Linearized EUV mask optimization based on the adjoint method

Pinxuan He[1], Jiamin Liu[1, #], Honggang Gu[1], Hao Jiang[1], Shiyuan Liu[1, 2, #]

1 State Key Laboratory of Digital Manufacturing Equipment and Technology, Huazhong University of Science and Technology, Wuhan 430074, China
2 Optics Valley Laboratory, Wuhan 430074, China
Corresponding Author / Email: jiaminliu@hust.edu.cn, shyliu@hust.edu.cn

KEYWORDS: EUV lithography, mask near field, mask optimization, Born series

Mask optimization, a contour compensation method designed to enhance lithography performance, is essential for advanced EUV-enabled production nodes. During the early stages of mask optimization, the process was utilized to mitigate the optical proximity effect, essentially functioning as a low-pass filter. With the lithography node shrinking, the thick mask effect has to be considered, which makes it a diffraction-related image processing problem. The problem becomes more complex owing to the severe thick mask effect in EUV lithography. It is challenging to optimize EUV masks under rigorous consideration of the thick mask effect. In this work, a linearized EUV mask optimization method based on the adjoint method is proposed to provide fast and effective optimizations. The adjoint method is introduced to calculate the gradient of the EUV mask model. Additionally, a linearized gradient is proposed to quickly compensate for wafer pattern distortion caused by the prominent thick mask effect. The proposed method is promising for accurate full-chip EUV mask optimization.