Assignment #4 Wonbin Ju 20182018

An electrostatic potential of the double-gate structure was calculated. The double gate-structure is comprised of a 5 nm thick conduction p-doped silicon channel, surrounded by 0.5 nm thick silicon dioxide. The doping density is 10^{24} cm^{-3}

The electrostatic potential is obtained under the depletion approximation using the Poisson equation shown in figure 1 first calculation. At equilibrium, the electron density was obtained at 300 K using the Boltzmann statistics. Then, the Poisson equation was re-calculated using the net charge density including the electron density shown in figure 1 second calculation. There was no distinctive difference between the first calculation and the second calculation.

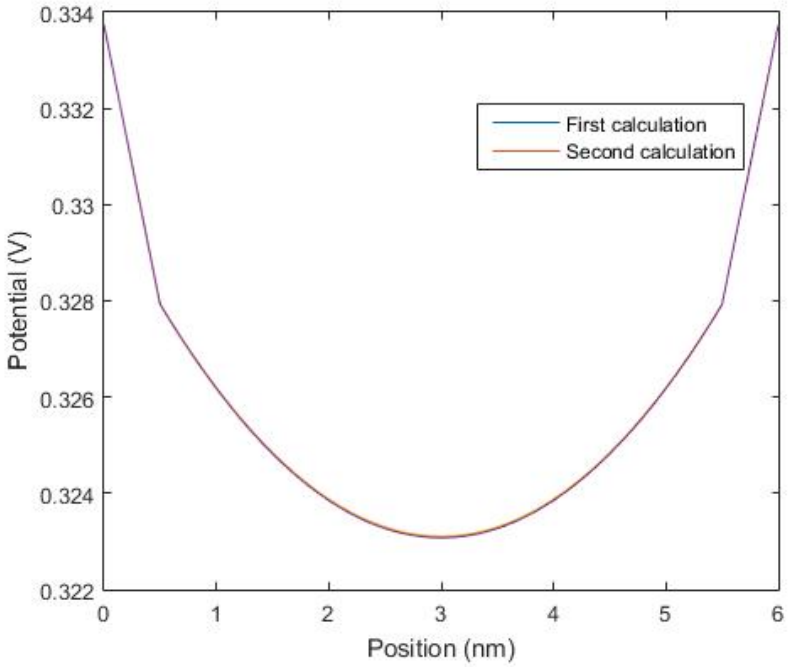

Figure 1. The electrostatic potential of the double-gate structure.

The electrostatic potential, the electron density, and the potential difference were calculated at different gate voltages. The re-calculated electrostatic potentials are given in figure 2. They are similar but have different offsets. The potential difference between the first and second calculation shown in figure 3. As the gate voltage increases, the difference decrease shown in figure 4. The reason can be explained by check the electron densities. The electron density decrease as the gate voltage increase. Above 0.2 gate voltage, the electron density is much smaller than the dopant density. That's way the second calculation is similar to the first calculation.

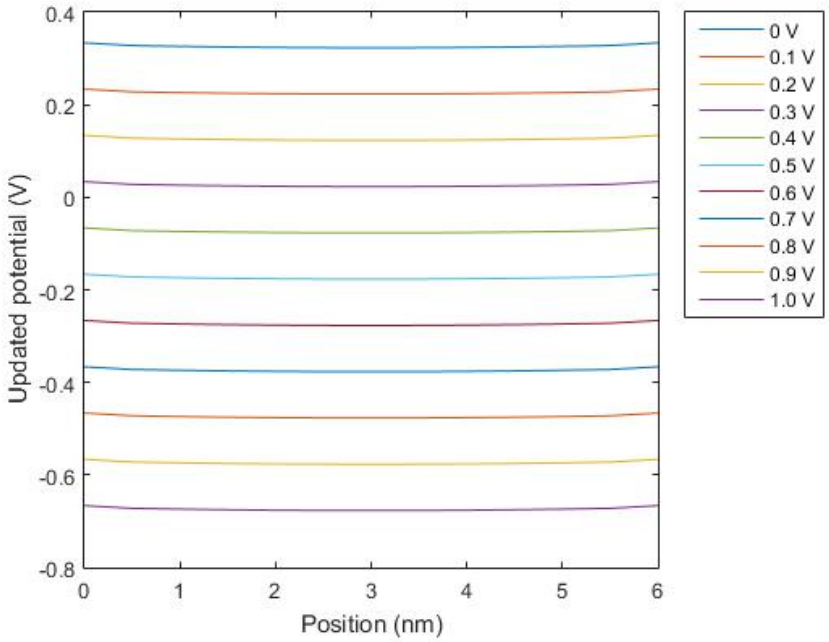

Figure 2. The re-calculated electrostatic potentials at the different gate voltage.

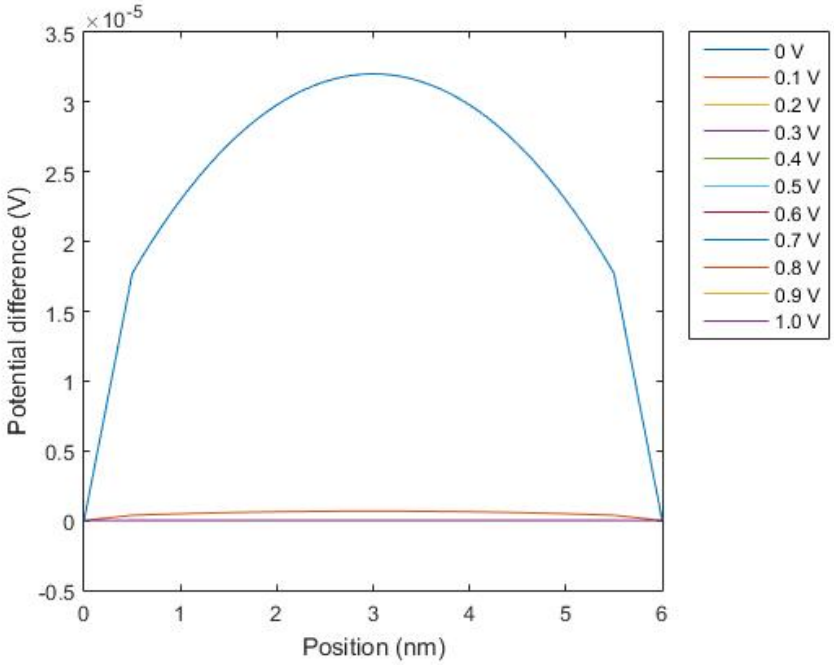

Figure 3. The potential difference between the first calculation and the second calculation at different gate voltage.

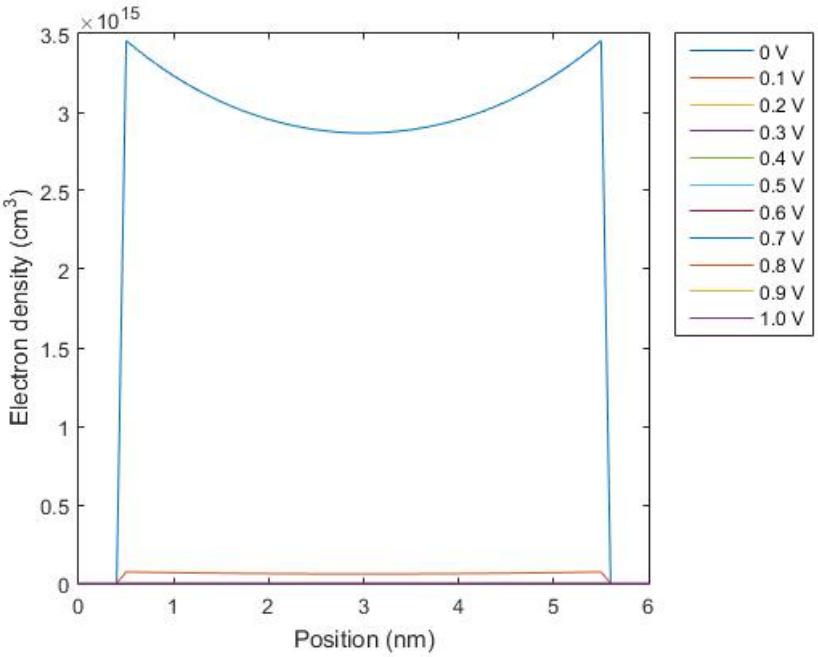

Figure 4. The electron density at different gate voltage.