Class : 12th Chemistry
Chapter-1 : The Solid State (Part_1)

Primitive: Particles only on the corner position

Cubic : (NaCl, Cu) $a=b=c$; primitive, *bc*, *fc*; $\alpha=\beta=\gamma=90°$
Tetragonal : (SnO_2, TiO_2) $a=b\neq c$; $\alpha=\beta=\gamma=90°$; primitive, bc
Orthorhombic : → (KNO_3, $BaSO_4$) $a\neq b\neq c$; $\alpha=\beta=\gamma=90°$; primitive, *bc*, *fc*,
Hexagonal : → (ZnO, CdS) $a=b\neq c$; $\alpha=\beta=90°$ $y=120°$; primitive
Rhombohedral or Trigonal : ($CaCO_3$, HgS) $a=b=c$; $\alpha=\beta=\gamma\neq90°$;primitive
Monoclinic : (Monoclinic sulphur, $Na_2SO_4.10H_2O$) $\alpha=\gamma=90°$ $\beta\neq90°$; primitive, ec
Triclinic : ($K_2Cr_2O_7$, H_3BO_3) $\alpha\neq b\neq c$; $\alpha\neq\beta\neq\gamma\neq90°$; primitive

Centred
- **Body centred:** One particle at its body centre and at its corn.
- **Face centred:** One particle at centre of each face and at its corner.
- **End centred:** One particle at centre of any two opposite faces and at its corner.

Metal Excess: Due to anionic vacancies (LiCl) and presence of extra cations (ZnO)

Smallest Unit

Unit Cell

$$\text{Density} = \frac{zM}{a^3NA}$$

The Solid State

Crystal Lattice

Metal Deficiency: Metal shows variable vacancy vacancy (Fe^{2+}, Fe^{3+})

Non Stoichiometric : disturb Stoichiometry

Electrical Properties

Imperfections

Line defects: in entire row

Point defects: At a Point

Conductors
(Cu, Al) ← Overlapping /very small gap between conduction and valence band

Insulators
(Polyethylene, clay) ← Small energy gap between conduction and valence band

Stoichiometric do not : disturb Stoichiometry

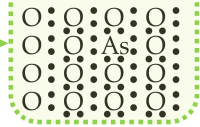
Vacancy: Lattice sites vacant (non-ionic solids)

Interstitial: Particles occupy interstitial site (non -ionic solids)

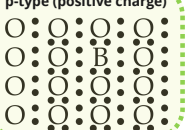
Semiconductors

(Si, Ge) ← Very large gap between conduction and valence band

n-type (negative charge)



p-type (positive charge)



Magnetic Properties
- **Paramagnetic:** weakly attracted → Unpaired electrons → (O_2, Cu^{2+})
- **Diamagnetic:** weakly repelled → Paired electrons → (H_2O, NaCl)
- **Ferromagnetic:** strongly attracted → domains in same direction → (Fe, Co)
- **Antiferromagnetic:** domain opposite and equal → (MnO)
- **Ferromagnetic:** domains unequal → (Fe_3O_4, $MgFe_2O_4$)

Packing Efficiency
- scp → AAA....type → 52.4% → (Po)
- hcp → ABABAB.....type → 74% → (Mg Zn)
- ccp/ fjcc → ABCABC....type → 74% → (Cu, Ag)
- bcc → square close → 68% → (Li, Na

Amorphous solids:
Particles with irregular shape

The Solid State

Voids: Empty space between spheres

Trigonal
Three spheres in contact → 0.155 – 0.225

Tetrahedral
Four spheres at the vertices of tetrahedron → 0.225 – 0.414

Octahedral
Six spheres at vertices of octahedron → 0.414 – 0.732

Crystalline Solids: Large Number of small crystal with definite shape

Metallic solids
Metal atoms held by metallic bond → (Fe, Cu)

Molecular solids
Molecules held by intermolecular forces

Polar
Molecules held by dipole-dipole interactions → (HCl, SO_2)

Non-Polar
Atoms /molecules held by weak dispersion forces /London forces → (Ar, He)

Hydrogen bonded
Molecules held by hydrogen bonding → (H_2O(ice))

Ionic solids
Ilons held by strong coulombic forces → (NaCl, MgO)

Covalent solids
Non-metals held by covalent bond → (SiC, C)