DIFFERENCES BETWEEN DIRECT AND INDIRECT BAND GAP SEMICONDUCTORS

○ Feature	• Direct Band Gap Semiconductor (DBG SC)	• Indirect Band Gap Semiconductor (IBG SC)
• **Energy Band Alignment**	• Maximum VB energy and minimum CB energy at the **same** wave number (K).	• Maximum VB energy and minimum CB energy at **different** wavenumber (K).
• **Recombination Product**	• Photon of light is released.	• Heat energy is produced.
• **Recombination Process Name**	• Radiative recombination / spontaneous emission.	• Non-radiative recombination.
• **Efficiency**	• More effective/efficient.	• Less efficient.
• **Electron Motion Direction**	• Direction of electron motion remains unchanged during recombination.	• Direction of electron motion changes during recombination.
• **Charge Carrier Lifetime**	• Very short.	• Long.
• **Recombination Speed**	• Faster (implied by "more effective").	• Slower, as it requires electron, hole, and phonon interaction.
• **Recombination Mechanism**	• Direct recombination.	• Occurs through some defect states.
• **Electron-Hole Pair Gen.**	• Electron-hole pairs are easily generated (requires less momentum).	• (Not explicitly stated for IBG SC, but generally harder due to phonon involvement).
• **Common Material Types**	• Mostly compound semiconductors.	• Mostly elemental semiconductors.
• **Typical Examples**	• InP, GaAs.	• Si , Ge .
• **Applications**	• Used to fabricate LEDs and laser diodes.	• Used to amplify signals (diodes, transistors).