

Analytical solution of nonlinear Poisson equation for symmetric double-gate metal-oxide-semiconductor field effect transistors

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Abstract

In this paper, an analytical solution of the Poisson equation for double-gate metal-semiconductor-oxide field effect transistor (MOSFET) is presented, where explicit surface potential is derived so that the whole solution is fully analytical. Based on approximations of potential distribution, our solution scheme successfully takes the effect of doping concentration in each region. It provides an accurate description for partially and fully depleted MOSFET devices in different regions of operation. Comparison with numerical data shows that the solution gives good approximations of potential for MOSFETs under different biases and geometry configurations. The solution can be applied to estimate classical and quantum electron density of nanoscale double-gate MOSFETs.

Keyword : Analytical solution; Poisson equation; Surface potential; Double-gate MOSFET