Homework #6 — EE 528

due 11/17/08

1. Problem 8.14 in text.

2. What fraction of the dose for a 100keV B implant would penetrate through a gate stack consisting of 300nm of $TiSi_2$ and 300nm of polysilicon (ultrathin gate oxide can be ignored)? Do the calculation using R_p scaling and dose matching and compare your answer.

3. Problem 8.16 in text. Check your answer using Sentaurus-Process.

4. Consider the implantation of As into silicon at an energy of 80 keV. Assume that the implant is Gaussian with $R_p = 60$nm and $\sigma = 25$nm independent of dose (negligible channeling). Assume that stopping is dominated by nuclear collisions and the damage associated with each implanted atom is centered near that atoms final location (damage is actually skewed towards the surface). Use the Kinchin-Pease formula ($N = E_n/2E_d$) with $E_d = 15$eV and assume that the threshold for amorphization is 10% ($5 \times 10^{21}\text{cm}^{-3}$).

   (a) What is the minimum dose to start getting amorphization at the implant peak?

   (b) What is the minimum dose to get a continuous amorphous layer all the way to the surface? How would this answer change if we used the true energy deposition profile (skewed towards surface)?

   (c) How does the net excess interstitial concentration below the amorphous crystalline interface scale with dose (increase, decrease, no change)? Explain. Assume the +1 net damage model.

5. Problem 5.3 in text.

6. A mask has periodic lines and spaces of equal widths with total period of 260nm (130nm half-pitch). This mask is used in a coherent imaging system with $\lambda = 0.193\mu$m and $NA = 0.8$. The development, light intensity and photoresist sensitivity are such that less than 0.4 and more than 0.6 times the unmasked photon dose give negligible and complete resist removal during development, respectively. Sketch the resulting resist profile assuming perfect focus (indicate the dimensions of full and negligible development).

7. Send a brief description of your proposed class project to me at dunham.ee.washington.edu by Tuesday 11/18/08. I would be happy to meet with you to discuss appropriate options.