08-12-23

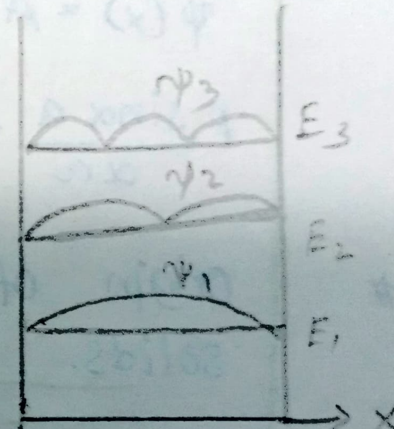
Bloch's Theorem

Day 63

- Mathematical statement of election function moving in a periodical potential.

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(E-v)\psi_x = 0 \rightarrow (1)$$

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}E\psi_x = 0$$



$v(x) = v(x+a) \rightarrow (2)$ # theorem

Where, a - Periodicity of Potential

$$\psi(x) = e^{ikx} u_k(x)$$

$$\therefore k = \frac{2m}{\hbar^2}(E-v)$$

$\psi(x+a) = e^{ik(x+a)} \, U_k(x+a) \rightarrow ③$ # Function

$\psi(x+a) = e^{ikx} \cdot e^{ikx} \cdot u_k(x+a)$

$\psi(x+a) = \psi(x) \cdot e^{ika} \rightarrow ④$ # Proof

$\psi(x+a) = \psi(x) \rightarrow ⑤$

Depends on → direction, Periodical

Behaviour of an electron in a periodic potential - The Kronig Penney model (Qualitative Treatment)

$$\frac{d^2\psi(x)}{dx^2} + \frac{2m}{\hbar^2}(E-V)\psi(x) = 0 \rightarrow ①$$

$$\frac{d^2\psi(x)}{dx^2} + \frac{2m}{\hbar^2} E \, \psi(x) = 0 \qquad \therefore V = 0$$

$$\frac{d^2\psi}{dx^2} + \alpha^2 \psi(x) = 0 \rightarrow ② \qquad \therefore \frac{2m}{\hbar^2} E = \alpha^2$$

$$\frac{d^2\psi}{dx^2} + \frac{2m}{\hbar^2}(V-E)\psi(x) = 0 \qquad \therefore V > E$$

$$\frac{d^2\psi}{dx^2} - \beta^2 \psi(x) = 0 \rightarrow ③ \qquad \frac{2m}{\hbar^2}(V-E) = \beta^2$$

$$\psi(x) = \psi(x+a)$$

$$\psi(x) = A \sin kx + B \cos kx$$

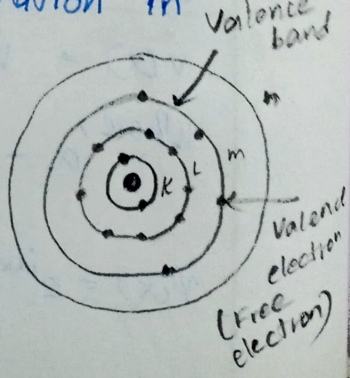
$$P \frac{\sin \alpha a}{\alpha a} + \cos \alpha a = \cos ka \qquad \therefore P = \frac{m V_0 b a}{h^2}$$

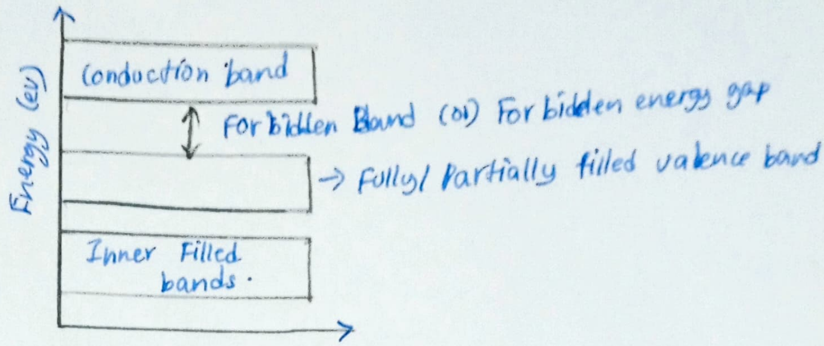
Origin of energy bond Formation in solids.

①	②
3p²	3p²
3s²	3s²
2p⁶	2p⁶
2s²	2s²
1s²	1s²

Si ① ② ... ⓝ

A = 14




Energy (ev)
Conduction band
Forbidden Band (or) Forbidden energy gap
Fully/Partially filled valence band
Inner Filled bands.