LECTURE 17 - DIELECTRIC STRUCTURES
PHOTONIC CRYSTALS
LEDs - INITIAL DISCUSSION

Ridge guide
Later on determined by $\Delta$
Photoric crystals

A materials with periodic index of refraction variations

Original proposal: 3D structure \( \sim 70 \)

1 \( \mu \)m, \( n \sim 3 \) \( \Rightarrow \) \( \lambda_{\text{in}} = 300 \text{nm} \)

First realization: 1D structures

Distributed feedback

Bragg reflector
2D photonic crystals

3D photonic crystals
Recombination

$E_c$  → $E_s$

Band-to-band
radiation
[In both direct
and indirect gap]

via mid-gap
level
[Vast majority
are normal]

Auger Stimulflation
Back to band

Direct gap

\[ \rightarrow h\nu \]

Very fast

Indirect gap

Relatively slow

Indirect (\text{red}) \quad \text{Mid gap level (\text{red})} \quad \text{Direct (\text{red})} \quad \text{\text{red}}
Light emitting diode

Issues

Structure and material to achieve efficient emission
1 carrier in ⇒ 1 photon out

Geometry that lets the light out & directed where we want it
\( n = 3.5 \)

\( n = 6.0 \)

1. Carrier \( \rightarrow \) 1 photon
2. 1 photon created \( \rightarrow \) 1 photon coming out