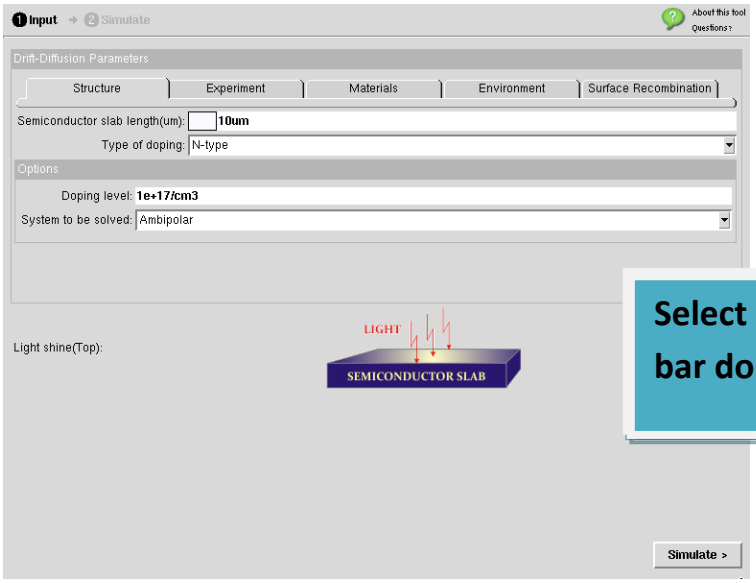
Analytical verification of Drift-Diffusion Tool

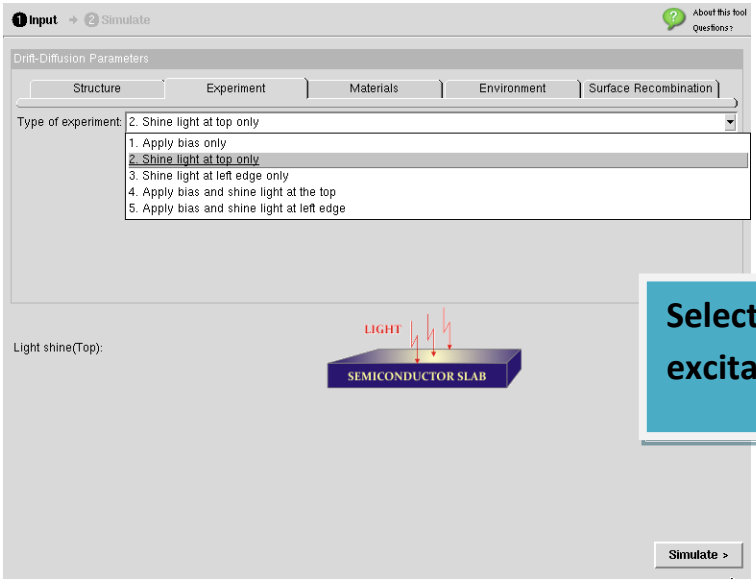
(www.nanohub.org/tools/semi)

by Saumitra Raj Mehrotra

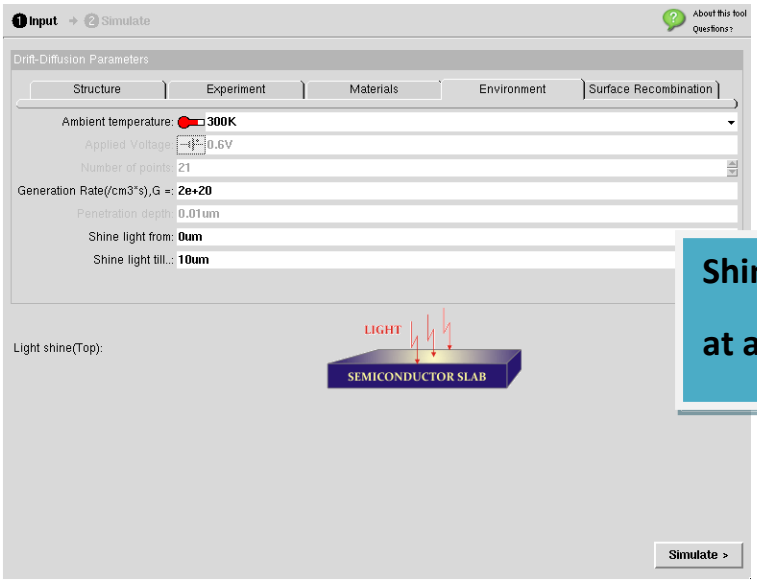
1. Generation & Recombination verification steps.



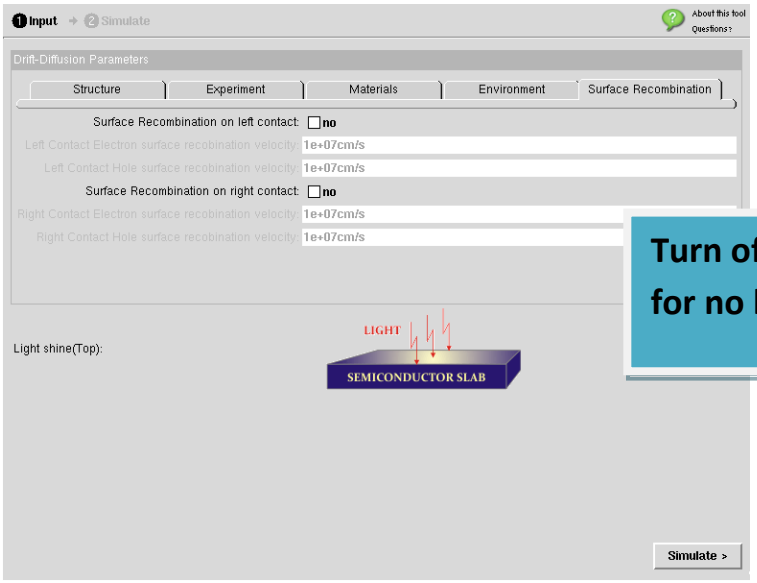
Select a 10 µm longs silicon bar doped N-type 1e17/cm^3.



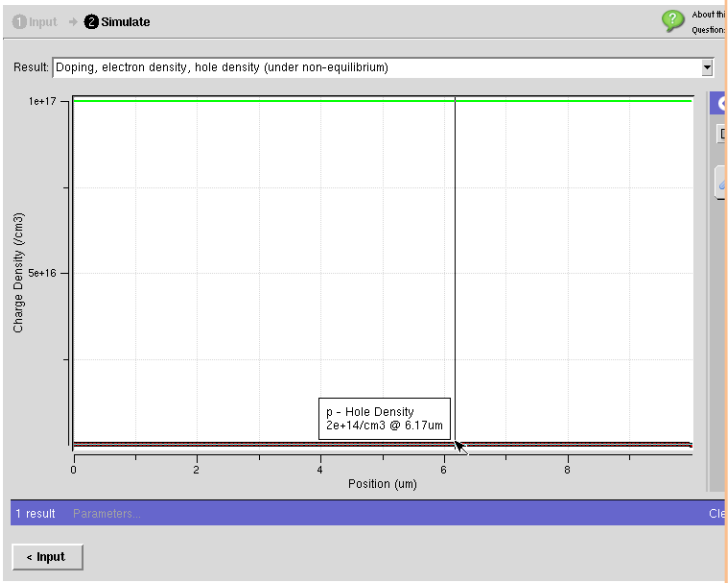
Select experiment #2 – Light excitation from the top.



Shine light all along the bar at a rate of ,G=2e20 /cm^3 .



Turn off surface recombination for no loss of excess carriers.



Verification

Generation Rate, G = 2x10^{20}/cm^3.s

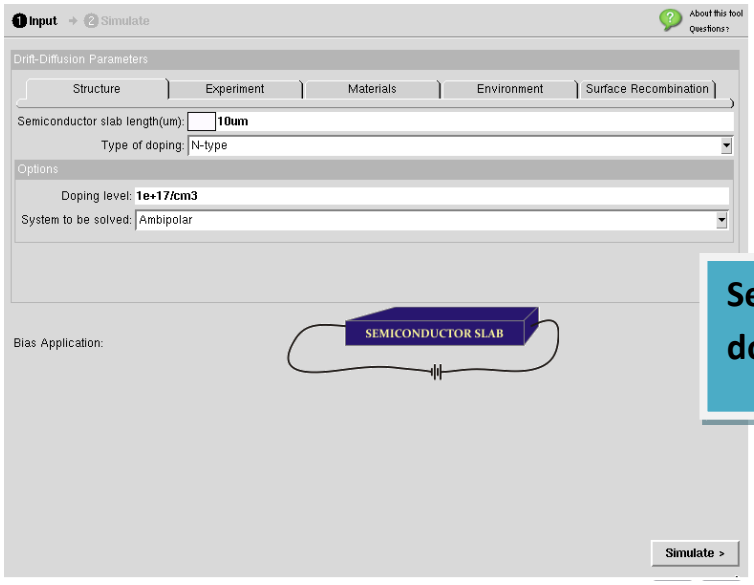
Carrier lifetime, τ = 10^{-6} s

Analytically calculated excess minority carrier concentration,

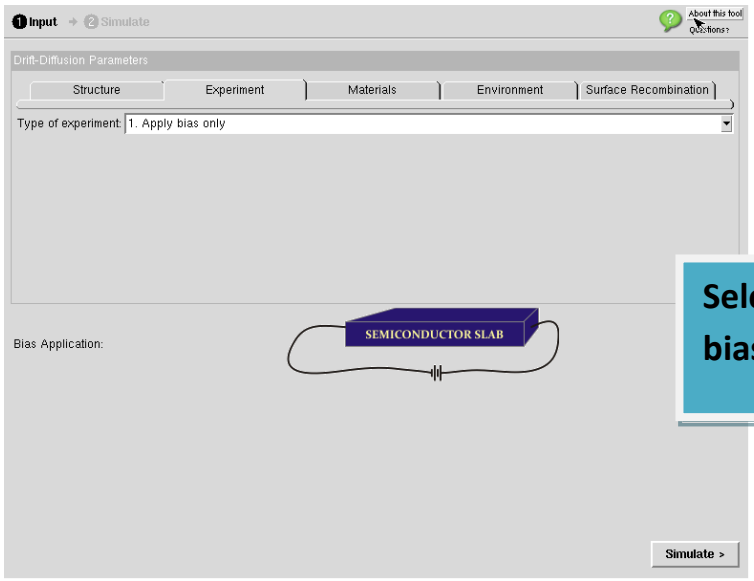
G. τ =2x10^{14}/cm^3

Numerically calculated minority carrier density using tool= 2x10^{14}/cm^3

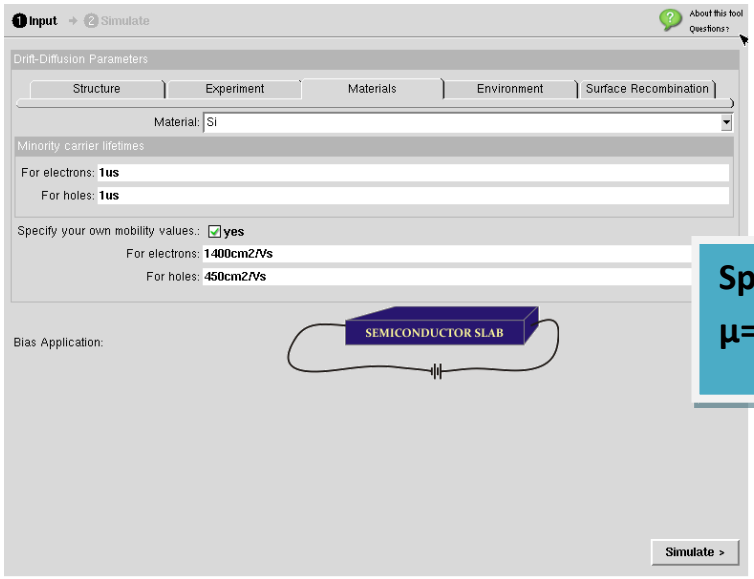
2. Drift current verification steps.



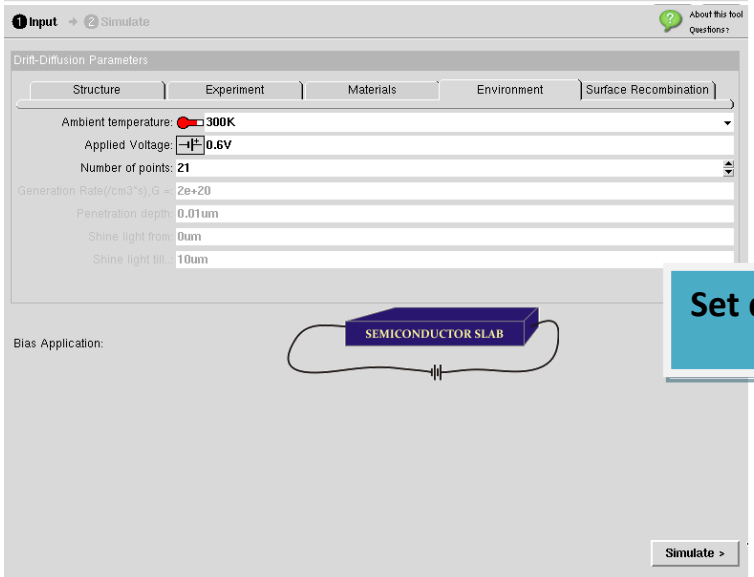
Select a 10 µm longs silicon bar doped N-type, N= 1e17/cm^3.



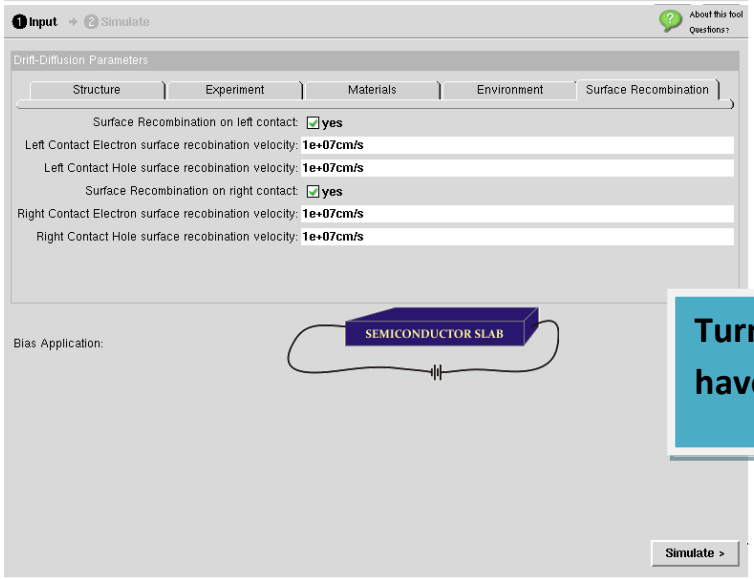
Select Experiment # 1 – Apply bias only.



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

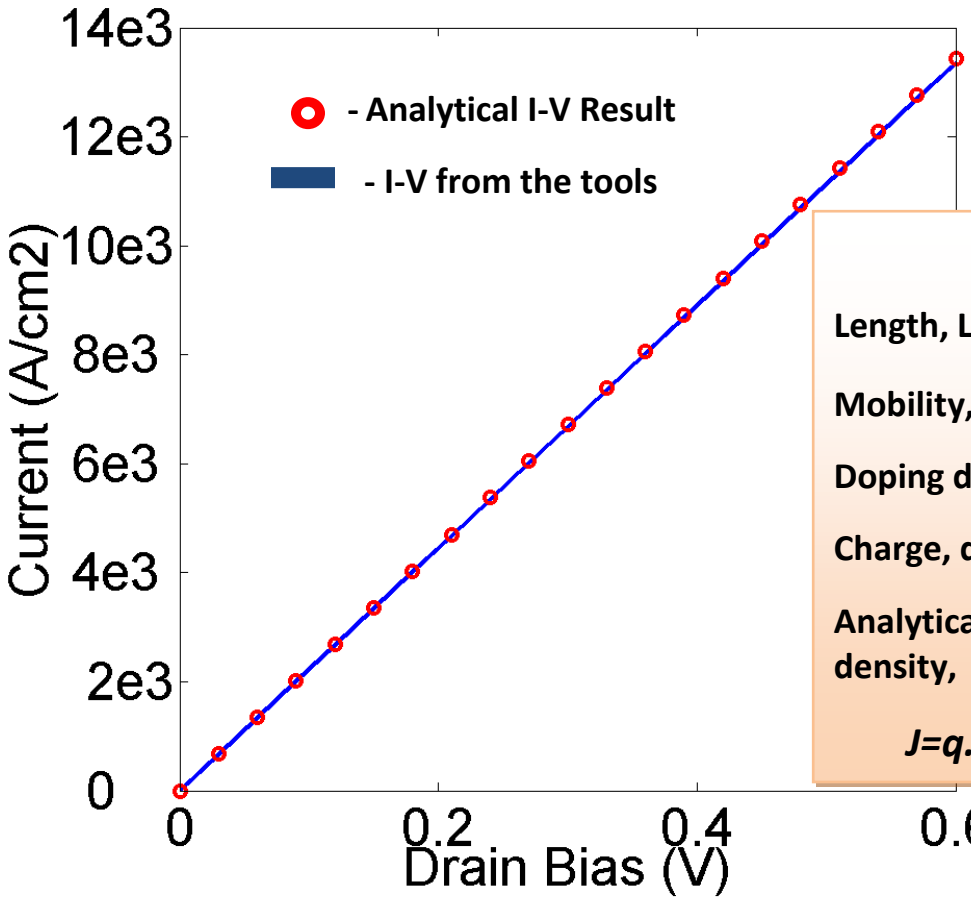


Set drain bias range of 0-0.6V.



Turn on surface recombination to have a good contact definition.

I-V characteristic from Drift-Diffusion tool.



Verification

Length, L= 10 µm= 10 e-4 cm

Mobility, μ_n= 1400 cm^2/V-s

Doping density, N_d = 1e17 /cm^3

Charge, q =1.6e-19 C

Analytical formula for current density,

$$J=q.N_d.\mu_n.(V/L) \quad A/cm^2$$