

Emisión de Luz

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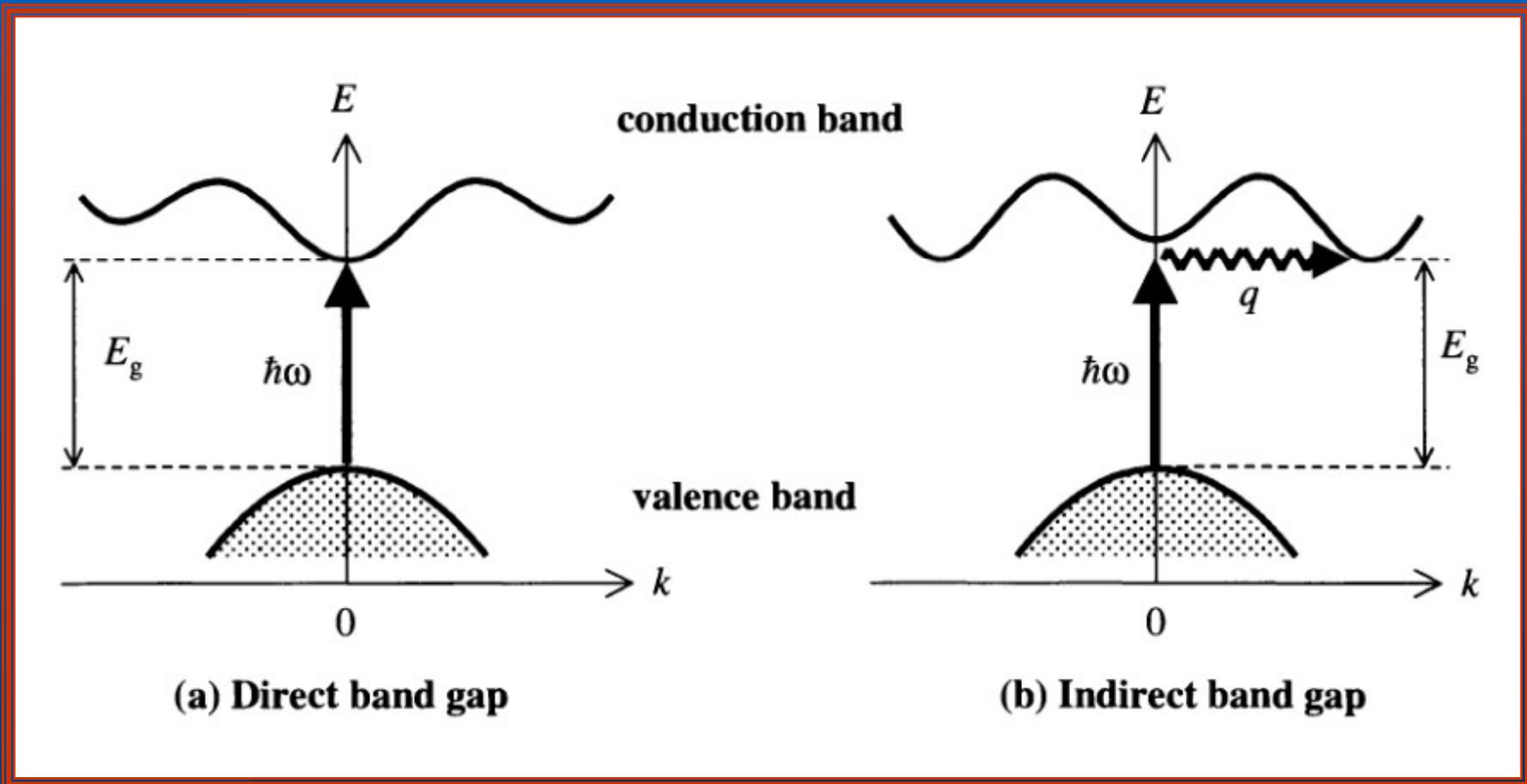
Contenido

- **Semiconductores**
- **Materiales Moleculares**
- **Defectos en Sólidos**

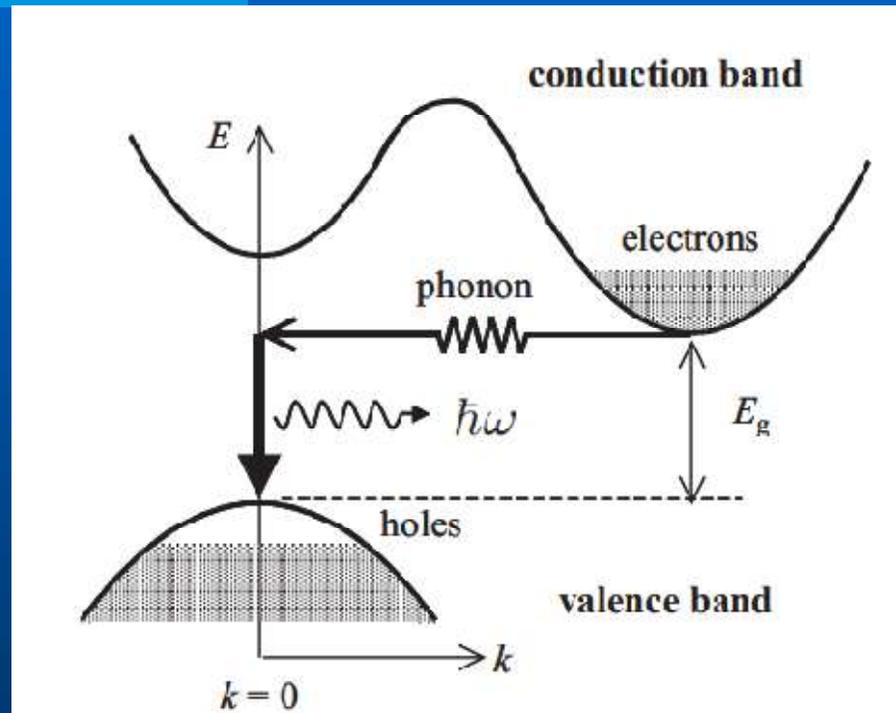
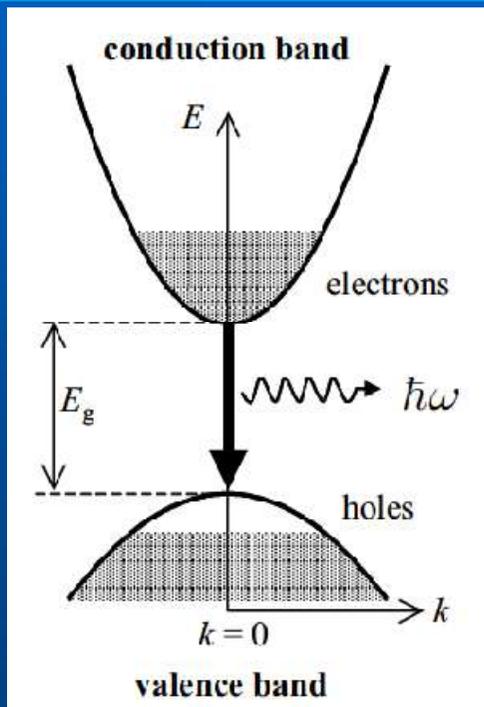
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Borde de Bandas de Energía: Semiconductores Directo e Indirecto



Borde de Bandas de Energía: Semiconductores Directo e Indirecto

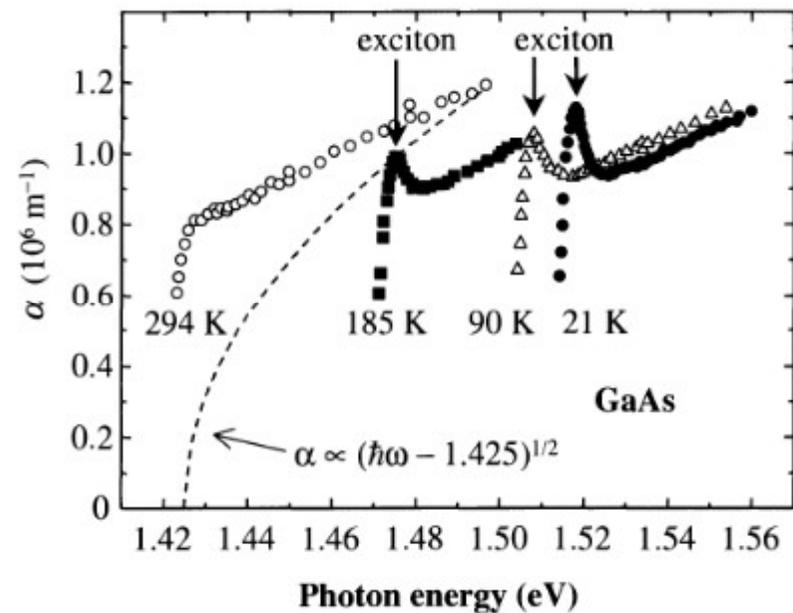
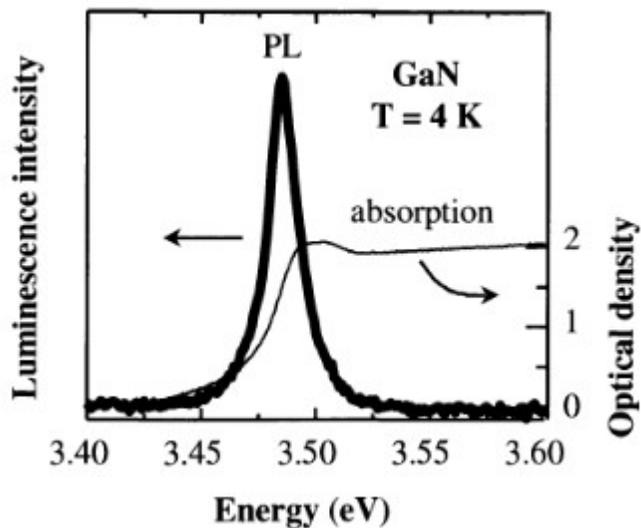
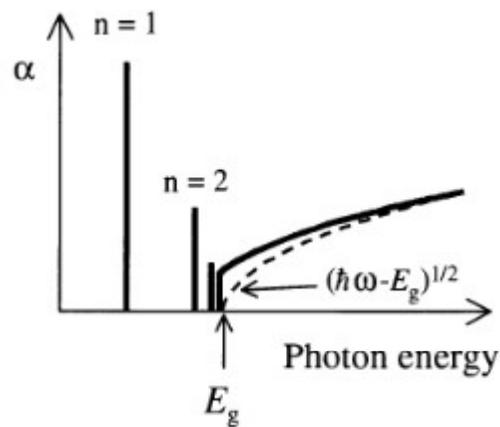


Semiconductor *Directo* \Rightarrow Buen Emisor de Luz.

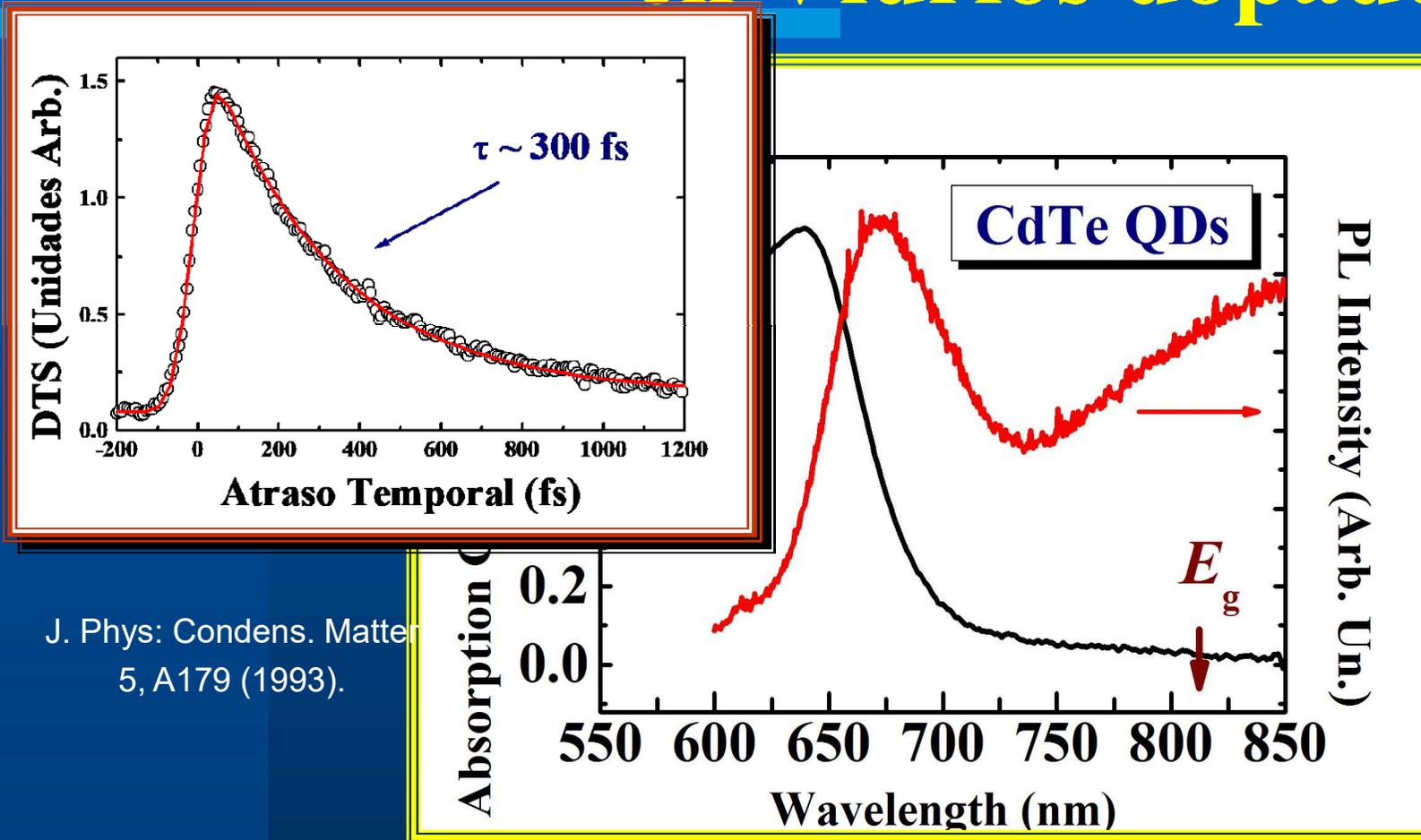
Semiconductor *Indirecto* \Rightarrow Mal Emisor de Luz.

Silicio y Germanio son Semiconductores Indirectos

Propiedades Ópticas de Excitones



Absorción y Emisión de Luz en Vidrios dopados



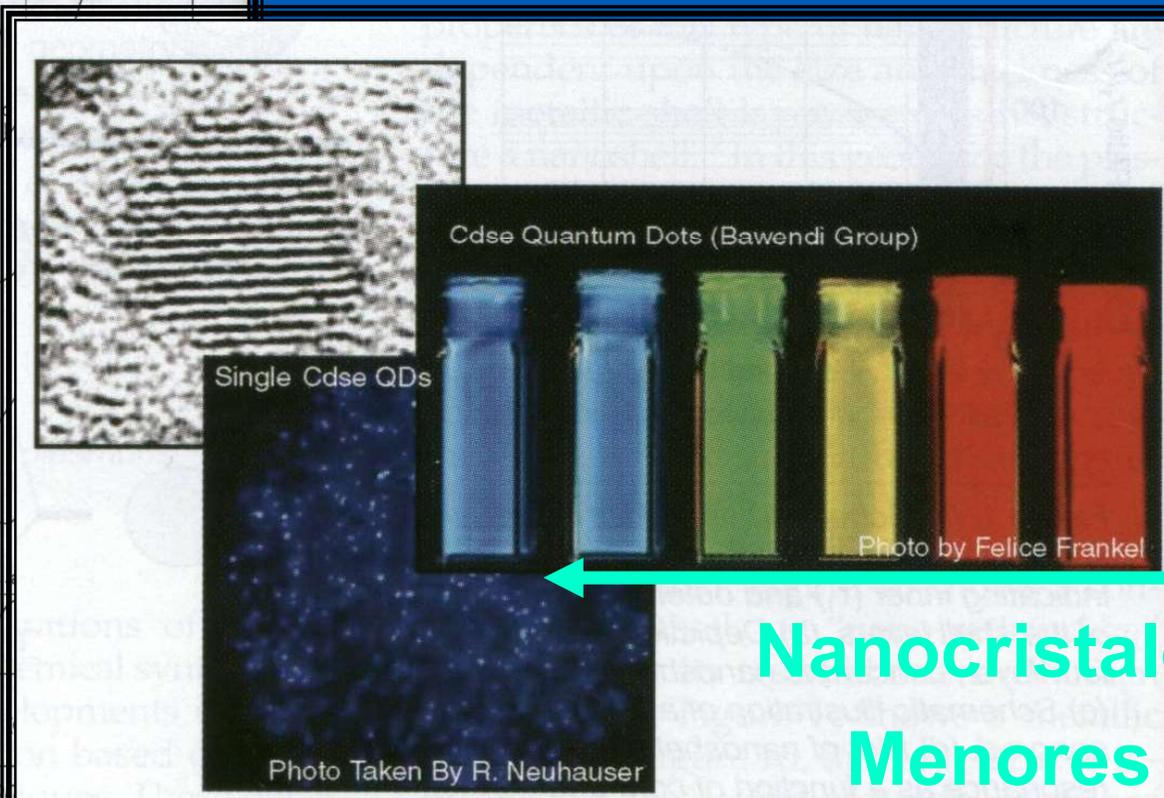
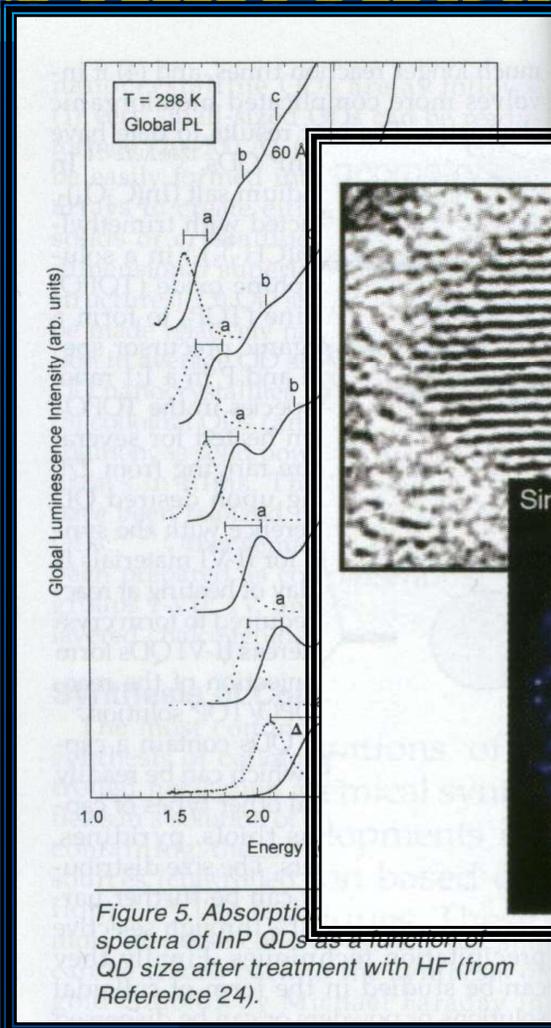
J. Phys: Condens. Matter
5, A179 (1993).

Appl. Phys. Lett. 59, 2715 (1991).

Caracterización Óptica, Ricardo Marotti, khamul@fing.edu.uy, Montevideo, Junio 2015

Puntos Cuánticos Coloidales de Semiconductores III-V y II-VI.

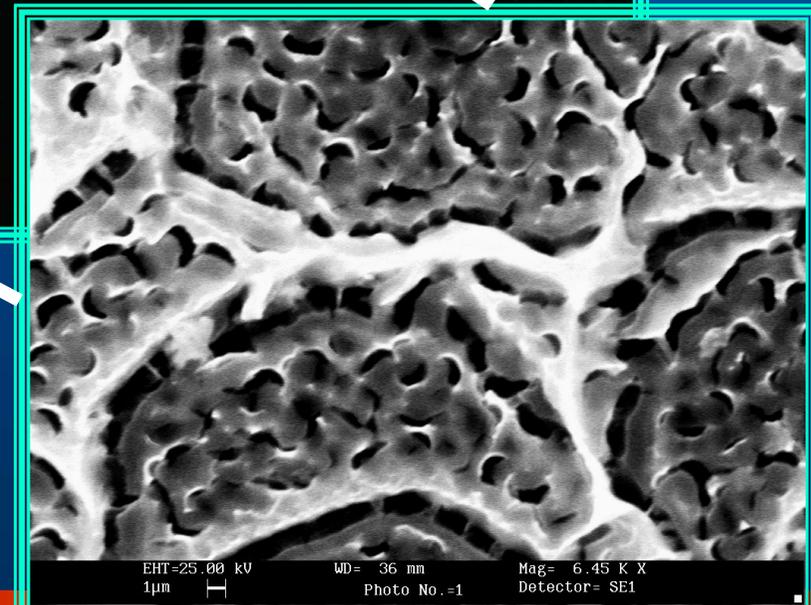
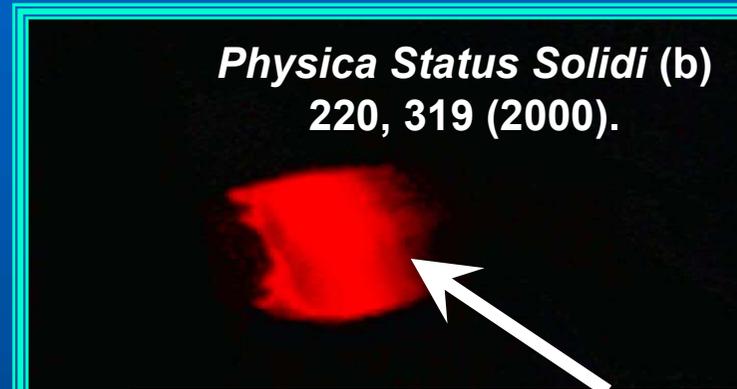
MRS Bulletin 23, 23 (1998)



Nanocristales Menores

MRS Bulletin 30, 362 (2005)

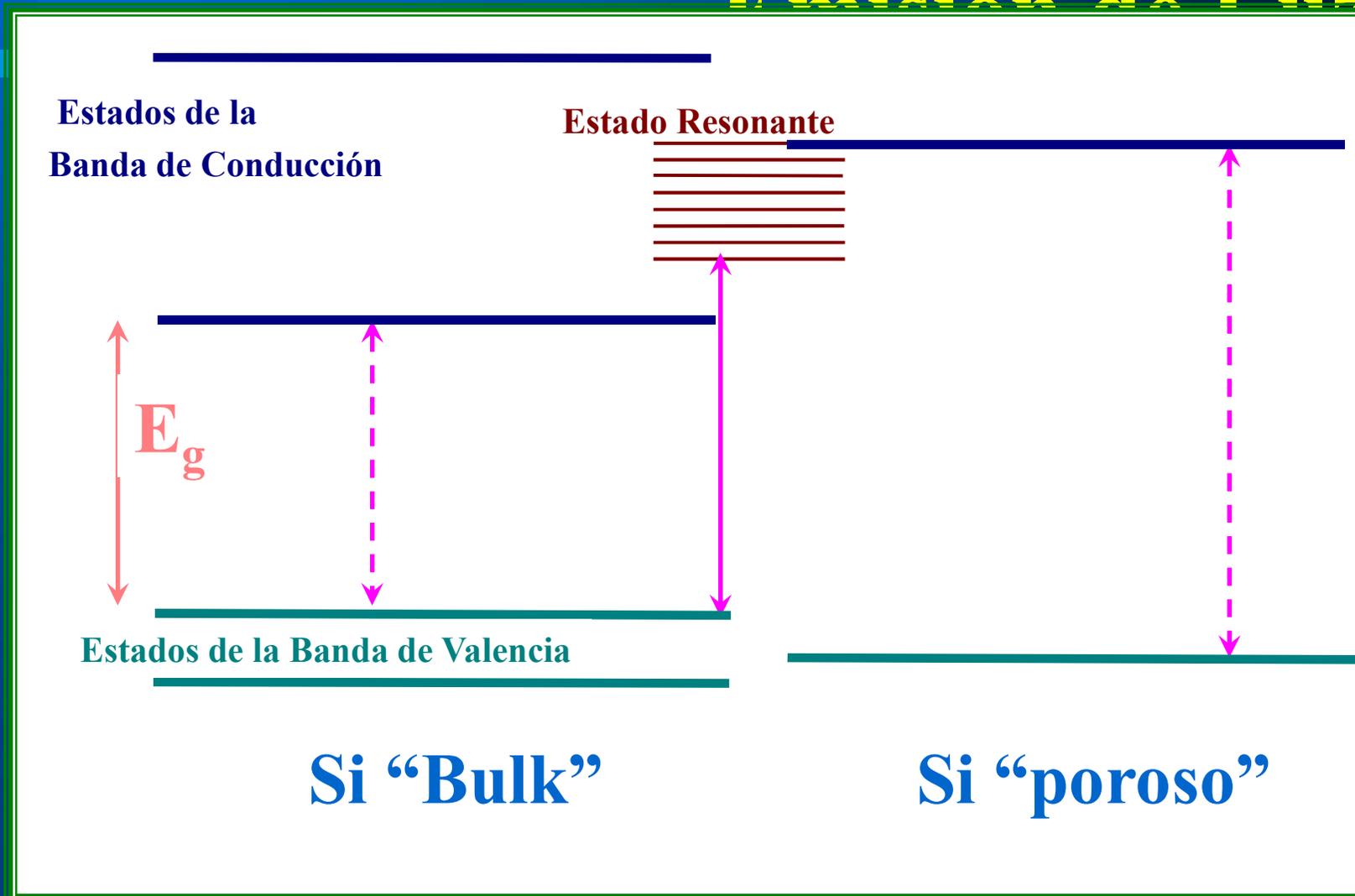
Silicio Poroso (π -Si): Material Poroso Nanoestructurado



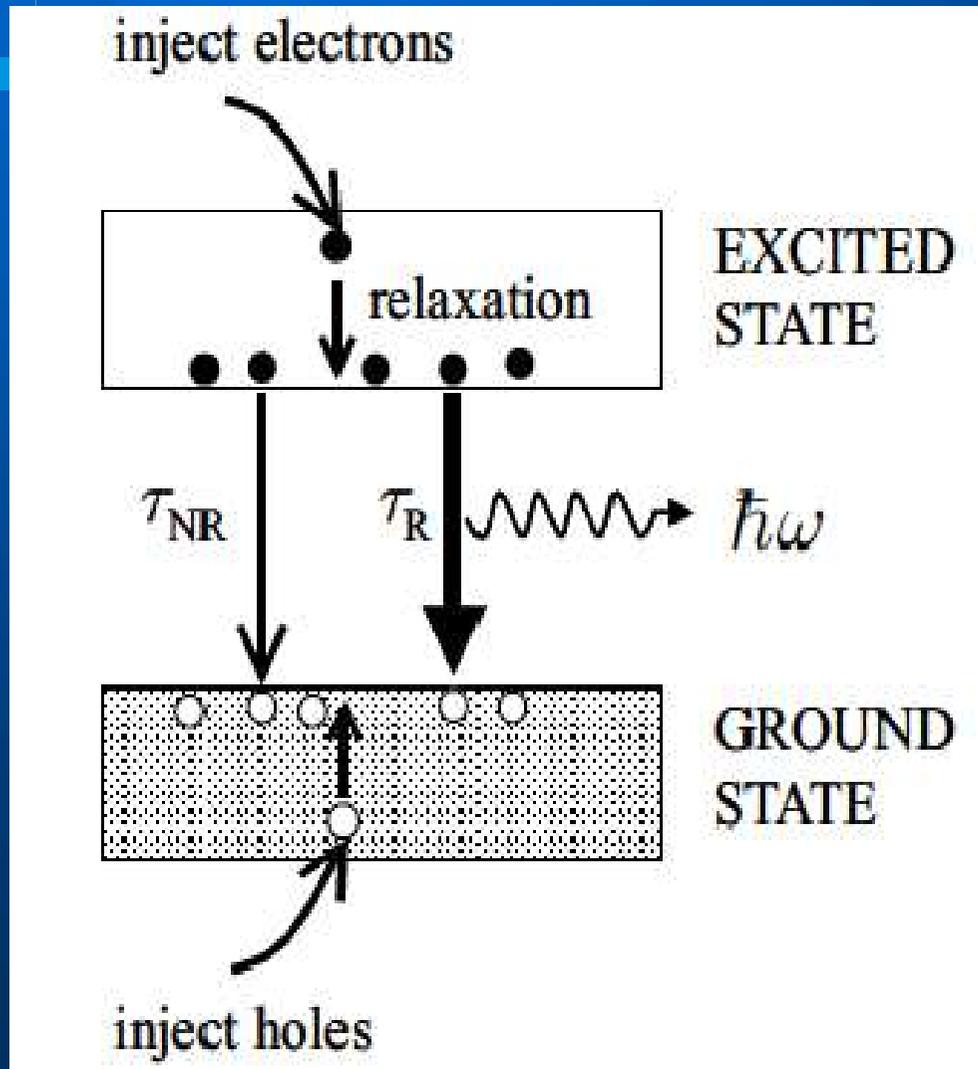
- 95 % electrónica basada en Silicio.
- Silicio: semiconductor indirecto
 - ▷ Mal emisor de luz
- Silicio Poroso emite luz roja.

Si Poroso:

Definición de E_{eff}



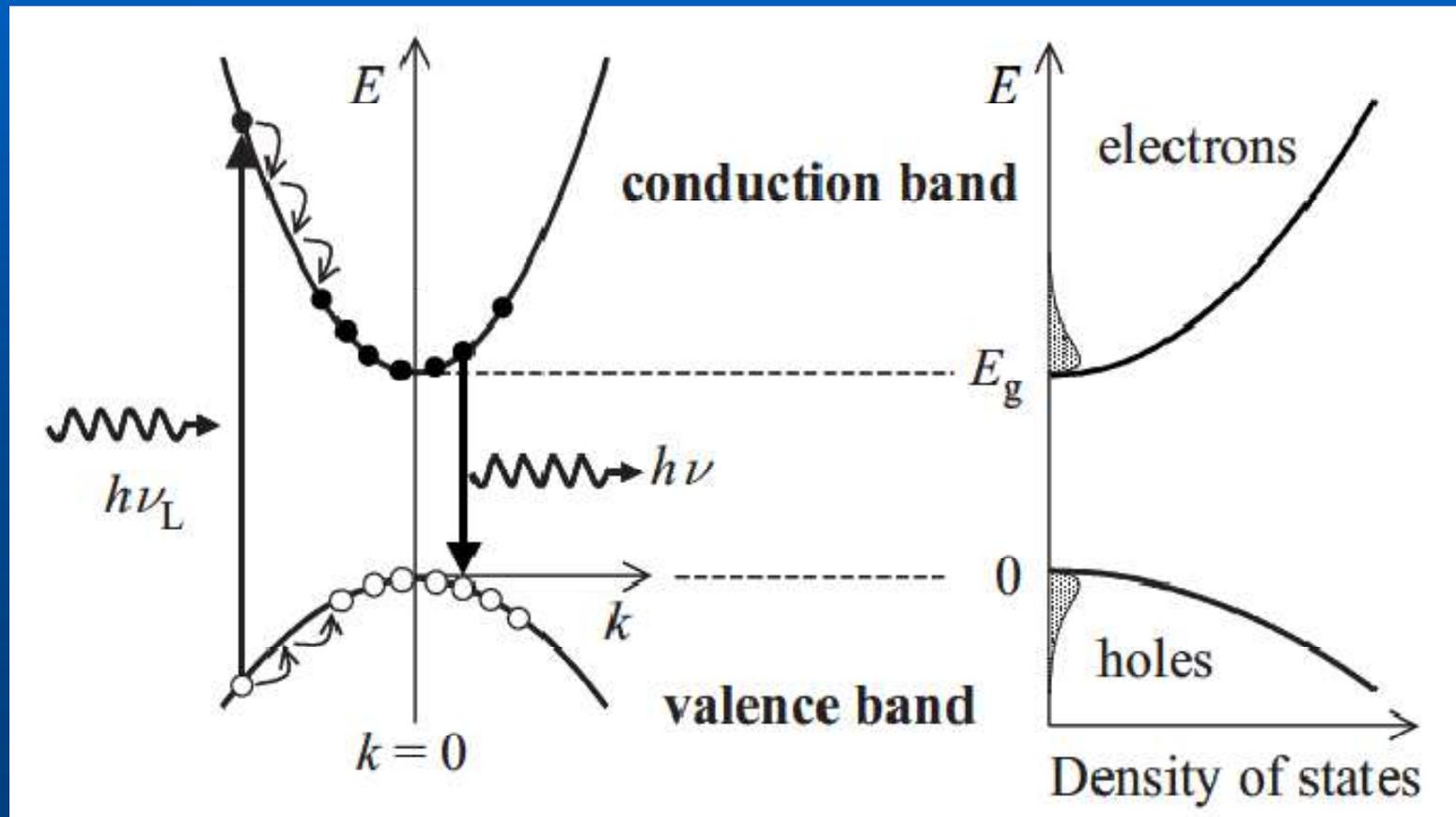
Luminiscencia



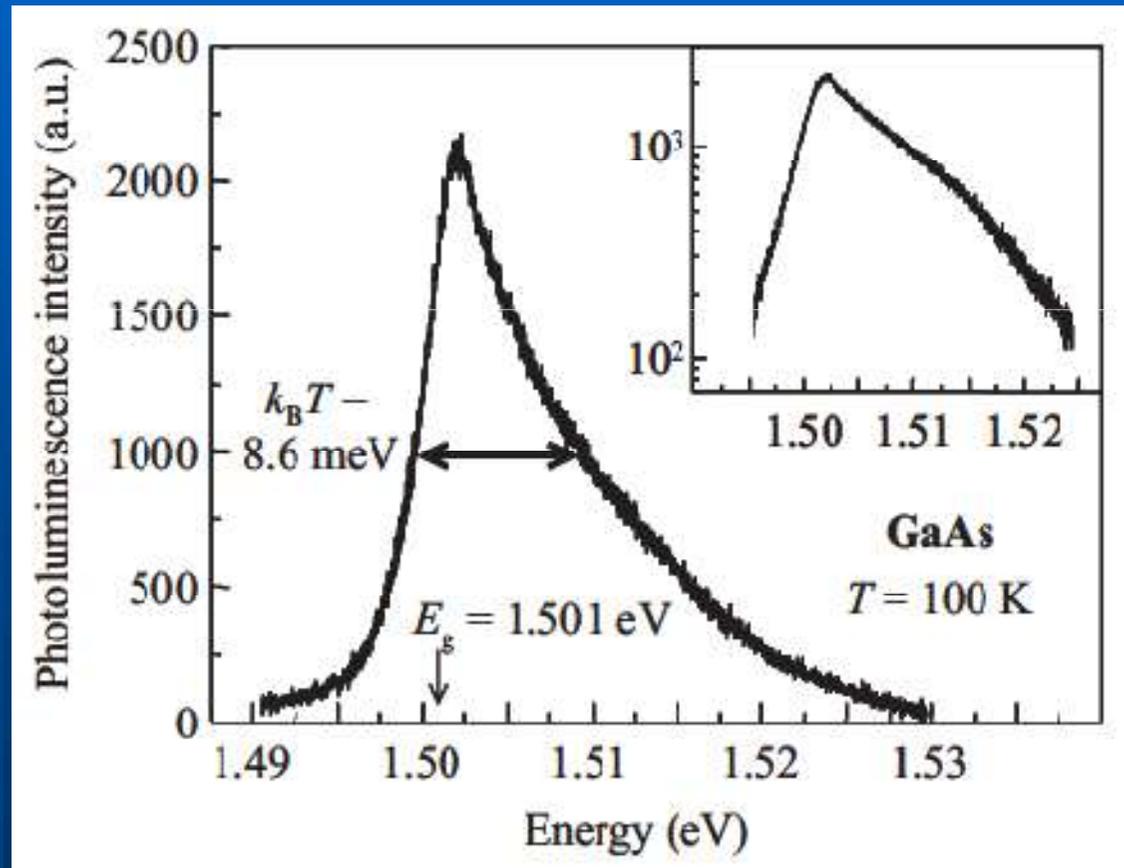
- Eficiencia de Radiación:

$$\eta_R = \frac{1}{1 + \frac{\tau_R}{\tau_{NR}}}$$

Fotoluminiscencia



Fotoluminiscencia



Fotoluminiscencia

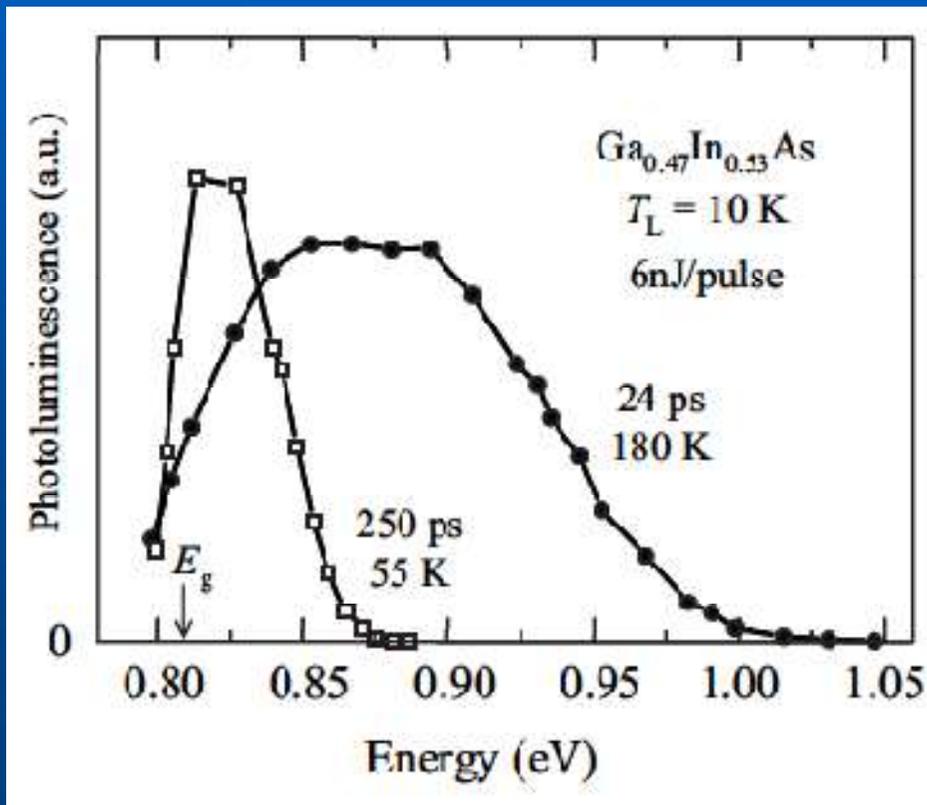
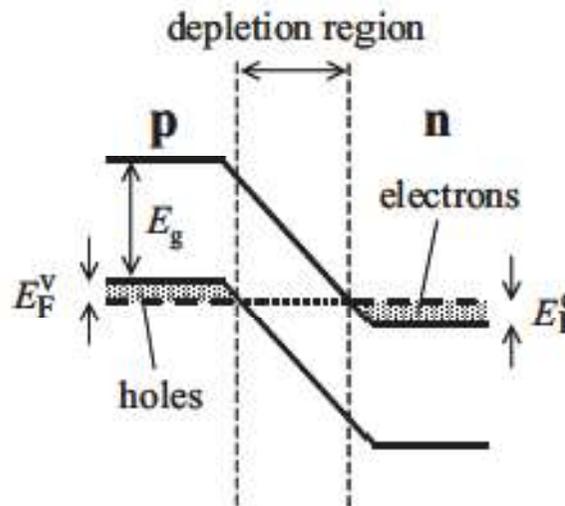
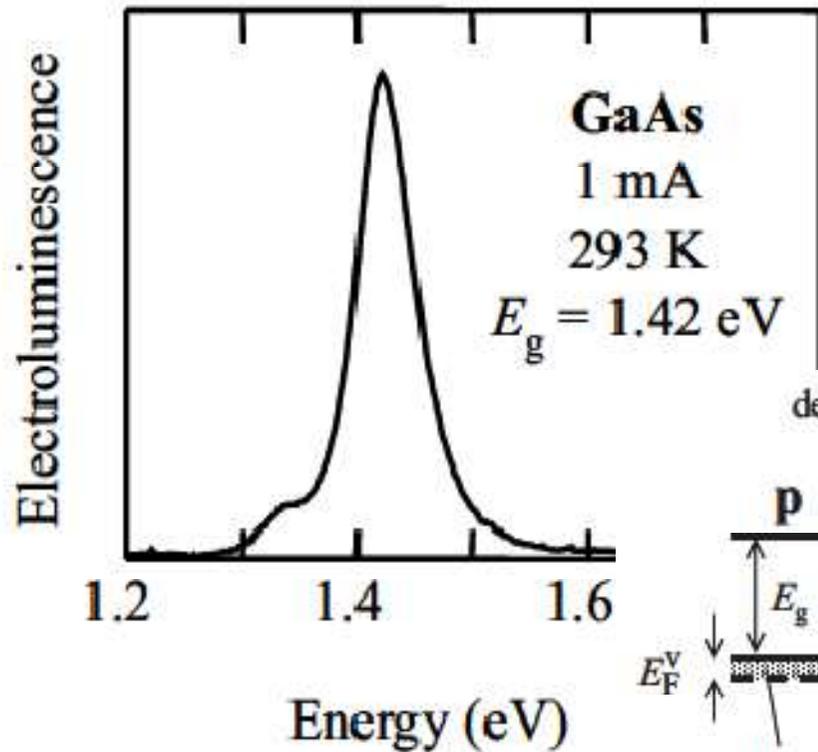


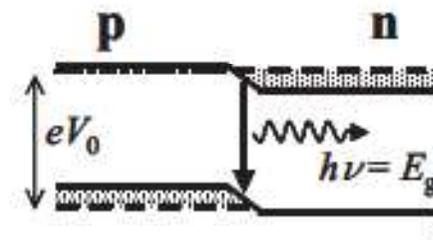
Fig. 5.8 Time-resolved photoluminescence spectra of the direct gap III-V alloy semiconductor $\text{Ga}_{0.47}\text{In}_{0.53}\text{As}$ at a lattice temperature T_L of 10 K. The sample was excited with laser pulses at 610 nm with an energy of 6 nJ and a duration of 8 ps. This generated an initial carrier density of $2 \times 10^{24} \text{ m}^{-3}$. Spectra are shown for time delays of 24 ps (filled circles) and 250 ps (open squares). The effective carrier temperature at the two time delays is indicated. After Kash and Shah (1984), © American Institute of Physics, reprinted with permission.

Diferentes niveles de Inyección

Electroluminiscencia: LEDs



(a) $V_0 = 0$



(b) $V_0 \approx +E_g/e$

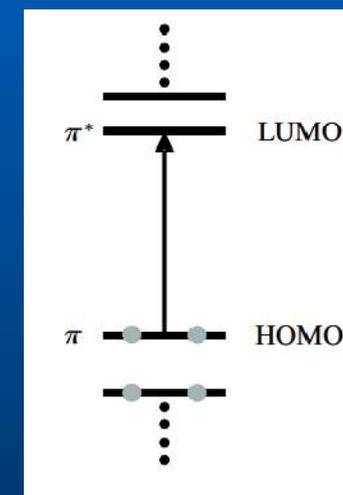
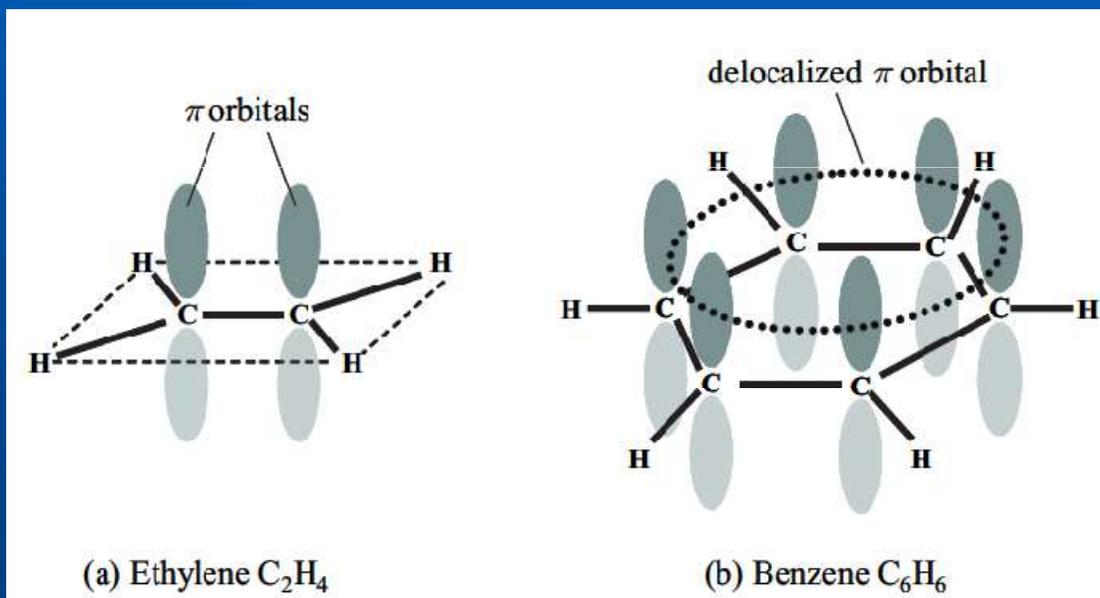
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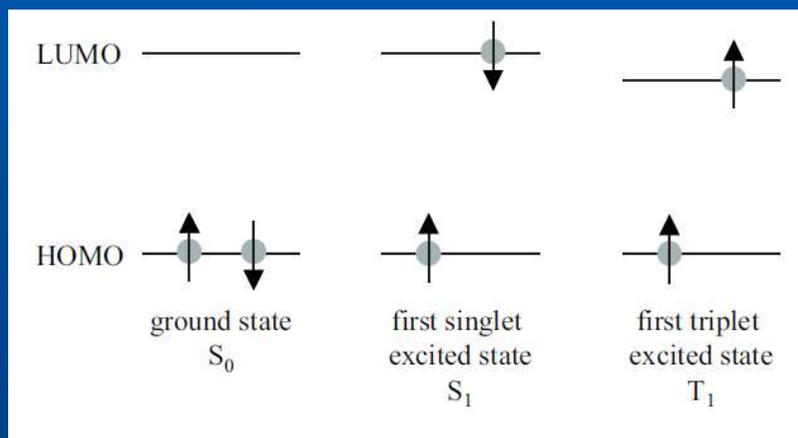
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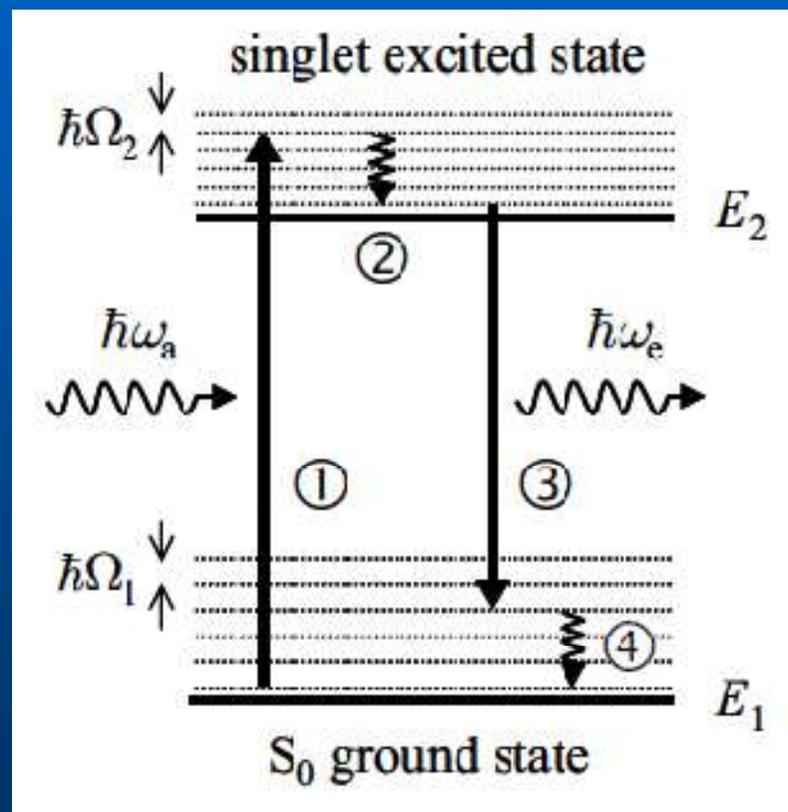
Materiales Moleculares



Estados Electrónicos vs Estados Vibrónicos



Estados Electrónicos



Estados Vibrónicos (Vibracional Electrónicos)

Diagrama Configuracional y Principio de Franck-Condon

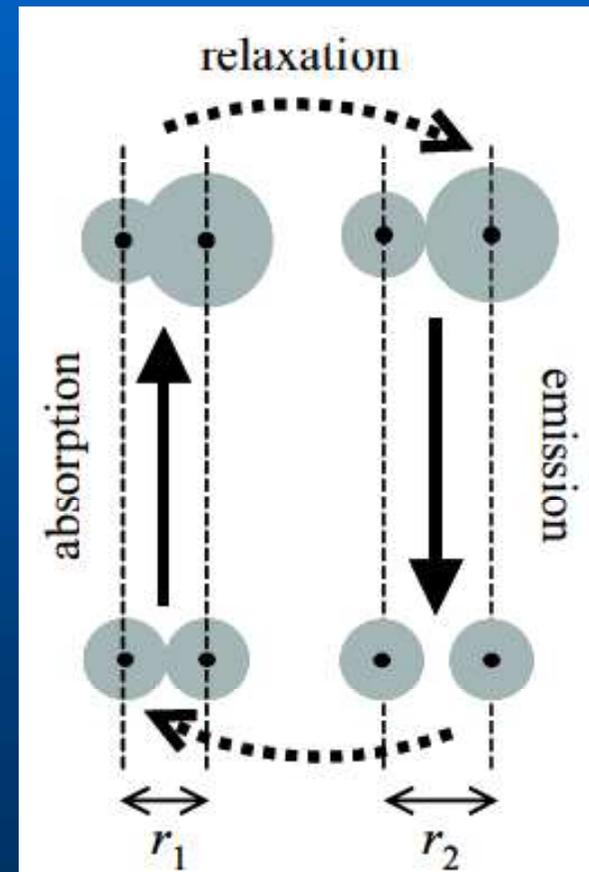
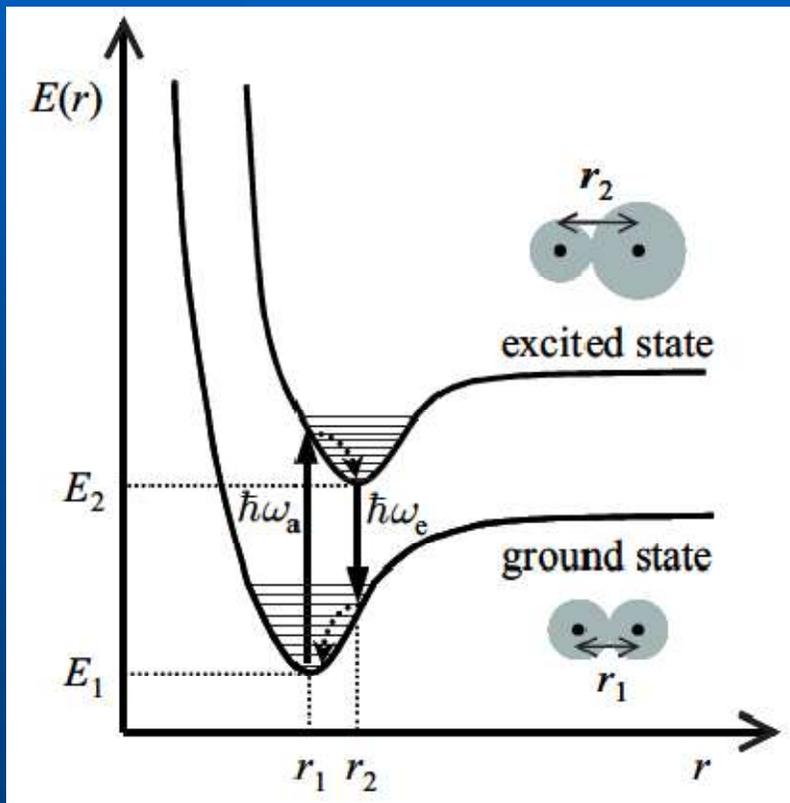
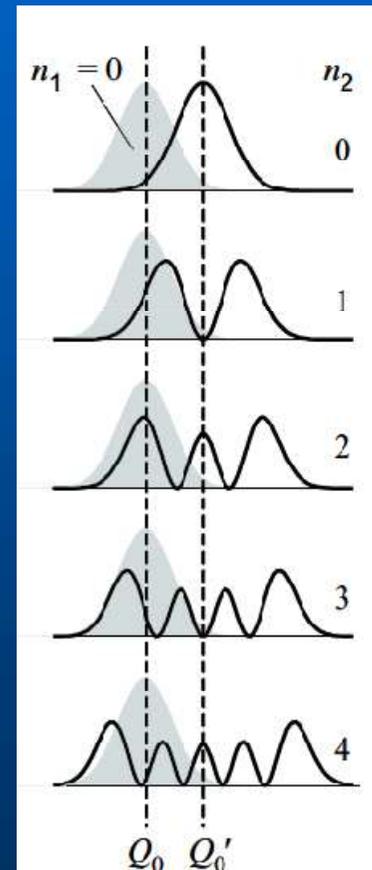
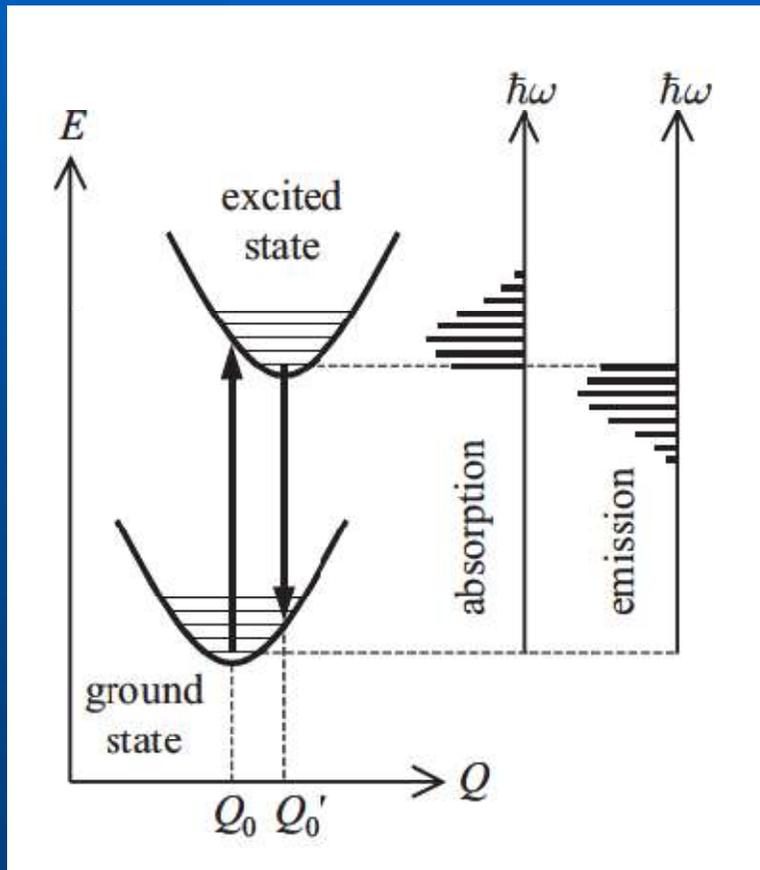
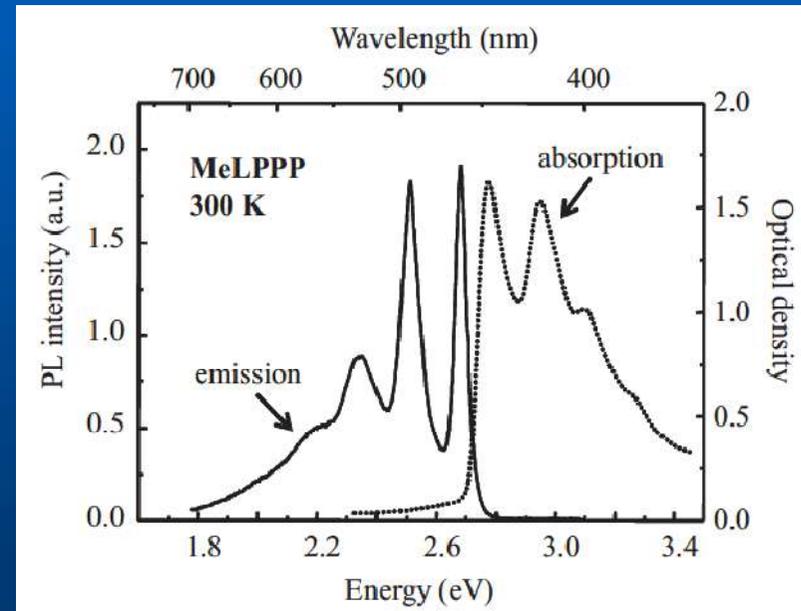
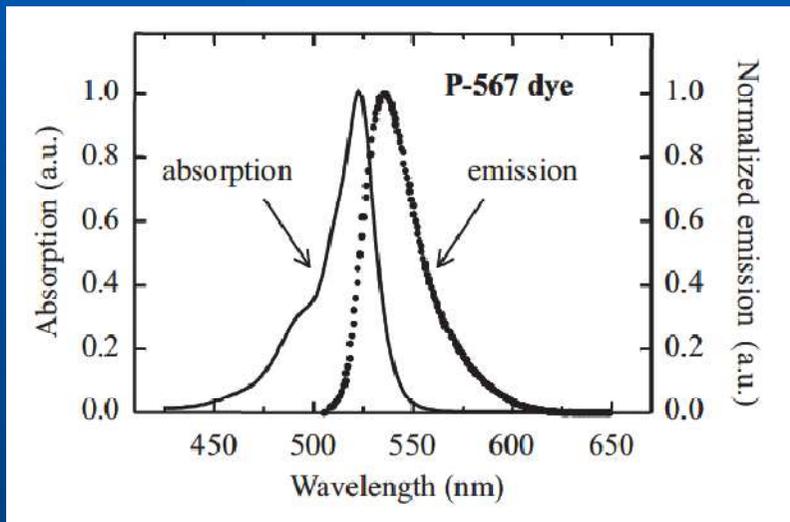


Diagrama Configuracional y Principio de Franck-Condon



Absorción vs. Fotoluminiscencia



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Centros Luminiscentes en Cristales

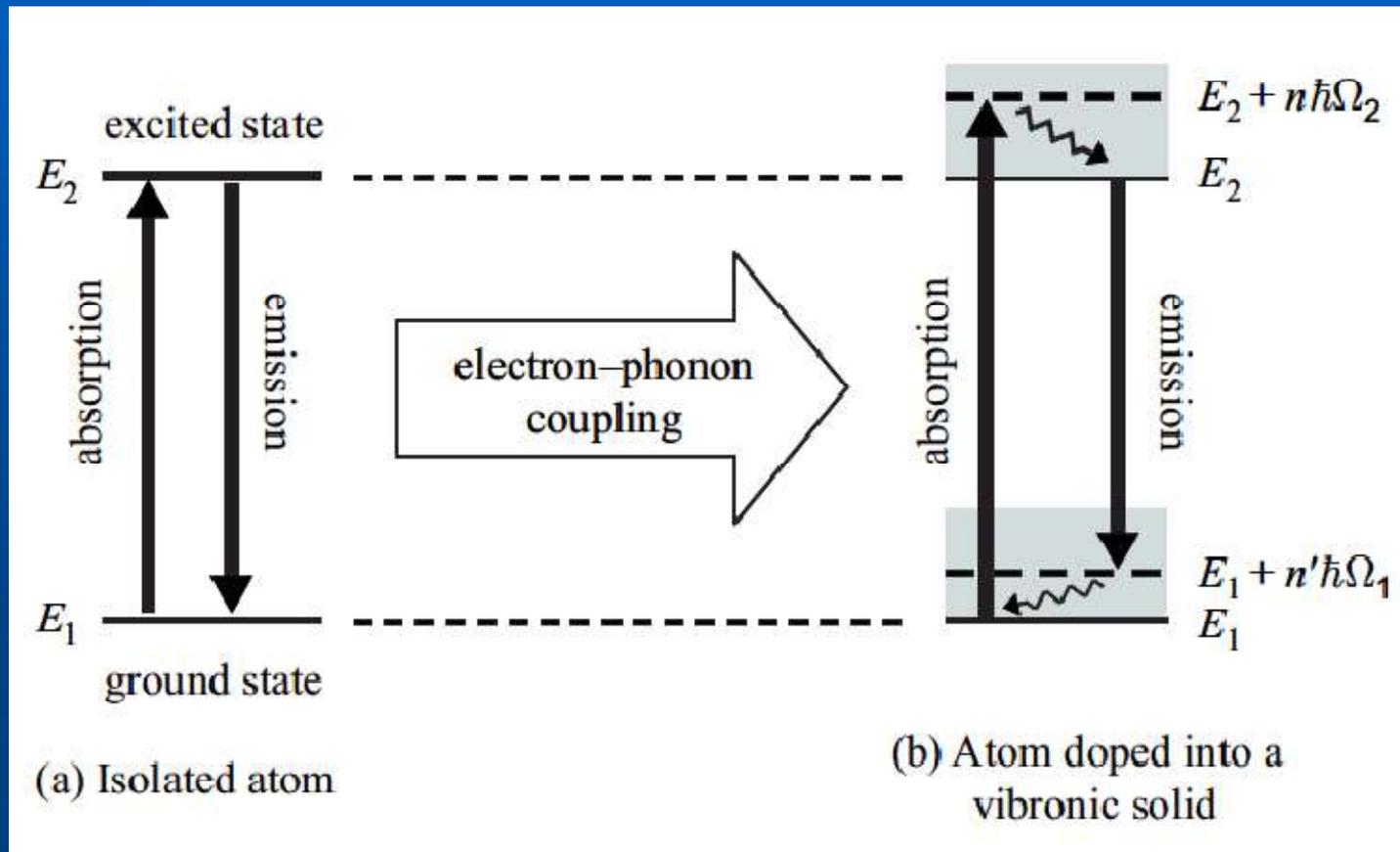
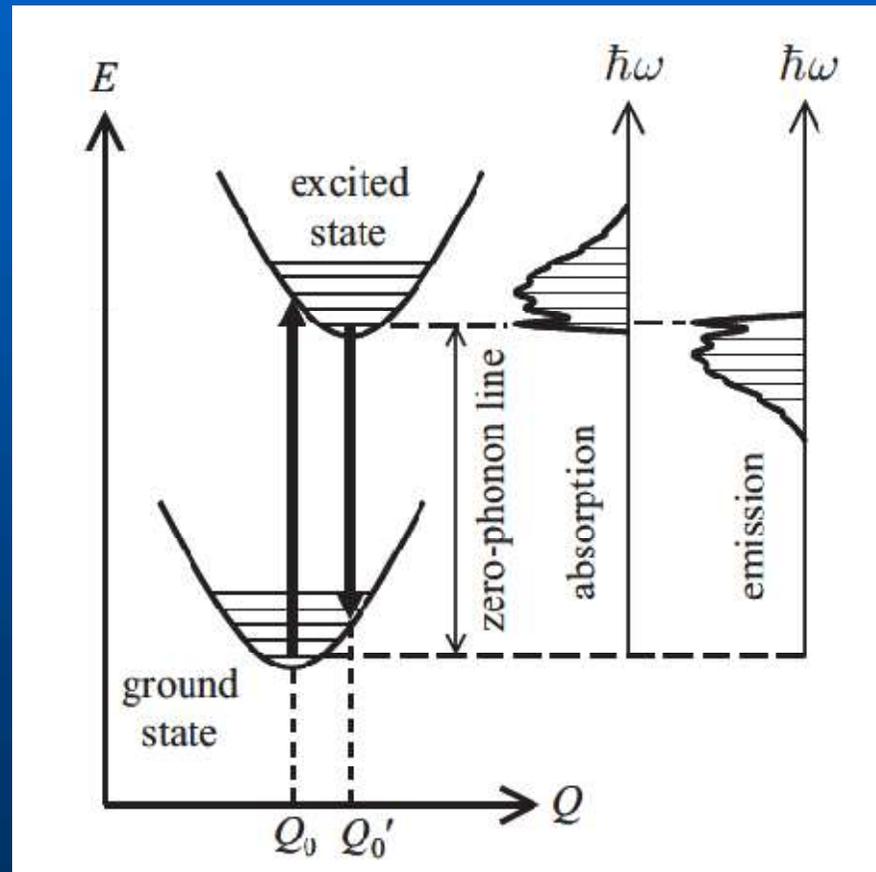
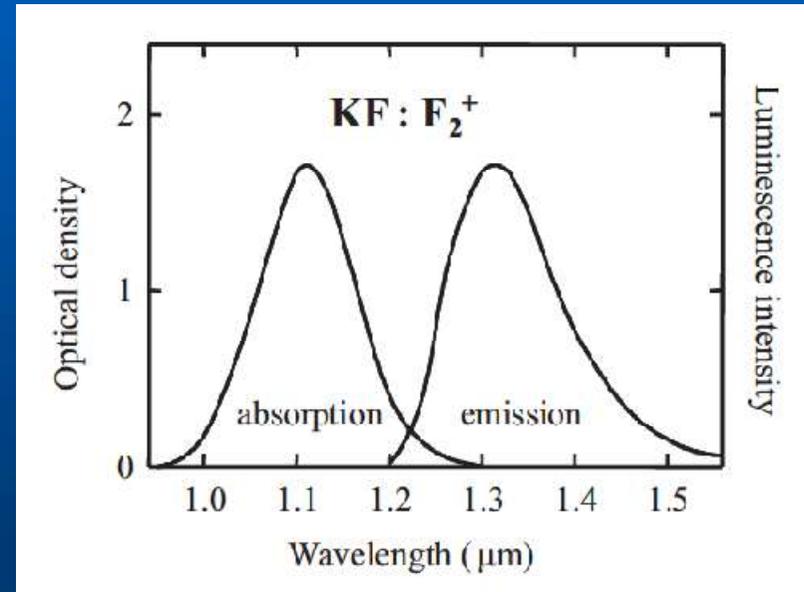
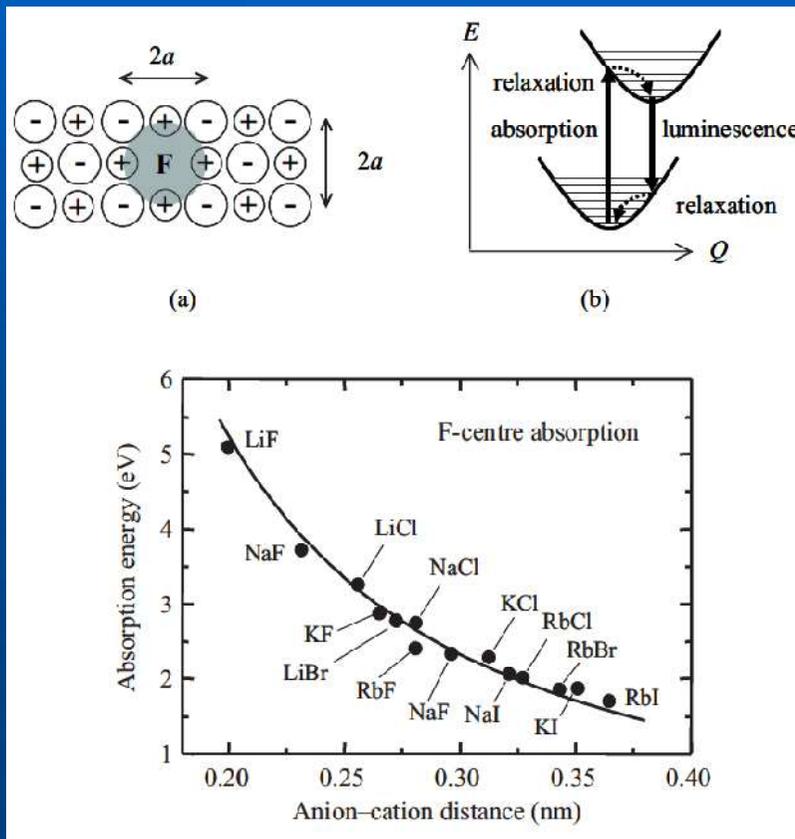


Diagrama Configuracional



Centros de Color



Tierras Raras

Nome degli elementi

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra																

Terre rare

Lantanidi	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
Attinidi	Ac	Th	Pa	U	Np	Pu								

 **Gruppo I Alcalini**

 **Gruppo IV**

 **Gruppo VII**

 **Gruppo II Alcalino terrosi**

 **Gruppo V**

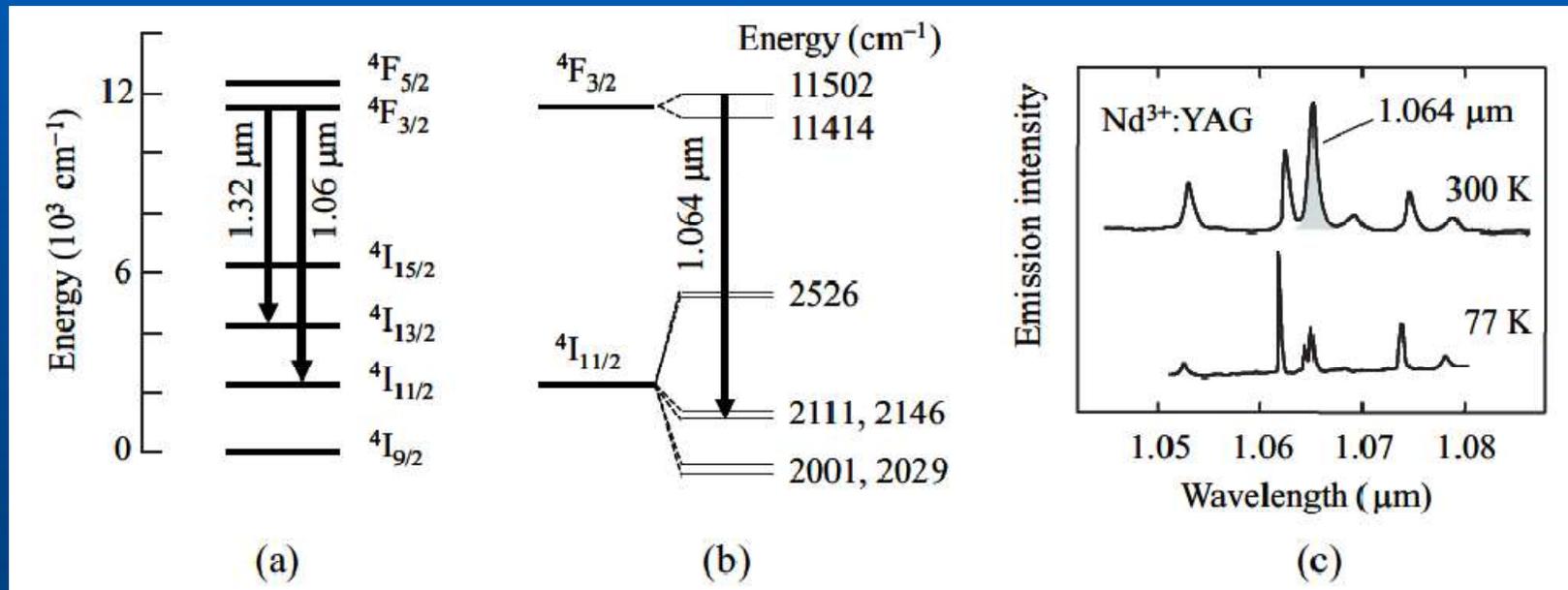
 **Gruppo VIII**

 **Gruppo III**

 **Gruppo VI**

 **Gruppi di transizione**

Tierras Raras



Metales de Transición

Nome degli elementi

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra																

Terre rare

Lantanidi	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
Attinidi	Ac	Th	Pa	U	Np	Pu								

 Gruppo I Alcalini

 Gruppo IV

 Gruppo VII

 Gruppo II Alcalino terrosi

 Gruppo V

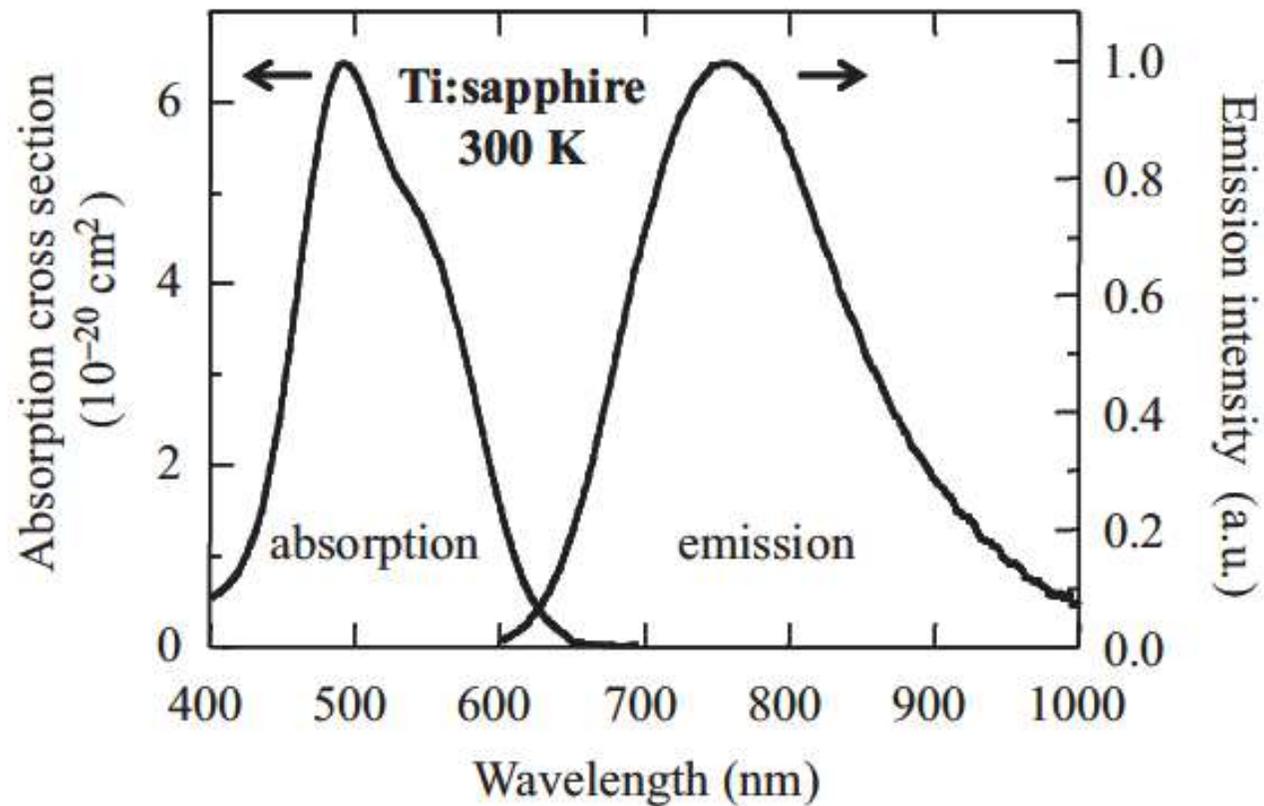
 Gruppo VIII

 Gruppo III

 Gruppo VI

 Gruppi di transizione

Metales de Transición

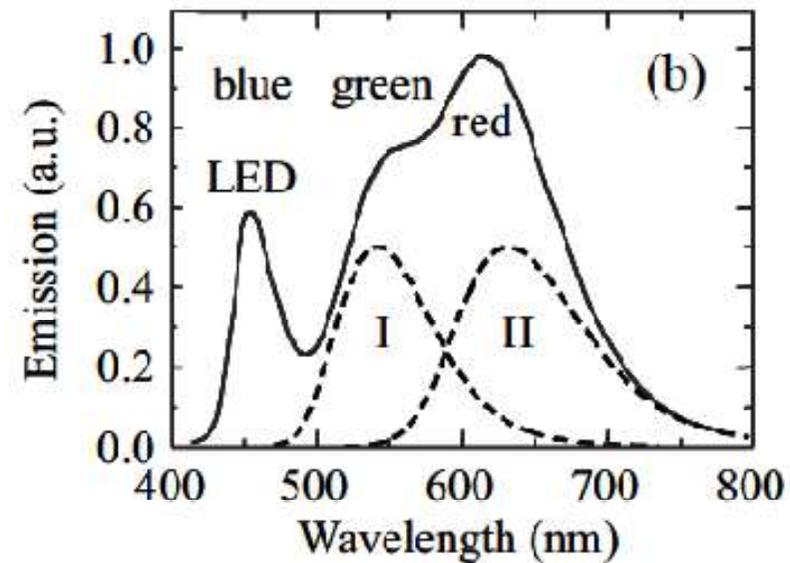
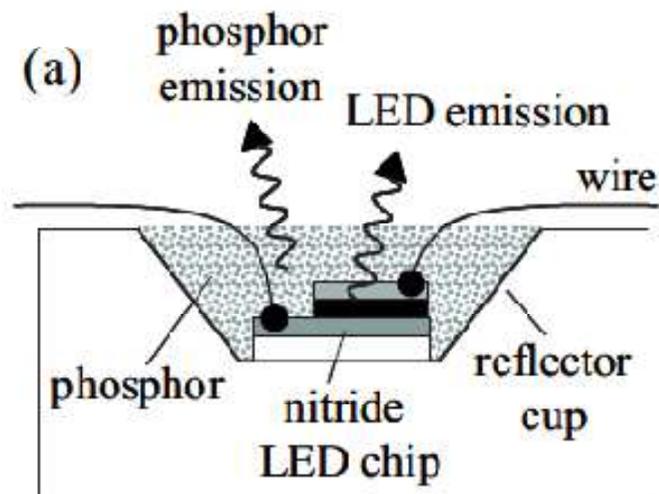


Láseres de Estado Sólido (No Diodos Láser)

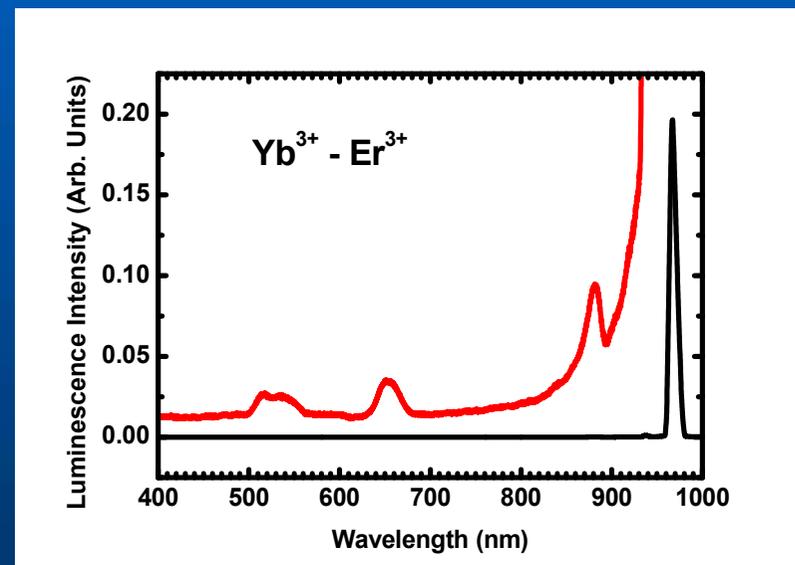
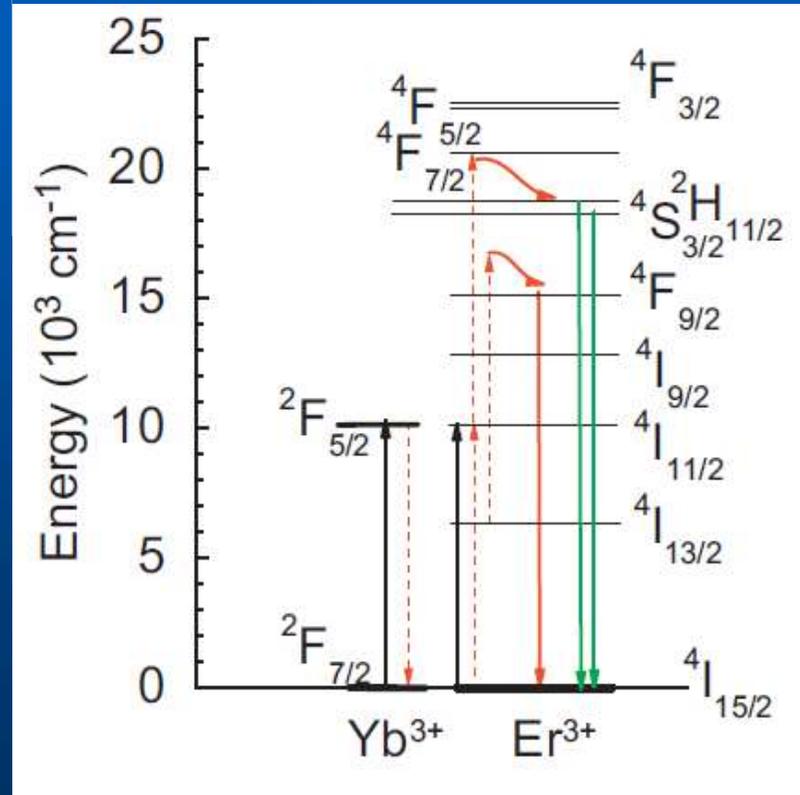
Table 9.4 Common solid-state lasers based on rare-earth or transition-metal ions. The lasers operate at room temperature unless stated otherwise.

Laser	Active ion	Configuration	Host	Wavelength (nm)
Ti:sapphire	Ti ³⁺	3d ¹	sapphire (Al ₂ O ₃)	700–1100
Ruby	Cr ³⁺	3d ³	sapphire (Al ₂ O ₃)	694
Alexandrite	Cr ³⁺	3d ³	beryl (BeAl ₂ O ₄)	700–820
Cr:LiSAF	Cr ³⁺	3d ³	LiSAF (LiSrAlF ₆)	780–1010
Cr:LiCAF	Cr ³⁺	3d ³	LiCAF (LiCaAlF ₆)	720–840
Cr:forsterite	Cr ⁴⁺	3d ²	forsterite (Mg ₂ SiO ₄)	1150–1350
Co:MgF ₂	Co ²⁺	3d ⁷	magnesium fluoride (MgF ₂)	1500–2500 at 77 K
Nd:YAG	Nd ³⁺	4f ³	yttrium aluminium garnet (YAG: Y ₃ Al ₅ O ₁₂)	1064
Nd:glass	Nd ³⁺	4f ³	phosphate glass	1054
Nd:YLF	Nd ³⁺	4f ³	yttrium lithium fluoride (YLF: LiYF ₄)	1047 and 1053
Nd:vanadate	Nd ³⁺	4f ³	yttrium vanadate (YVO ₄)	1064
Yb:YAG	Yb ³⁺	4f ¹³	yttrium aluminium garnet (YAG: Y ₃ Al ₅ O ₁₂)	1030 at 100 K
Erbium fibre	Er ³⁺	4f ¹¹	optical fibre	1530–1560

Fósforos



Up Conversion



Tiempo de Decaimiento

