## Intermolecular Forces

### Molecular Solids

**Molecules held by intermolecular forces**

#### Non-Polar

Atoms/ molecules held by weak dispersion forces/ London forces (Ar, He)

#### Polar

Molecules held by dipole-dipole interaction ⟶ (HCl, $SO_2$)

#### Hydrogen Bonded

Molecules held by hydrogen bonding ⟶ ($H_2O$(ice))

### Ionic Solids

Ions held by strong coulombic forces ⟶ (NaCl, Mg )

### Covalent Solids

Non-metals held by covalent bond ⟶ (SiC, C)

### Metalllic Solids

Metal atoms held by metallic bond ⟶ (Fe, C)

## Electric Properties

#### Conductors

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

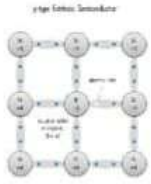
#### Insulators

(Polyethylene, day) ⟶ Small energy gap between conduction and valence band

#### Semi-Conductors

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

**p-type (positive charge)**



**n-type (negative charge)**

## Magentic Properties

**Paramagnetic:** Weakly attrated ⟶ Unpaired electrons ⟶ ($O_2$, $Cu^{2+}$)
**Diamagentic:** Weakly repelled ⟶ Paired electrons ⟶ ($H_2O$, NaCl)
**Feromagnetic:** Strongly attracted ⟶ domains in same direction ⟶ (fe, Co)
**Antiferromagnetic:** Domain opposite and equal ⟶ (MnO)
**Ferromagnetic:** Domains unequal ⟶ ($Fe_3O_4$, $MgFe_2O_4$

## Crystalline Lattice

#### Primitive: Particles only on the Corner Position

**Cubic:** (NaCl, Cu) a=b=c; primitive, bc, fc; α=β=γ= 90°
**Tetragonal:** ($SnO_2$, T $iO_2$) a=b ≠ c; α=β=γ= 90°; primitive, bc
**Orthorhombic:** ($KNO_3$, $BaSO_4$) a ≠ b ≠ c ; α=β=γ= 90°; primitive, bc, fc,
**Hexagonal:** (ZnO, CdS) a=b ≠ c; α=β= 90° y =120°; primitive
**Rhombohedral or Trigonal:** ($CaCO_3$, HgS) a=b=c; α=β=γ≠90°; primitive
**Monoclinic** : (Monoclinic sulphur, $Na_2SO_4.10H_2O$) α=γ= 90° β ≠90°;primitive, etc
**Triclinic** : ($K_2Cr_2O_7$, $H_3BO_3$) a ≠ b ≠ c; α≠β≠γ ; primitive

#### Centered

**Body centred:** One particle at its body centre and at its corner.
**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.

## Voids

**Empty space between the Spheres**

#### Trigonal

Three spheres in contact 0.155 - 0.225

#### Tetrahedral

Four spheres at vertices of tetrahedron 0.225 - 0.414

#### Octahedral

Six spheres at vertices of octahedron 0.414 - 0.732

## Imperfections

#### Point Defects

### Stoichiometric: Do not disturb Stoichiometry

**Vacancy:** lattice sited vacant (non-ionic solids)

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

#### Line Defects

### Non-Stoichiometric: Disturb Stoichiometry

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

**Metal Dificiency:** Metals shows variable vacancy (Fe2+, Fe3+)

### Impurity: Foreign elements are present

**Frenkel:** Smaller ion dislocated to interstitial site (ZnS, AgCl)
**Schuttky:** Equal number of Ions missing (NaCl. KCl)