Application of Contrast Enhancement Layer (CEL) to 193nm lithograpy

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Feasibility in an application of contrast enhancement layer (CEL) into a double exposure scheme for future nodes has been studied through numerical modeling, rigorous coupled wave (RCWA) analysis, and finite difference time-domain (FDTD) analysis. All simulations showed that CEL is applicable to obtain contrast enhancement effect. The contrast enhancement effect appeared to be non-linear [Fig. 1] and more effective on the images of low incident-contrast [Fig. 2]. Because of its non-linear behavior, many parameters should be carefully chosen to obtain contrast improvement. Both RCWA and FDTD showed good agreement in the process window study. In addition, other possible side effects such as contact diffraction and top-coat induced aberration were also studied. As a result, with consideration of the contact diffraction [Fig. 3] and aberration that produced by the CEL, it is proven that CEL is promising for the use of future technologies through numerical modeling and simulations.

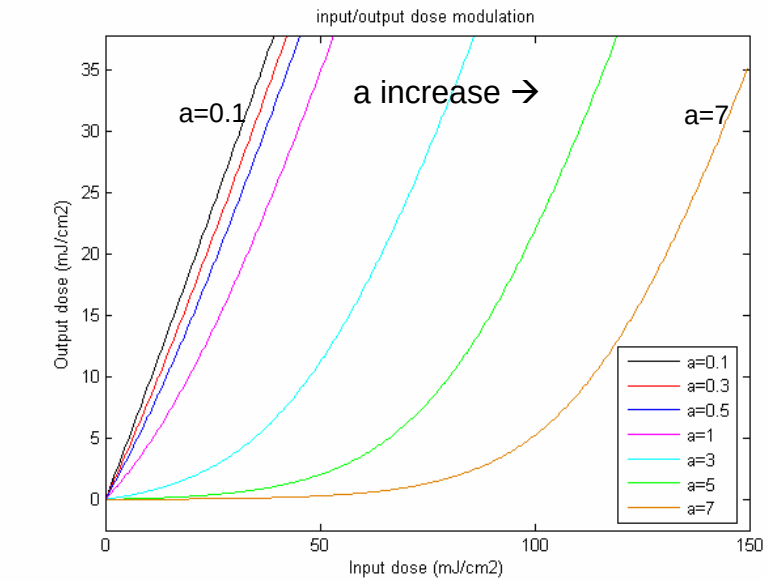


Fig. 1. Input/output dose modulation by CEL layer

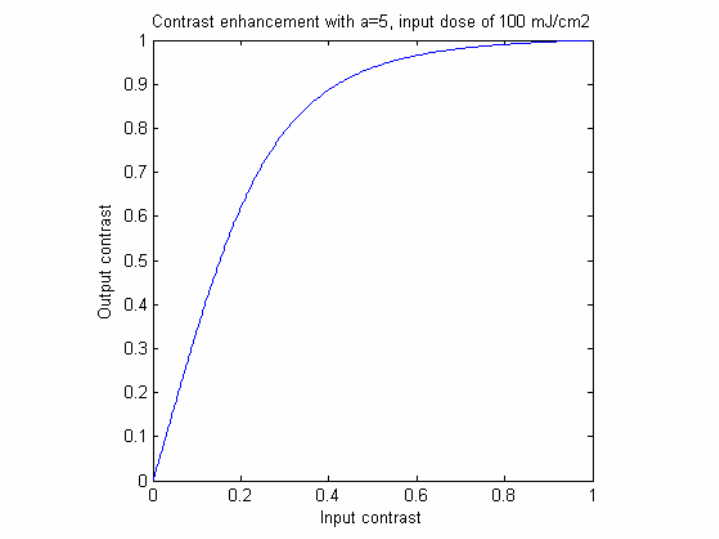
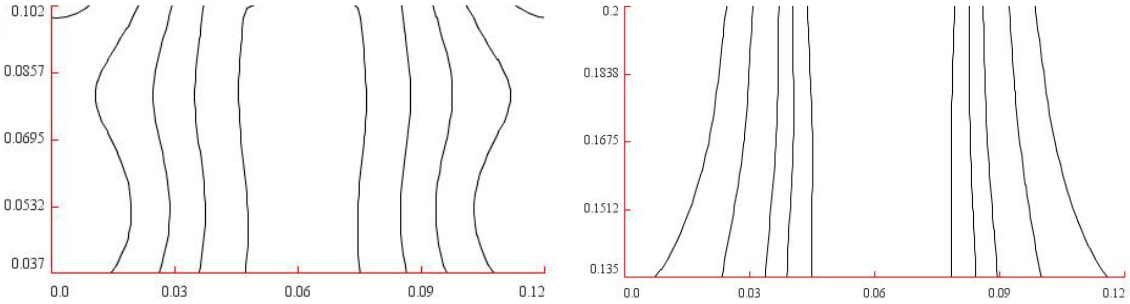


Fig. 2. Contrast enhancement for a=5 and maximum input dose=100mJ/cm^2



(a) (b)

Fig. 3. Image threshold contour in the resist under (a) chrome contact mask and (b) CEL layer that shows there is no visible contact diffraction effect generated by CEL.