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Abstract
In recent years, studies about Double-Gate (DG) transistor have successively been proposed, and have attracted a lot of attention. As CMOS is scaled to the limit, dou-ble-gate (DG) MOSFET becomes increasingly important. Besides, we use dual material on the front gate to overcome Short Channel Effect (SCE). A number of authors have applied various simplifying assumptions to model the SCE of DMDG fully-depleted MOSFETs analytically. Some of them make use of a parabolic potential approximation approach for the device in the direction perpendicular to the surface. This results in a scale length proportional to the oxide and the silicon thickness. Large errors occur when one of thickness is much less than the other. Other approaches apply the superposition method to solve the 2-D boundary-value problem for the bulk MOSFETs. Most of them only put focus on device scaling scheme, threshold degradation by ignoring the 2-D ef-fects in the gate oxide. In order to give insight into the device physics, we need to de-velop a consolidated threshold voltage model for the DG transistor with fully 2-D ef-fects included in both silicon and gate oxide regions.
In this thesis, we successfully develop a physical and analytical sub-threshold be-havior model for fully depleted ADMDG MOSFET's by use of the 2-D analytical solu-tion in the entire region of the device based on fully closed-form solutions of Poisson's equation. Without any fitting parameters, these analytical results are useful in predictive compact modeling of ADMDG MOSFET's. The model shows the distribution of elec-tric potential, electric field, short channel threshold voltage roll-off (ΔVTH), sub-threshold current and sub-threshold slope (Swing). The new model is verified by published numerical simulations with close agreement. Due to its computational effi-ciency, this model can be applied for SPICE simulation.
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