Drift-diffusion Solver

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Salient features

The drift-diffusion solver simulates the electronic device by solving *Poisson*, and electron/hole *continuity equations*.

- Can perform a quasi-stationary DC ramp, small-signal analysis at a fixed DC bias, and a transient analysis.
- Coupled Poisson, electron, and hole continuity equations are solved.
- The mixed-mode-system consisting of the semiconductor devices and the external components can be solved coupled with drift-diffusion equations.
- Physics-based models for mobility, recombination phenomena, traps, etc. in semiconductors available.
- The model parameters editable in the material config file, thus allowing model calibration.

Easy-to-use Config file

- Specify simulation setup in an intuitive config file.
- Define active models – region-wise, material-wise.
- Set Voltage Ramps– quasistationary, transient, small-signal.

```
File: {Device = "FinFET_str.cfg";
       Out = "FinFET";}
Contacts: {...}
Physics*Region*RegSi: {
  Mobility: {DopingDep: { Masetti: [];}
  FieldDep: { Lombardi: []; }
  Recombination:{SRHRecombination=["DopingDep"];}
  } }
Solve: {Static*Poi:{ Coupled: ["Poisson"];}
  Quasistationary*Dr: {initstep = 1E-3;
    Ramp: { Voltage*drain = 1.;}
    Coupled: ["Poisson","Electron"] } }
```

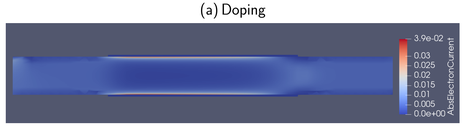
Convinient 'Python' Interface

- Import meshed device and setup simulation.
- Perform drift-diffusion simulations.
- Retrieve data for postprocessing in `Python`.

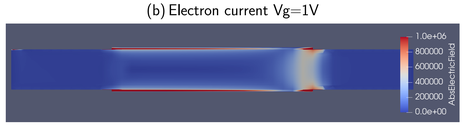
Visualization of Results

- I-V characteristics stored in csv files.
- Spatial Data stored in hdf file. Also, *xdmf* script stored for visualization in *paraview*.

(a) Doping



(b) Electron current Vg=1V

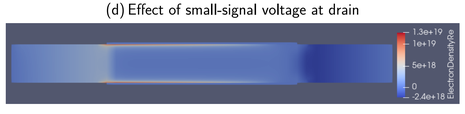


(c) Electric field Vg=1V

Small-signal Analysis

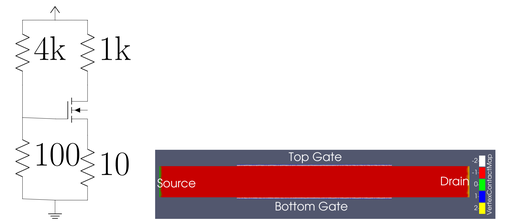
- `ACAnalysis`: DC time(s) at which analysis is done.
- `Nodes`: Contacts to be included in the AC analysis.
- Jacobian at the bias point is used to perform small-signal analysis. Admittances and capacitances are written in the csv file.

(d) Effect of small-signal voltage at drain



(e) Effect of small-signal voltage at gate

Mixed-mode System Analysis



(f) W1 (g) MOS1

Figure 1: MOSFET system shown in the System section on the LHS.

- Mixed-mode Analysis solves the circuit-system containing electronic device which is connected to the external components.
- `System` section defines external circuit and links the `Device` named `MOS1` to it.

Electro-thermal simulations

- Electro-thermal simulations solve Poisson and/or continuity equations with heat transport equation.
- `ThermalContacts`: act as heat-sink at a set Temperature.
- In `ThermalProperties`, list active thermal models.
- In `Coupled`, add `Temperature` to include heat equation.

(a) Temperature distr. in Copper plate at 1V

(b) Copper plate conductivity at 1V

Figure 2:Heat generation in a 2D copper plate

Material Properties and Composition

Material config file is loaded at the start of the simulation.

- List and edit parameters of all models.
- Define composition dependence (linear and quadratic) of the parameters in semiconductor alloys, e.g. SiliconGermanium.

```
BandStructure: {
  BandGap: {
    // ( [XFrac0, val0, ... )]
    Chi0*Xdep = [0., 4.07,
       0.45, 3.575, 1., 3.5];
    Eg0*Xdep = [0., 1.424,
       0.45, 1.985, 1., 2.17];
  ...
  DoS: { Formula = 0;
    Nc300 = 2E19; Nv300 = 2E19;
    me = 0.91; mh = 0.53; } }
```

User-manual and examples

A detailed user-manual describes –

- Available analyses and how to perform.
- Physical models and their usage,
- Settings in a config file and their use,

License Purchase

Send the organization details along with –

- Node-locked licenses: mac-id of the machine.
- Server licenses: mac-id of the server.

Contact Information

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