Day - 13

→ Silicon Solar Photovoltaic cell:

Device that converts light energy to electrical energy. It is made of several materials.

light absorber ⟶ Single crystalline Silicon

⟵ ⟶

electron - hole pair

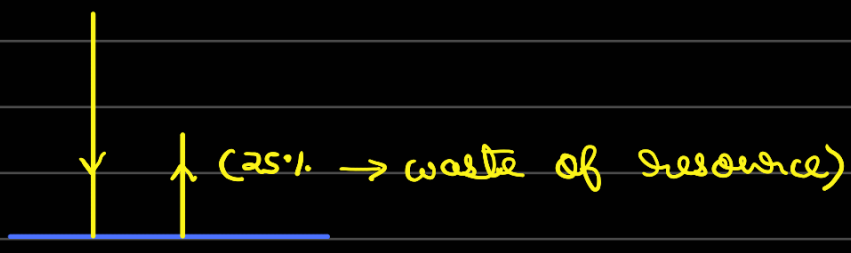
(Seperates automatically)

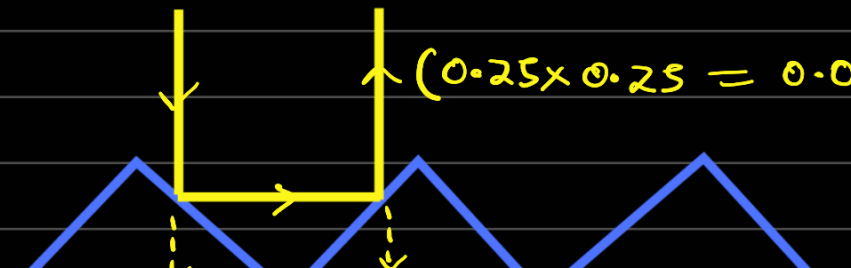
electron- selective
hole- selective

metallically conducting layer
metals are opaque

Generate Power from Sunlight

Serrations are real and they are purposely made in the device as they have reflectance

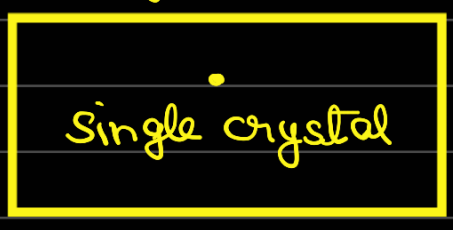




Transmitted

Texturization of Silicon (Light trapping structure)

→ Single crystal



OR

(001) ∥ $\hat{i}$, $\hat{j}$

[1$\bar{1}$0] ∥ $\hat{j}$

made very carefully (12" squared)

Flat single crystal ⟶ etching treatment

(linear density)

↓

produces those pyramidal structures (square pyramid – base plane is (001))

Triangle planes → close to (111)

→ Problem:

CF; a = 5.43 Å

Atoms : Si at (0,0,0), (1/4, 1/4, 1/4)

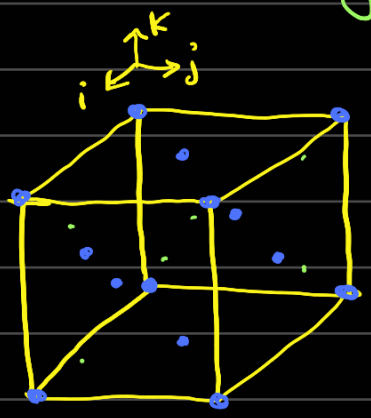
a.) 2D proj. ⊥ to (001)*

b) l.d along [001], [110], [111]

c.) ∠ between planes binding pyramids

d.) calculate density ($Si \rightarrow 28.085\ g\ mol^{-1}$)

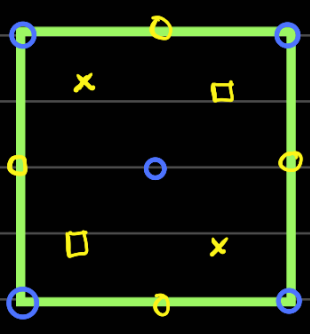
Ans.) a.)



(0,0,0)
(1,0,0)
(0,1,0)
(0,0,1)
(0,1,1)
(1,1,0)
(1,0,1)
(1,1,1)

(½, ½, 0) , (0, ½, ½) , (½, 0, ½)

(+ each vertex)



b.) [001] → $ld = \frac{\frac{1}{2} \times 2}{a} = \frac{1}{a}$

[110] → $ld = \frac{\frac{1}{2} \times 2 + 1}{\sqrt{2}a} = \frac{\sqrt{2}}{a}$

[111] → $ld = \frac{\frac{1}{2} \times 2 + 3}{\sqrt{3}a} = \frac{4}{\sqrt{3}a}$

c.) {1, 1, 1}

↳ This has to be +ve 1

Basically $(h\ h\ 1)$ where $h = 1$

$(h\ \bar{h}\ 1)$

(1 1 1) ($\bar{1}$ 1 1) (1 $\bar{1}$ 1) ($\bar{1}$ $\bar{1}$ 1)

A B C D

Angle: $= \cos^{-1} \frac{1}{3}$

d.) m.w. (unit cell) $= \left(8 \times \frac{1}{8} + 6 \times \frac{1}{2} + 4\right) \times \frac{28.18}{N_A}$

$= \frac{8 \times 28.18}{6.022 \times 10^{23}}$

→ Solid Oxide Fuel cell (SOFC) → High T (800°C)

→ Polymer electrolyte membrane Fuel cell (PEMFC) → 100 - 150°C

Conducts oxygen ions

Conducts protons OR H^+

Very good ionic conductor (of O^{2-} ions)

Extremely poor electronic conductor (circuit mustn't short)

Oxide material

high bandgap 'insulator'

Based on ZrO_2 (3 atom motif on cubic cell)

Perovskite (5 atom motif on cubic cell)