madFETs

mad-FET introduction

The Field-Effect-Transistor has been proposed and implement in many physical systems, materials, and geometries. A multitude of acronyms have developed around these concepts. The “Many-Acronym-Device-FET” or “madFET” was born. The author of this document was able to trace an attribute to the acronym madFET from Bill Frensley to Herbert Kroemer.

nanoHUB.org hosts a variety of tools that enable the simulation of field effect transisors for a variety of different geometries in a variety of different levels of approximations. This page provides an easier access to some of these tools.

MOSfet Lab

(Image(/site/resources/tools/mosfet/1mosfet.gif, 120px, class=align-right) failed - File not found) (Image(/site/resources/tools/mosfet/mosfet.jpg, 120px, class=align-right) failed - File not found) The MOSfet Lab tool enables a semi-classical analysis of current-voltage characteristics for bulk and SOI Field Effect Transistors (FETs) for a variety of different device sizes, geometries, temperature and doping profiles.

Exercises:

- MOSFET Exercise
- Exercise: Basic Operation of n-Channel SOI Device
- MOSFET - Theoretical Exercises
- MOSFET Operation Description

nanoMOS

(Image(/site/resources/tools/nanomos/nanomos3.gif, 120px, class=align-right) failed - File not found) (Image(/site/resources/tools/nanomos/nanomos2.gif, 120px, class=align-right) failed - File not found) (Image(/site/resources/tools/nanomos/nanomos1.gif, 120px, class=align-right) failed - File not found) The nanoMOS tool enables a 2D simulation for thin body MOSFETs, with transport models ranging from drift-diffusion to quantum diffusive for a variety of different device sizes, geometries, temperature and doping profiles.

nanoFET

(Image(/site/resources/tools/nanofet/nanofet1.gif, 120px, class=align-right) failed - File not found)(Image(/site/resources/tools/nanofet/nanofet2.gif, 120, class=align-right) failed - File not found) The nanoFET simulates quantum ballistic transport properties in two-dimensional MOSFET devices for a variety of different device sizes, geometries, temperature and doping profiles.

FETtoy

(Image(/site/resources/tools/fettoy/1-fettoy.gif, 120px, class=align-right) failed - File not found)(Image(/site/resources/tools/fettoy/fettoy1.gif, 120px, class=align-right) failed - File not found) FETtoy is a set of Matlab scripts that calculate the ballistic I-V characteristics for a conventional MOSFETs, Nanowire MOSFETs and Carbon NanoTube MOSFETs. For conventional MOSFETs, assumes either a single or double gate geometry and for a nanowire and nanotube MOSFETs it assumes a cylindrical geometry. Only the lowest subband is considered, but it is readily modifiable to include multiple subbands. Additional related documents are: FETToy Detailed Description, Theory of Ballistic Nanotransistors, Learning Module on FETToy, Homework Exercises for FETToy.

PADRE

(Image(/site/resources/tools/padre/padre.jpg, 120px, class=align-right) failed - File not found) PADRE is a 2D/3D simulator for electronic devices, such as MOSFET transistors. It can simulate physical structures of arbitrary geometry—including heterostructures—with arbitrary doping profiles, which can be obtained using analytical functions or directly from multidimensional process simulators such as . A variety of supplemental documents are available that deal with the PADRE software and TCAD simulation:

- User Guide
- Abbreviated First Time User Guide
- FAQ
- A set of course notes on Computational Electronics with detailed explanations on bandstructure, pseudopotentials, numerical issues, and drift diffusion.
- Introduction to DD Modeling with PADRE
- Description and Semiclassical Simulation With PADRE
- A Primer on Semiconductor Device Simulation (Seminar)

Exercises:

- BJT Problems and PADRE Exercise
- Introduction to DD Modeling with PADRE
- MOS Capacitors: Description and Semiclassical Simulation With PADRE

PROPHET

(Image(/site/resources/tools/prophet/prophet.jpg, 120px, class=align-right) failed - File not found) PROPHET was originally developed for semiconductor process simulation. Device simulation capabilities are currently under development. PROPHET solves sets of partial differential equations in one, two, or three spatial dimensions. All model coefficients and material parameters are contained in a database library which can be modified or added to by the user. Even the equations to be solved can be specified by the end user. It is supported by an extensive set of User Guide pages and a seminar on Nano-Scale Device Simulations Using PROPHET.