

# Introduction

## Lightwave Devices

- LED
- Lasers
- Modulators
- Photodetectors

## Optoelectronics



Optical

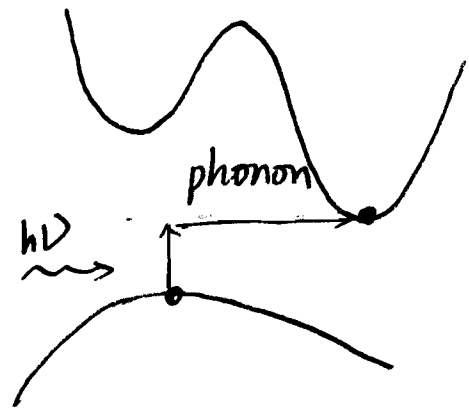
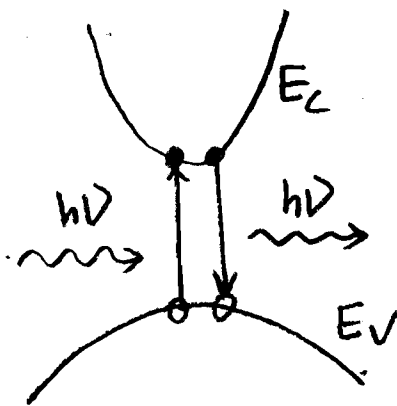
Semiconductors with strong interaction with light

Direct Bandgap

eg. GaAs, InP, III-V

Indirect Bandgap

eg. Si, Ge



$$E_g \sim h\nu = \frac{hc}{\lambda} = \frac{1.24}{\lambda} \text{ eV}$$

$$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$$

↑  
in  $\mu\text{m}$

eg. GaAs.  $E_g = 1.42 \text{ eV}$ ,  $h\nu \sim \frac{1.24}{1.42} = 0.87 \mu\text{m}$

InGaAs  $E_g = 0.74 \text{ eV}$ ,  $h\nu \sim \frac{1.24}{0.74} = 1.68 \mu\text{m}$

## Optoelectronics



- Classical electrostatics (Maxwell's eqs.)
- Solid state theory (electron wave, effective mass approx. energy bands. DOS)

## Quantum Electronics

- Classical electromagnetics (Maxwell's eqs.)
- Light interaction with electronic states  
( Quantum Mechanics. < Phys 137 AB >  
Time-dependent perturbation,  
Fermi's Golden rule )