





UNIT - I  
Crystal Physics

Lattice - unit cell - Bravais lattice - lattice planes -  
Miller indices - d spacing in cubic lattice - calculation  
of no. of atoms per unit cell - Atomic radius - coordination  
number - Packing factor for SC, BCC, FCC & HCP structures  
- Diamond & graphite structure.

Introduction:  
Materials differ from one another in their  
properties. Some solids are brittle, are malleable,  
some are strong, some are weak, some are good  
conductors of heat & electricity, some are non-conductors  
of heat & electricity. Some are magnetic and so on.  
The difference in the properties of the solids are  
due to their structure.

Classification of solids:  
1. Crystalline Materials  
2. Non-crystalline materials (or) Amorphous

1. Crystalline Materials:  
The materials in which the atoms are arranged in  
a regular pattern are known as crystalline materials.  
It may be either a single crystal or poly crystal.  
In the single crystal, the entire solid consists of  
only one crystal.





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In poly-crystalline material, a collection of many small crystals are separated by well-defined boundaries.  
The crystalline solids are made up of either metallic crystals (eg. copper, silver etc), or non-metallic crystals (eg. carbon, silicon etc).

## Amorphous Materials:

The materials in which atoms are arranged in an irregular pattern are known as amorphous material.  
eg: glass, rubber etc.



## Crystal:

A crystal is a three-dimensional solid which consists of a periodic arrangement of atoms.

## Crystal Structure:

The arrangement of atoms in a crystal.

## Crystallography:

The branch of physics which deals with internal structure, properties, external or internal symmetries in a crystal is called as crystallography.

## Lattice:

The representation of atoms in the crystal as points in 3-dimensions is called space lattice or simply lattice.

## Defination:

Every point has identical surroundings to that of every other point in the array.



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Explanation:  
The collection of points in two dimensions as shown in fig.

Two-dimensional space lattice  
[The environment about any two pts is same]

Two-dimensional collection of pts but not a space lattice

Lattice points:  
The pts in a space lattice are called lattice pts.

Lattice lines:  
The lattice pts are joined with lines are called L. lines.

Lattice plane:  
A plane containing lattice pts.

Basis:  
The crystal structure is obtained by adding a unit assembly of atoms to each lattice point. This unit assembly is called as basis.

Space lattice + Basis  $\rightarrow$  Crystal structure.

For NaCl & KCl, each basis has two atoms.

Lattice planes

Lattice points  
Lattice lines





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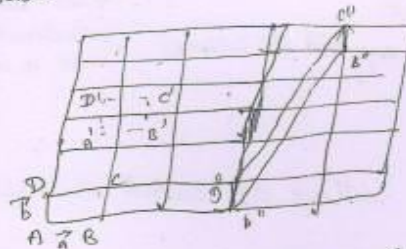
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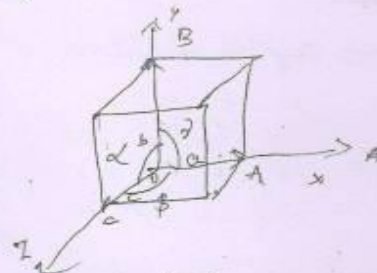
## UNIT CELL

It is defined as the smallest geometric figure which is repeated to derive the actual crystal structure. It represents the characteristics of the entire crystal.



## Lattice parameters of the unit cell:

- ⇒ The distance between two neighbouring lattice points is nothing but the edge of the unit cell.
- ⇒ The lengths  $OA, OB, OC$  in three axes  $Ox, Oy, Oz$  are the axial lengths or intercepts.



The axial lengths  $OA = a$ ,  $OB = b$ ,  $OC = c$  are known as intercepts  $a, b, c$  along three axis.

## Interfacial angles:

The angles b/w three intercepts  $(a, b, c)$  are called Interfacial angles.

The actual shape & size of the unit cell is determined by lattice parameters of the unit cell. [i.e. intercepts & interfacial angles].