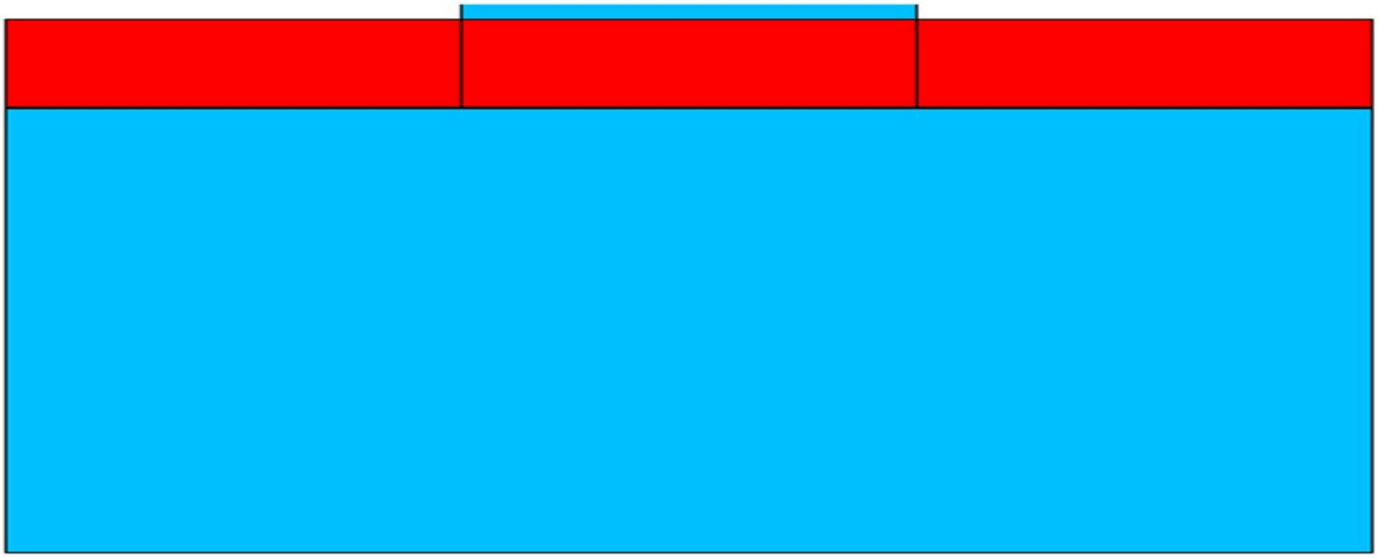
Monte Carlo Particle Device Simulator (PDS)



Introduction

An innovative fastest Particle Device Simulator uses Monte Carlo technique for solution of coupled Boltzmann-Quantum-Poisson equations equipped with parallel computing feature. Monte Carlo particle simulator takes into account the transport of Monte Carlo particles (also called as super particles) under influence of applied external field, determined self-consistently through the solution of decoupled Poisson's and BTE equation over a suitably small time-step. The time step is taken typically less than the inverse plasma frequency obtained with the highest carrier density in the device. Poisson’s solution is generated over the node points of the mesh, wherever carrier transport solution is obtained using Ensemble Monte Carlo (EMC) on the full range of space coordinates (Full Energy Band) in accordance with the particle distribution itself. Particle-mesh (PM) coupling scheme is used for assignment of carrier charge on different nodes and for calculation force on each charges.

(1) Carrier charge assign at the mesh nodes through Charge in Cloud (CIC) scheme

(2) Solution of Poisson's equation on the mesh points through Successive over Relaxation (SOR) method

(3) Calculation of the mesh defined electric field components

(4) Interpolation of forces at the particle positions.

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Features

- No initial assumptions & Solution for non-equilibrium transport conditions
- 2D and 3D carrier transport solution
- Transport of Monte Carlo particles
- Full Energy band based transportation
- Particle-mesh (PM) coupling scheme is used for assignment of carrier charge on different nodes
- Poisson Solver
- Charge assignment at the mesh nodes through Charge in Cloud (CIC) scheme
- Successive over Relaxation (SOR) Technique
- Simulates Mobility of carriers based on applied external field
- Particle boundary conditions contain Neuman and Dirichlet conditions.
- Accuracy upto single carrier

Benefits can be realized

- No need for initial Assumption like in Drift-Diffusion model
- Ensemble Monte Carlo Technique
- Scattering Rates
- Number of Carrier's Initialization depends on Users Hardware configuration
- Quantum Confinement effect can be seen with:
  - Density Gradient & Effective Potential Method
- Transportation on Parabolic & Nonparabolic energy bands
- Coupled Boltzmann- Wigner -Poisson Solver
- Self low and high field mobility simulation
- Accurate device I-V prediction
- Trace single carrier under different operating conditions
- Extract exact carrier position & energy before & after free flight
- Parallel Computing feature
- World's fastest particle device simulator

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