Day - 19

→ Description of perfect crystals
↓
Characterization of a material — XRD

Starting point → Real crystals
↓
Perfect crystals + Defects introduced in them

→ Dimensionality :

- Higher dimensional defects (HD Defects)
- 1-D defect
- 0-D defect

HD defects:
2D : surface
3D : void/pore
↓
crack propagation
↓
stress concentration at a void.

1-D defect → line defect
↓
dislocations
↓
Plastic deformation in materials

0-D defect → point defect
↓
aberration in the crystal structure at a location
↓
vacancies, interstitials, e^-/h^+
↳ electronic devices

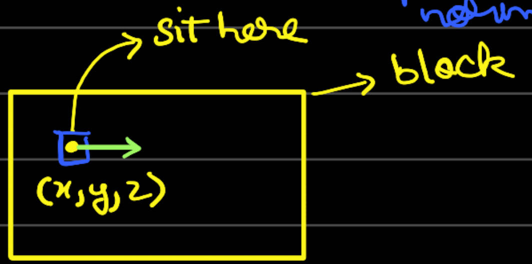
order of size of defect $\geq$ 1 mm/μm → higher dimensional

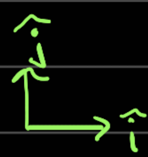
1 nm/μm → 1D defect

- Point defects
  - → ionic
  - → electronic

- HD defects → interfaces
  - → material and the ambient
    - broken bonds (at the surface)
  - → internal interfaces
    - → grain boundary → boundary region between 2 grains → ?
    - → hetero-interface

(what is the plane normal?) → assume (hkl)





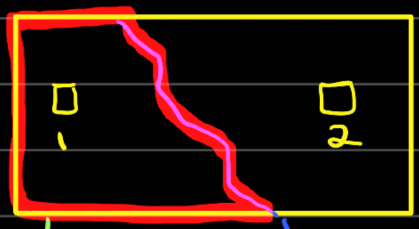
irrespective of (x,y,z)
if O.R. is satisfied,
we get single crystal → orientation relationship (O.R.)

$$\begin{cases} (hkl) \parallel (xy \text{ plane}) \\ [uvw] \parallel \hat{i} \end{cases}$$

$$hu + kv + lw = 0$$

Let at location 1,

$(h_1 k_1 l_1) \parallel \hat{k}$, $[u_1 v_1 w_1] \parallel \hat{i}$



At location 2,
$(h_2 k_2 l_2) \parallel \hat{k}$
$[u_2 v_2 w_2] \parallel \hat{i}$

grain

O.R. changes at this boundary
(hinders e^- transfer)

This is a polycrystalline material.

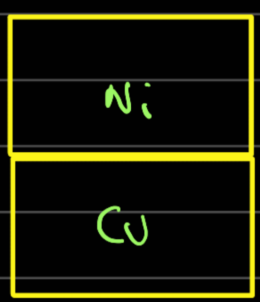
It has a single O.R.

When there is a unique $(h\,k\,l) \parallel \hat{k}$
but $[u\,v\,w]$ can be different,
we call the material textured.

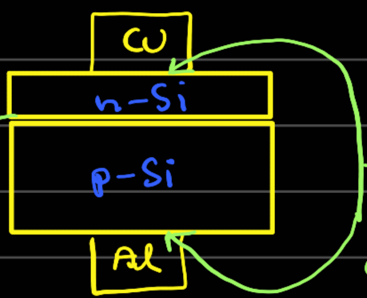
→ Hetero-interface :

Between 2 different materials
↓
Device

(eg: Bimetallic Barring)



p-n junc^n diode



homo-junction

Ohmic contact

→ insulating materials

↓

Perovskite

↓

$$\underbrace{LaAlO_3 \ , \ SrTiO_3}_{\text{Insulators}}$$

Tapping the surface → became metallic

metal → 2D electron 'gas'

collection of e^- in metal is modelled as ideal gas (3D e^- gas)