Drift-Diffusion Versus Monte Carlo Simulated ON-Current Variability in Nanowire FETs

Abstract

© 2013 IEEE. Variability of semiconductor devices is seriously limiting their performance at nanoscale. The impact of variability can be accurately and effectively predicted by computer-aided simulations in order to aid future device designs. Quantum corrected (QC) drift-diffusion (DD) simulations are usually employed to estimate the variability of state-of-the-art non-planar devices but require meticulous calibration. More accurate simulation methods, such as QC Monte Carlo (MC), are considered time consuming and elaborate. Therefore, we predict TiN metal gate work-function granularity (MGG) and line edge roughness (LER) induced variability on a 10-nm gate length gate-all-around Si nanowire FET and perform a rigorous comparison of the QC DD and MC results. In case of the MGG, we have found that the QC DD predicted variability can have a difference of up to 20% in comparison with the QC MC predicted one. In case of the LER, we demonstrate that the QC DD can overestimate the QC MC simulation produced variability by a significant error of up to 56%. This error between the simulation methods will vary with the root mean square (RMS) height and maximum source/drain n-type doping. Our results indicate that the aforementioned QC DD simulation technique yields inaccurate results for the ON-current variability.

Palavras chave

Drift-diffusion, line edge roughness, metal gate granularity, Monte Carlo, nanowire FET, quantum corrections