Computational Microelectronics HW.14

EECS, 20204003

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1. PN Junction , Drift-Diffusion calculation

1) Numerical Expression

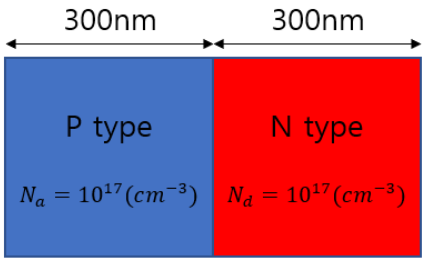

Fig. 1 Double Gate FET

위의 소자는 이번 과제에서 사용할 Model이다. 총 길이는 약 600nm이고, 각각 300nm이며, 도핑 농도는 위와 같다.

$$\nabla \cdot (q\mu_n nE + qD_n \nabla n) = 0$$

$$\nabla \cdot (q\mu_p pE - qD_p \nabla p) = 0$$

위의 두 개의 식은 각각 electron과 hole을 이용할 때 수식으로, 위의 수식을 이산화 과정을 거쳐 풀게 된다.

$$res = \frac{n_{i+1} + n_i}{2}\frac{\phi_{i+1} - \phi_i}{\Delta x} - V_T \frac{n_{i+1} - n_i}{\Delta x} - (\frac{n_i + n_{i-1}}{2}\frac{\phi_i - \phi_{i-1}}{\Delta x} - V_T \frac{n_i - n_{i-1}}{\Delta x})$$

위의 residual 식을 이용하여 Jacobian 행렬을 구하게 되면, 전자 농도를 구할 수 있게 된다. hole 또한 마찬가지로 부호를 잘 맞추면, 구할 수 있게 된다.

2) Results

A) Electron Density. Constant electron density is used. ($V_{gs} = 0V, 0.5V, 1V$)

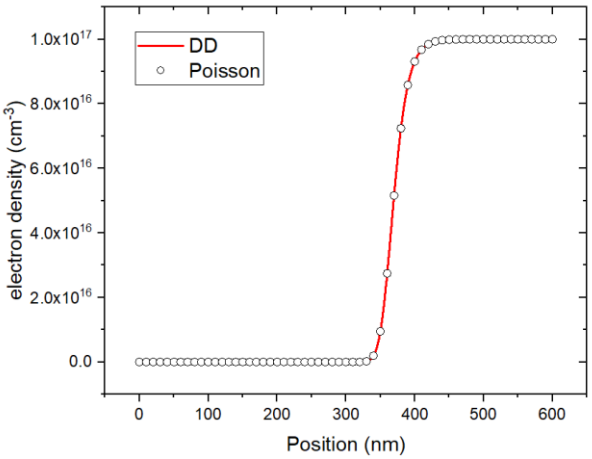

Fig 2. Position vs. Electron density graph. Red line represents the electron density which is solved by Drift-Diffusion method. Black circles are results from Poisson Solver.

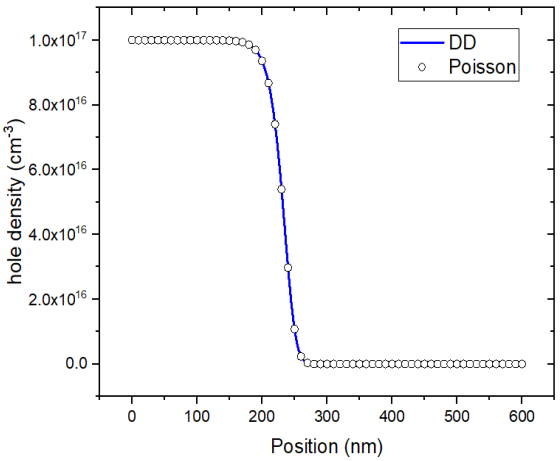

Fig 3. Position vs. hole density graph. Blue line represents the hole density which is solved by Drift-Diffusion method. Black circles are results from Poisson Solver.

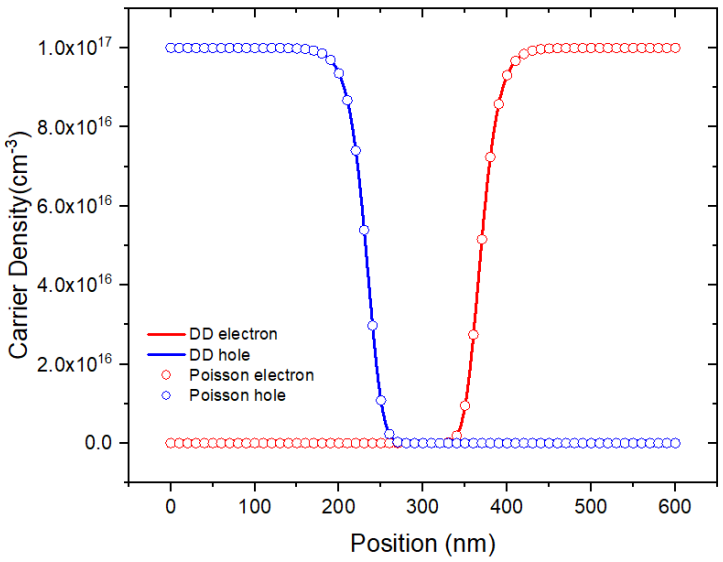

Fig 4. All of results are drawn together.