B.Sc. (Chemistry Hons) – III

19th Lecture

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Law of Crystallography

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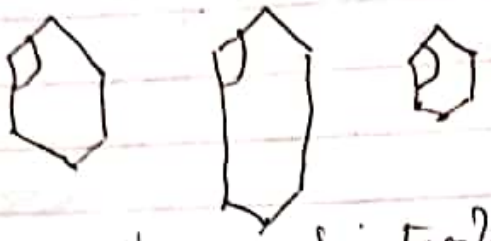
Crystallography is a branch of Science that deals with discerning the arrangement and bonding of atoms in crystalline solids and with the geometric structure of crystal lattices. Classically the optical properties of crystals were of value in mineralogy and chemistry for the identification of the substances. The crystallography is based on the three fundamental laws which are as follows :—

(1) Law of Constancy of interfacial angles :-

This law state that angle between the adjacent corresponding faces is the interfacial angles of the crystal of the particular substance is always constant in spite 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

crystallisation. This law is also called as steno's Law.



Constancy of interfacial angles.

(2) Law of rational indices:- This law describes that the ratio of intercepts of the different faces of a crystal with the three axis are constant and can be expressed by the rational numbers that is intercepts of any face of the crystal along the crystallography are either equal to unit intercepts a, b, c or various simple whole number multiples of them such as $n'b, na, n''c$ where n, n' and n'' are the simple whole numbers. The whole number n, n', n'' are known as Weiss indices. This was given by the scientist Hauy.

(3) 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.

Miller Indices :- The planes in the crystals are described by a set of integers (such as h, K and j) known as Miller indices. The Miller indices of the plane are reciprocals and of the fractional intercepts of the plane on the variety of crystallographic axis. For calculating the Miller indices a reference plane generally known as parametral planes is selected having the intercepts of a, b and c along the x, y and z axis respectfully. Then the intercepts of the unknown plane are given with respect to the a, b and c of parametral plane.

Therefore the Miller indices are :-

$$h = \frac{a}{\text{intercept of the Plane along X-axis}}$$

$$K = \frac{b}{\text{intercept of plane along Y-axis}}$$

$$l = \frac{c}{\text{intercept of plane along Z-axis}}$$

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Distance between the parallel planes in the crystals are designated as d_{HKL}. For different cubic lattices these inter planer spacing can be given with the help of general formula which is given as follows.

$$d(h,k,l) = \frac{a}{\sqrt{h^2+k^2+l^2}}$$

Here a is the length of the side of the cube while h, k and l are the Miller indices of the plane.

When the plane is parallel to the axis, its intercept with that axis is taken as infinite and the Miller indices become zero.

The negative sign in Miller indices are indicated by placing the bar on the intercept. All the parallel planes have same Miller indices.

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