33. A Comparison of Quantum Correction Models for the Three-Dimensional Simulation of FinFET Structures

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Keywords: three-dimensional device simulation, FinFET, quantum correction models

Many advanced CMOS devices, for example double- and triple-gate FinFETs, require threedimensional device simulation in order to accurately analyze current flow [1].

We used Minimos-NT for the study of double-gate FinFET structures with ultrathin fin thicknesses, where carrier confinement has a major impact on the device characteristics. This should be accounted for by a Schrodinger-Poisson solver. However, the use of rigorous Schrodinger-Poisson simulations is computationally extremely demanding due to the large number of grid points in three-dimensional problems. Efficient quantum correction models are therefore desirable.

Several models have been reported in the literature. Three of them, namely the H"ansch model [2], the van Dort model [3], and the model of Dragosits el al. [4] have been implemented in Minimos-NT and were compared.

The Hansch model is based on a reduction of the density of states near the interface. The amount of this reduction does not depend on the bias voltage, and the band edge energies are not influenced. The van Dort model and the model of Dragosits et al. both approximate the density of states using a distance dependent weight function. However, while van Dort uses the same weight function to adjust the band edge energy, Dragosits et al. replace the conduction band edge by the first energy eigenvalue calculated from a triangular band edge shape.

Quantum correction leads to a considerable reduction of the saturation current. Comparing the different models the H"ansch model does not account for the band bending and must therefore be calibrated for each bias point. Both, the van Dort model and the model of Dragosits et al. are able to reproduce the carrier concentration in the channel very accurately. However, the model parameters have to be carefully calibrated for the use in such ultrathin silicon layers.

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