

## Imperfections in Solids

Usually a crystalline solid consists of an aggregate of large number of small crystals. These small crystals have defects in them. This happens when crystallisation process occurs at fast or moderate rate. Single crystals are formed when the process of crystallisation occurs at extremely slow rate. Even these crystals are not free of defects.

The defects are of two types:

i) Point defects.

Point defects are the irregularities or deviations from ideal arrangement around a point or an atom in a crystalline substance.

ii) Line defects

Line defects are the irregularities or deviations from ideal arrangement in entire row of lattice points.

### Types of Point Defects

a) Stoichiometric defects

These are the point defects that do not disturb the stoichiometry of the solid. They are also called intrinsic or thermodynamic defects.

These are of two types, vacancy defects and interstitial defects.

i) Vacancy defects:

In this defect some of the lattice sites are vacant.

Thus density of the substance decreases. This defect can also develop when a substance is heated



### ii) Interstitial Defect:

In this defect some constituent particles (atoms or molecules) occupy an interstitial site. This increases the density of the substance.



Vacancy and interstitial defects can be shown by non-ionic solids. Ionic solids must always maintain electrical neutrality. Rather than simple vacancy or interstitial defects, they show these defects as Frenkel and Schottky defects

### iii) Frenkel Defect:

In ionic solids the smaller ion (usually cation) is dislocated from its normal site to an interstitial site. It creates a vacancy defect at its original site and an interstitial defect at its new location. It is also called dislocation defect. It does not change the

density of the solid. It is shown by ionic substances in which there is a large difference in the size of ions, for example:  $ZnS$ ,  $AgCl$ ,  $AgBr$  and  $AgI$  due to small size of  $Zn^{2+}$  and  $Ag^+$  ions.



Perfect crystal



Frenkel Defect

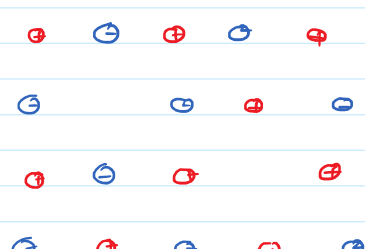
#### IV) Schottky defect

In ionic compounds anions and cations are missing from their lattice sites. Number of missing ions is such that charge neutrality is maintained. This is called Schottky defect. This is similar to vacancy defect. Schottky defect also decreases the density of the substance. Schottky defect is shown by ionic substances in which the cation and anion are of almost similar sizes. For example:  $NaCl$ ,  $KCl$ ,  $CsCl$  and  $AgBr$ .

It may be noted that  $AgBr$  shows both, Frenkel as well as Schottky defects.



Perfect crystal



Schottky defect