Unit: Solid State

B.Sc-I

Paper-1

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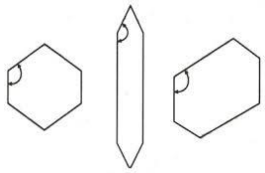
Laws of crystallography : The crystallography is based on the three fundamental laws which are as follows.

(i) ***The Law of constancy of the interfacial angles*** **:** Crystals are bound by plane faces. The angle between any two faces are called interfacial angle. This law states that interfacial angle of the crystal of the particular substance is always constant inspite of having different shapes and sizes and mode of growth of crystal. The size and shape of the crystal depend upon the conditions of the crystallization. This law is also known as Steno's Law.

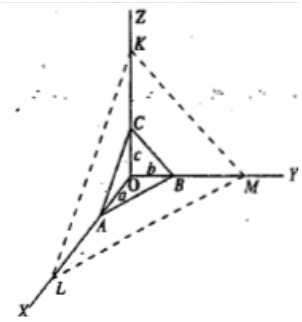


Interfacial angle of the crystal

(ii) ***The Law of constancy of symmetry*** **:** In accordance to this law, all the crystals of a substance have the same elements of the symmetry is the plane of symmetry, the axis of symmetry and the centre of symmetry.

(iii) The ***Law of rational indices*** **:** This law describes that the ratio of intercepts of the different faces of a crystal with the three axes are constant and can be expressed by the rational numbers that the intercepts of any face of the crystal along the crystallographic axes are either equal to unit intercepts (which means intercepts made by the unit cell) *a*, *b*, *c* or various simple whole number multiples of them such as *na*, *n*' *b*, *n*"*c*, where *n*, *n*' and *n*" are the simple whole numbers. The whole

numbers *n*, *n*' and *n*'' are known as **Weiss indices.** This law was given by the scientist **Hauy.**



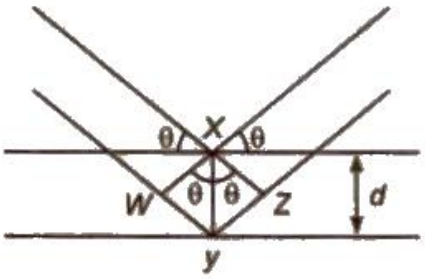
Miller indices are a set of integers (h,k,l)which are used to describe a given plane in a crystal. The miller indices of a face of a crystal are inversely proportional to the intercept of that face on the various axes.

Procedure for determining the miller indices

1) Prepare a three column table with the unit cell axes at the top of the column.
2) Enter in each column the intercept (expressed as multiplet of a,b and c) of the plane with these axes.
3) Invert all number.
4) Clear fraction to obtain h,k and l.

Structure Determination by X-ray Diffraction (Bragg's Equation)

When a beam of X-rays falls on a crystal plane composed of regularly arranged atoms or ions, the X-rays are diffracted. If the waves are in phase after reflection, the difference in distance travelled by the two rays ti.e., path difference) must be equal to an integral number of Wavelength, nλ for constructive.



Thus, path difference = WY + YZ

= XY sin θ + xy sin θ

= 2 XY sin θ = 2d sin θ

∴ nλ = 2d sin θ

This equation is called Bragg's equation.

Where, n = 1. 2, 3… (diffraction order)

λ = wavelength of X·rays incident on crystal

d = distance between atomic planes

θ = angle at which interference occurs..