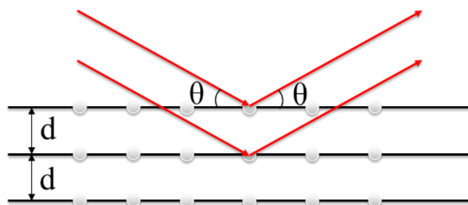
X-ray diffraction (XRD) is one of the most important characterization tools used in solid state chemistry and materials science, which could provide most definitive structural information (e.g. interatomic distances, bond angles, crystallinity, and etc…). The extensive use of X-rays for the analysis of atomic structural arrangements is based on the fact that the wavelength of the X-ray is in the 1 x 10^{-10}m range, which is the same order magnitude of the atomic spacings in crystalline solids. When x-rays interact with crystal lattice, a simple model called Bragg's law can be used to understand the required conditions for diffraction. The Bragg's law can be expressed as

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

where λ is the wavelength of X-ray, d is the spacing between layers of atom, θ is angle between incident X-ray beam and scattering plane, and n is integer.



Thus, the diffracted waves will consist of sharp interference maxima (peaks) with the same symmetry as in the distribution of atoms if the atoms are arranged in a periodic fashion in crystals. And the structural information of the crystals can be revealed based on the diffraction peaks.

AIF X-ray Diffraction Laboratory provides access to 3 state-of-the-art X-ray diffractometers for characterizing microstructural and crystallographic properties of powders, thin films, fibers and other solid materials. Below is a list of the applications that AIF

1. **Crystal Phase Identification and Quantitatively Phase Analysis:**

XRD users may access to the International Centre for Diffraction Data (ICDD) database, which updates every year at AIF.

2. **Crystal Structure and Unit Cell Lattice Parameter**

The crystal structural information of the sample may obtain by indexing peak positions or Rietveld refinement. AIF also offers Rietveld refinement workshop annually.

3. **Crystallite Size and Microstrain**

The information of crystallite size and microstrain of the sample may acquire by analyzing peak broadening.

4. **Epitaxial/Texture/Orientation in the Samples**

Bruker AXS General Area Detector Diffraction System (GADDS) at AIF equipped with a High-Star area detector and a Four-circle Eulerian cradle that allow for rapid analysis of polycrystalline and single crystalline samples, texture in the samples, and coarse-grained materials.

5. **Crystallinity**

Crystallinity of polymeric materials or fibers can be determined by comparing the intergrated peak area between amorphous phase and crystalline phase.

6. Thickness, Roughness, and Density of the thin films

Rigaku SmartLab X-ray diffractometer is capable of performing X-ray reflectivity technique on thin films, which provide the information of film thickness, roughness, and density.