Process Technology Preliminary Examination, August 25, 2000

Lithography

1) The Microfabration Laboratory is installing a DUV stepper with $\lambda = 248$ nm, NA = 0.5.
   a) What is the expected resolution and focal range for general patterns on chrome on glass masks?
   b) What is the expected resolution and focal range for fine lines on phase-shifting masks?

2) A substrate has a refractive index of about 4.
   a) What choice of the refractive index of a single layer resist will minimize standing wave effects?
   b) What choice of the refractive index of the resist will maximize energy coupling?
   c) Find the energy coupled for these two cases?
   d) Find the vertical variation in energy density within the resist for these two cases.

Deposition and Etching

1) Why is it often found difficult to improve etch anisotropy without degrading etch selectivity? Give an illustration of etching a device structure that requires both good selectivity and anisotropy and explain what happens if anisotropy is traded away for selectivity.

2) A wafer sits in vacuum system at room temperature in argon at a pressure of 1 Torr with no plasma excitation. If all of the particles that strike the wafer top surface stick, what will be the rate of growth of the thickness of the wafer?