Consistent DC and AC models of non-fully depleted SOI MOSFETs in strong inversion

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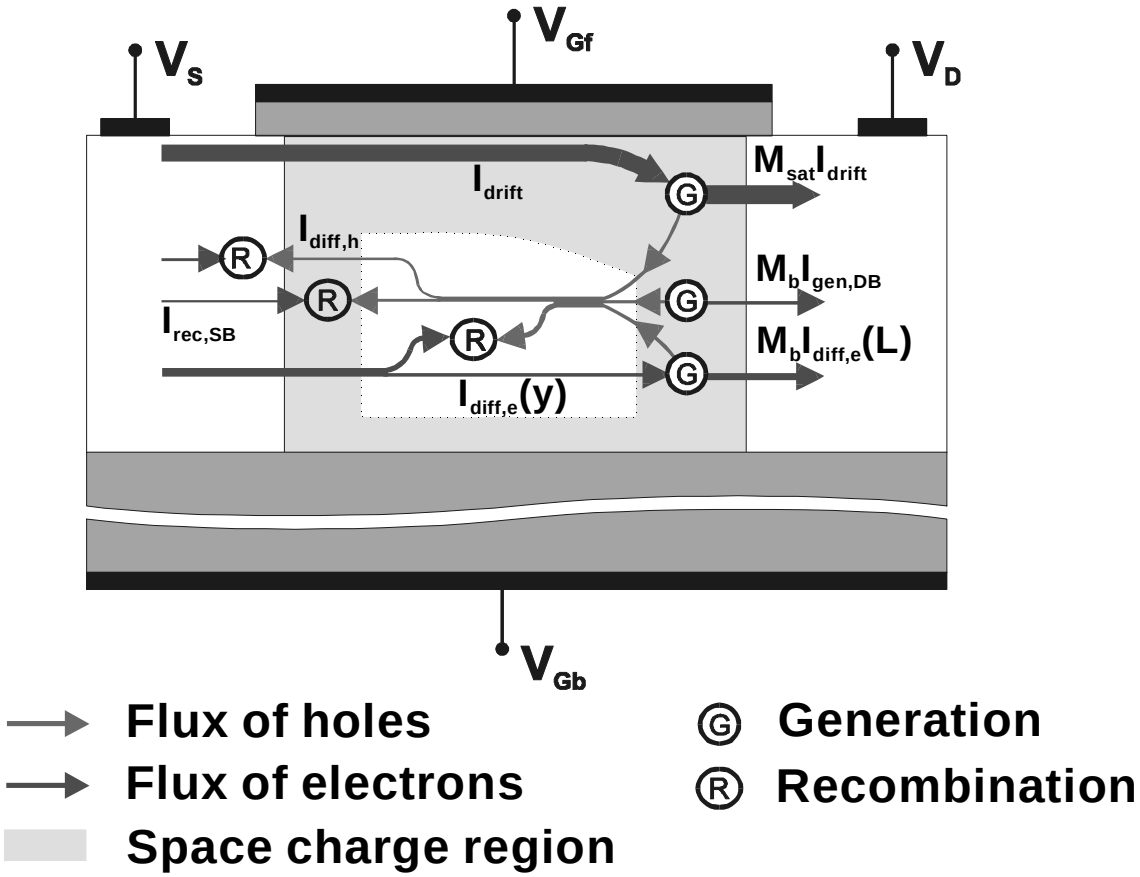
Model



Phenomena:

- ✓ Transport at the Si-SiO_2 interface (diffusion/drift)
- ✓ Diffusion in the floating body
- ✓ Thermal generation/recombination in the space-charge areas
- ✓ Avalanche ionization
- ✓ Displacement currents (AC analysis)
- ✗ Self-heating

Basic equations

Key variable of the model

$v_{BS}(t)$ - time-dependent body-source voltage

Charge neutrality / current continuity condition

$$i_S(t) + i_{Gf}(t) + i_D(t) + i_{Gb}(t) = 0$$

Sinusoidal steady-state analysis (S^3A) method
[Hauser 1965, Laux 1985]

$$u(t) = U + u^* \cdot e^{j\omega t}$$

$$v(y,t) = V(y) + v^*(y) \cdot e^{j\omega t}$$

DC model

$$I_S + I_{Gf} + I_D + I_{Gb} = 0 \qquad \Rightarrow \qquad \mathbf{V_{BS}}$$

AC model

$$i_s^* + i_{gf}^* + i_d^* + i_{gb}^* = 0 \qquad \Rightarrow \qquad \mathbf{v_{bs}^*}$$

Results

- **Physical, self-consistent DC and AC models of SOI MOSFETs**
- **Model sensitive to variations of physical and device parameters**
- **Implementation of model in WINDOWS environment (SOIMOS program)**
- **Easy-to-use application**
- **Fast and reliable calculations of**
  - ◊ **terminal characteristics (I-V, C-V, G-V)**
  - ◊ **bias dependence of internal variables (e.g. widths of space charge areas)**
  - ◊ **bias dependence of spatial distribution of several internal variables (e.g. diffusion current in the body)**

Example of model output