Homework #6

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Double gate MOS

Introduction

To get self-consistent solution of double gate MOS, we need to solve non-linear equation.

$$\epsilon\frac{\mathrm{d}^2\varphi}{\mathrm{dx}} = \mathrm{qN_{acc}} + \mathrm{qn_i}\exp(\frac{q\varphi}{k_B T})$$

where ni = 1.075e10 /cm^3, Nacc = 1e18 /cm^3, Each displacement = 0.1e-9 m, Temperature = 300 K.

However, this nonlinear solution cannot be solved directly with matrix presentation. Therefore, we used newton's method to solve this problem.

Result

We calculated potential φ and calculated electron density in the silicon with the relation

$$n(r) = \mathrm{n_i}\exp(\frac{q\varphi}{k_B T})$$

And then calculated the electron density as a function of gate voltage.

From the figure 1, we can clearly see that electron density of silicon edge increases as gate voltage increases. And this increase can be also seen in integrated electron density (figure 2). The integrated electron density increases steeply until the gate voltage reaches 0.3V. After that, slope gradually decreases.

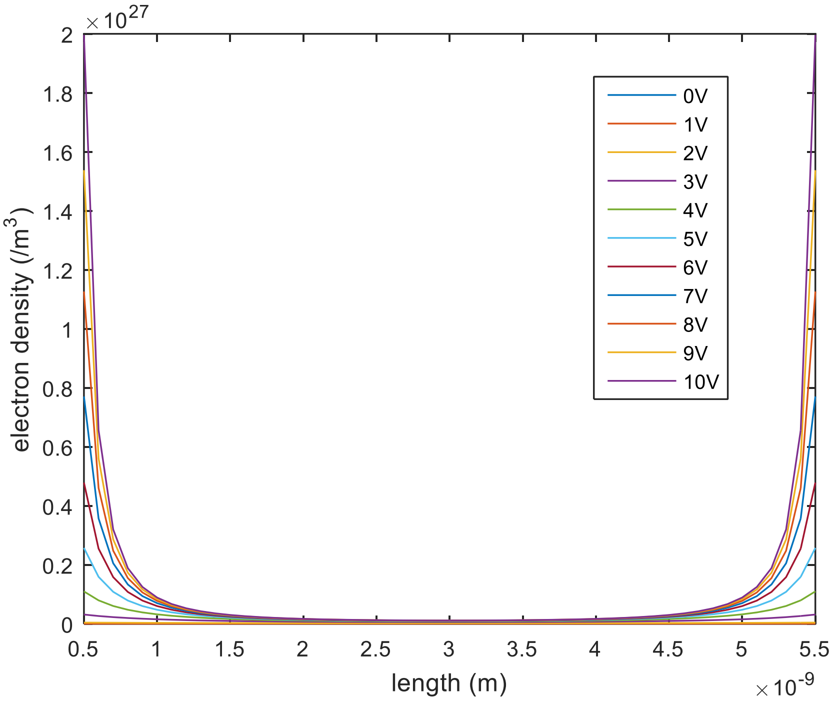

Figure 1. electron density inside the silicon.

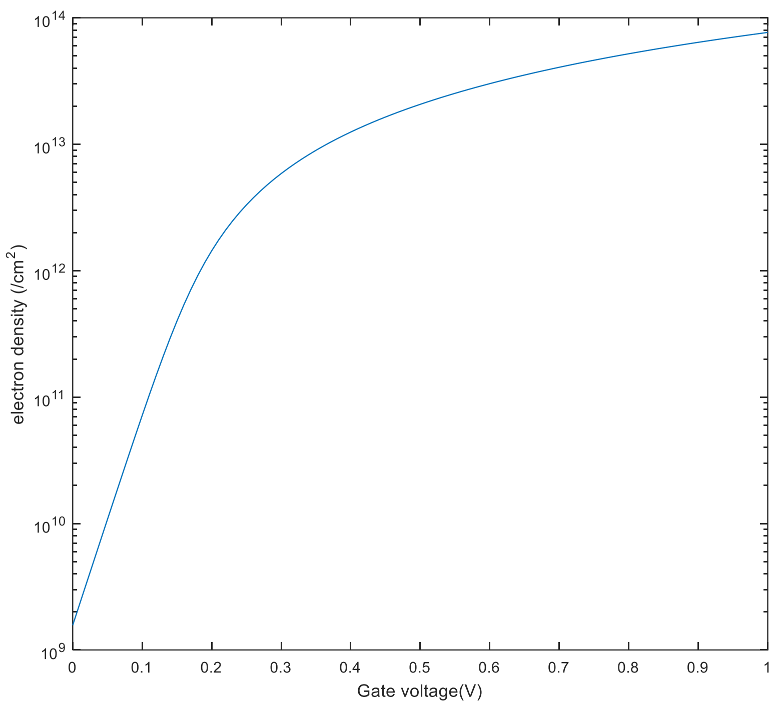

Figure 2. Integrated electron density as a function of gate voltage.