TCAD simulation VIII

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Overview

- **Simulation example of 2D PN junction using SPROCESS and SDEVICE**

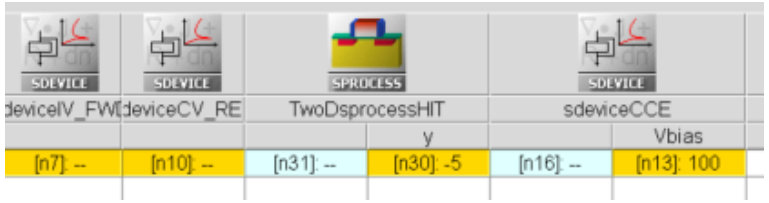
- **Charge generation and collection**

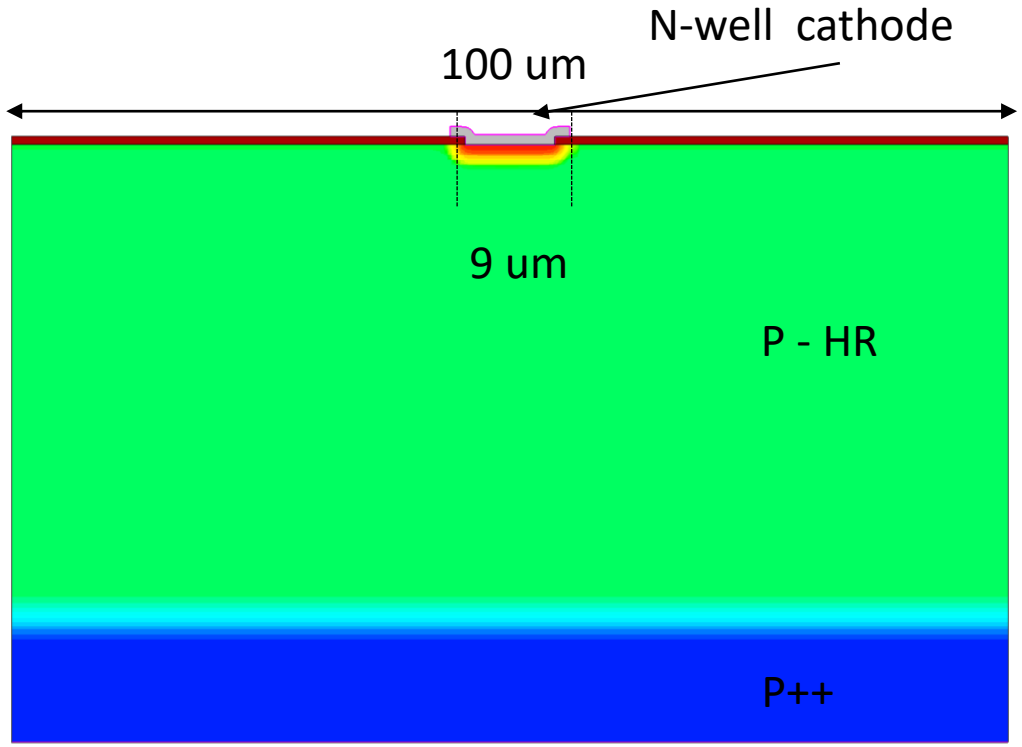
TCAD Synopsys Simulation

- SDEVICE simulation of 2D pn junction
  - **Charge generation**

- **Within SDEVICE, charge injection by particles can be modelled using the models for carrier generation by gamma radiation, alpha particles and heavy ions (optical generation is also available)**
- **Heavylon generation:**

Glet: linear energy transfer(LET) generation density
R(w,t): spatial distribution (exponential/Gaussian)
T(t): temporal profile





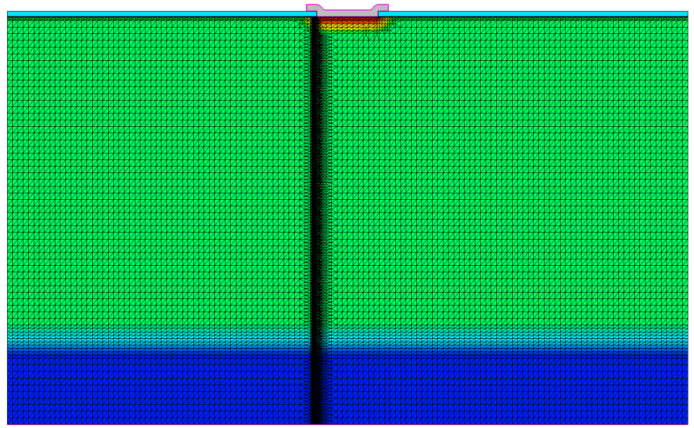
TCAD Synopsys Simulation

- Additional SPROCESS to increase the mesh resolution in the region of the hit: vertical hit at coordinate (0,Y)
- SDEVICE command file: physics section

```
### if {$HIT}  {
## MIP
### From G4 MIP sims, the meshing in the track region needs to be as small as nm's...

refinebox Silicon name= HIT min= {0 @<@y@-0.1>@} max= {@<@Epi_thick@+@Sub_thick@>@  @<@y@+0.1>@} xrefine= {.05 .05 .05} yrefine= { .05 .05 .05}

###                }
```



TCAD Synopsys Simulation

- SDEVICE command file: physics section

  - **The ionisation is obtained by a Minimum Ionising Particle (MIP)**
  - **Details of the ionisation are included in a file (MIP_EXC) which has the LET and spatial parameters required for MIP emulation**

```
Physics {

####if "@Ionization@" =="MIP"

#include "MIP_EXC"

…

#define WT_hi 0.1

                    HeavyIon (
Time = HitTime
Location = (0, 0)  ### Hits at the top surface, right in the middle of the device
Direction = (1.0,0.0)              ### Perpendicular hit

###LET_f  = [1.28e-5 1.28e-5 1.28e-5]  ### 80 e/h per micron is 1.28E-5 for THICK sensor
LET_f  = [1.056e-5 1.056e-5 1.056e-5]  ### 66 e/h per micron as MPV for 50 um thick
active region
### LET_f  = [1.15e-5 1.15e-5 1.15e-5]  ### 72 e/h per micron as MPV for 300 um thick
active region

Wt_hi  = [WT_hi WT_hi WT_hi ] ###              ro = 0.1/0.2 micron
Length = [ 0.0  20 60 ] ### LET @ different depths, irrelevant for a MIP
PicoCoulomb
Gaussian
                                    )
```

TCAD Synopsys Simulation

- MIP transient
  - **Effects due to different bias**
  - **Charge collection vs. hit location**
  - **Charge collection vs. meshing resolution**
  - **Charge collection vs. doping**

- Simulation example : 2D pn using SPROCESS
- MIP Charge generation and collection

Thank you

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