

## The refined EUVL mask model

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A refined model of a state-of-the-art extreme ultraviolet photo lithography (EUVL) mask stack consisting of the Mo/Si multilayer mirror coated by a Ru protective layer and a TaBN/TaBO absorber layer was developed to facilitate accurate simulations of EUVL mask performance for high-NA EUVL imaging and to provide the better insight in the mask material structure. The model is derived by combined analysis of the measured EUV and hard X-ray reflectance of a state-of-the-art mask blank. These two sets of measurements were analyzed using a combined free-form analysis procedure that delivers high-resolution X-ray and EUV optical constant depth profiles based on self-adapted sets of sublayers as thin as 0.25 nm providing a more accurate description of the reflectance than obtained from only EUV reflectance. "Free-form analysis" means that the shape of the layer-interfaces in the model is determined during the analysis procedure and is not given a priori by the structure model. To reduce the numerical effort for EUV imaging simulations a low-resolution model of the multilayer and absorber stack with sublayer thicknesses larger than 2 nm, that fits to only the EUV reflectance was derived from the high-resolution model. Rigorous simulations at high NA EUV were performed to evaluate the predictive power of this model for mask sensitive imaging metrics. This model should be able to capture the EUV lithographic imaging impact of the mask stack optimization since our previous model [1].

[1] Vicky Philipsen, et al., "Actinic characterization and modeling of the EUV mask stack," Proc. SPIE 8886, 29th European Mask and Lithography Conference, 88860B (1 October 2013);