

	Simple Cubic Unit Cell (S.C.C.)	Body Centered Cubic Unit Cell (B.C.C.)	Face Centered Cubic Unit Cell (F.C.C.)	Hexagonal Closed Packed Unit Cell (H.C.P.)
Lattice Points	Corners	Corners + Body Center	Corners + All Face Center	Corners + Face Centers + 3 atoms in middle layers
Effective Number of atoms (Z)	$(8 \times \frac{1}{8}) = 1$	$(8 \times \frac{1}{8} + 1) = 2$	$(8 \times \frac{1}{8} + 6 \times \frac{1}{2}) = 3$	$(12 \times \frac{1}{6} + 2 \times \frac{1}{2} + 3) = 6$
Packing Efficiency (PE)	52%	68%	74%	74%
Coordination No.	6	8	12	12

DENSITY

$$d = \frac{Z \times M}{N_A \times a^3}$$

COORDINATION NO. (C.N.)

It is no. of nearest neighbours of a lattice point

PACKING EFFICIENCY (P.E.)

$$PE = \frac{\pi r^3}{a^3} \times 100$$

STRUCTURE OF VARIOUS IONIC CRYSTALS

Crystal Structure	Lattice Points	C.N.	Number of Formula Units per Unit cell	Eg
Rock Salt NaCl type	Cl ⁻ -CCP Na ⁺ -OV	6:6	4	LiCl, KCl RbCl, AgCl
Zinc-Blende ZnS type	S ²⁻ -CCP Zn ²⁺ -Alternate TV	4:4	4	ZnS, Bes, CuCl, CuI
CSCl type (BCC type)	Cl ⁻ -Corners Cs ⁺ -Body centre	8:8	1	CSBr, CsI, CSCN
Fluorite type (CaF ₂)	Ca ²⁺ -CCP F-all TV	8:4	4	CaF ₂ , BaF ₂ , SrCl ₂
Anti-Fluorite type (Na ₂ O)	O ²⁻ -CCP Li ⁺ -all TV	4:8	4	K ₂ O, Li ₂ O, K ₂ S

CRYSTALLINE	AMORPHOUS
Have a long range order of particles	Do not have ordered structure or have a very short order
Anisotropic	Isotropic
True Solids	Pseudo Solids
Sharp melting point	Diffused melting point
NaCl, Quartz, ZNS	Glass, Rubber, etc.
Molecular	Covalent/Network
Ionic Solid	Metallic Solids

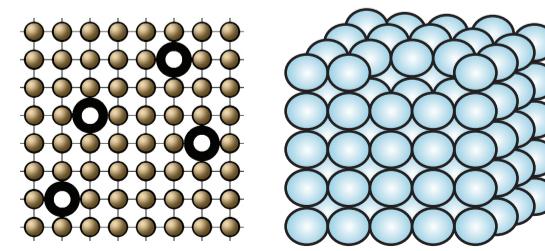
CRYSTAL LATTICE / SPACE LATTICE

A regular 3-D arrangement of constituent particles.

UNIT CELL
Smallest repeating unit which repeats itself over and over again to generate entire crystal

TYPES OF CRYSTAL LATTICE/ 14 Bravais Lattices

Cubic	$a = b = c$	$\alpha = \beta = \gamma = 90^\circ$
Tetragonal	$a = b \neq c$	$\alpha = \beta = \gamma = 90^\circ$
Orthorhombic	$a \neq b \neq c$	$\alpha = \beta = \gamma = 90^\circ$
Monoclinic	$a \neq b \neq c$	$\alpha = \gamma = \beta \neq 90^\circ$
Hexagonal	$a = b \neq c$	$\alpha = \beta = 90^\circ \gamma = 120^\circ$
Rhombohedral	$a = b = c$	$\alpha = \beta = \gamma \neq 90^\circ$
Triclinic	$a \neq b \neq c$	$\alpha \neq \beta \neq \gamma \neq 90^\circ$



DEFECTS IN CRYSTALS

STOICHIOMETRIC DEFECTS

IN NON-IONIC SOLIDS

Vacancy Defects

- Some of the lattice sites are vacant
- Decrease in density

Interstitial Defects

- Some particles occupy an interstitial site
- Increase in density

IN IONIC SOLIDS

Schottky Defects

- Equal no. of cations and anions are missing
- Decrease in density

Frenkel Defects

- Smaller ion is dislocated from its normal site to an interstitial site
- No change in density

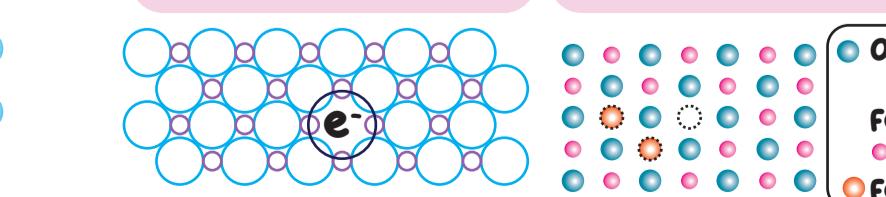
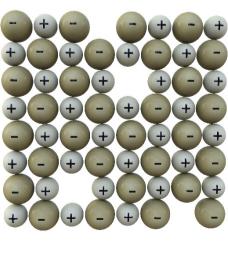
NON STOICHIOMETRIC DEFECT

Metal excess Defect

- It may arise either due to anionic vacancies or due to presence of extra cations at interstitial sites
- Generate F-centres which are responsible for colour in crystal

Metal deficiency Defects

- Occurs due to cationic vacancy and presence of a cation having higher charge
- Appearance in oxides of d-block metals



MAGNETIC & ELECTRICAL PROPERTIES

MAGNETIC PROPERTIES

- Paramagnetic - weakly attracted by magnetic field. e.g. O₂, Cu²⁺ etc.
- Diamagnetic - weakly repelled by magnetic field. H₂O, NaCl, etc.
- Ferromagnetic - permanent magnetism even in absence of magnetic fields e.g. Fe, Ni, Co, CrO₂, etc.
- Ferrimagnetic - Magnetic moment is smaller than that of ferromagnetic substances. e.g.
- Antiferromagnetic - Zero magnetic moment due to equal no. of anti-parallel e.g. MnO, etc.

ELECTRICAL PROPERTIES

- Conductors - Valence bond is partially filled or it overlaps with higher energy unoccupied conduction band.
- Insulators - Large energy gap between valence and conduction band.
- Semi-conductors - Small energy gap between valence and conduction band.
- P-type Semiconductor (by doping e⁻ deficient impurities)
- N-type Semiconductor (by doping e⁻ rich impurities)