Quantum Confinement

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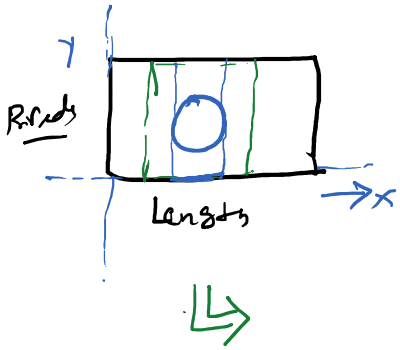
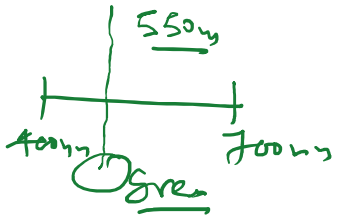
Very Crude analogy



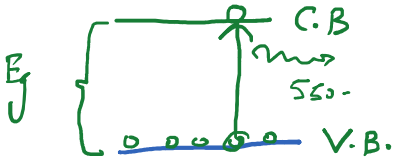
Ball can move in x as well as in y direction

$\boxed{Dof = 2}$

$\boxed{L = 2r}$



Statement – If you are decreasing the size of nanoparticles then Energy gap increases $\leftrightarrow$ (Semiconductor)



Valence Electrons

$\Rightarrow E = h\nu \Rightarrow \nu = E/h$

$E_g = 2.6\,eV$

$\lambda = 550\,nm$

Quantum Confinement

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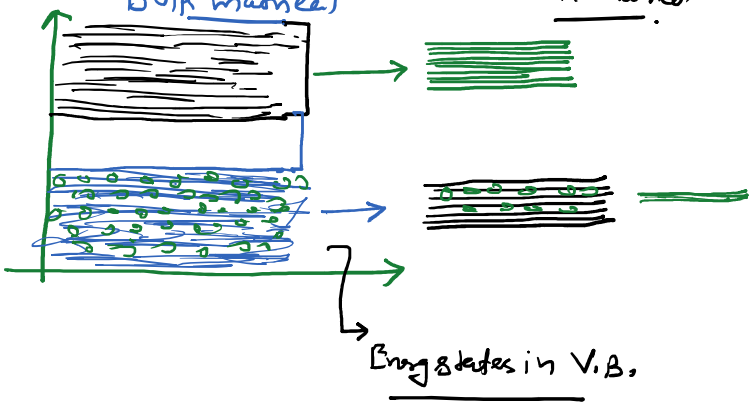
Nano material — No. of atoms — 10 – 10^6 atoms

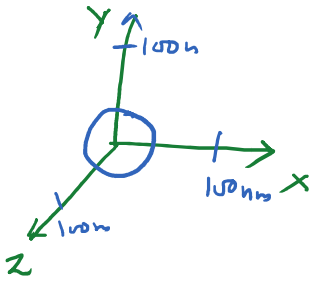
Bulk material — Nano material — Greater 10^6 atoms — Bulk Material



In case of bulk material they have huge no. of atoms compared to the atoms in nano material.

Energy states in V.B.

Quantum Dot:— $Df = 0$ & $Dc = 3$



All dimensions are in the nano-range or Under 100nm.

(i) QDs were discovered by Alexy Ekimov in 1981.

(ii) Usually, size of the QDs lie in between 2 to 10nm

(iii) QDs falls in between bulk semiconductor and atoms. That is why they show intermediate properties

(iv) Energy gap $\propto \frac{1}{\text{Size QD}}$

(v) QDs gives better Contrast with Electron microscope

(vi) QD Emitts the wavelength which is falling between UV & IR

Nano Wires:—
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Length Can vary from 100nm to tens of microns.

Nanowire is a nanostructure having the diameter of the order of a nanometer.

$$\text{Ratio} = \frac{\text{Length}}{\text{Width}} = 1000$$

Length = 1000 × width

Width — Nano-Range
Length ≠ Nano-Range
↳ 1-D.

NP — Find the maximum Energy of photoelectrons, the work function and threshold frequency, if the potassium surface is illuminated by a light of wavelength 5893 A°. The stopping Potential for the Emitted e⁻ is 0.36eV.

Kinetic Energy of e's

$$E_K = eV = h\nu - \phi_0$$

$$\Rightarrow E_K = 0.36\,eV$$

$$\phi_0 = h\nu - E_K = h\nu - eV = \frac{hc}{\lambda} - eV$$

$$\phi_0 = 2.11 - 0.36 = 1.75\,eV$$

↳ $\phi_0 = h\nu_0 \Rightarrow \nu_0 = \frac{\phi_0}{h} = 4.23 \times 10^{14}$ Cycles/sec