**Drift Diffusion Lab – Worked out problems 2**

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

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Q1) Compute concentration dependent electron and hole mobility for Gallium Arsenide (GaAs) and Germanium (Ge).

1. Which material has higher electron mobility at doping level of 1015 cm3?
2. Which material has higher hole mobility at doping level of 1015 cm3?
3. Why does mobility reduce at higher doping?

A1) Set up the simulation assuming a semiconductor bar of length, *l*=10µm. Mobility values can be extracted by applying small amount of bias V~ 0.1V and measuring the current density (J).

 Following formula can be then used to extract mobility values.

 For electrons: $J\_{n}=qnμ\_{n}(^{V}/\_{l})$

 For holes: $J\_{p}=qpμ\_{p}(^{V}/\_{l})$

 After calculations we obtain the following results,



1. a) **GaAs** shows higher electron mobility doping level of 1015 cm3.

b) **Ge** shows higher hole mobility at doping level of 1015 cm3.

c) At higher doping levels scattering due ionized impurities become significant and lead to a reduction in overall mobility value.