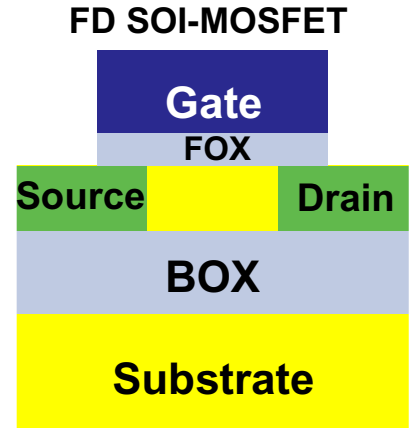


HiSIM-SOI: Complete Surface-Potential-Based Fully-Depleted SOI-MOSFET Model for Circuit Simulation

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Background

SOI MOSFETs are considered to be a candidate for next generation device.



Reliable circuit simulation model for SOI-MOSFETs is needed.

Objectives

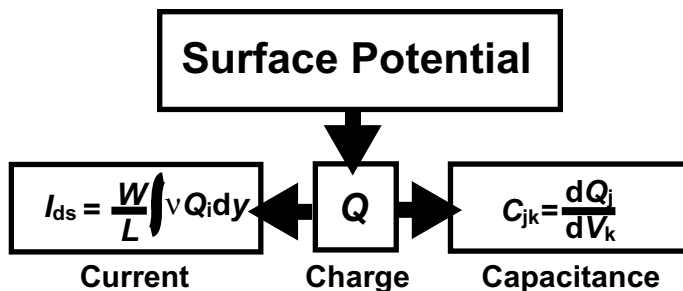
- Fully-depleted SOI MOSFET
- Surface-potential-based model

HiSIM

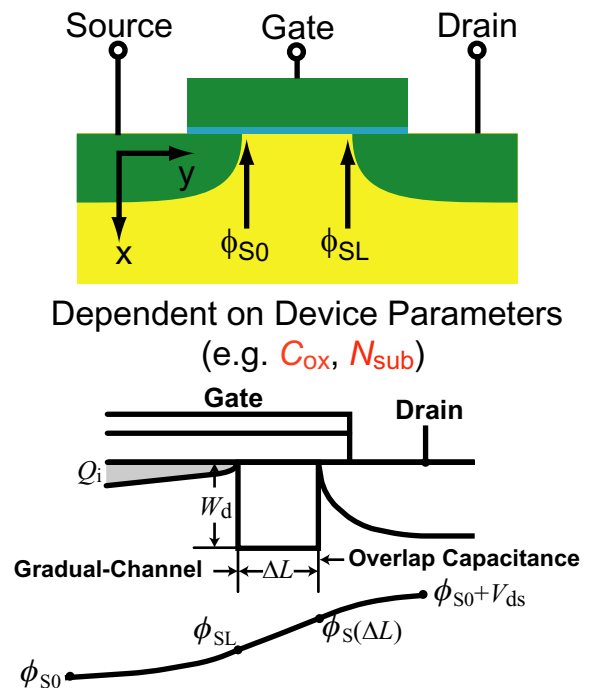
HiSIM : Hiroshima-University STARC IGFET Model

HiSIM for bulk-MOSFET

ϕ_s : Solution of the 1D Poisson Equation solved iteratively

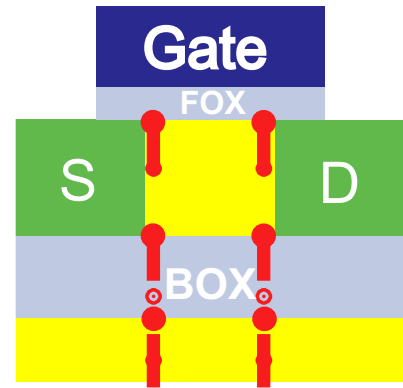
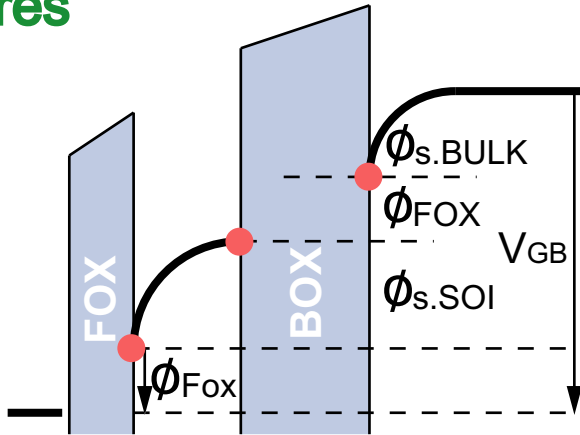


Accurate calculation of ϕ_{s0} and ϕ_{sL} is the core for HiSIM



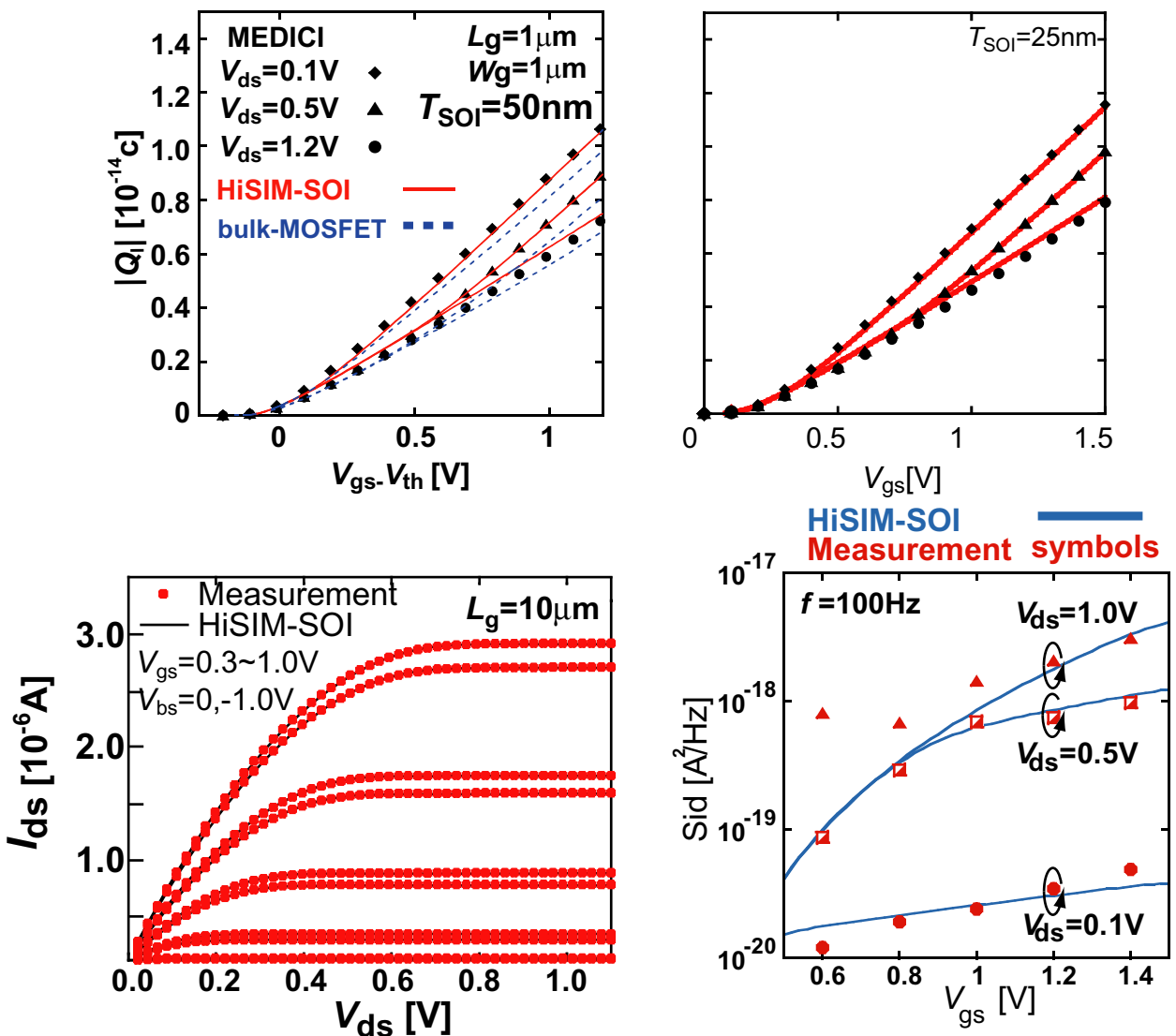
HISIM-SOI

Features



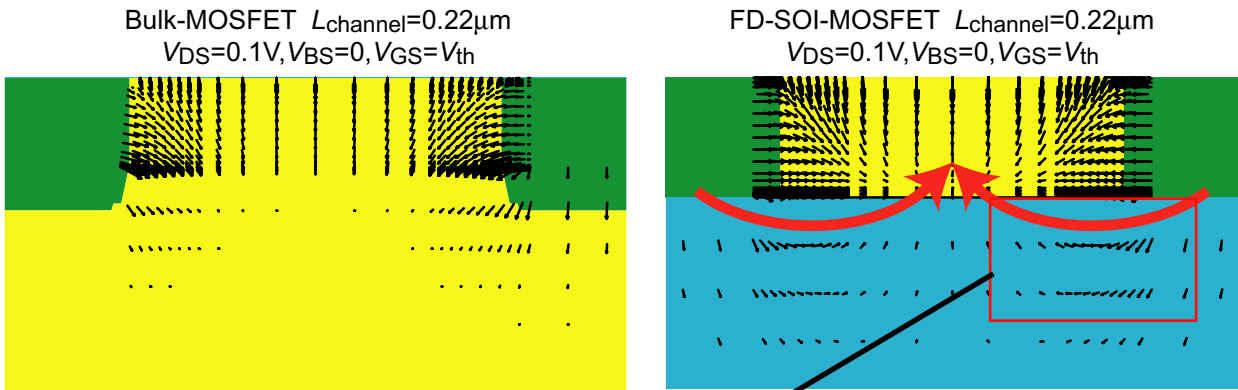
- HiSIM-SOI**
- Calculates three surface potentials
 - Iterative surface potential calculation

(1) Charge, I - V and $1/f$ Noise Calculation Results

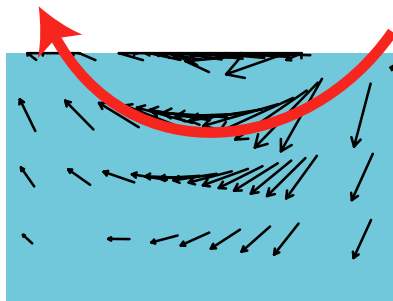


I - V and $1/f$ noise characteristics calculated by HiSIM-SOI are in good agreement with measured results.

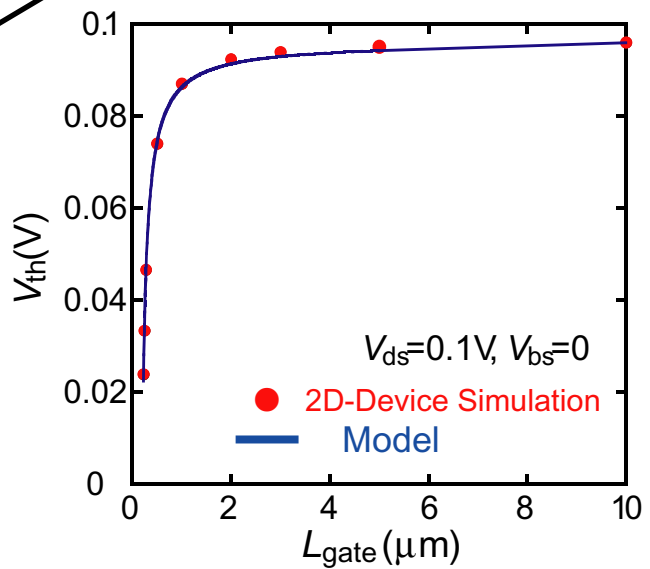
(2) Short Channel Effect in SOI MOSFET



Electric Field Distribution



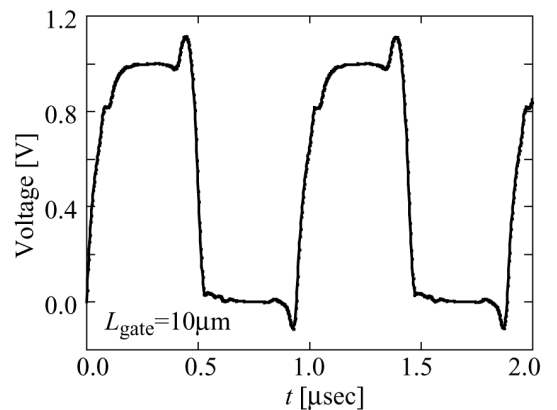
Electric field from drain to SOI channel via BOX is observed.



Short channel effect model considering detour field describes $V_{\text{th}}-L_{\text{g}}$ characteristics accurately.

(3) Application to Circuit Simulation

Simulation result of a 5-stage ring oscillator by HiSIM-SOI.



HiSIM-SOI achieves stable calculation.

Summary

- We have developed the circuit simulation model HiSIM-SOI for SOI MOSFET.
- Inversion charge characteristics calculated by HiSIM-SOI show good agreement with 2-D device simulation results.
- HiSIM-SOI reproduces measured I - V and $1/f$ noise characteristics accurately.
- Short channel effect model for SOI-MOSFET is developed.
- HiSIM-SOI is implemented into the circuit simulator SPICE 3F5.