Non-Equilibrium Green’s Function (NEGF) Simulation of nanowire MOSFET
Advanced physical models of nanowire-MOSFET

- Use of cylindrical coordinate system to achieve maximum simulation efficiency.

- Hybrid approach with channel region using NEGF while all other regions using conventional drift-diffusion.

- Flexible choice of subbands to be included in NEGF quantum confinement and quantum ballistic transport.

- Self-consistent solution of NEGF equations with all other equations of drift-diffusion.
NEGF Simulation of Nanowire MOSFET

Quantum confined (NEGF) region

Net-doping distribution
NEGF Simulation of Nanowire MOSFET

Differential potential/Bias distribution

Current flow distribution
NEGF Simulation of Nanowire MOSFET

Quantum confined states

Electron penetration into thin oxide
NEGF electron energy density spectrum at Vg=1V  Vd=1V; log10 scale
NEGF electron energy density spectrum at $V_g=1\,\text{V}$ $V_d=1\,\text{V}$
NEGF Simulation of Nanowire MOSFET

NEGF region electron conc. distribution at Vg=1V Vd=1V
NEGF Simulation of Nanowire MOSFET

NEGF current flow spectrum at Vg=1V Vd=1V
Comparison of DD and NEGF models. Both models used quantum confinement. DD model uses simple bulk mobility.
Crosslight’s NEGF based simulation tools are suitable for nanowire MOSFET simulation.

Hybrid approach combining DD and NEGF offer both accuracy and efficiency.

Use of cylindrical coordinate system further enhances computation efficiency.

For both Id-Vd and Id-Vg curves, total computation time is 7 minutes on an i7 laptop with Windows 7.

It was found that without elaborate silicon mobility model calibration, the difference between DD and NEGF can be large.