CHE323/384 Chemical Processes for Micro- and Nanofabrication
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Homework #14

1. The time required to process a wafer in an EUV lithography tool is the sum of the actual time spent exposing and the overhead time (to load and unload the wafer, move between scans, etc.). Suppose that a tool has an overhead time of 8 seconds per wafer. Further suppose that this tool has a throughput of 60 wafers per hour when the photoresist requires an exposure dose of 15 mJ/cm^2. How much will the throughput be reduced if the required dose increases to 25 mJ/cm^2? What will the throughput improve to if the required dose decreases to 10 mJ/cm^2?

2. Explain the main advantages and disadvantages of EUV lithography versus 193-nm double patterning for the production of 25 nm lines and spaces.

3. Consider a wafer with a mean dopant concentration of 7×10^{18} cm^{-3} in the channel region of the transistor. If the channel length is 30 nm, the channel width is 60 nm, and the channel depth is 15 nm, what is the mean and standard deviation of the number of dopant atoms in the channel. Assume the dopant number of atoms follows a Poisson distribution.

4. Assuming that a certain amount of acid is required to achieve a desired lithographic effect (that is, assuming the mean concentration of photogenerated acid is fixed), how low can the mean number of photons go before photon shot noise exceeds the PAG loading shot noise for an EUV resist and for a 193-nm resist? Assume for both cases that $\langle h \rangle$ = 0.3, the PAG loading is $\rho_{PAG} = \langle n_{0-PAG} \rangle / V$ = 0.05 /nm^3, and the region of interest is $(10\ nm)^3$. Also, assume typical values for EUV resist parameters: $\phi_e = 0.9$, $\alpha = 6.5\ \mu m^{-1}$.