# Experimental evaluation method of point spread functions in EBL used for proximity effect correction

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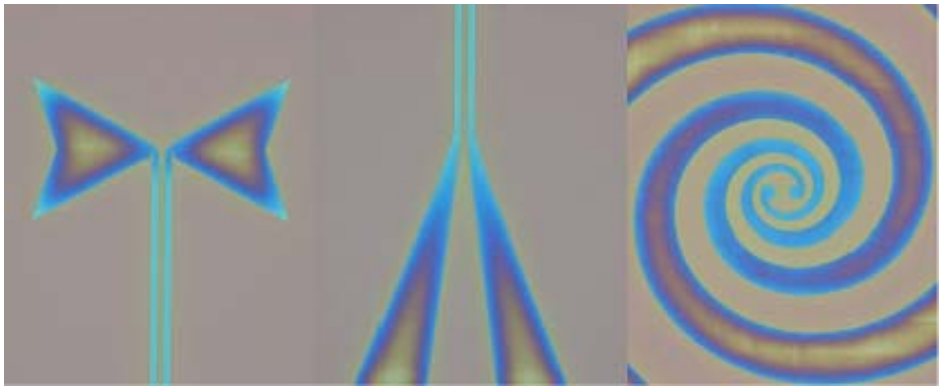
Electron scattering in resist and substrate in electron beam lithography leads to deterioration of pattern quality, and proximity effect correction is needed to fabricate high resolution patterns with varying density. The proximity correction requires detailed knowledge of point spread function.[1] The accuracy of the correction is determined by the accuracy of the point spread function used in the correction.

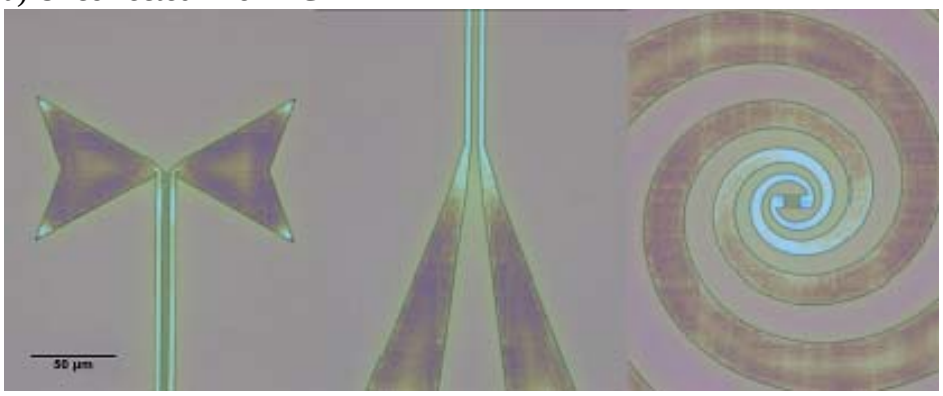
Various point spread functions generated by two commercial Monte Carlo simulation programs were experimentally evaluated. These Monte Carlo software products differ by using various physical models and algorithms. Complex patterns were prepared and corrected. For proximity correction, one same proximity correction software[2] was used with various point spread functions as inputs. A Semi-Insulating GaAs wafer covered with 475 nm resist was used in experiment and simulations. The exposure was done using a 100 kV JEOL JBX-9300FS electron beam lithography system. Partial resist development was used as this method provided high sensitivity of experimental results to non-uniformity of absorbed energy in e-beam exposure due to the interference color effect from the varying thickness of the remaining resist, as shown in Figure 1. This non-uniformity of color was the basis for a qualitative judgment about the accuracy of the medium and long range proximity effect correction.

The results of the evaluation are presented and discussed.

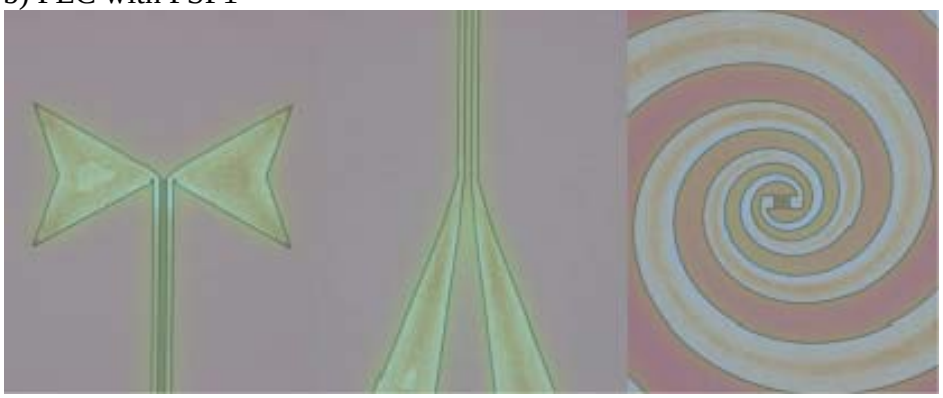
1. S.A.Rishton, D.P.Kern, J. Vac. Sci. Technol., B5, N1, 1987, 135
2. 2. T.Waas, H.Eisenmann, O.Voellinger, H.Hartmann, Microelectronic Engineering, v.27, 1995, 179



a) Uncorrected - no PEC




b) PEC with PSF1



c) PEC with PSF2

Figure 1. Patterns used for evaluation of point spread functions using the same proximity correction software with different point spread functions as input. a) Uncorrected - no PEC, b) PEC with PSF1, c) PEC with PSF2. The pattern corrected with PSF2 shows better color uniformity which means better accuracy of correction.