Homework #4

20152052

SoonHee Park

1. Numerical calculation of position dependent potential in double-gate MOS device, by using Poisson's equation including source term

   (Applied voltage = 0 V, gate voltage=0.33374 V)

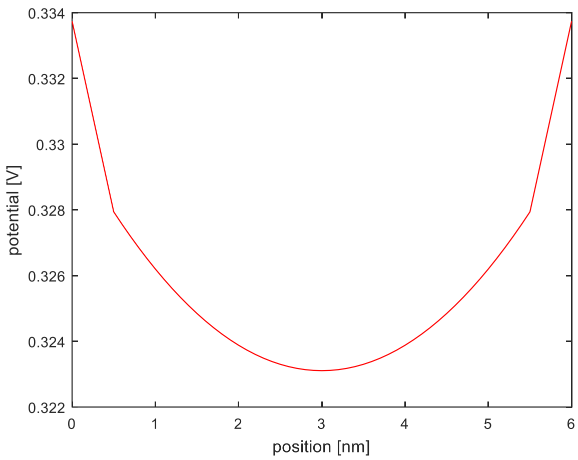

Figure 1. Calculated potential with gate voltage 0.33374 V

2. Calcuation of carrier density from the potential obtained above by using Boltzmann distribution function

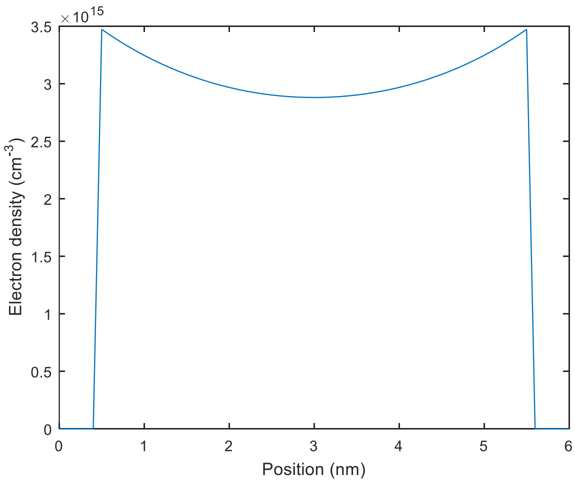

Figure 2. Charge density with gate voltage 0.33374 V

3. Re-calculation of potential (comparison first potential with second potential)

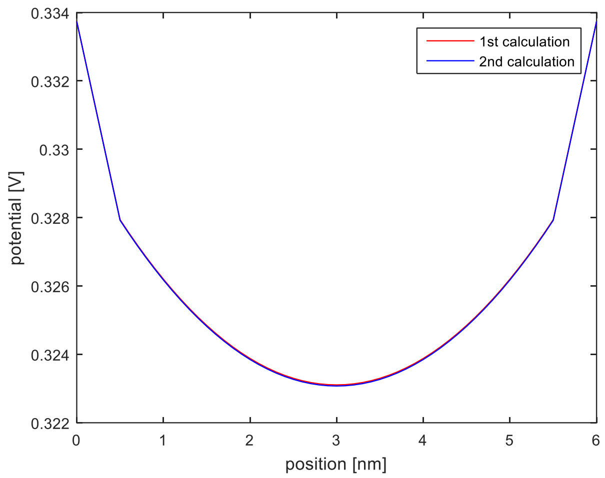

Figure 3. 1st and 2nd calculated potential

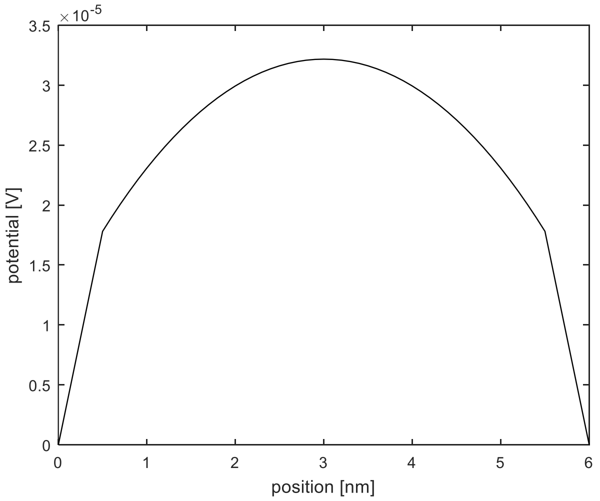

Figure 4. Difference potential between 1st and 2nd calculated potential

The difference comes from additional source because of potential itself.

$$\rho(x) = -qn(x) - qN_{acc}(x)$$

We first consider only N_{acc} and neglect n(x). However, the potential in Si affect charge density following Boltzmann distribution. Although n(x) is very small amount compared to N_{acc}, n(x) as another source makes electrostatic potential different.

4. Difference in 1st and 2nd calculated potential with different gate voltage

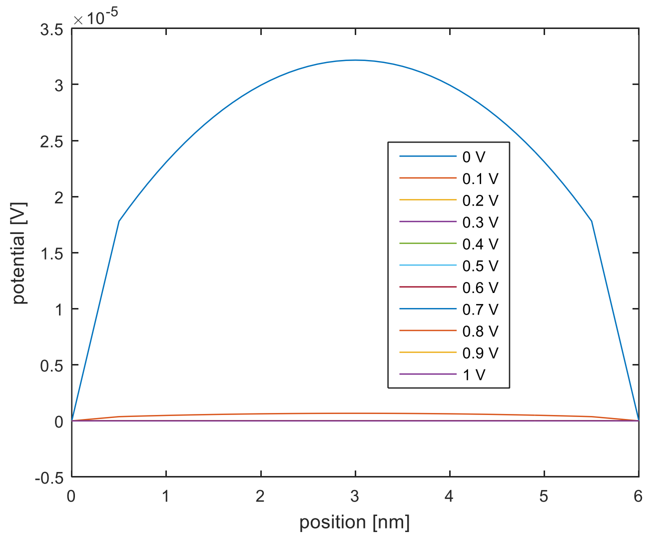

Figure 5. Difference of two potential with different applied voltage (0 V ~ 1V)

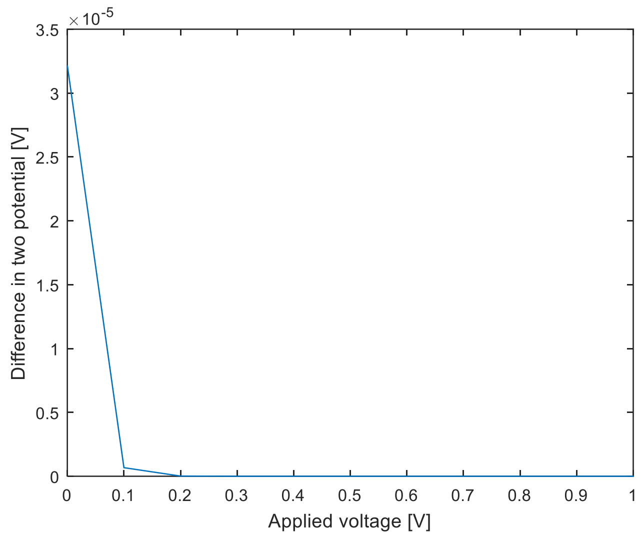

Figure 6. Difference of two potential at 3 nm as a function of applied voltage

As applied voltage is large, difference of two potential tends to be small.

The carrier density is a function of potential that varies with applied voltage. As the applied voltage is large, conduction band is located upwards. It means that electron density is small in according to Boltzmann distribution. Thus, small electron density makes the difference of two potential be small.