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Opinion Article

Fundamental Principles of X-ray Powder Diffraction and Applications

Ribis Soumen*

Department of Pharmaceutical Sciences, University of Kentucky, Lexington, United States

DESCRIPTION

The fundamental principle of X-ray diffraction is the constructive interference of monochromatic X-rays with a crystalline sample. A cathode ray tube generates these X-rays, which are then filtered to produce monochromatic radiation, collimated to concentrate, and directed toward the sample.

When an incident of monochromatic X-rays occurs on a crystal. The atomic electrons in the Crystal are vibrated. They are accelerated with the same frequency as the incident ray's frequency. These accelerated electrons then emit radiation in all directions with the same frequency as the incident X-rays. Rapid analytical methods such as X-ray Powder Diffraction (XRD), which can provide details about unit cell dimensions, are typically employed to determine the phase of crystalline materials. The material under analysis is homogenized and ground to a fine powder before the bulk composition average is calculated. If the incident radiation's wavelength is large in comparison to the Crystal's dimensions. The radiated X-rays are then in phase with each other. However, because the atomic dimensions are nearly equal to the wavelength of an X-Ray. If the wavelength of the incident radiation is large in comparison to the dimensions of the Crystal. The emission X-rays are in phase with others. However, because the atomic dimensions are nearly equal to an X-Ray wavelength.

Constructive interference between monochromatic X-rays and a crystalline sample is the basis of X ray diffraction. A cathode ray tube produces the X-rays, which are then filtered to produce monochromatic radiation, focused by collimation, and pointed at the sample. When the circumstances are in accordance with Bragg's Law ($n\lambda=2d \sin \theta$), the interaction of the incident rays with the sample results in constructive interference and a diffracted ray. W.L. Bragg considered X-ray diffraction from a crystal as a problem of reflection of X-rays from the atomic planes of the crystal in accordance with the laws of reflection in order to explain it.

Laue Patterns- Laue Method of X ray Diffraction If a crystal is made up of a regular and orderly arrangement of atoms. The Crystal's planes should be spaced by 1 Armstrong. In addition, a crystal should behave as a neutral three-dimensional diffraction grating for X-ray diffraction. Which also have a wavelength of about 1 Armstrong. As a result, it was predicted that if an inhomogeneous X-Ray beam is directed at a crystal. A series of geometrically arranged spots. The diffraction pattern should be obtained near the centre of the incident beam. Obtained from a photographic plate list on the Crystal's other side. This was experimentally confirmed, and a specific arrangement of atoms in the Crystal was established. The spots on the photographic plate obtained when the experiment was carried out with ZnS crystal, Laue spot refers to these sports.

X-ray Diffraction Methods the phenomenon of X-ray diffraction can be used to determine the structure of a solid and also for the study of X-ray spectroscopy. Both of these applications make extensive use of Bragg's law for determining crystal structure using Bragg's law it is required that and be properly matched. Another continuous range of wavelength or is provided to do so experimentally. As a result, for a given value of the orientation the value of is arbitrarily chosen. For the study of crystal structure, three methods are commonly used. There are three of them the Laue Method, the Rotating Crystal Method, and the Powder Method.

Correspondence to: Ribis Soumen, Department of Pharmaceutical Sciences, University of Kentucky, Lexington, United States, E-mail: soumen.lu.ck.ribis@gmail.com

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