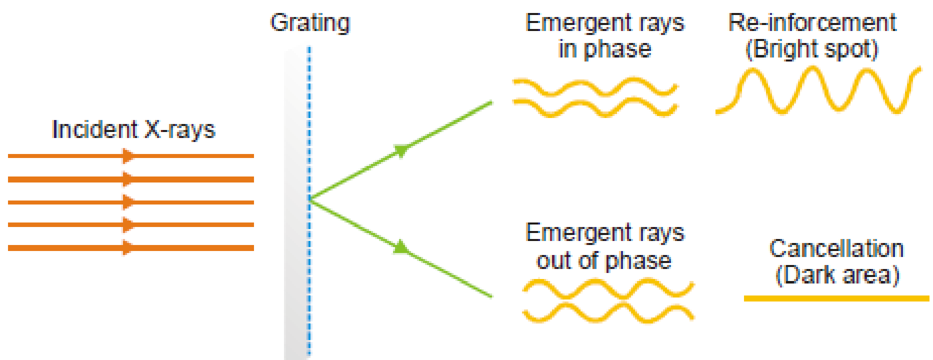
X-RAY CRYSTALLOGRAPHY

A crystal lattice is considered to be made up of regular layers or planes of atoms equal distance apart. Since the wavelength of X-rays is comparable to the interatomic distances, Laue (1912) suggested that crystal can act as grating to X-rays. Thus when a beam of X-rays is allowed to fall on a crystal, a large number of images of different intensities are formed. If the diffracted waves are in the same phase, they reinforce each other and a series of bright spots are produced on a photographic plate placed in their path. On the other hand, if the diffracted waves are out of phase, dark spots are caused on the photographic plate. From the overall diffraction patterns produced by a crystal, we can arrive at the detailed information regarding the position of particles in the crystal. **The study of crystal structure with the help of X-rays is called X-ray crystallography.**

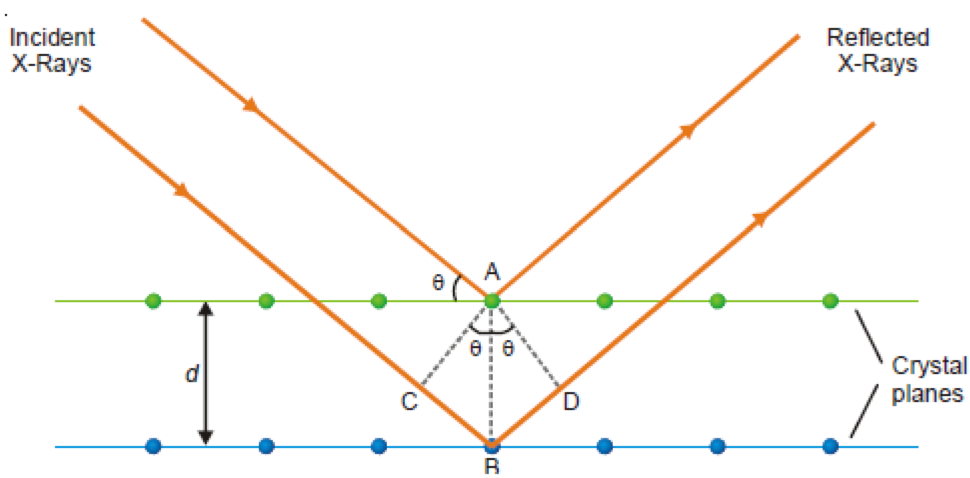


BRAGG'S EQUATION

In 1913 the father-and-son, W.L. Bragg and W.H. Bragg worked out a mathematical relation to determine interatomic distances from X-ray diffraction patterns. This relation is called the **Bragg equation.** They showed that :

(1) **the X-ray diffracted from atoms in crystal planes obey the laws of reflection.**

(2) **the two rays reflected by successive planes will be in phase if the extra distance travelled by the second ray is an integral number of wavelengths.**



$$n\lambda = CB + BD \quad \text{...}(i)$$

Geometry shows that

$$CB = BD = AB \sin\theta \quad \text{...}(ii)$$

From (*i*) and (*ii*) it follows that

$$n\lambda = 2AB \sin\theta$$

or

$$n\lambda = 2d \sin\theta$$

This is known as the **Bragg equation.** The reflection corresponding to $n = 1$ (for a given series of planes) is called the first order reflection. The reflection corresponding to $n = 2$ is the second order reflection and so on.

Book : A. Bhal, B. S. Bahl, G. D. Tuli, Essentials of Physical Chemistry