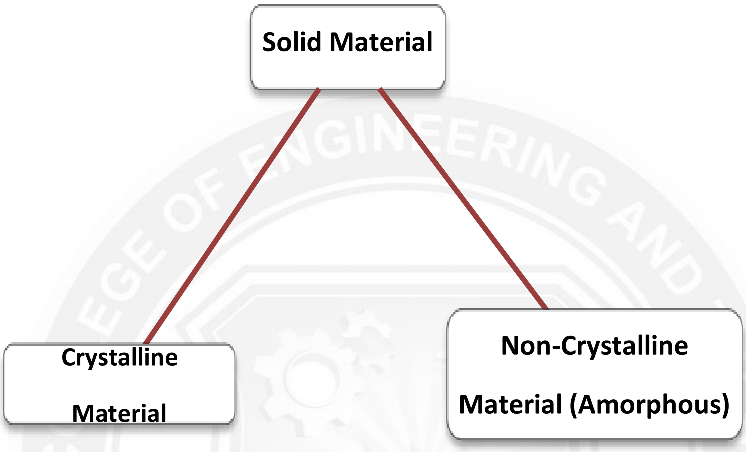
5.1 CRYSTAL PHYSICS

Introduction

Many of the properties of solid materials depend mainly on their crystal structures. Based on the arrangement of atoms and molecules, the solid material classified as follows



Crystalline Material

The periodic arrangement of atoms in all three dimensions space is called crystal. It has regular shape and when it is broken, all broken pieces have the same regular shape. It has sharp melting point. The physical properties of the crystal vary with direction and therefore they are called ***anisotropic*** substances. It may be made up of metallic crystals or non-metallic crystals.

Examples: Cu, Al, W, Mg, Carbon, crystalized polymer and plastics.

Non-Crystalline Material

Random arrangement of atoms in all three dimensions space is called non-crystalline material or amorphous. They have no directional properties and therefore they are called ***isotropic*** substances. They do not possess any regular shape and they have a wide range of melting points.

Examples: Glass and Rubber.

Fundamental Definitions

Space Lattice

A regular and periodic arrangement of infinite number of points in three dimensions space is known as space lattice. Every point in this arrangement is identical to that of every other point.

Fig: 5.1.1 Lattice

Basis (Motif)

A group of atoms in every lattice point is called basis or motif.

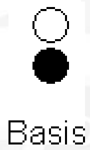


Fig: 5.1.2 - Basis

Crystal

A crystal is defined as regular and periodic arrangements of atoms or molecule in three dimensional spaces.

Crystal = Space lattice + Basis

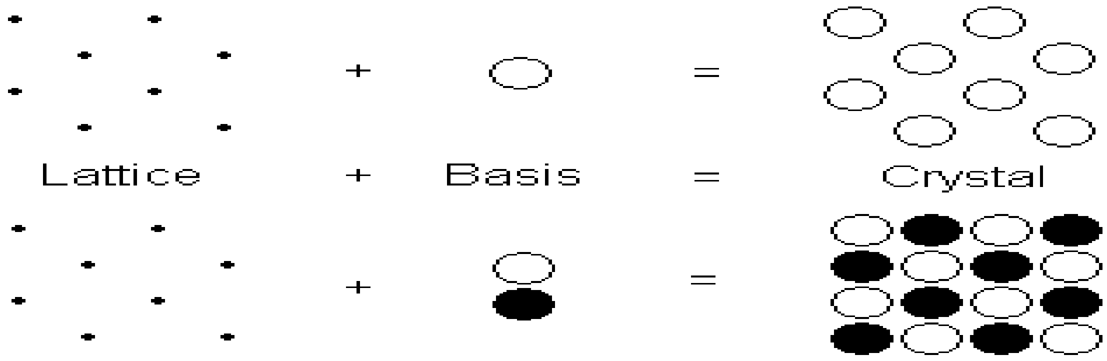


Fig: 5.1.3 – Crystal Structure

It can be classified into two types. They are,

1. Single Crystal
2. Polycrystalline Material

1. Single Crystal

The entire crystalline material consists of only one crystal is known as single crystal.

Example: KDP, ADP.

2. Polycrystalline Material

A collection of many small crystals are separated by well-defined boundaries is called polycrystalline materials.

Example: GaP, GaAs, ZnO and ZnS.

Fundamental translation vector

Mathematical representation of position vector in the space lattice is called fundamental translation vector.

In two dimension $R = n_1a + n_2b$

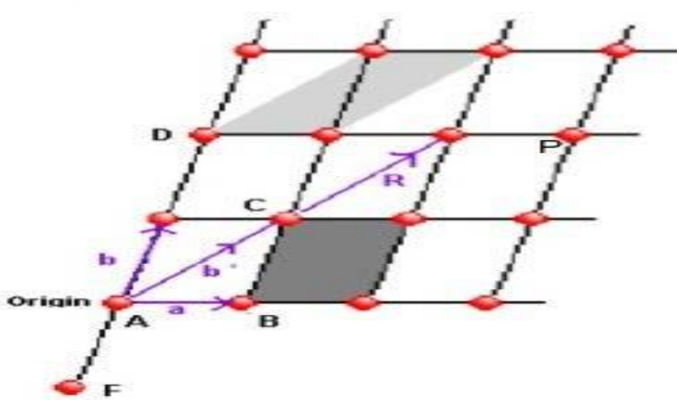


Fig: 5.1.4 –Lattice

In three dimension $R = n_1a + n_2b + n_3c$

Where, *a*, *b* and *c* are the fundamental translation vectors and n_1, n_2 and n_3 are the integers.

Interfacial angle

The angles between the three crystallographic axes are known as interfacial angles.

Generally it's are represented as α, β and γ respectively.

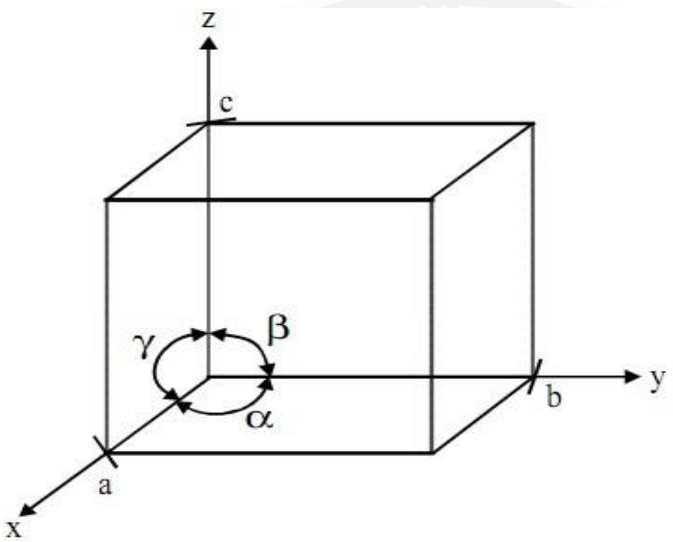


Fig :5.1.5- Interfacial angle *α, β and γ*