Impact of different LER patterns on scattered light intensities

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Efficient algorithms are proposed for stochastical investigations of the impact of structure roughness such as LER on light diffraction pattern of photo masks. This is important for the scatterometry, i.e. the indirect determination of geometry parameters from scattered light intensities in wafer metrology. The sensitivity to roughness increases the smaller the wavelengths of the incident light are. For EUV scatterometry at 13.5 nm, many higher diffraction orders can be measured and they are sensitive to structure details. Our fast and non-rigorous method for the analysis of stochastic LER with amplitudes in the range of a few nanometers is based on a 2D Fourier transform method. The key concept is to calculate the light diffraction patterns of apertures with many rough slits and to compare the patterns with those obtained from non-rough apertures. Different ensembles of rough line-space structures characterized by the imposed standard deviation of the roughness amplitude σ, the linear correlation length ξ and the roughness exponent α were examined. The rough edges of the aperture are created by means of power spectrum density (PSD) functions used with a random complex exponential phase term. For correlation lengths smaller than 200 nm the impact of LER is dominated only by the standard deviation of the roughness amplitude, i.e., the mean scattering light efficiencies reveal an exponential decrease in terms of the diffraction orders and the standard deviation σ of the roughness amplitude.