



**Figure 2.8.1 :** Carrier recombination mechanisms in semiconductors

1. Band-to-band recombination occurs when an electron moves from its conduction band state into the empty valence band state associated with the hole.

This band-to-band transition is typically also a radiative transition in direct bandgap semiconductors.

2. Trap-assisted recombination occurs when an electron falls into a "trap", an energy level within the bandgap caused by the presence of a foreign atom or a structural defect.

Once the trap is filled it cannot accept another electron. The electron occupying the trap, in a second step, moves into an empty valence band state, thereby completing the recombination process.

One can envision this process as a two-step transition of an electron from the conduction band to the valence band or as the annihilation of the electron and hole, which meet each other in the trap. We will refer to this process as Shockley-Read-Hall (SRH) recombination.

3. Auger recombination is a process in which an electron and a hole recombine in a band-to-band transition, but now the resulting energy is given off to another electron or hole. The involvement of a third particle affects the recombination rate so that we need to treat Auger recombination differently from band-to-band recombination.