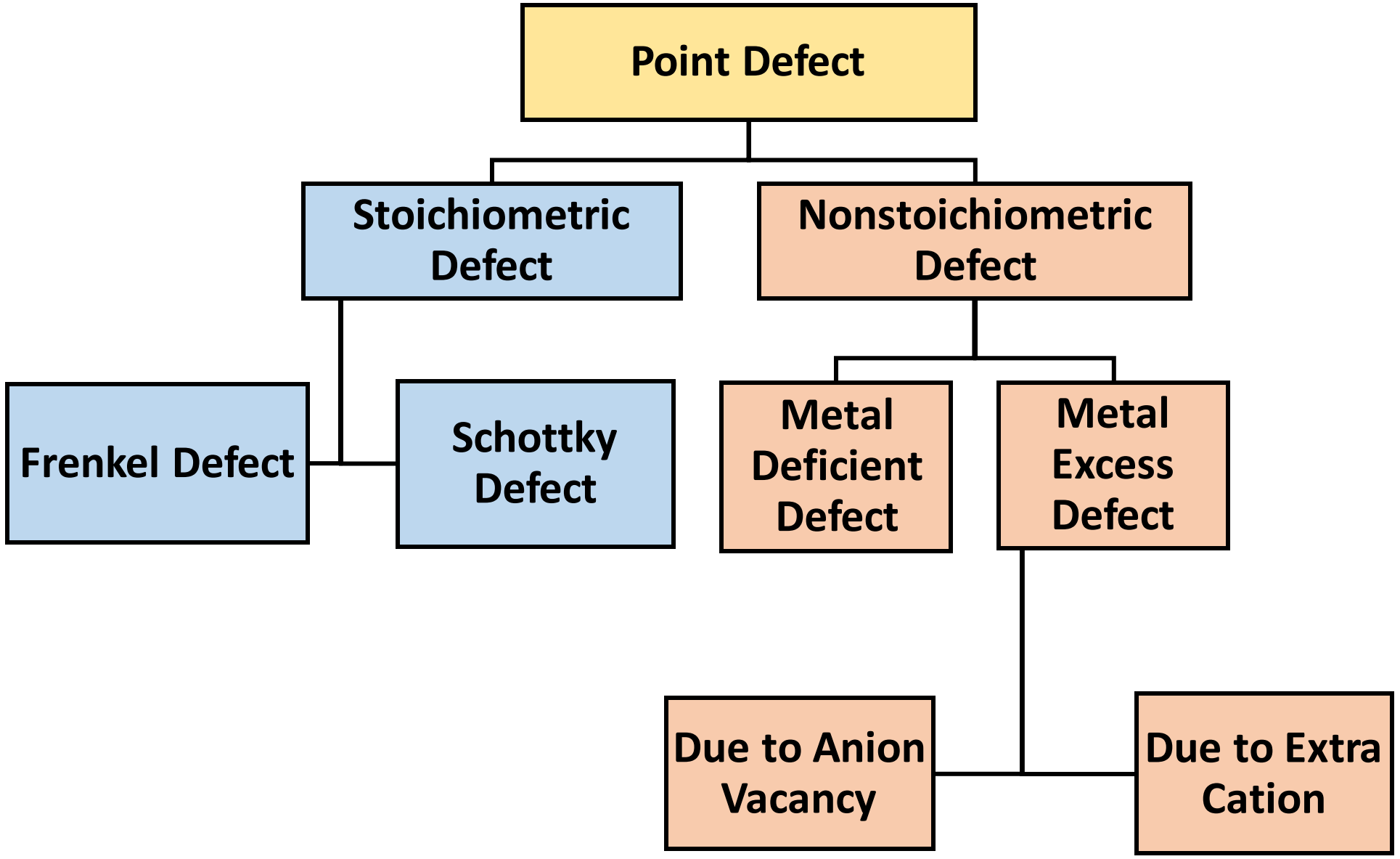
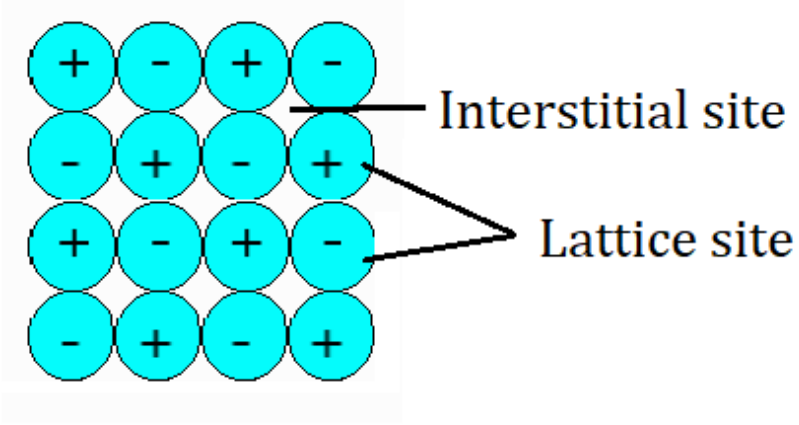
Imperfection in Crystal
or
Crystal Defect


Point Defect
Stoichiometric Defect
Nonstoichiometric Defect
Frenkel Defect
Schottky Defect
Metal Deficient Defect
Metal Excess Defect
Due to Anion Vacancy
Due to Extra Cation



stal has a well ordered arrangement of atoms or ions line, or planar defects. There are a wide variety of crystallographic defects .

A perfect crystal structure is possible at absolute zero (-273^{o}C). As the temperature increases, defect in crystal structure arises.

Point Defects

- These defects mainly happen due to deviation in the arrangement of constituting particles.
- In a crystalline solid, when the ideal arrangement of solids is distorted around a point or atom, it is called a point defect.

There are 2 types of point defects:

1. Stoichiometric defect
2. Non Stoichiometric defect

Stoichiometric Defect:

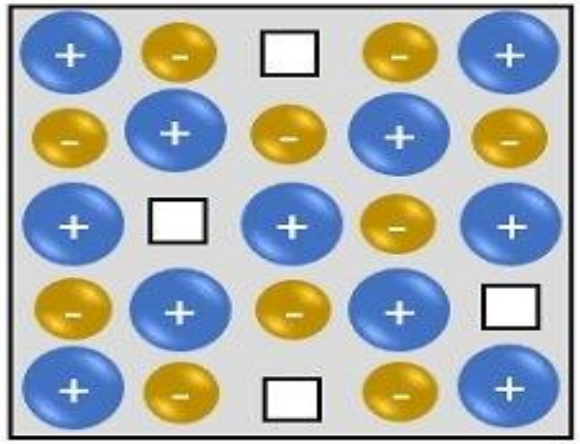
In this kind of point defect, the ratio of positive and negative ions (Stoichiometric) and electrical neutrality of a solid is not disturbed. Sometimes it is also known as intrinsic or thermodynamic defects.

Fundamentally, they are of two types:

Vacancy defect: When an atom is not present at their lattice sites, then that lattice site is vacant and it creates a vacancy defect. Due to this, the density of a substance decreases. (Schottky Defect)

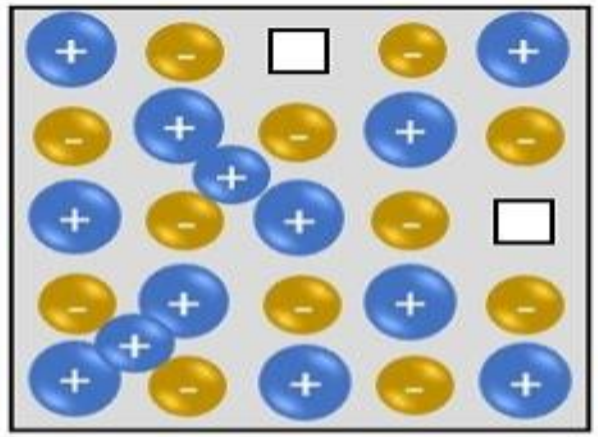
Interstitial defect: It is a defect in which an atom or molecule occupies the intermolecular spaces (Interstitial site)in a crystals. In this defect, the density of the substance remains same. (Frenkel Defect)

Schottky Defect



1. This kind of vacancy defects is found in Ionic Solids. An equal number of anions and cations will be missing from the compound.
2. Electrical neutrality is maintained.
3. It reduces the density of the substance.
4. In this, the size of cations and anions are of almost the same.
5. Example: NaCl, KCl, CsCl etc.

Frenkel Defect

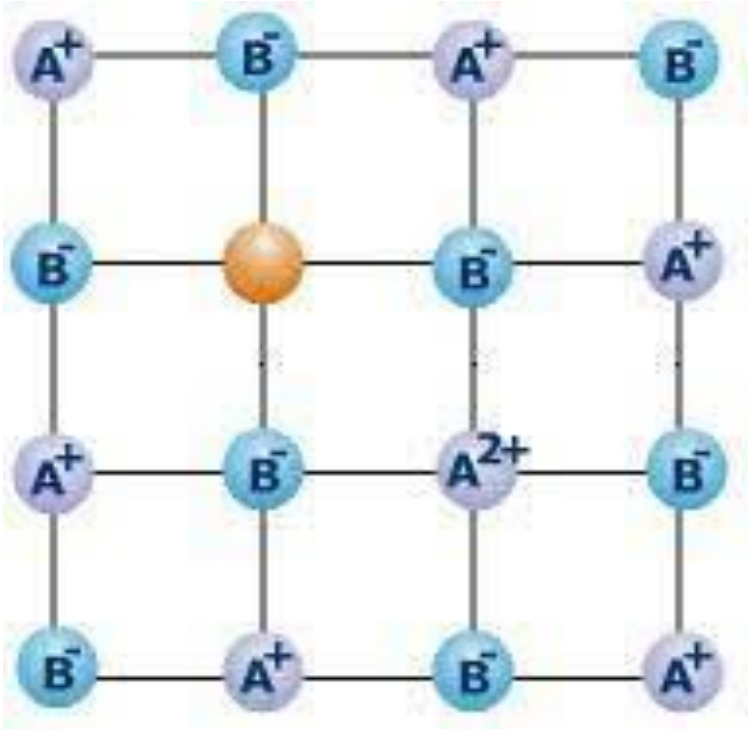


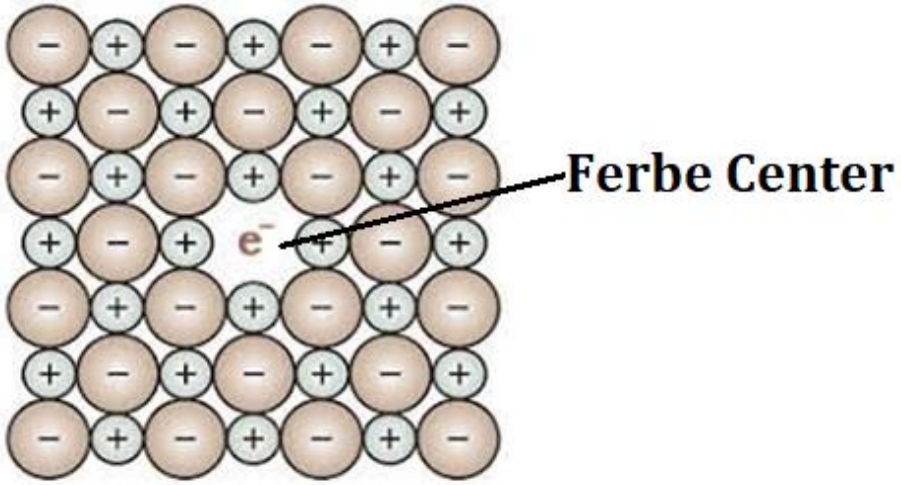
1. In ionic solids generally, the smaller ion (cation) moves out of its place and occupies an interstitial space.
2. It is also known as dislocation defect. Electrical neutrality is maintained.
3. The density of a substance remains unchanged.
4. It happens when there is a huge difference in the size of anions and cations.
5. Example: ZnS, AgBr, and AgCl etc.

Types of Non-Stoichiometric Defect:

1. Metal deficiency defect:

In this, the solids have less number of metals relative to the described Stoichiometric proportion. A cation is removed from the lattice and another cation of higher valency is introduced to maintain the electrical neutrality.





here are two types of metal excess defect:

lue to

f anions

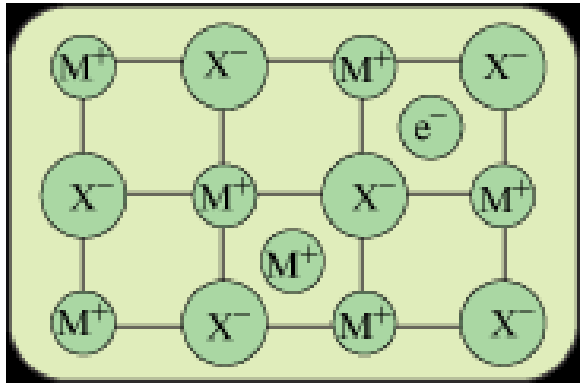
crystals. Therefore, instead of anions, electrons occupy their position, called as Ferbe center or colour center. Ex. KCl (Pink), NaCl (Yellow).

2. Metal excess defect due to the presence of extra cations at interstitial sites:

Here, on heating the compound, it releases extra cations. These cations

occupy the interstitial sites in crystals and the same number of electrons

goes to neighboring interstitial sites. This type of defect is exhibited by alkali halides like NaCl and KCl.



Thank You

Prof. S. K. Hasan
Institute of Technology & Management, GIDA, Gorakhpur
drskhasan@yahoo.com