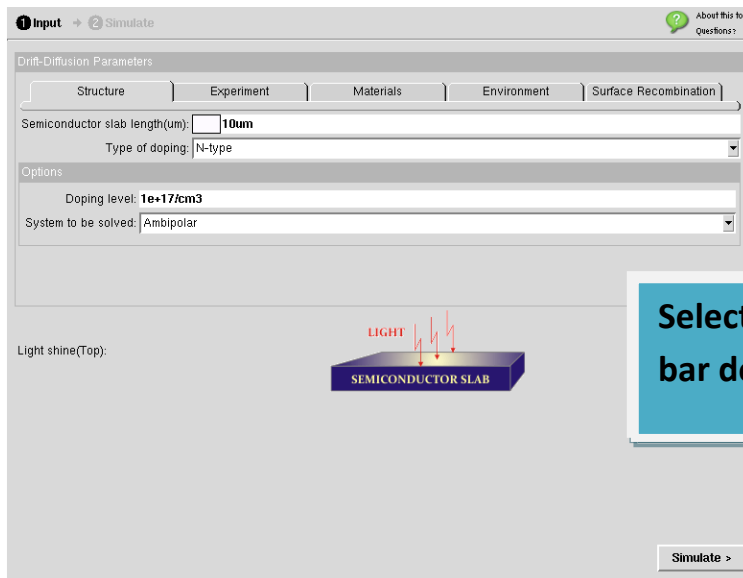


Analytical verification of Drift-Diffusion Tool

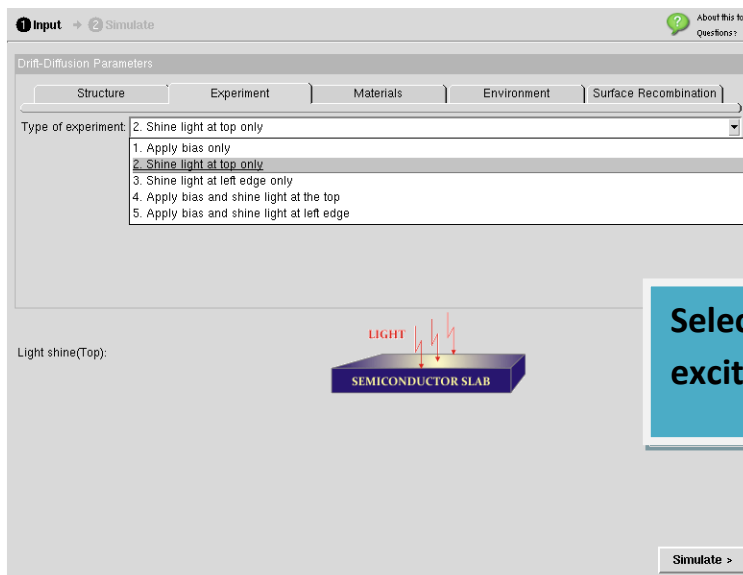
www.nanohub.org/tools/semi

by Saumitra Raj Mehrotra

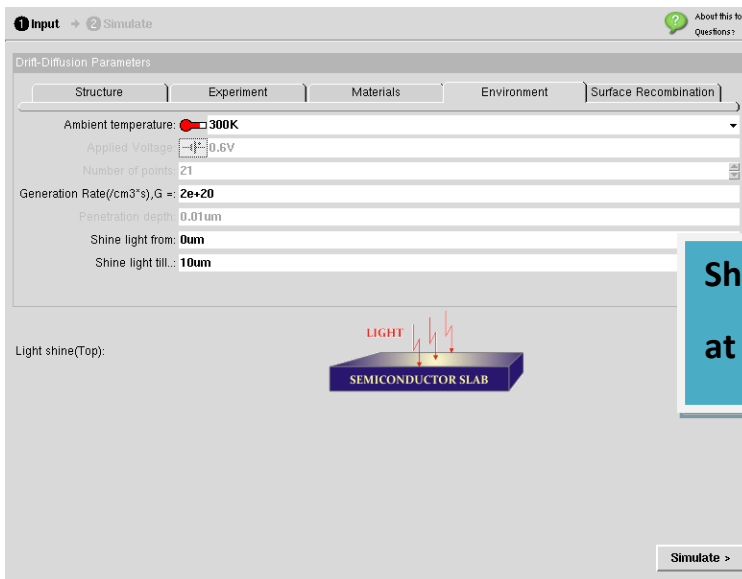
1. Generation & Recombination verification steps.



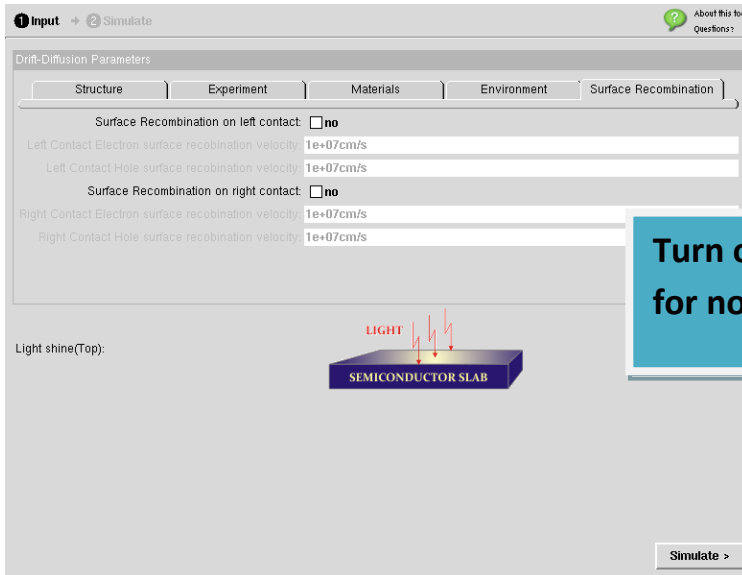
Select a 10 μm long silicon bar doped N-type $1\text{e}17/\text{cm}^3$.



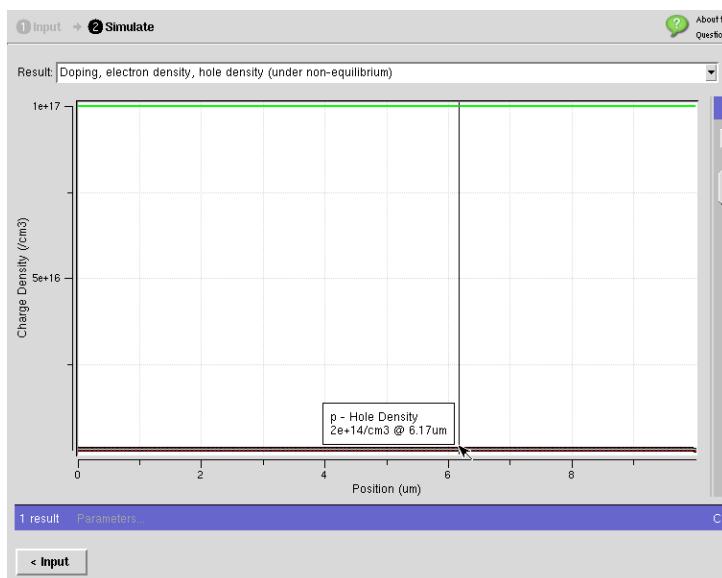
Select experiment #2 – Light excitation from the top.



Shine light all along the bar at a rate of $G=2e20 / \text{cm}^3$.



Turn off surface recombination for no loss of excess carriers.



Verification

Generation Rate, $G = 2 \times 10^{20} / \text{cm}^3 \cdot \text{s}$

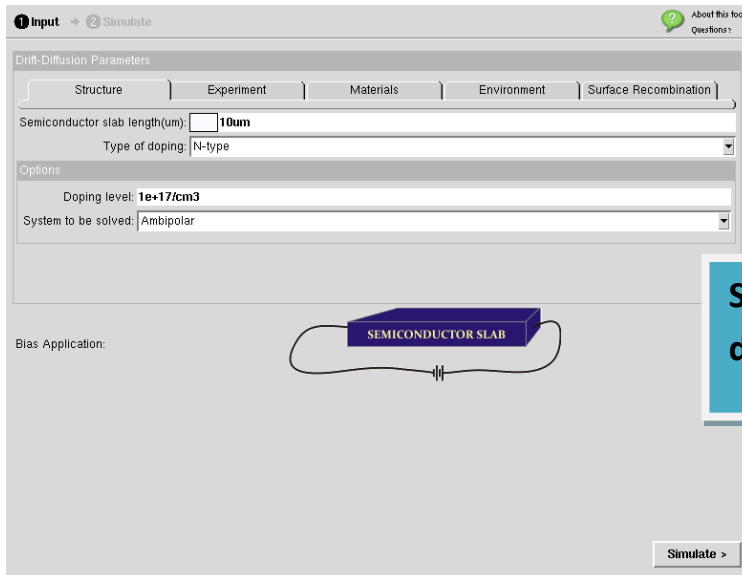
Carrier lifetime, $\tau = 10^{-6} \text{ s}$

Analytically calculated excess minority carrier concentration,

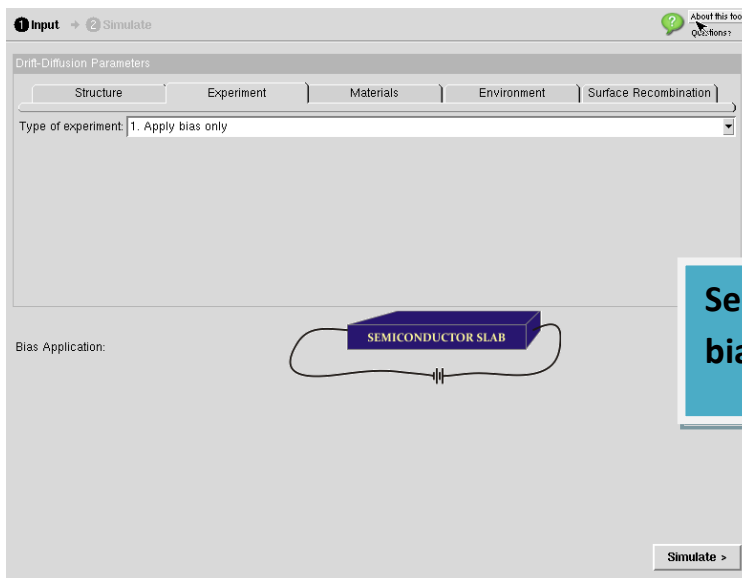
$$G \cdot \tau = \underline{2 \times 10^{14} / \text{cm}^3}$$

Numerically calculated minority carrier density using tool = $\underline{2 \times 10^{14} / \text{cm}^3}$

2. Drift current verification steps.



Select a 10 μm long silicon bar doped N-type, $N = 1 \times 10^{17} / \text{cm}^3$.



Select Experiment # 1 – Apply bias only.

Input → Simulate

Drift-Diffusion Parameters

Structure Experiment Materials Environment Surface Recombination

Material: Si


Minority carrier lifetimes

For electrons: 1us
For holes: 1us

Specify your own mobility values: yes

For electrons: 1400cm²/Vs
For holes: 450cm²/Vs

Bias Application:



Simulate >

Specify mobility for this sample, $\mu=1400/\text{cm}^3$.

Input → Simulate

Drift-Diffusion Parameters

Structure Experiment Materials Environment Surface Recombination

Ambient temperature: 300K

Applied Voltage: 0.6V

Number of points: 21


Generation Rate/(cm³·s), G = 2e+20

Penetration depth: 0.01um

Shine light from: 0um

Shine light till: 10um

Bias Application:



Simulate >

Set drain bias range of 0-0.6V.

Input → Simulate

Drift-Diffusion Parameters

Structure Experiment Materials Environment Surface Recombination

Surface Recombination on left contact: yes

Left Contact Electron surface recombination velocity: 1e+07cm/s


Left Contact Hole surface recombination velocity: 1e+07cm/s

Surface Recombination on right contact: yes

Right Contact Electron surface recombination velocity: 1e+07cm/s

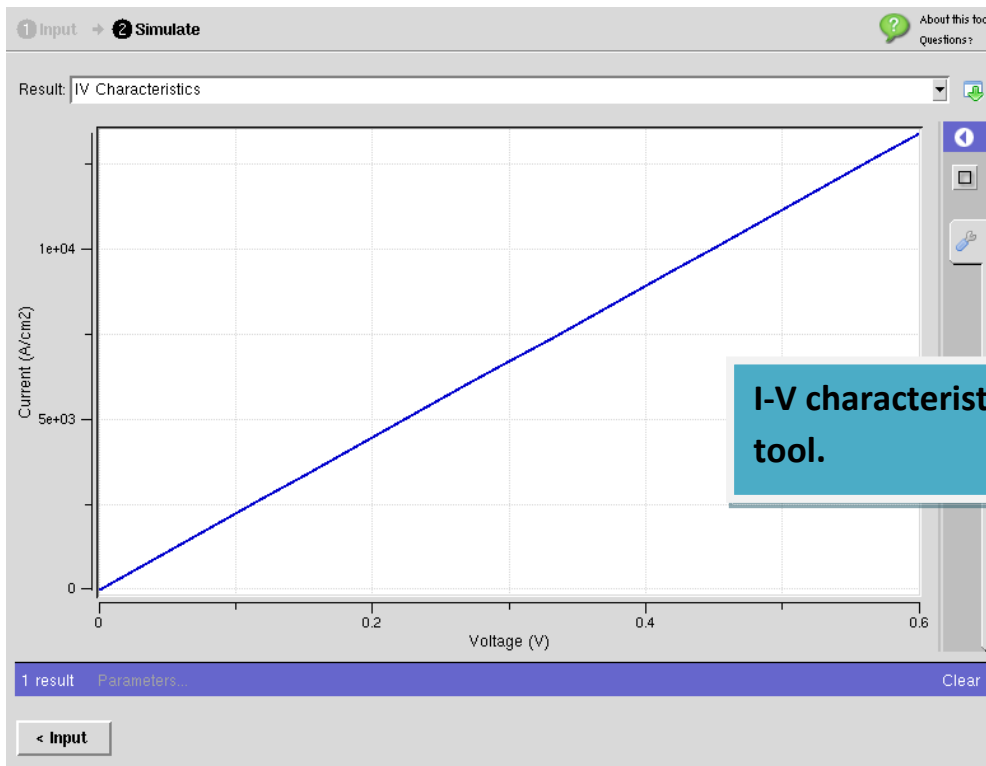
Right Contact Hole surface recombination velocity: 1e+07cm/s

Bias Application:



Simulate >

Turn on surface recombination to have a good contact definition.



I-V characteristic from Drift-Diffusion tool.

