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MOS-C V_{FB} Calculation: Comparison of Theoretical and Simulation Values

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Simulate a MOS-Capacitor using the MOSCap Simulation Tool located on the nanoHUB.org website. Use the following input parameters:

Gate Insulator Thickness: 0.1 µm
Gate Insulator Layer Nodes: 100
Gate Insulator Dielectric Constant: 3.9
Semiconductor Thickness: 5 µm
Semiconductor Layer Nodes: 200
Semiconductor Doping Type: p-type
Semiconductor Doping Characteristics: Uniform
Gate Electrode: n+poly silicon
Substrate Doping Conc: $10^{15}/cm^3$

Use default parameters for all other inputs

Answer Questions 1-2

Question 1

a) Calculate ϕ_B
b) Calculate V_{FB}

Question 2

Run the MOSCap simulation on the nanoHUB.org website assuming $N_A = 10^{15}/cm^3$, $T_{ox} = 0.1$ µm and n+poly silicon gate and answer the following questions:

a) Print the energy band diagram at $V_G = 0$. Based on the band bending, is ϕ_S positive or negative?
b) Determine the value of ϕ_S based on the band bending in the energy band diagram at $V_G = 0$.
c) Print the electric field plot at $V_G = 0$ indicating the maximum value with the cursor.
d) Calculate the potential drop across the oxide (V_{ox}) based on the value of the electric field determined in part (c) and the thickness of the oxide (T_{ox}).
e) Determine the flatband voltage based on the values of ϕ_S and V_{ox} determined in parts (b) and (d).
f) How does the simulated value of V_{FB} compare to the theoretical value calculated in part 1(b).