EE_735 Assignment 5 (part b)

- Perform 2D simulations. (You can make use of the .cmd files which were shared in 'part a' of this assignment.)
- Use constant mobility model unless specified.
- Use finer meshing near the contacts. For all the questions, show a plot of device structure with mesh grid. [3]

Q1. Consider a Si bar of length 5 µm and thickness 3 µm (the width being 1 µm). Assume it is doped N-type with a density of 10^{16} cm^{-3}. Apply bias to left contact and simulate I-V (voltage: 0 to 3 V) for the following conditions: [3]

a. both contacts are ohmic
b. left contact is ohmic and right contact is schottky (ϕ_B = 0.3 eV)
c. left contact is schottky (ϕ_B = 0.3 eV) and right contact is ohmic

*(**Note:** φ_B is the barrier height (the difference between the contact workfunction and the electron affinity of the semiconductor in n-type semiconductors, or the difference between the band gap and the barrier as defined for n-type semiconductors in the case of p-type semiconductors))*
Give a qualitative analysis of the I-V profiles obtained in the above 3 cases. [3]
Draw the 0 bias energy band diagrams for the 3 cases. [3]

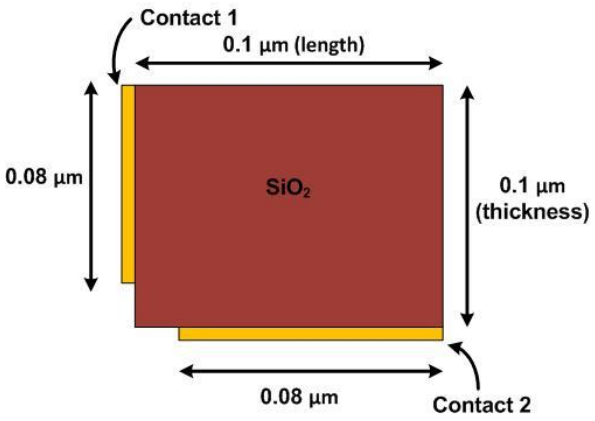
Q2. Consider a Si bar of length 0.1 µm and thickness 0.1 µm (the width being 1 µm). Assume it is doped N-type with a density of 10^{16} cm^{-3}. Simulate I-V (voltage: 0 to 3V) for the following mobility models: [3]

a. constant mobilty
b. doping dependence
c. high-field saturation

Give a qualitative analysis of the I-V profiles. [3]

Q3. Simulate the following structure (the width being 1 µm). Use shottky contacts (ϕ_B = 4 eV). [3]

a. Plot charge vs voltage (voltage: 0 to 3V) [1]
b. Plot electri field (vector) within the device at an applied bias of 3V. (If required, change the scaling to make the plot clearer) [1]



(**Hint:** Refer **section** '**Assigning contacts to edge segments in 2D**' of **sense_ug.pdf** for contact definition. Refer **sections** '**Specifying model parameters**' and '**Library of materials**' of **sdevice_ug.pdf** for generating parameter file for different materials.)