

Simulation assisted separation of stochastic effects in EUV lithography and their contribution to line edge roughness and defectivity

With the shift from 193nm immersion (193i) to EUV lithography stochastic effects have to be taken into account for lithography simulations. The number of photons for an equivalent dose is reduced by about a factor of 14, the probability for an EUV photon to initiate the transition of a photo acid generator (PAG) molecule to an acid molecule is close to 0, because the photon energy of 93 eV is way higher than the molecule binding energy of about 5eV and electron cascades initiated by the EUV photons are facilitating the acid formation.

Shot noise and secondary electron distribution are new EUV specific characteristics and critical dimensions and pitches of these processes require stochastic simulations of the Post Exposure Bake (PEB). The stochastic nature of all these processes has an impact on line edge roughness / line width roughness (LER/LWR) and defects like micro bridging and pinching, especially due to the reduced feature size of EUV patterns in contrast to 193i lithography.

In this work we use simulations to show the influence of these stochastic effects on the pattern formation in the resist and separate the different effects and their influences on LER and defectivity. The simulations are based on physical assumptions regarding photon and secondary electron distribution, mean free path of low energy electrons and a secondary electron model.