

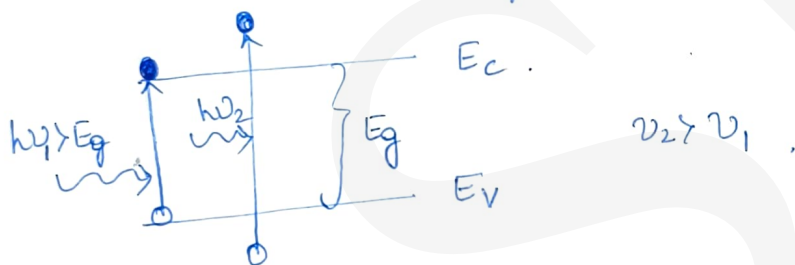
Carrier generation and recombination

carrier generation is a process whereby electrons and holes are created.

- (i) Photogeneration
- (ii) Thermal generation (phonon generation)
- (iii) Impact ionization

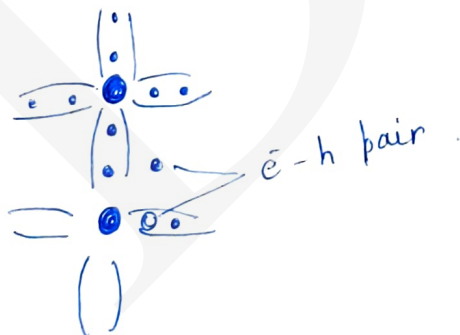
(i) Photogeneration -

When light of energy $h\nu > E_g$ of semiconductor falls on it, excites an e^- from VB to CB.



(ii) Thermal generation -

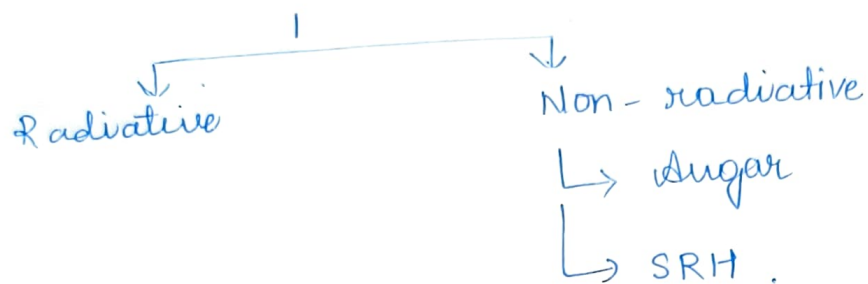
With increase in temperature, covalent bonds in semiconductor break down and e^- -hole pairs are generated.



(iii) Impact ionization -

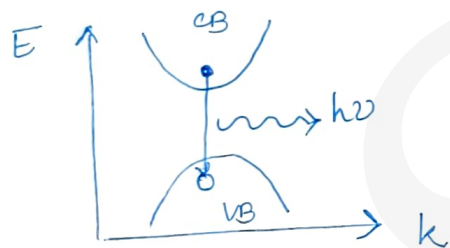
When electric field is applied to semiconductor, e^- gain energy & accelerates. These accelerated e^- s hit other e^- s and e^- -h pairs are generated by breaking the bonds.

Recombination



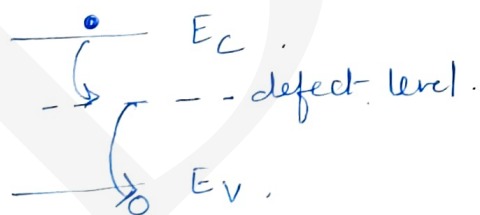
(i) Radiative recombination

In a direct band gap semiconductor, an e^- in CB combines with a hole in VB, emitting a photon of energy $h\nu \approx E_g$.



(ii) Shockley-Read-Hall recombination

Presence of impurity modifies electronic structure within the crystal, giving rise to defect levels.



It's a two step relaxation process where conduction e^- relax to the defect level and then relax to the valence band, annihilating a hole in the process.

(iii) Auger recombination

Auger recombination is a non-radiative process where the excess energy from the e^-h recombination is transferred to e^- s or holes that are subsequently excited to higher energy states within the same band instead of giving off photons.

