the effect of these wavelengths on imaging performance in a real system, we are also in the process of integrating a DUV source into the SEMATECH Berkeley 0.3-NA Micro-field Exposure Tool (MET). Any available exposure data from experiments will be presented.

This work was supported by the Director, Office of Science, Office of Basic Energy Sciences, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.