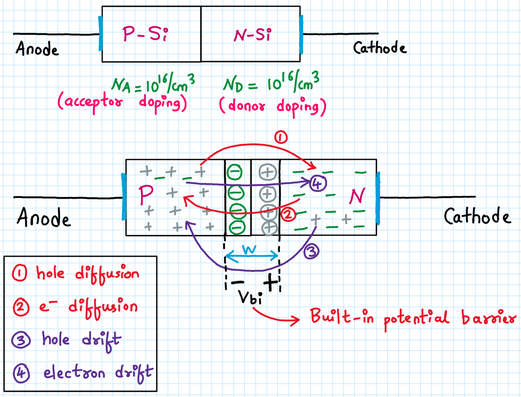
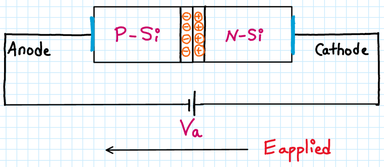
28 May 2021 20:47

Todays topic:
PN junction under reverse bias

✱ PN Junction under reverse bias:

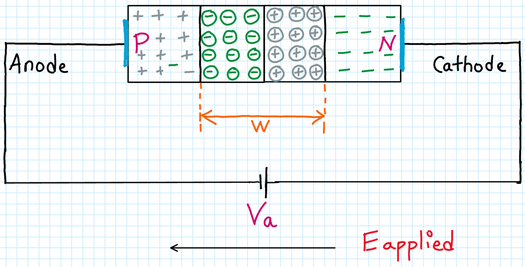


① Applying external potential to PN junction such n-side is connected to positive terminal and p-side is connected to negative terminal of external voltage supply makes the PN Junction reverse bias



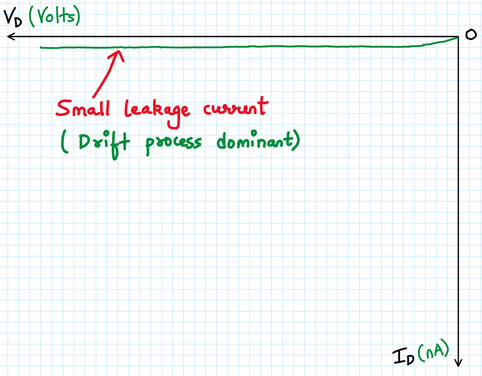
PN Junction in reverse bias

② Applying reverse bias increases the potential barrier for carriers to diffuse i.e e⁻s on n-side see a v.big barrier to diffuse to p-side & holes on p-side also see a large barrier to diffuse to n-side
Thus, diffusion process possibility is very very low



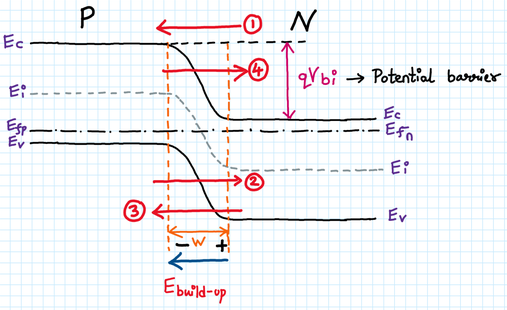
③ When PN junction is reverse bias, a very small reverse current ($I_{leakage}$) flows → only due to drift process

④ As reverse bias Va increases, majority carriers are driven away towards supply (e⁻s attracted to +ve terminals & holes are attracted to -ve terminal of supply) → This results in increase in the depletion region W

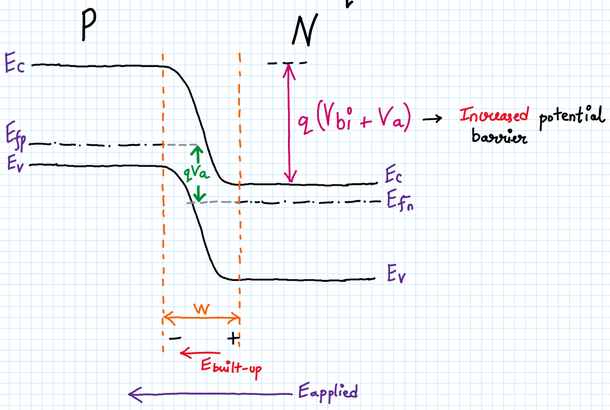


5) In summary, when PN junction is reverse-biased, negligible current flows → tiny drift current flows in nA range. Diffusion process is negligible in reverse bias

6) Also, in reverse bias → depletion region width increases because majority charge carriers are being pulled out of the bulk of the material



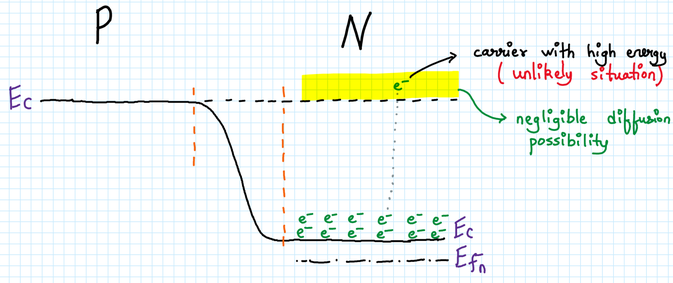
Energy band diagram of PN Junction (under equilibrium)



Energy band diagram of PN Junction (under reverse bias)

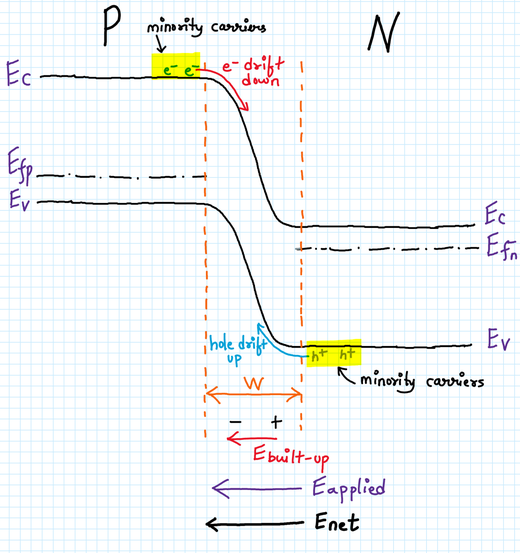
i) Forward bias Va raises the energy of p-side and lowers the energy of n-side semiconductor

ii) In reverse bias, diffusion process possibility is very low and drift process provide small tiny reverse current
let us understand why this happens ?



iii) In reverse-bias, the potential barrier is very large, so for diffusion to take place → eligible carriers should have very high energy state which is very unlikely event. Thus, diffusion possibility in reverse bias is almost negligible

iv) What about drift process in reverse bias ?



v) In reverse bias, any minority carriers that reaches depletion region will be swept across the junction by a a powerful net electric field (E_{net}) within the depletion region (i.e minority carriers are captured by depletion region)

vi) Since, the concentration of minority carriers are v.small thus the drift current is very small (~nA)

vii) Even with increase in reverse bias → drift current will not increase & remain in nA range for Si