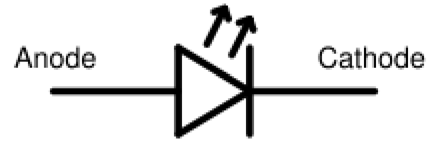
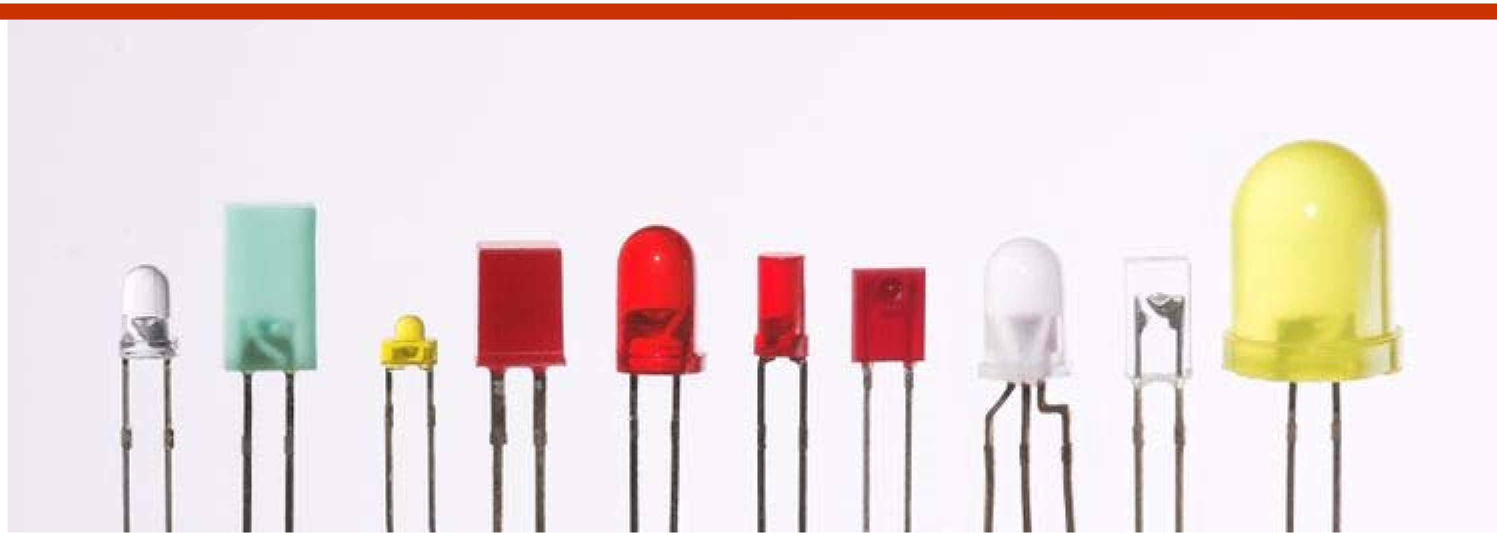
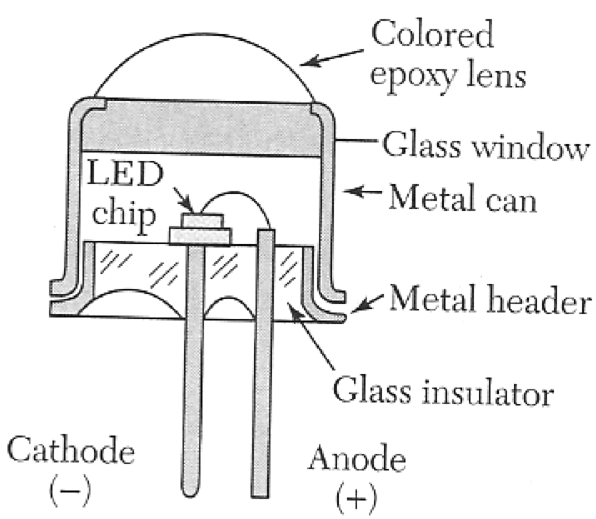
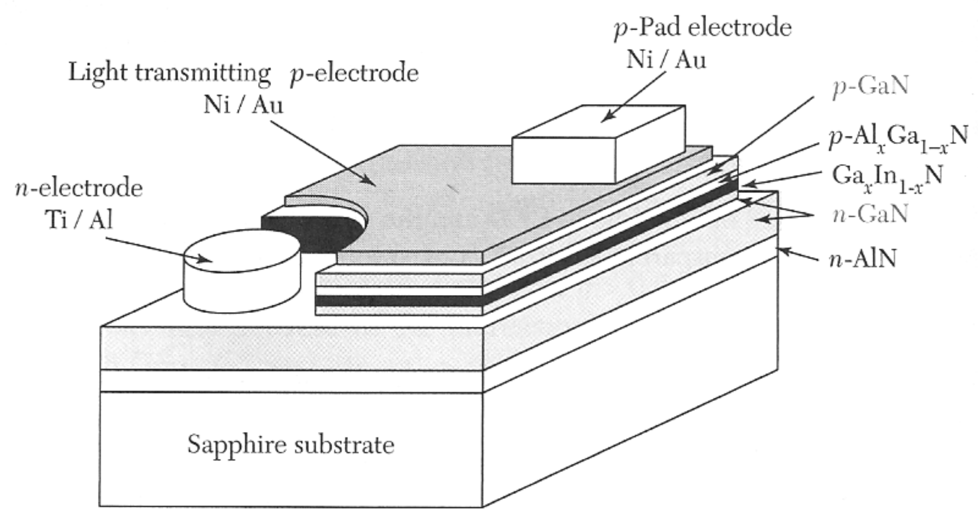
Semiconductor devices

Light emitting diodes

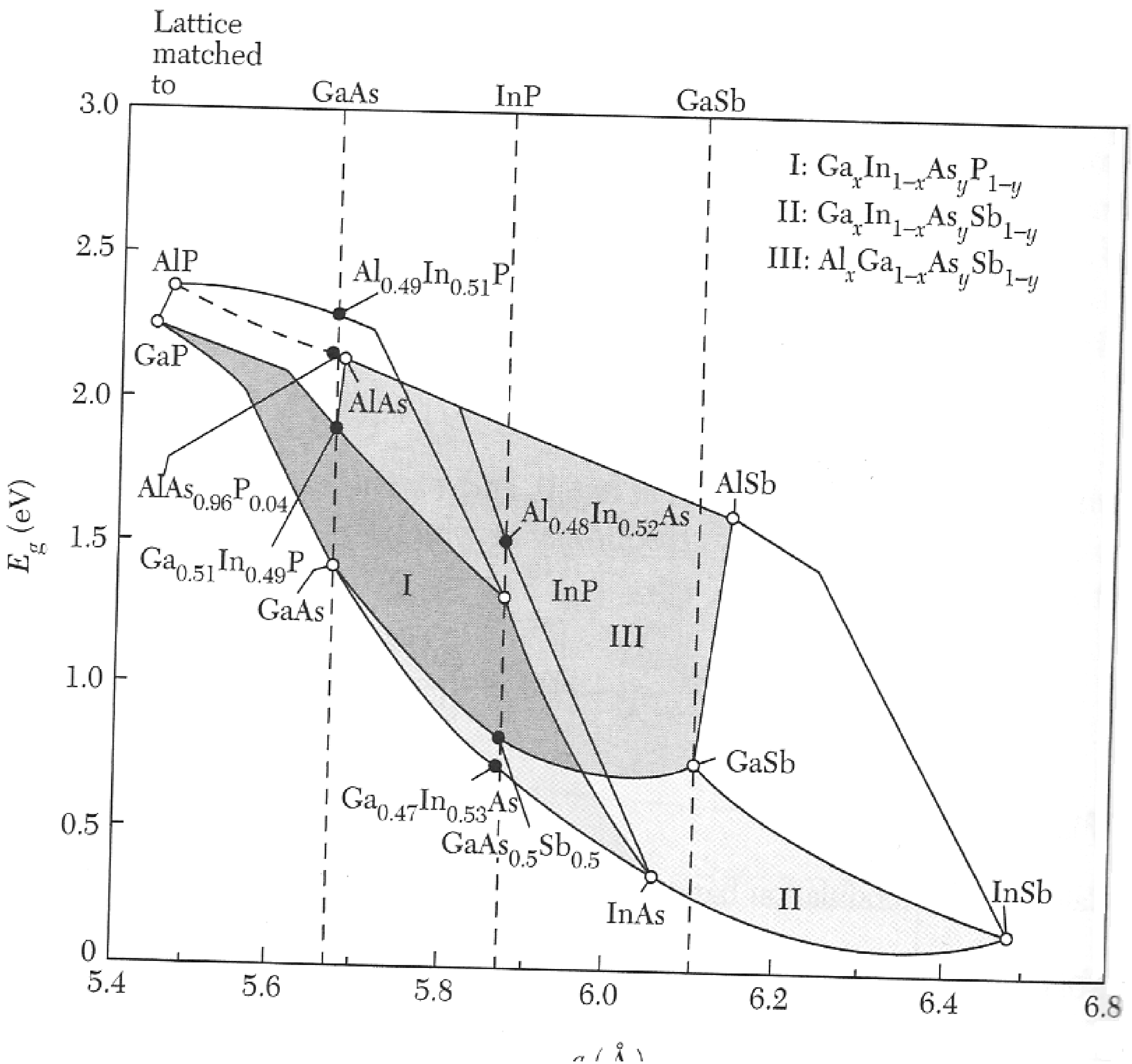




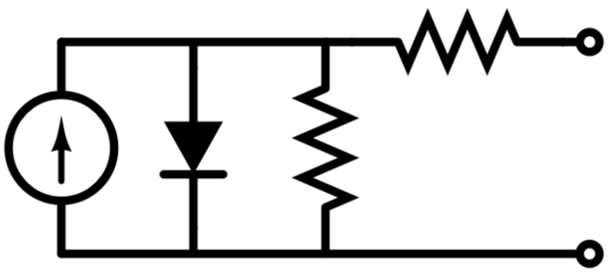




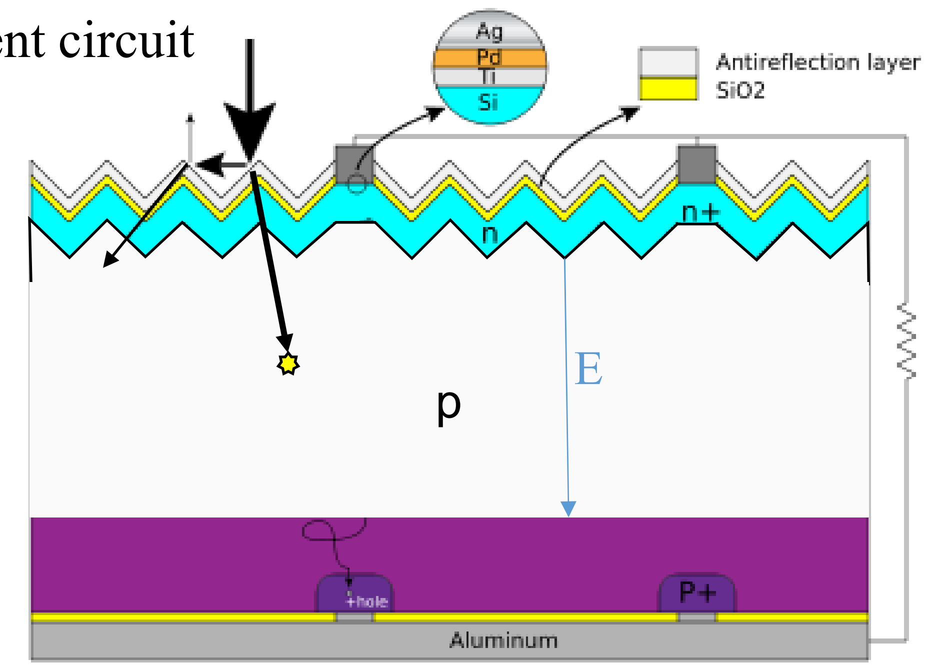
Solid state lighting is efficient.

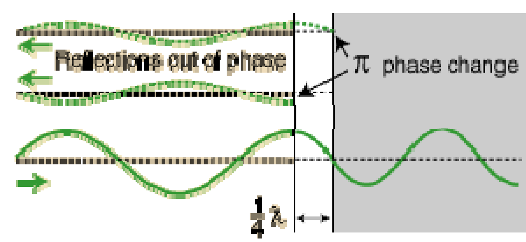

Lattice matched to
GaAs
InP
GaSb
I: $Ga_xIn_{1-x}As_yP_{1-y}$
II: $Ga_xIn_{1-x}As_ySb_{1-y}$
III: $Al_xGa_{1-x}As_ySb_{1-y}$
AlP
GaP
$Al_{0.49}In_{0.51}P$
AlAs
$AlAs_{0.96}P_{0.04}$
$Ga_{0.51}In_{0.49}P$
GaAs
AlSb
$Al_{0.48}In_{0.52}As$
InP
I
III
GaSb
$Ga_{0.47}In_{0.53}As$
$GaAs_{0.5}Sb_{0.5}$
InAs
II
InSb
E_g (eV)
3.0
2.5
2.0
1.5
1.0
0.5
0
5.4
5.6
5.8
6.0
6.2
6.4
6.8

Solar cell

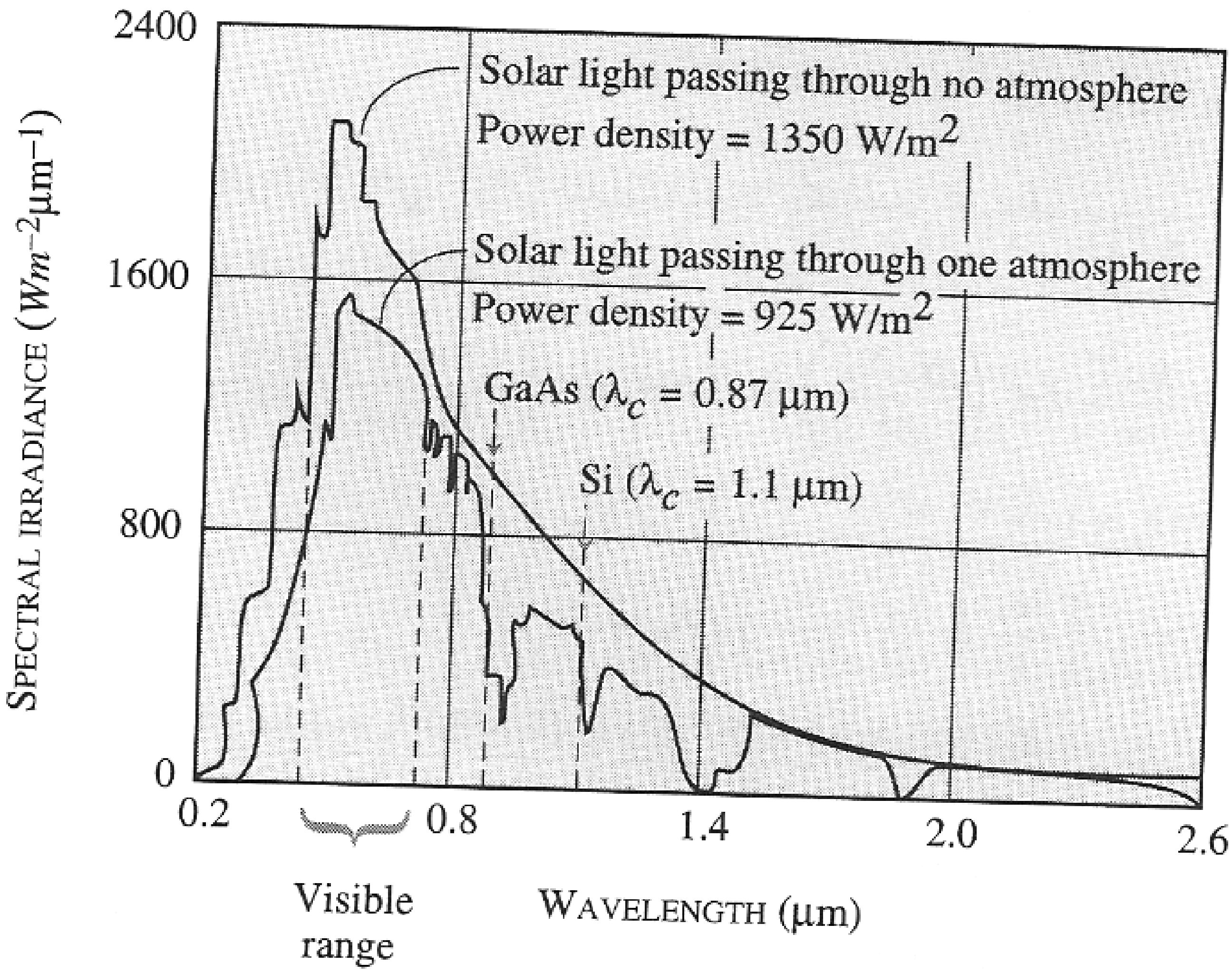


Equivalent circuit



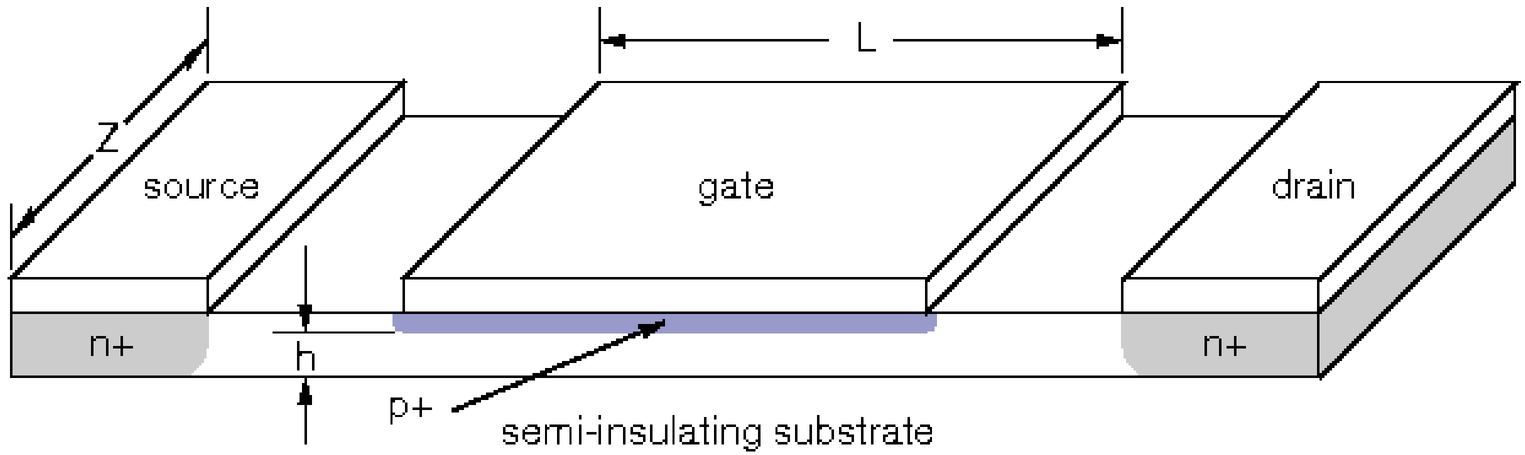


Solar spectrum



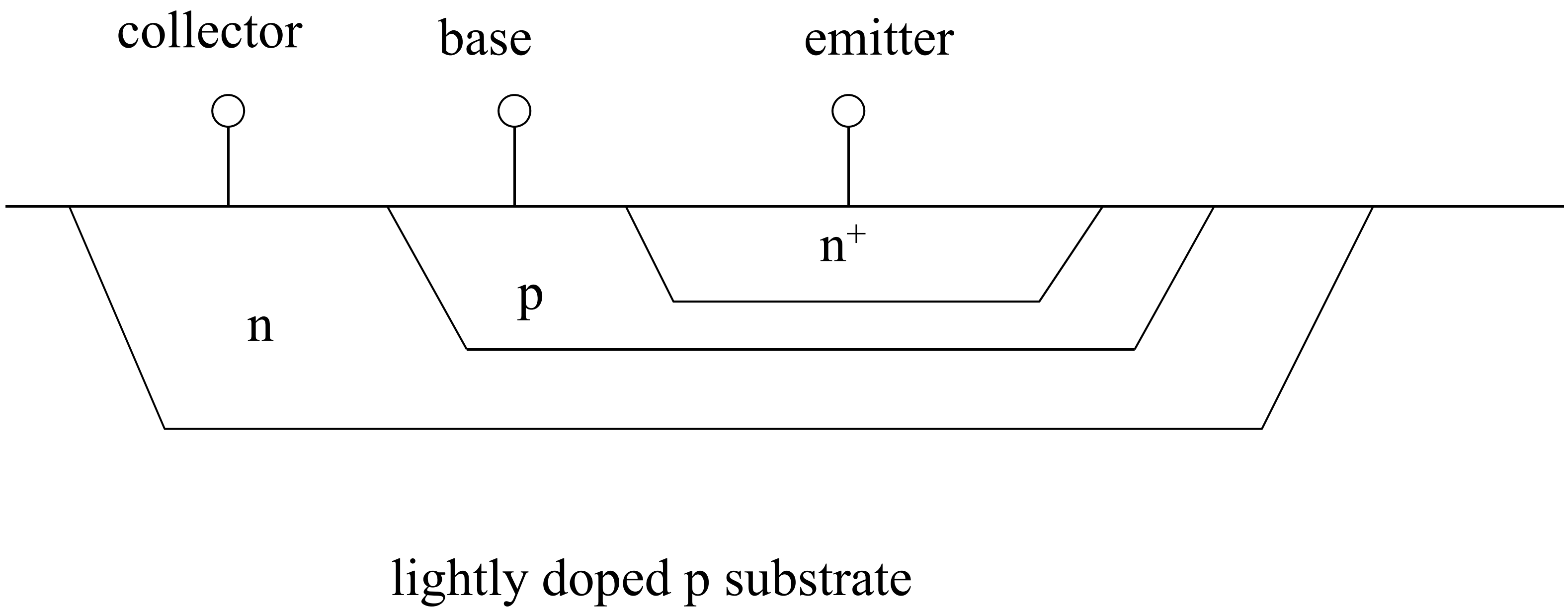
JFETs

Junction Field Effect Transistors



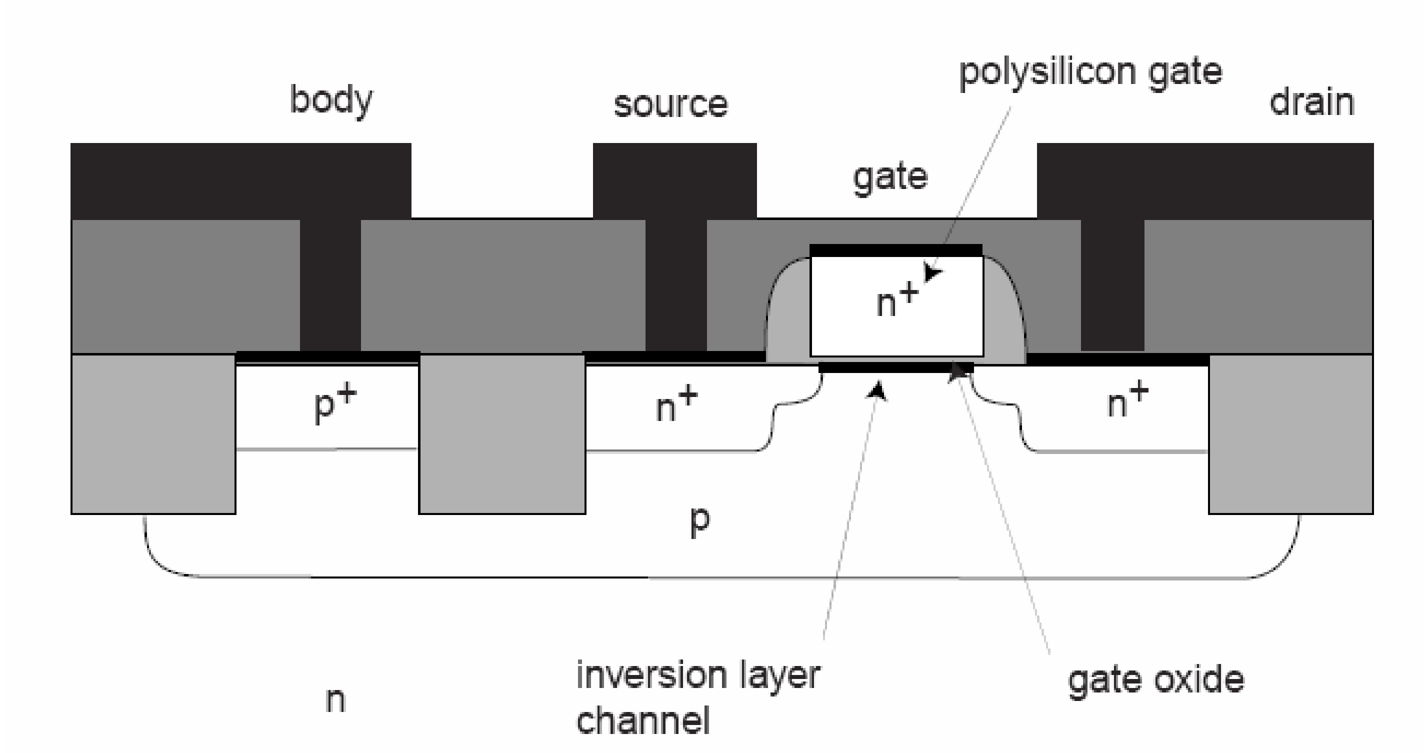
low noise

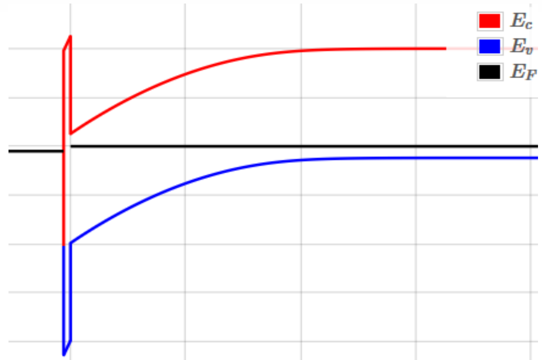
Bipolar transistor



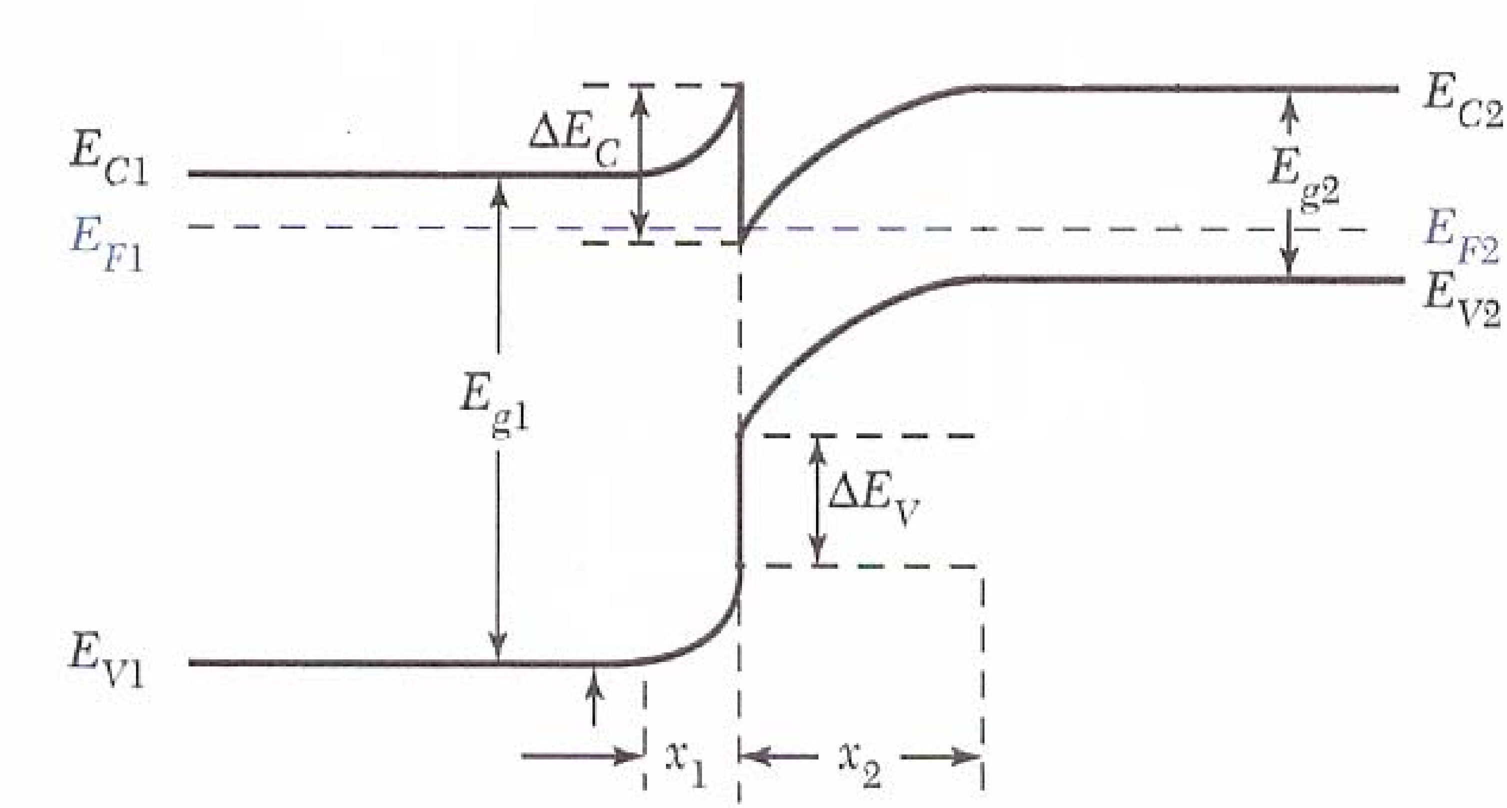
MOSFETs

Metal-oxide semiconductor field effect transistors





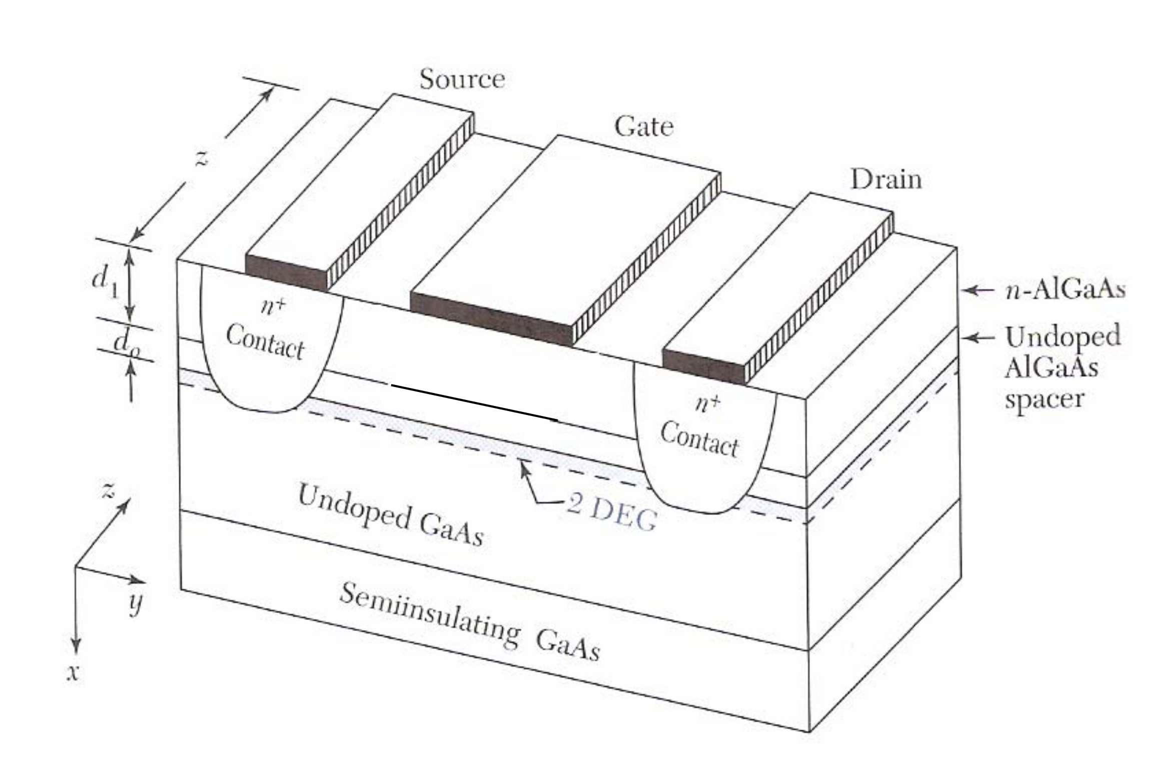
Heterojunctions

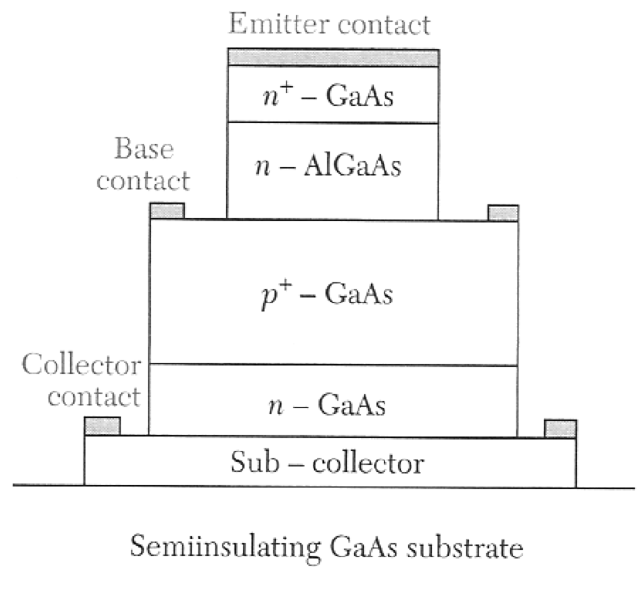


Quantum hall effect
Quantized conductance
HBTs
HEMTs

HEMT High electron mobility transistor

HBT Hetero junction bipolar transistor

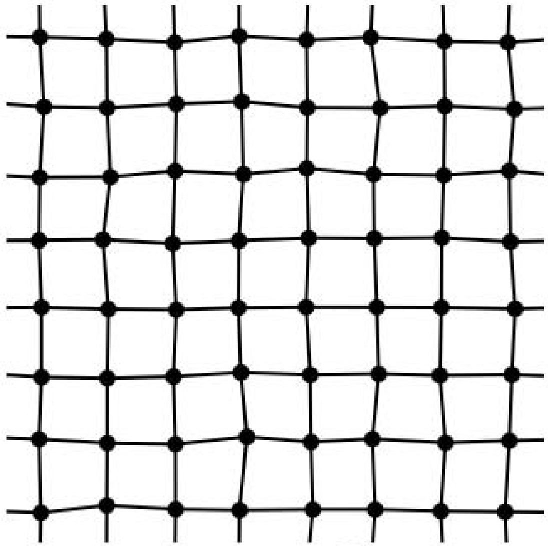




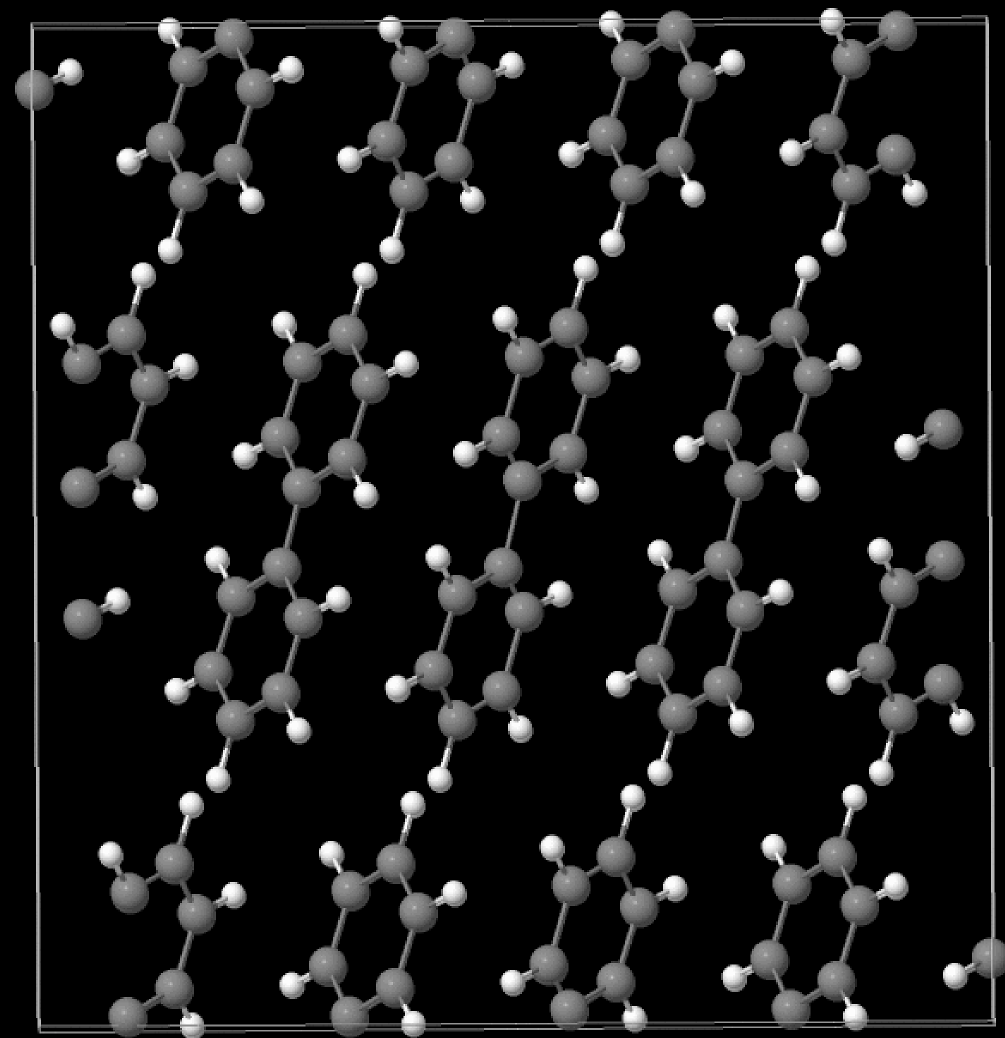
Phonons

Normal Modes and Phonons

At finite temperatures, the atoms in a crystal vibrate. In the simulation below, the atoms move randomly around their equilibrium positions.



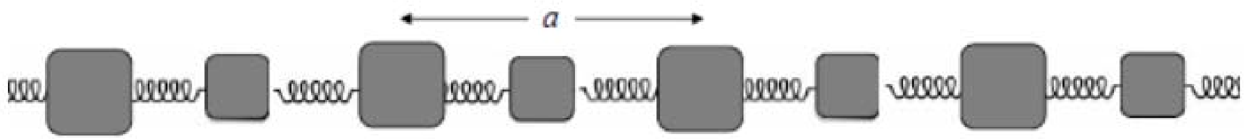
T = 300 K - +



Natalia Bedoya

In a normal mode, all of the atoms oscillate at the same frequency.

1-d chain of atoms with two different masses



$$M_1 \frac{d^2 u_l}{dt^2} = C(v_{l-1} - 2u_l + v_l)$$

$$M_2 \frac{d^2 v_l}{dt^2} = C(u_l - 2v_l + u_{l+1})$$