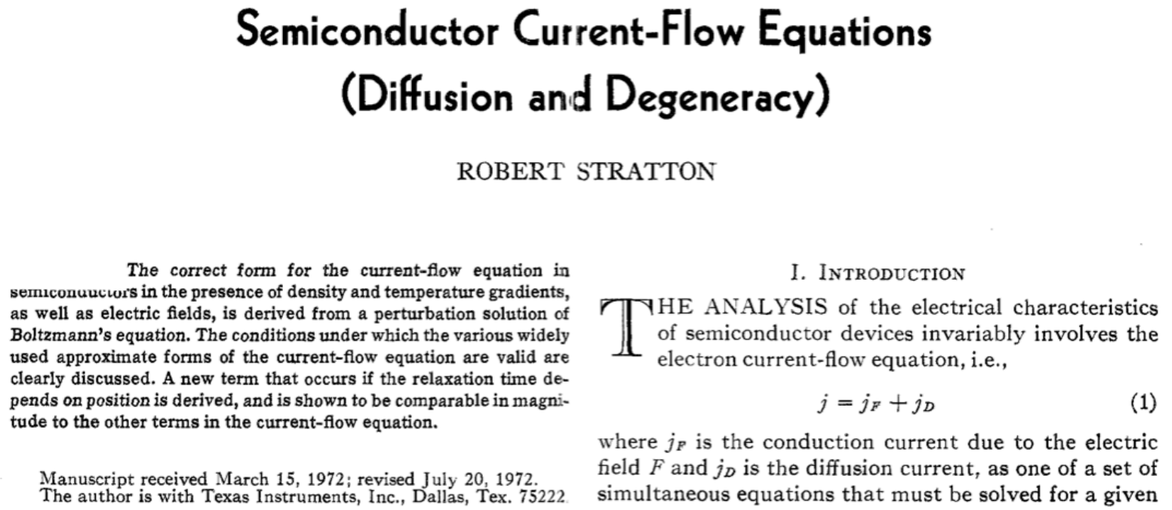
Sesame

Sesame is a Python3 package for solving the drift diffusion Poisson equations for multi-dimensional systems using finite differences.

Install instructions

Semiconductor current-flow equations (diffusion and degeneracy),
R.Stratton,
IEEE Transactions on Electron Devices
https://ieeexplore.ieee.org/document/1477063



Semiconductor Current-Flow Equations (Diffusion and Degeneracy)

ROBERT STRATTON

The correct form for the current-flow equation in semiconductors in the presence of density and temperature gradients, as well as electric fields, is derived from a perturbation solution of Boltzmann's equation. The conditions under which the various widely used approximate forms of the current-flow equation are valid are clearly discussed. A new term that occurs if the relaxation time depends on position is derived, and is shown to be comparable in magnitude to the other terms in the current-flow equation.

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I. Introduction

THE ANALYSIS of the electrical characteristics of semiconductor devices invariably involves the electron current-flow equation, i.e.,

$$j = j_F + j_D \quad (1)$$

where j_F is the conduction current due to the electric field F and j_D is the diffusion current, as one of a set of simultaneous equations that must be solved for a given

Sesame

File Console

System | Simulation | Analysis

Grid

Each axis of the grid is a concatenation of sets of evenly spaced nodes. Edit the form with (x1, x2, number of nodes), (x2, x3 number of nodes),...

Grid x-axis ,100),(3e-4,4e-4,10(cm

Grid y-axis (0,1e-5,5) cm

Illumination

monochromatic 1 sun

Wavelength [nm]

Power [W cm⁻²]

Absorption

User defined from file

alpha [cm⁻¹]

absorption file

Browse...

Manual Generation rate

Use manual generation

Provide a number for uniform illumation, or a space-dependent function, or simply nothing for dark conditions.
A single variable parameter is allowed and will be looped over during the simulation.

Expression [cm⁻³s⁻¹] 0

Paramater name

Materials

Material 1 | New | Save | Remove

Save a material before adding a new one.

Location x < 2e-4

Tip: Define the region for y < 1.5 µm or y > 2.5 µm with (y < 1.5e-6) | (y > 2.5e-6). Use the bitwise operators | for `or`, and & for `and`.

	Value	Unit
N_D	0.0	cm⁻³
N_A	1e+15	cm⁻³
Nc	3.2e+19	cm⁻³
Nv	1.8e+19	cm⁻³
Eg	1.1	eV
epsilon	11.8	NA

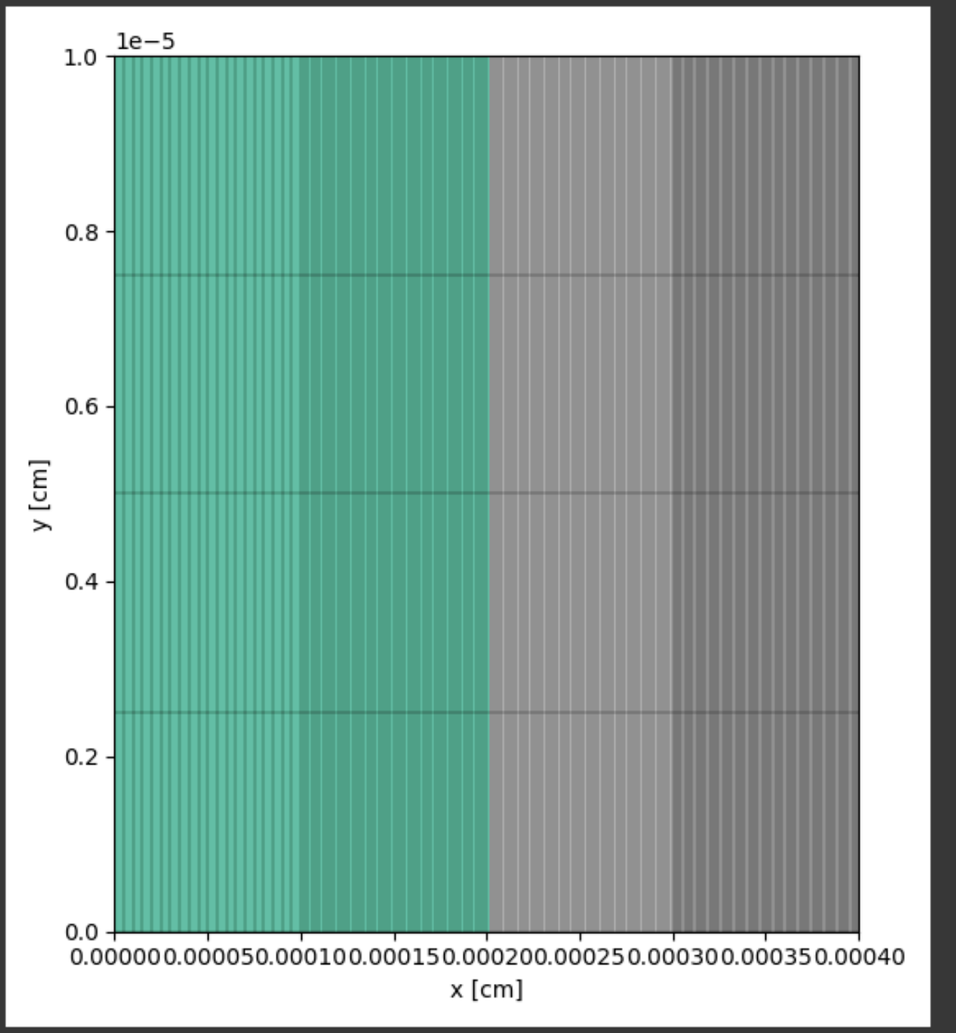
Planar Defects

New | Save | Remove

Save a defect before adding a new one.

Location

View system



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Basic settings

Loop over: (•) Voltages ( ) Generation rates

Loop values: [0.3|0.0,-1]

Working directory: same/wulff/pndiode/ Browse...

Output file name: pndiode .gzip

Boundary conditions

Contact boundary conditions at x=0: (•) Ohmic ( ) Schottky ( ) Neutral

Electron recombination velocity in x=0 [cm/s]: 1e5

Hole recombination velocity in x=0 [cm/s]: 1e5

Metal work function [eV]: 4.7

Contact boundary conditions at x=L: (•) Ohmic ( ) Schottky ( ) Neutral

Electron recombination velocity in x=L [cm/s]: 1e5

Hole recombination velocity in x=L [cm/s]: 1e5

Metal work function [eV]: 4.7

Transverse boundary conditions: (•) Periodic ( ) Hardwall

Algorithm settings

Generation ramp: 0

Algorithm precision: 1e-6

Maximum steps: 100

Mumps library: ( ) Yes (•) No

Iterative solver: (•) Yes ( ) No

Iterative solver precision: 1e-6

Newton homotopy: 1

Simulation log

Run simulation | Stop simulation

```
INFO: step 25,error = 0.9999995808573537
INFO: step 26,error = 0.9999988596577988
INFO: step 27,error = 0.999996898179034
INFO: step 28,error = 0.9999915642702679
INFO: step 29,error = 0.999977061282639
INFO: step 30,error = 0.9999376312764978
INFO: step 31,error = 0.9998304427570286
INFO: step 32,error = 0.9995391106703418
INFO: step 33,error = 0.9987476260090542
INFO: step 34,error = 0.9965997108182367
INFO: step 35,error = 0.9907879485052914
INFO: step 36,error = 0.9751877095968543
INFO: step 37,error = 0.9342041943279747
INFO: step 38,error = 0.8325334222710672
INFO: step 39,error = 0.614963842698804
INFO: step 40,error = 0.28784490108657
INFO: step 41,error = 0.05031109907804321
INFO: step 42,error = 0.001309360091800371
INFO: step 43,error = 8.591859291703617e-07
INFO: ** Calculations completed successfully **
```

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File Console

System Simulation Analysis

Import data

Upload files... Remove selected

pndiode_0.gzip
pndiode_1.gzip
pndiode_2.gzip

Surface plot

Hole density

Plot

Linear plot

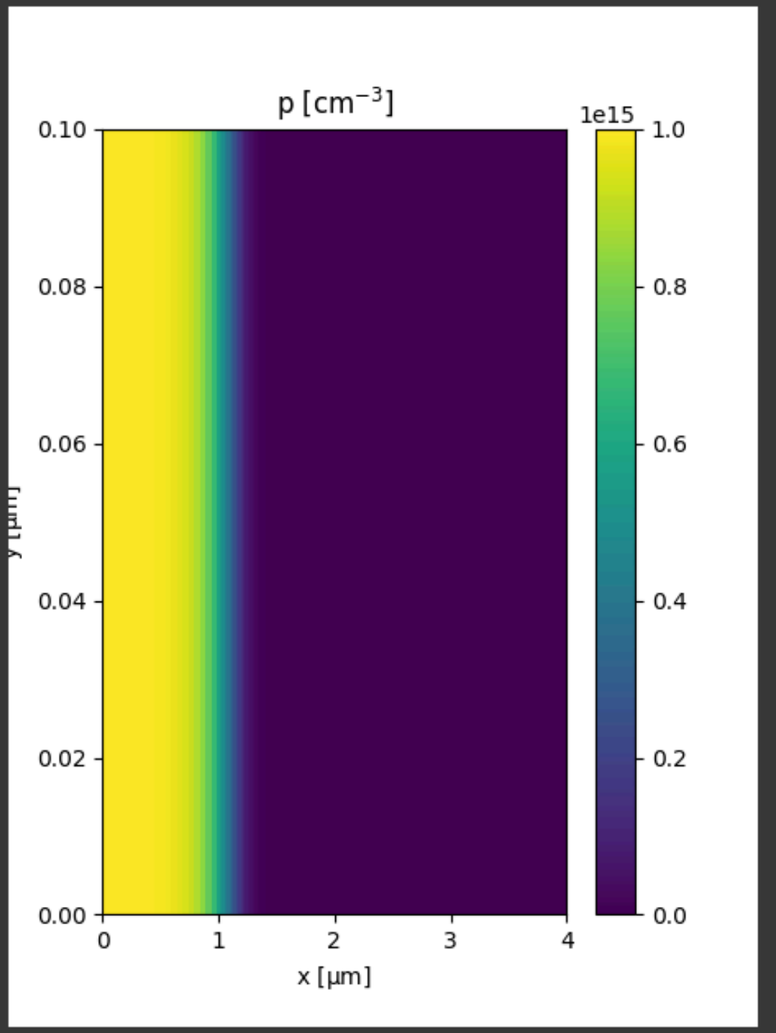
X data Loop values Position

(0,0),(3.8e-4,0)

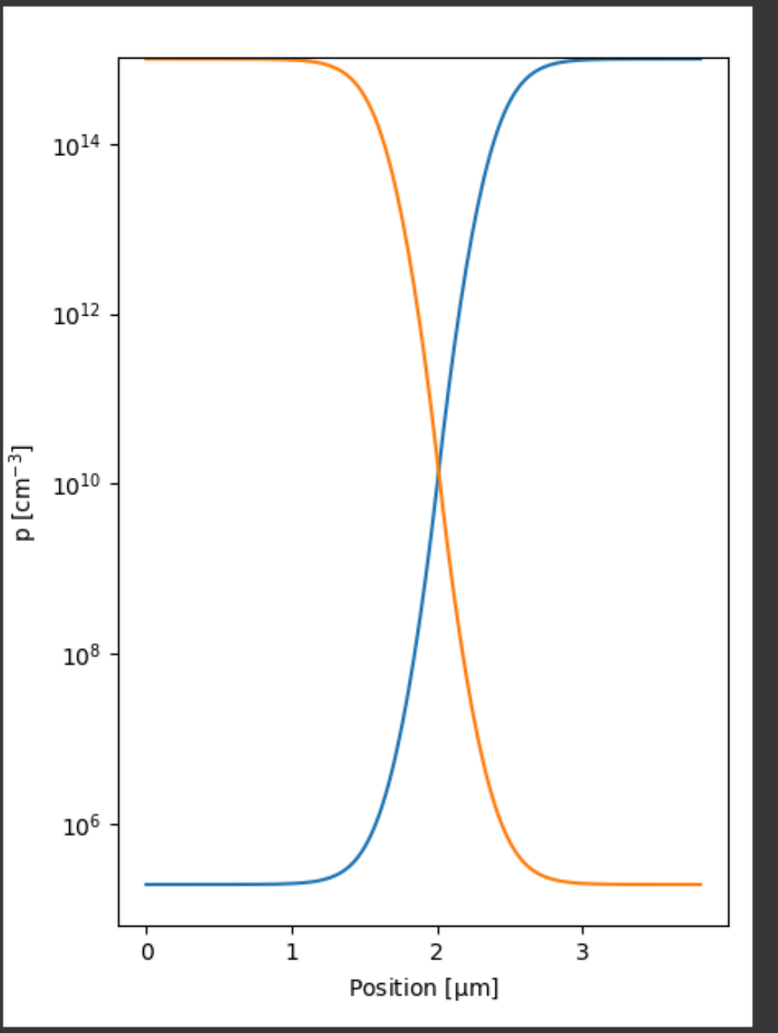
Y data Hole density

Clear Plot Export

Surface plot



Linear plot



Thanks!