Xiences

Double Gate MOSFET
Classical Drift Diffusion

Xiences GmbH

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Executive Summary

This is a document describing an example project for the **XienceSim** software.

Note The XienceSim environment is a Finite element software package designed to solve complex physical problems. It is capable to handle 1,2 and 3 dimensional structures, with various analysis types: stationary, periodic, time dependent, eigenvalue. We hope that you are going to

nd our tutorial useful, comments are well appreciated: info@xiences.com.

Editor: Zoltan Jehn

1 Introduction

Normal

2 Structure

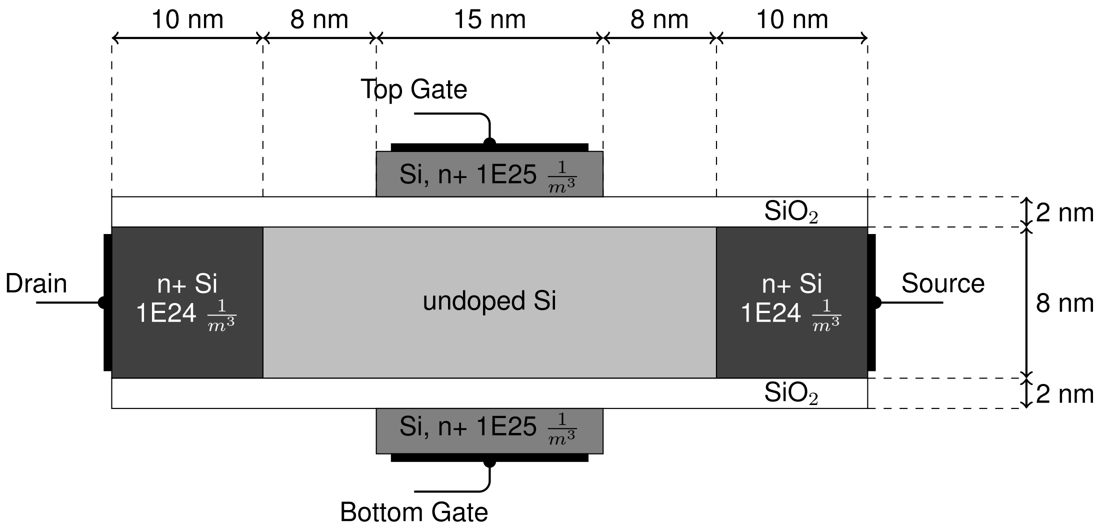


Figure 1: Schematics structure of the simulated layer structure

We simulated a structure which is depicted in figure 1, which is built from Si and SiO_2. The channel is built from undoped Si, while the oxide layer is a thin SiO_2 layer.

3 Zero-bias properties

The conduction band structure without bias is depicted in figure 2.

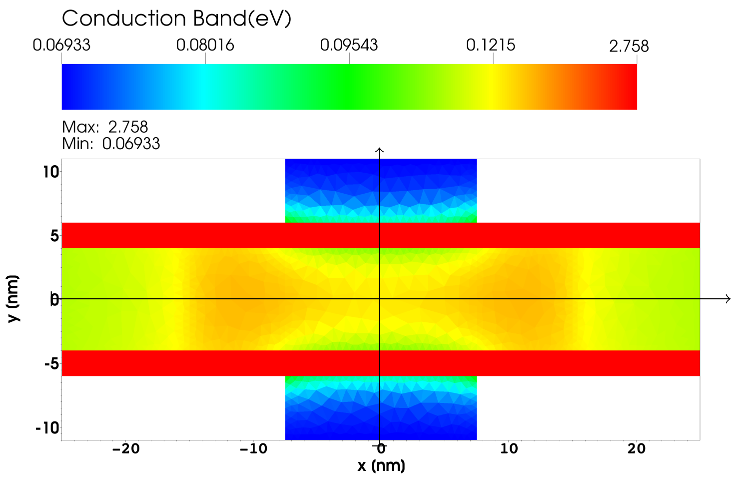
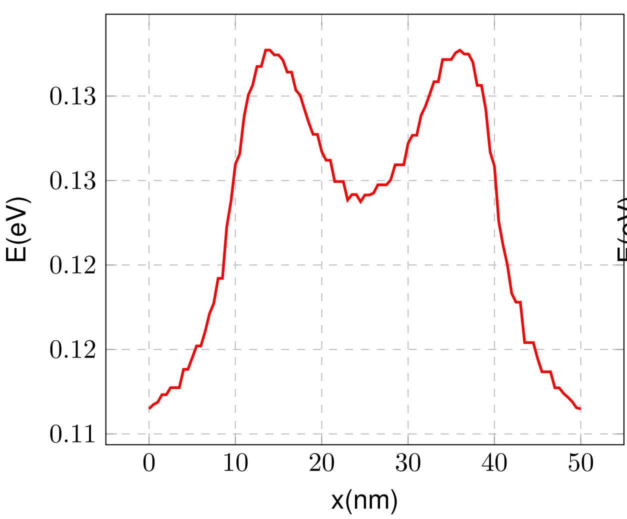


Figure 2: Schematics of the double-gate mosfet's conduction-band

If we make a slice of the conduction band in the X and Y directions as it is plotted in figures 3, 4 we are creating a quantum confinement of electrons in the channel region. If we calculate the electron density in the channel region it makes a huge difference, whether we calculate with quantum mechanical effects or not.



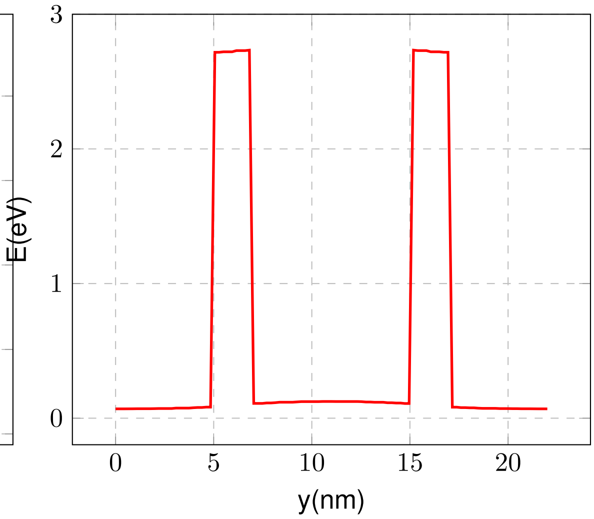


Figure 3: Conduction band profile in the X direction

Figure 4: Conduction band profile in the Y direction

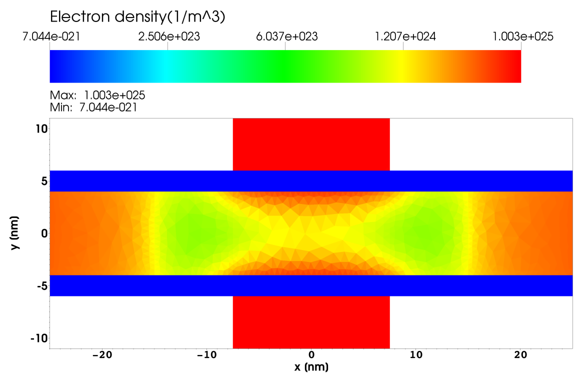


Figure 5: Classically calculated electron density

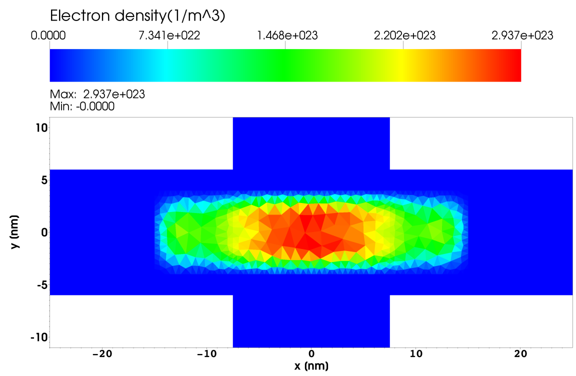


Figure 6: Quantum mechanically calculated electron density in the channel

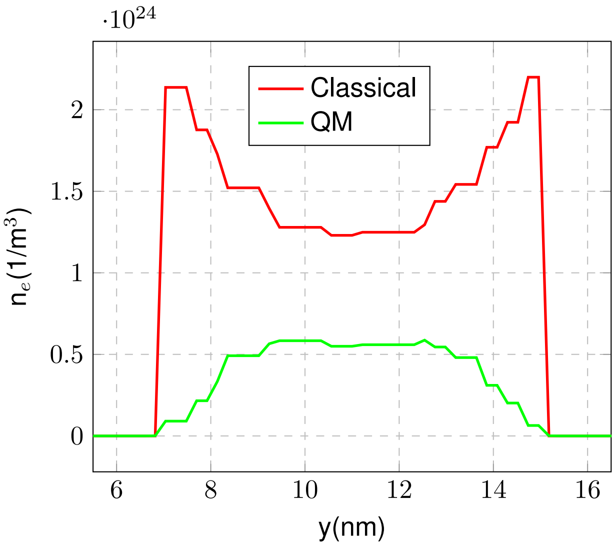


Figure 7: Electron density in the channel with and without quantum-mechanical correction

Due the fact that the electron density in the channel controls the current between the drain source contacts, it is important to compare the tho models with each other, which is plotted in figures 7. The used quantum-mechanical model was simple effective mass model in the channel region.

The electron density profiles in the sample are also compared in figure **??**. It shows that including quantum mechanical effects the electron density is shifted in positive direction, while it gets wider.

4 Online materials

The full tutorial can be found at the website **http://xiences.com**, with example project files.

References