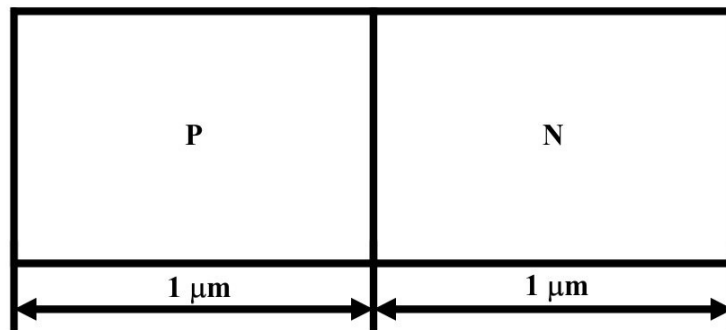


ECE 441 HOMEWORK #8
Due: Friday, April 3rd, 2009

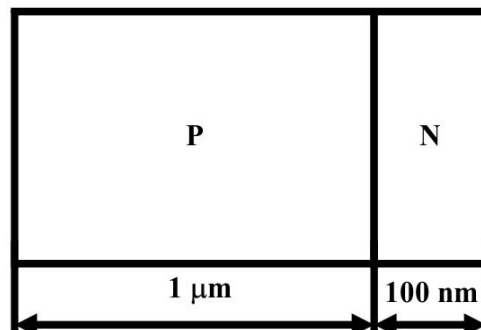
Use TCAD to simulate the following two 1D PN-diodes (see drawings) with the specifications:

- (a) Uniform doping: p-type, $N_a = 3 \times 10^{17} \text{ cm}^{-3}$; n-type, $N_d = 3 \times 10^{18} \text{ cm}^{-3}$,
- (b) Applied Biases: Reverse bias: -2 V, Zero bias: 0 V, Forward bias: 0.5 V, and plot the electrostatic potential, electric field, electron density, hole density, minority carrier currents, and total current along the diode at each bias. Estimate the length of the depletion regions for each bias.
- (c) Compare the behavior of the two diodes and explain any differences you may observe?

Case 1



Case 2



2. Solve Poisson Equation using TCAD for a 2D pn-diode under equilibrium (no contact is defined), with a **Gaussian-profile** for the n-doped region onto p-type substrate with $1 \times 10^{16} \text{ cm}^{-3}$ Boron doping. The n-type Gaussian profile should be Phosphorus-doped with the following specifications:

- (i) Lateral factor = 0.8
- (ii) Junction value = $1 \times 10^{16} \text{ cm}^{-3}$, depth = 0.3 μm
- (iv) Peak concentration = $1 \times 10^{19} \text{ cm}^{-3}$
- (iii) Doping peak density should be at the top boundary of the device

Produce profile plots in two different directions (one for horizontal slicing and the other for vertical slicing) for the electrostatic potential and the electric field. Dashed lines indicate the position where you should take profiles; 0.05 μm from the top and 0.5 μm from the left. Compare E-field graphs with what you learned in Ch. 4 and comment on them.

