**Drift Diffusion Lab – Worked out problems 1**

**(** <http://nanohub.org/tools/semi> )

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Q1) As shown in figure below, the right half of a 100 µm long Silicon bar is illuminated with light. This light generates GL=1018/cm3-s electron-hole pairs uniformly throughout 50 µm of right half. GL=0 for left half of the bar. Steady state conditions prevail. The entire bar is doped with ND=1018/cm3. Set τp=1ns and T=300 K. Assume finite surface recombination on left end and no recombination on right end.

1. What is the diffusion length for minority carriers?
2. What is the hole concentration at left end?
3. What is the hole concentration at right end?
4. Plot Δp(x) for all along the bar.
5. Do low level injection conditions prevail?
6. How does energy band diagram look like under non-equilibrium conditions?

A1) a) Diffusion length can be calculated as $L=\sqrt{μ\*kT\*τ}$

 For holes here $L\~\sqrt{450\*0.025\*10^{-9}}=1.06 μm $

 b) Left edge is many diffusion lengths from the perturbation hence hole concentration, p0=ni2/ND=**100 /cm3**

c) On the right end hole concentration p= p0+GLτp

 Δpr=100+1018/cm3-s\*10-9 s = **109 /cm3**

d) Excess carrier density plot can be obtained from *Drift-Diffusion Lab* as shown below.

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e) We have Δpr << n0=ND, hence low level injection condition do prevail.

 **YES.**

Also as can be seen in the figure below excess hole concentration is still less than electron doping level.



1. The energy band diagram under perturbation shows splitting of Fermi level into Electron (Fn) and hole *quasi Fermi levels*. Hole quasi Fermi level (Fp) is pushed down due to excess holes on right half of the bar.



**Fn**

**Fp**