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Interstitial and Substitutional Defects

An interstitial defect is formed when an extra atom is inserted into the lattice structure at a site which is not a normal lattice point.

A substitutional defect is introduced when an atom is replaced by a different type of atom.

Both distort the surrounding lattice structure.

Imperfection Pairs

A Frenkel defect is a vacancy–interstitial pair defect formed when an ion jumps from a normal lattice point to an interstitial site, leaving behind a vacancy.

A schottky defect is a pair of vacancies in an ionically bonded material. In this case, both an anion and a cation must be missing from the lattice if electrical neutrality is to be preserved in the crystal.

EXAMPLE

Iron has a measured density of $7.87\ Mg/m^3$. The lattice parameter of BCC iron is $2.866\ A^0$. Calculate the percentage of vacancies in pure iron.

$$\text{Density } \rho = \frac{(\text{atoms/cell})(\text{atomic mass of each atom})}{(\text{Volume of unit cell})(\text{Avogadro number})}$$

$$= \frac{(\text{atoms/cell})(55.85\ g/g\cdot mole)}{(2.866\times10^{-8})^3(6.02\times10^{23})}$$

$$= 7.87\ Mg\,m^{-3}$$

$$\text{Atoms/cell} = \frac{(7.87)(2.866\times10^{-8})^3(6.02\times10^{23})}{55.85}$$

$$= 1.998$$

There should be 2 atoms/cell in a perfect BCC iron crystal. Thus, the difference must be due to the presence of vacancies.

$$\text{Vacancies} = \frac{2-1.998}{2}\times100 = 0.1\%$$

EXAMPLE

Line Defects

(a) Screw Dislocation
(b) Edge Dislocation

Skew
= More developed on one side than other
= slanting = deviation from straight line