EE486 Integrated Circuit Fabrication
Spring 2017

Homework 4
Due in class on <u>Monday</u>, May 1, 2017

1. Using the experimental results given in the notes for phosphorus OED, determine the time-averaged interstitial supersaturation (C_I/C_I^*) during the first 30 and final 90 minutes of oxidation under the conditions of Problem 3 in Homework #3. Use these values to calculate the expected enhancements or retardations in antimony and arsenic diffusion (e.g., $\langle D_{As} \rangle / D_{As}^*$) under the same conditions. Assume f_I = 0.95 for phosphorus, f_I = 0.4 for arsenic and f_I = 0.05 for antimony and that the Frenkel reaction, $I+V \Leftrightarrow 0$, is near equilibrium in the bulk. Don't ignore antimony diffusion with interstitials since $C_{\mathrm{I}} > C_{\mathrm{I}}^*$. Compare your calculated average interstitial supersaturations to Sentaurus simulations (sample at several times to calculate average).
2. It is desired to mask a 10^{14} cm^{-2} 5keV B implant with various layers. The range statistics vary with material, with denser materials typically having greater stopping power. If the maximum dose of B that is allowed to penetrate the mask is $2\text{x}10^{12}$ cm^{-2}, what is the minimum masking layer film thickness for (a) SiO_2 and (b) photoresist. Assume Gaussian profiles with range parameters from plots posted on class webpage. Compare your results to Sentaurus simulations.
3. A boron implant is performed into silicon at 20 keV. The boron beam is aligned with the silicon crystal so that channeling is present. Estimate the range of the channeled boron profile, by considering that electronic stopping is the primary mechanism for slowing these boron ions. Compare to the expected range from tables and comment. Roughly sketch the expected depth profile if approximately 50% of ions are channeled.