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XRD: A Pioneer Technique for Characterizing the Polymer and Fiber

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X-ray diffraction (XRD) is an advanced and sophisticated analytical method to evaluate the structure and chemical composition of a material. Many polymers and fibers are the blend of crystalline and amorphous matrix. XRD is an independent, non destructive and fast analytical approach to evaluate the amount of crystalline content present in polymers and fibers. The crystalline content in a material can be accessed by exposure of high energy X-ray light on the sample and its standard by analyzing its diffractogram (diffraction pattern). The degree of crystallinity of the material can be determined by measuring the width of the peaks on the integrated diffractogram. The technique presents the degree of crystallinity, identifies the angle of diffraction that can be helpful to determine the crystalline structure with the help of Bragg's Law and similarly, reveals the crystalline index. Since many fibers, polymers and composites used in the laboratory and industries are semi-crystalline so, XRD is a pioneer tool for analysis, evaluation and characterizing polymers before and after physico-chemical changes [1,2] (Figure 1).

When the x-ray beam lie incident on a crystalline material, diffraction gives rise to sharp peaks whereas non-crystalline material produces broad diffuse scattering. The efficiency of diffraction of crystalline and non-crystalline patterns are the same. Through the integration of collected data, one can evaluate the percent crystallinity with the comparative ratios of integrated intensities or peak area as calculated from the diffractogram. The XRD data can also help to determine the preferred orientation, texture, order disorder transformation, strain, stress in the sample. Using the several softwares, the integrations and simplifications can be further processed to eliminate the background noise, aberrant peaks as well as amorphous data in order to better identify and justify the crystalline structure. Through the process of X-ray diffraction and the analysis of the interference patterns, many characteristics of the molecular structure can be identified and studied [1-3] (Figure 2).

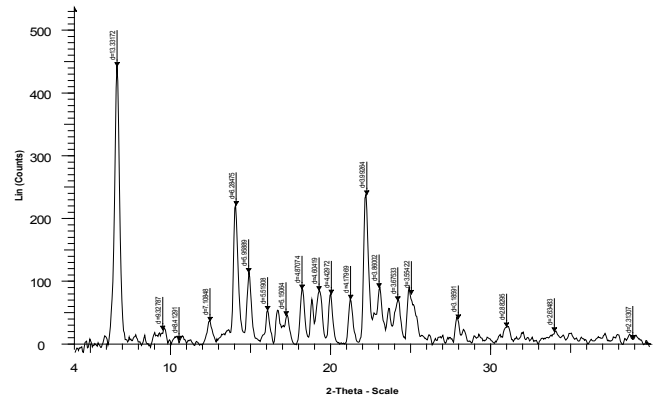

Figure 1: A typical diffractogram.

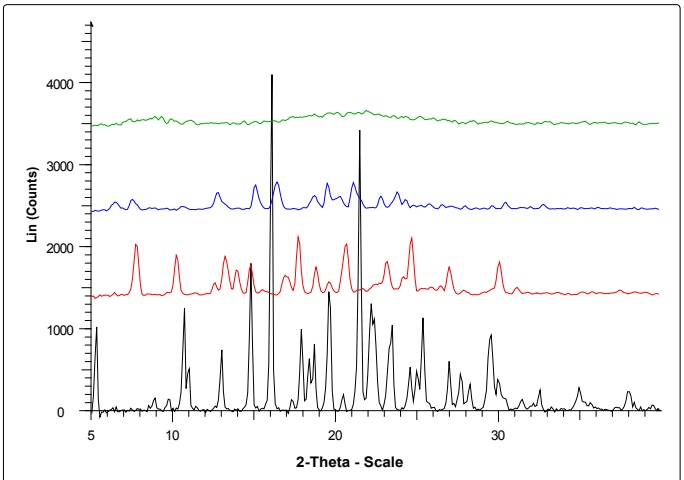

Figure 2: A comparative overlay of various diffractograms.

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