PROBLEM SET #8

Issued: Tuesday, Nov. 4, 2014
Due: Wednesday, Nov. 12, 2014, 8:00 a.m. in the EE 143 homework box near 140 Cory

- Ion Implantation/Diffusion

1. Consider the following cross-section that is to be doped with As using ion implantation to form the source/drain regions. Assume the Si substrate is initially doped with B with a uniform concentration of $10^{16}$ cm$^{-3}$.

   ![Cross-section diagram]

   (a) Assume that the SiO$_2$ and polysilicon layers have the same ion stopping power as Si, and that SiO$_2$ thickness is 60 nm. What are the ion implantation dose and energy required to achieve a peak concentration of $10^{19}$ cm$^{-3}$ of As at the SiO$_2$ and Si interface in the source/drain regions (i.e., $y = 60$ nm)?

   (b) Continuing from (a), calculate the junction depth of the source/drain regions.

   (c) What is the minimal thickness of the gate polysilicon for the polysilicon and SiO$_2$ stack to serve as an effective implantation mask that decreases the As concentration in the channel region below 1/10th the background concentration?

   (d) Continuing from (a), a following drive-in step at 1100°C yields a final junction depth of 2 μm (counted from the SiO$_2$ and Si interface). Estimate the final sheet resistance in the S/D regions.

   (e) Continuing from (d), estimate the required drive-in time.

2. Problem 4.3, 4.4, 4.6, and 4.19 in the textbook.
   (Note: Problem 4.4(b): Fig. 4.21 → Fig. 4.12; Problem 4.6 (c): Fig. 4.30(e) → Fig. 4.11)