Home work #5

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case1

$\phi_s = 0.3$[ev], $T_{\text{si}} = 5[\mu m]$, $N^- = 10^{15}[\text{cm}^{-3}]$

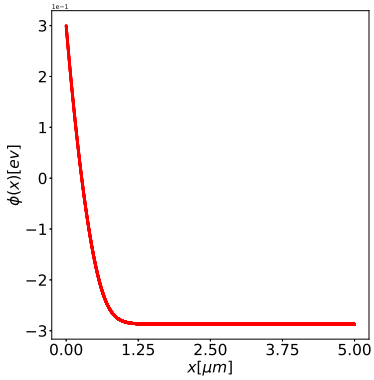

Figure 1: The energy ϕ in the semiconductor versus x

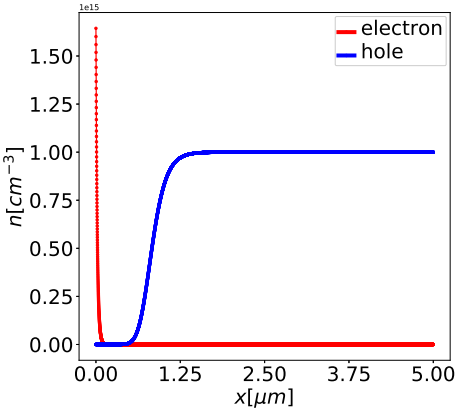

Figure 2: number density for the electron and hole concentration

case2

$\phi_s = 0.3[\text{ev}]$, $T_{\text{si}} = 5[\mu m]$, $N^- = 10^{15}[\text{cm}^{-3}]$

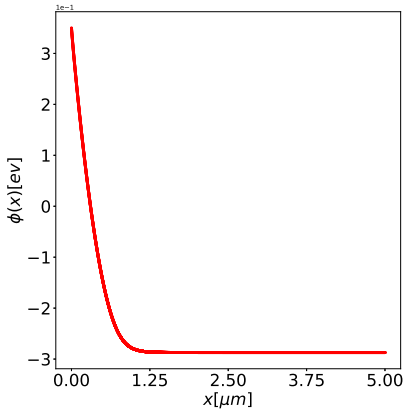

Figure 3: The energy ϕ in the semiconductor versus x

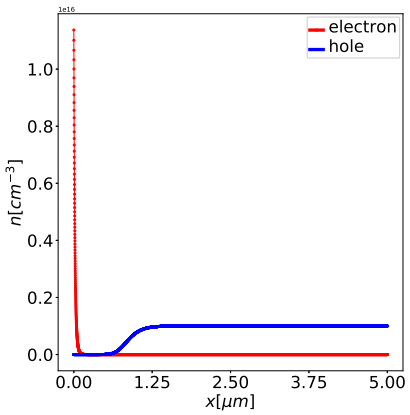

Figure 4: number density for the electron and hole concentration

case3.

Analytic results: $\vec{E_s}|_x = \sqrt{\frac{2K_bTN_a^-}{\epsilon_{\text{silicon}}}}\left\{\left(e^{-\frac{q_0\phi_d}{K_bT}} + \frac{q_0\phi_d}{K_bT} - 1\right) + \left(\frac{n_i}{N_a^-}\right)^2\left(e^{\frac{q_0\phi_d}{K_bT}} - \frac{q_0(\phi_s-\phi_d)}{K_bT} - 1\right)\right\}^{\frac{1}{2}}$ ($\phi_d = \phi_s - \phi_N$)

Numerical results: $-\nabla\phi|_x \simeq -\frac{\phi_2-\phi_1}{x_2-x_1}$, where $\phi_1 = \phi_s$.

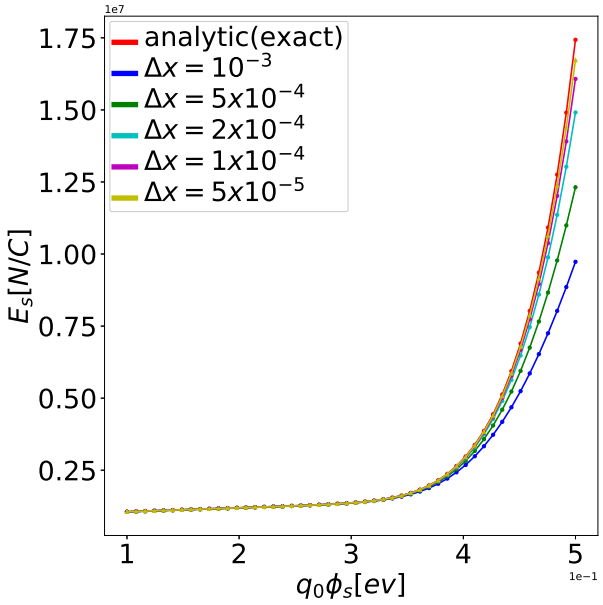

Figure 5: Benchmark between the analytic solution and numerical results