

SOLID STATE

For
B.Sc Chemistry(Part-III)
Physical Chemistry
Paper-III
Lecture-03



Estd.- 1962

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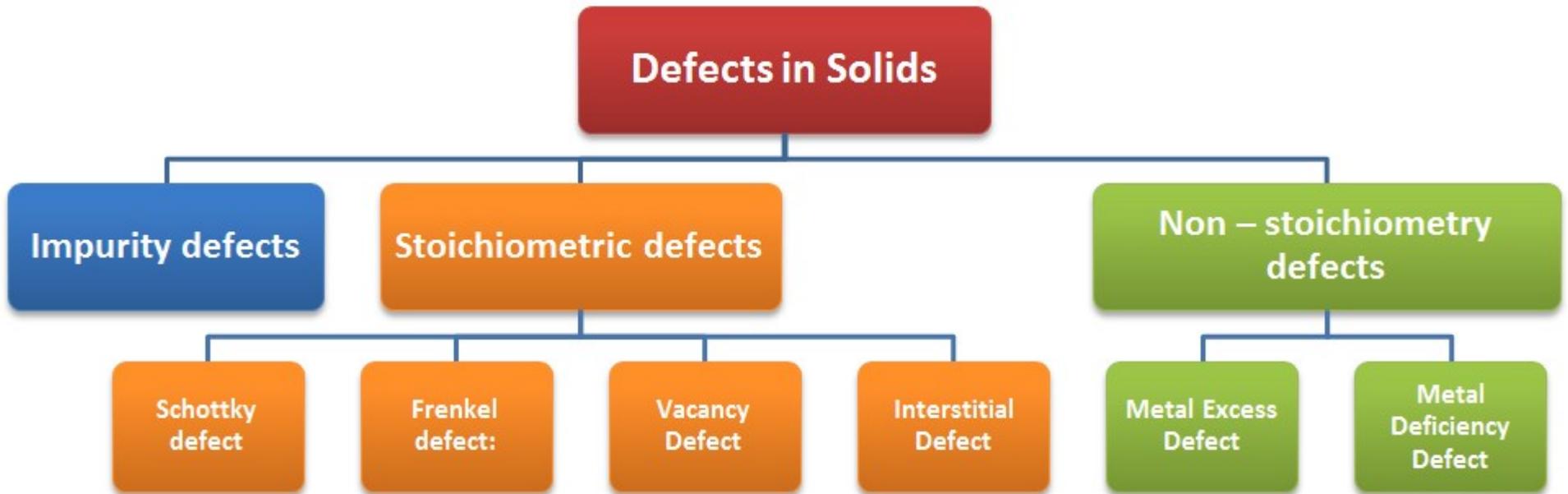
Stoichiometric defects in simple ionic solids

Non-stoichiometric defects in simple ionic solids

Elementary idea of X-ray diffraction techniques



Defects In Solids



STOICHIOMETRIC DEFECTS IN SIMPLE IONIC SOLIDS

Stoichiometric defects

Stoichiometric compounds :

- The **ratio of numbers of positive and negative ions** are called stoichiometric defects.
- The number of positive and negative ions are exactly in the ratios indicated by their chemical formulae .
- This defects do not disturb the stoichiometry of the compound
- Electrical neutrality of a solid is not disturbed
- Sometimes it is also known as intrinsic or thermodynamic **defects**.
- Density of the substance increases.

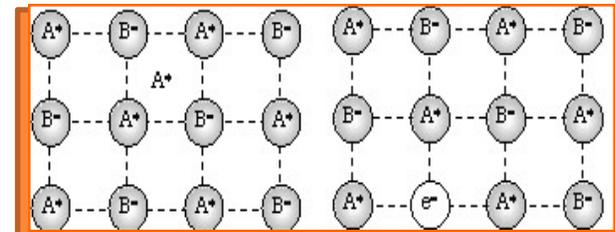
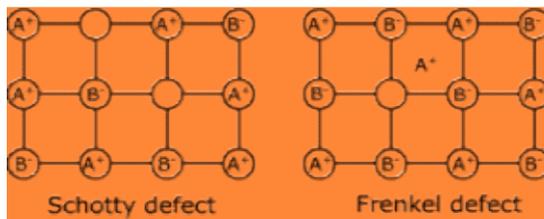
Difference

Stoichiometric defects

1. It do not disturb the stoichiometry of a compound
2. Several types of stoichiometric defects such as Schottky ,interstitial,Frenkel defects

Nonstoichiometric defects

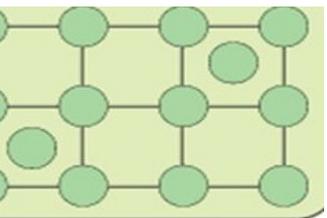
- It disturb the stoichiometry of a compound
- Several types of stoichiometric defects such as Metal excess defects, Metal deficiency defects



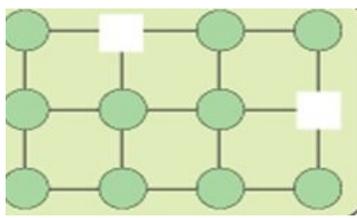
Metal excess defects, Metal deficiency defects

Stoichiometric Defects

Vacancy defect

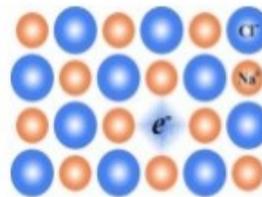


Interstitial defect



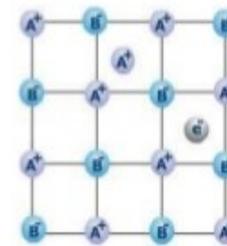
Non-Stoichiometric Defects

Anion vacancies

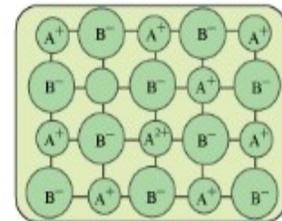


F-centre NaCl in Na vapor

Interstitial anion/ cation



Cation vacancies



Elementary idea of X-ray diffraction technique

Technique used in materials science for determining the atomic and molecular structure of a material.

This is done by irradiating a sample of the material with incident X-rays and then measuring the intensities and scattering angles of the X-rays that are scattered by the material.

X-ray powder diffraction (XRD) is a rapid analytical technique mainly used for phase identification of a crystalline material.



Elementary idea of X-ray diffraction techniques

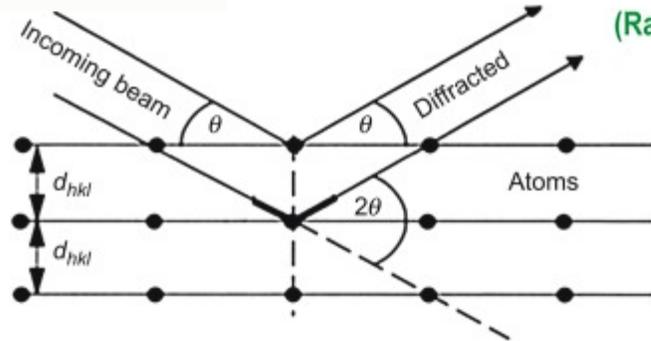
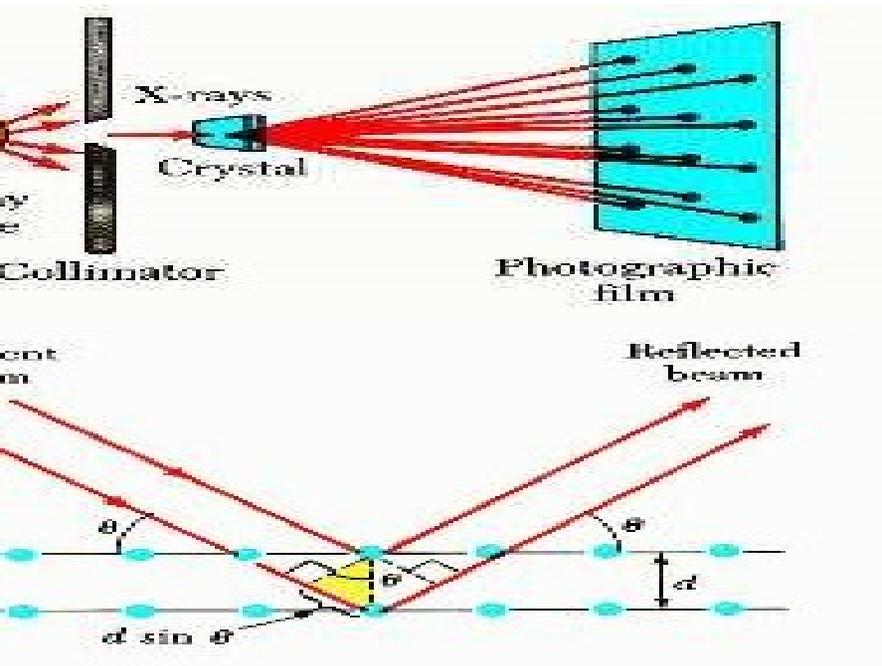
Fundamental Principles of X-ray Powder Diffraction (XRD)

X-ray diffraction is based on constructive interference of monochromatic **X-rays** a crystalline sample.

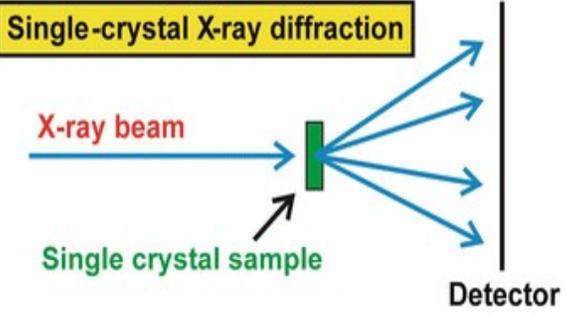
These X-rays are generated by a cathode ray tube, filtered to produce monochromatic radiation, collimated, concentrate, and directed toward the sample.

X-ray diffraction is a powerful nondestructive technique for characterizing crystalline materials. It provides information on structures, phases, preferred crystal orientations (texture), and other structural parameters such as average grain size, crystallinity, strain, and crystal defects.

X-ray diffraction techniques



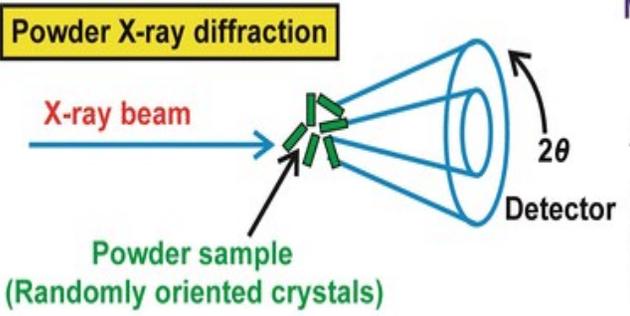
Single-crystal X-ray diffraction



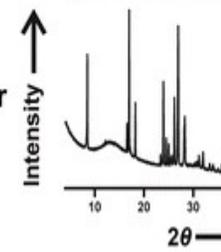
Measure 3-dimentional diffraction pattern



Powder X-ray diffraction



Measure 1-dimentional diffraction pattern (Peak overlap)



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problems for practice:

What is the difference between Schottky defect and Frenkel defect give an example?

What type of defect is shown by NaCl in stoichiometric defects and non stoichiometric defects?

Why AgBr shows both Schottky and Frenkel defect?

What is the principle of X ray diffraction?