

Resist Charging Effect in Photomask: Its Impact on Pattern Placement Error and Critical Dimension

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By the development of double exposure technique or double patterning technique the pattern placement error at photomask is concerned as one of the most important parameters to determine the quality of photomask and wafer overlay. Among various sources to induce the pattern placement error, the error depending on design layout affects directly on the overlay between two masks, so that it should be reduced effectively. According to a recent report from Nuflare, the resist charging effect generates pattern placement errors of over 10 nm for their specific pattern¹.

Here, we discuss on the electron beam charging effect in FEP-171 resist and its impact on placement error and critical dimension (CD) of pattern. As shown in Fig. 1, the charged resist results in an electric force which deflects incoming electrons. We have calculated the force by Coulomb equation and obtained the total distance of deflection. Furthermore, we have checked that our simulation well describes the experimental result, as shown in Fig. 2. We present the resist charging effect gives rise to pattern placement error and the dark CD change depending on the pattern density and the distance between the pattern and the incident electron beam. In addition, we show the resist charging effect can be removed by conducting layer coating and corrected by prediction based on simulation.

¹ T. Kamikubo, R. Nishimura, K. Tsuruta, K. Hattori, J. Takamatsu, S. Yoshitake, H. Nozue, H. Sunaoshi, and S. Tamamushi, Proc. SPIE **6730**, 673031 (2007).

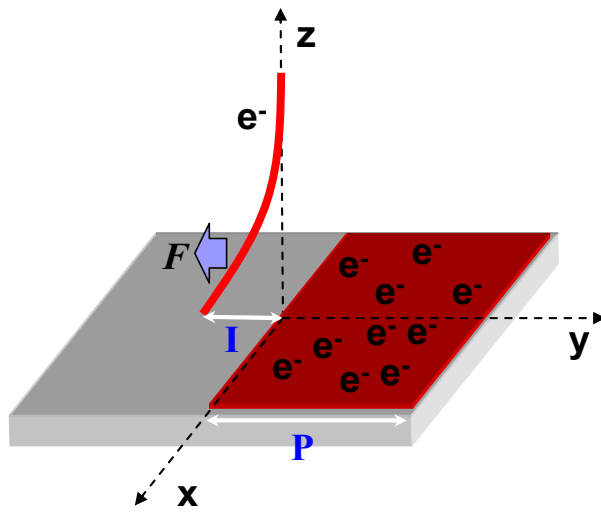


Fig. 1: Schematic diagram of electron beam deflection due to the charged resist in photomask. P is the pattern length and I is the deflection distance.

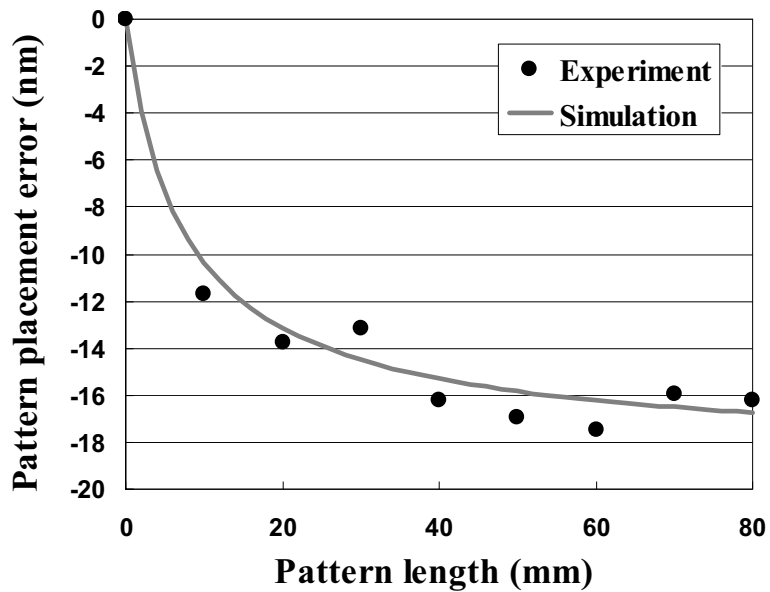


Fig. 2: Pattern placement error due to resist charging effect. The gray line and the black dot represent experimental and simulation results, respectively.