6.781
Submicron Structures Technology
Homework Set #10

36. Read the attached article "Patterning 100 nm Features Using Deep-Ultraviolet Contact Photolithography" by J. G. Goodberlet, *Appl. Phys. Lett.* vol. 76, no. 6 (2000), pp. 667-669.

(a) Write a 1-paragraph analysis of the type of mask used, specifically, why is a conformable mask important?

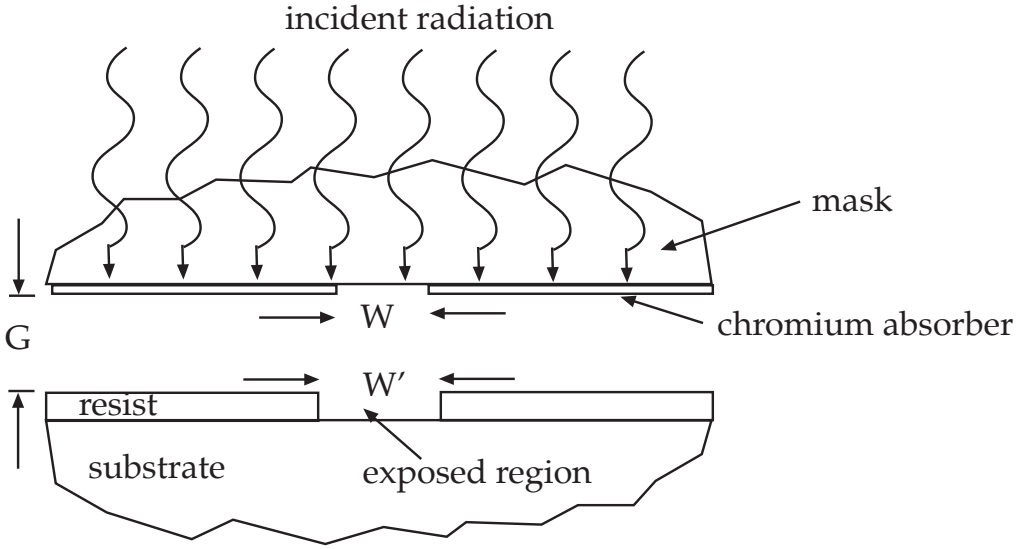
(b) What is the practical limit of linewidth for the contact photolithography described by the author.

(c) Why do you think this technique is not used in integrated circuit manufacturing?

(d) For what kinds of applications would it be a practical method of lithography?

(e) What would the practical resolution limit be if the wavelength were 400 nm.

37. In this problem we want to estimate the effect that a gap has on pattern transfer in conformable-contact photolithography. Consider the following figure:



(over)

Due to some mistake, or a dust particle, the gap, G, between mask and substrate has increased from zero to 5 μm. Because of this the width W' of an exposed linewidth in resist will differ from the width W of the feature on the mask. Assume that $W >> \lambda$ and $G >> \lambda$.

(a) Estimate W' in terms of λ, W and G. [Hint: consult the text "Optics" by Hecht. You can assume Fraunhofer Diffraction since $W \gg \lambda$ and $G \gg \lambda$]

(b) give a numerical result for W = 2 micron, λ = 220 nm, and G = 5 μm.

(c) critique and compare the use of the Fraunhofer model with the model used in the article by Goodberlet.

38. Suppose that the absorber shown in the previous problem is chromium and that the exposing radiation is λ = 220 nm. At this wavelength the real, n, and the imaginary, k, parts of the refractive index of Cr are n = 0.97, k = 1.74. How much chromium is needed to attenuate 95% of the incident radiation?

References

Problems 36 and 37

Goodberlet, J. G. "Patterning 100 nm Features Using Deep-ultraviolet Contact Photolithography." *Appl. Phys. Lett.* 76, no. 6 (2000): pp. 667-669.