CHE323/384 Chemical Processes for Micro- and Nanofabrication
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Homework #10

1. A photoresist gives a final resist thickness of 320 nm when spun at 2800 rpm.
   a) What spin speed should be used if a 290-nm-thick coating of this same resist is desired?
   b) If the maximum practical spin speed for 200-mm wafers is 4000 rpm, at what thickness would a lower viscosity formulation of the resist be required?

2. Complimentary mask features (for example, an isolated line and an isolated space of the same width) are defined by

$$t_m^c(x,y) = 1 - t_m(x,y)$$

Prove that the diffraction patterns of complimentary mask features are given by

$$T_m^c(f_x,f_y) = \delta(f_x,f_y) - T_m(f_x,f_y)$$

Use this expression to derive the diffraction pattern of an isolated line.

3. Show that the Fourier transform is a linear operation, that is, show that for two functions $f(x,y)$ and $g(x,y)$, and two constants a and b,

$$\mathcal{F}\{af(x,y) + bg(x,y)\} = aF(f_x,f_y) + bG(f_x,f_y)$$

4. Prove the shift theorem of the Fourier transform:

$$\text{If } \mathcal{F}\{g(x,y)\} = G(f_x,f_y), \quad \mathcal{F}\{g(x-a,y-b)\} = G(f_x,f_y)e^{-i2\pi(f_x a + f_y b)}$$

5. Prove the similarity theorem of the Fourier transform:

$$\text{If } \mathcal{F}\{g(x,y)\} = G(f_x,f_y), \quad \mathcal{F}\{g(ax,by)\} = \frac{1}{|ab|}G\left(\frac{f_x}{a},\frac{f_y}{b}\right)$$