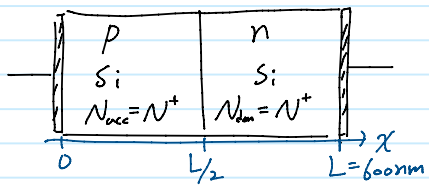
HW 14.

Thursday, October 29, 2020 5:35 PM

20184060 Jicheol Kim



Boundary Condition

$$\begin{cases} \phi(0) = -V_T \ln\left(\frac{N^+}{n_i}\right) \\ \phi(L) = V_T \ln\left(\frac{N^+}{n_i}\right) \\ n(0) = \frac{n_i^2}{N^+},\ n(L) = N^+ \end{cases} \quad \text{where } V_T = \frac{k_B T}{q}$$

Poisson eq. $\nabla\cdot(\varepsilon\nabla\phi(x)) = -\rho(x) = \begin{cases} q\left[N^+ + 2\sinh\left(\frac{\phi}{V_T}\right)\right] & 0<x<\frac{L}{2} \\ 2q\sinh\left(\frac{\phi}{V_T}\right) & x=\frac{L}{2} \\ q\left[-N^+ + 2\sinh\left(\frac{\phi}{V_T}\right)\right] & \frac{L}{2}<x<L \end{cases}$

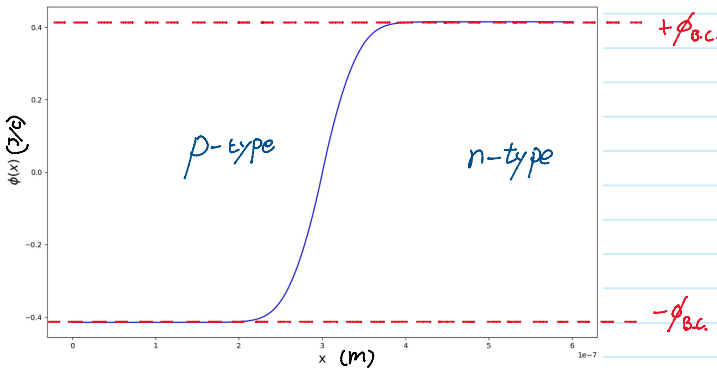
* Algorithm

Newton method로 Poisson eq.에서 $\phi(x)$ 구함. → Drift-Diffusion eq.에서 Newton method로 $n(x)$ (or $p(x)$) 구함.

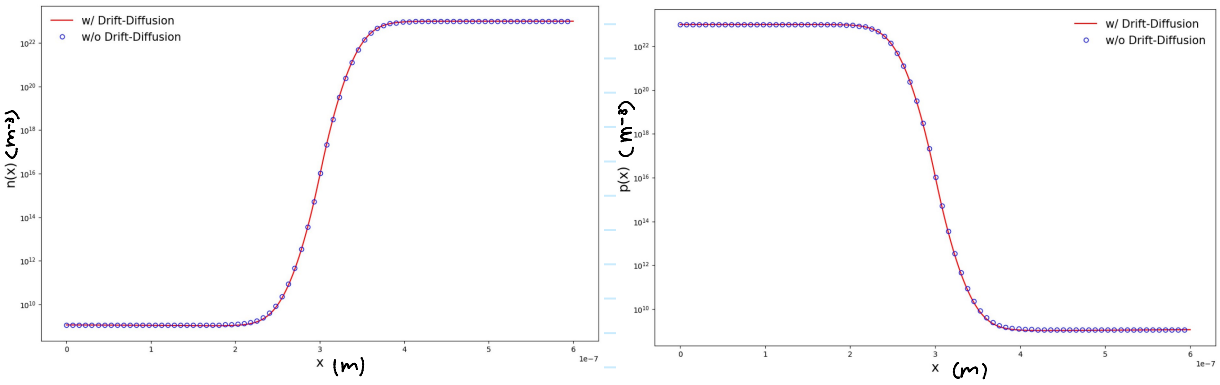
구한 $n(x), p(x)$로 다시 Poisson eq. update 하여 풀 수 있을 듯하다.

Results

$N = 800$으로 discretization, $T = 300K$, $\varepsilon = 11.7\varepsilon_0$, $n_i = 1.075 \times 10^{16}\ m^{-3}$



: 300nm 사이로 charge density에 따른 $\phi(x)$ 변화가 잘 보여진다.



: Drift-Diffusion eq. 포함한 결과와 Drift-Diffusion eq. 없이 구한 결과 사이 차이가 거의 없다.