PROBLEM SET #7

Issued: Tuesday, Mar. 30, 2010

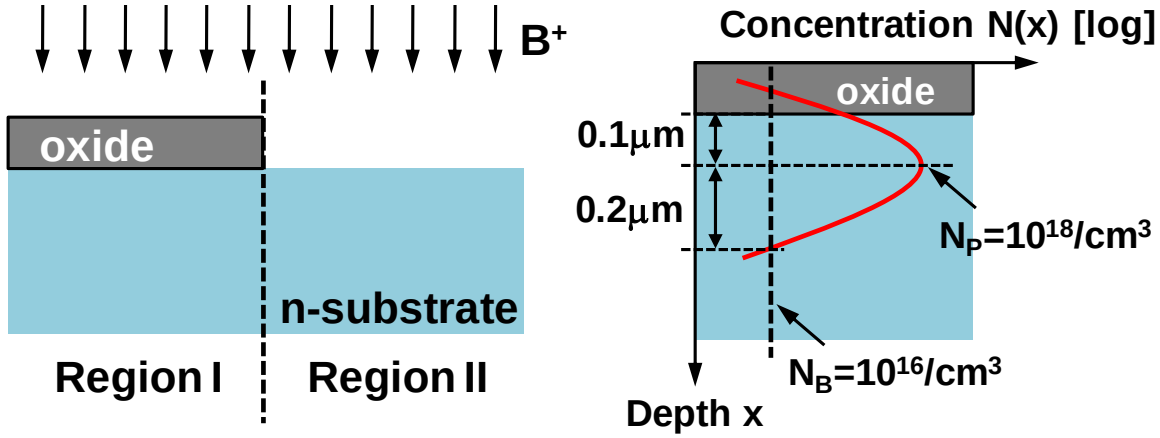
Due: Tuesday, Apr. 6, 2010, 7:00 p.m. in the EE 143 homework box in 240 Cory

1. An ion implanter with an accelerating voltage of 50 kV is used to implant the following ions into Si to an ion dose of 10^{15} ions/cm^2:
   (1) B^+; (2) B^{2+}; (3) B_2^+ ; (4) $(BF_2)^{2+}$.
   (a) Fill in the table below to calculate the velocities of these ions if they are accelerated through the 50 kV potential in the ion implanter and to estimate the vertical straggles, ΔR_P, and maximum concentrations, N_P, of the boron profile in each case using the full Gaussian approximation.

	B^+	B^{2+}	B_2^+	$(BF_2)^{2+}$
Velocities (m/sec)				
Vertical straggle, ΔR_P (μm)				
Max. concentration, N_P (/cm^3)				

   (b) If the Si substrate is n-type doped with a background concentration of 10^{16}/cm^3, explain qualitatively which ion above will give the deepest junction depth.

2. Suppose you implant boron ions (B^+) into an n-type Si wafer with partially oxide covered as shown below. The boron concentration, N(x), versus distance into substrate, x, is illustrated for the region I, which is the area with oxide covered.
   (a) What is the kinetic energy of the B^+ ions (in keV)?
   (b) What is the boron implantation dose (in #/cm^2)?
   (c) What is the thickness of the oxide?
   (d) Estimate the sheet resistance R_{sh} at Region II, i.e., the region without oxide covered, using Irvin's curves (Fig. 4.16).
   (e) Explain why a higher dose of boron ions is required to transform crystalline Si into amorphous Si as compared with arsenic ions.



3. Problem 5.6 in the textbook (Jaeger).
4. Problem 5.12 in the textbook (Jaeger).