Homework 2

1. There is a general push towards using smaller wavelength exposure in lithography via higher numerical aperture lenses, in addition to other novel techniques like immersion based lithography.

   Assuming a λ = 193nm, and NA = 0.75, k_1 = 0.25, k_2 = 0.75.

   a. Find the depth of focus, and minimum half pitch that is achievable in this system.

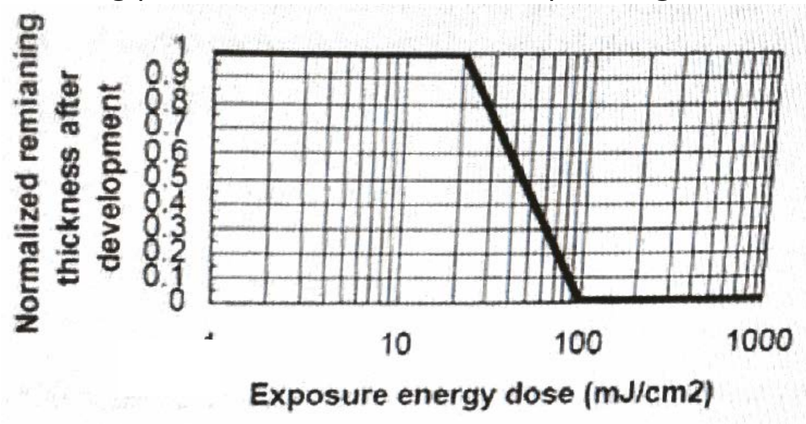
   b. Now consider NA = 1, calculate again, the depth of focus and minimum half pitch. Is this system possible?

   c. Now if we were to modify the litho system into an immersion lithography technology using a liquid with n = 1.7. Again using NA = 0.75, find your depth of focus and minimum half pitch.

   d. Given that your n_{resist} = 1.5, if you were to switch the fluid for immersion lithography, what is the n_{min} requirement which dictates the cut off for TIR? (total internal reflection between the fluid and resist interface). Assuming normal incidence.

   e. When TIR happens, will the resist be exposed? If not, what is the limit for both depth of focus and half pitch for this system?

2. Given the following photoresist with the corresponding information:



   a. Is this a positive or negative resist?

   b. Calculate the resist contrast for this resist

   c. Why does all photolithography room have "yellow" instead of just regular "white" light? Does fine temperature control of the lithography room matter? Why or why not?

3. In our EE143 lab:

   a. What type of lithography method do we use (i.e., projection, immersion, etc.) to process our wafers?

   b. Why is this process good?

   c. What's bad about it?

   d. State of the art transistors are on the nanometer scale, but ours are micron-sized devices! Why are ours so big?!