

Solid State Physics for Nano

SS 2019

Exercise sheet 5 semiconductors

Exercise 1: metal – semiconductor contact

From an ideal metal – SiO₂- Si diode having $N_A = 10^{17} \text{ cm}^{-3}$ calculate the maximum width of the surface depletion zone. Hint: at room temperature $kt/q = 0.026 \text{ eV}$ and $n_i = 9.65 \times 10^9 \text{ cm}^{-3}$, $\epsilon = 11.9 \times 8.85 \times 10^{-14} \text{ F/cm}$, How the width changes if one reduces the doping level by 2 orders of magnitude?

Exercise 2: Flat-band voltage

Calculate the flat-band voltage of an n+-polysilicon – SiO₂ – Si diode with $N_A = 10^{17} \text{ cm}^{-3}$ and $d = 5 \text{ nm}$. Assume that only the interface charges $Q_f/q = 5 \times 10^{11} \text{ cm}^{-2}$ have to be considered, for n+ polySi with $N_A = 10^{17} \text{ cm}^{-3}$ $\phi_{MS} = -0.98 \text{ V}$.

Exercise 3: Drain voltage at saturation

From n-channel n+ polySi MOSFET with gate oxid thickness 8nm and $N_A = 10^{17} \text{ cm}^{-3}$ and Gate voltage $V_G = 3 \text{ V}$ calculate V_{Dsat} , use $2\psi_B = 0.84 \text{ V}$ and $\epsilon_{ox} = 3.9 \times 8.85 \times 10^{-14} \text{ F/cm}^2$