

X-RAY OPTICS FOR TWO-DIMENSIONAL DIFFRACTION

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A two-dimensional x-ray diffraction (XRD²) system has both the capability of acquiring diffraction patterns in 2D space simultaneously, and analyzing the 2D diffraction data accordingly. An XRD² system consists of at least one 2D detector, x-ray source and optics, sample positioning stage, sample alignment and monitoring device as well as corresponding computer control and data reduction and analysis software. The function of the x-ray optics is to condition the primary x-ray beam into the required wavelength, beam focus size, beam profile and divergency. The conventional diffraction, either using a point detector or a PSD, is confined within the diffractometer plane. Since the variation vertical to the diffractometer plan is not considered, the x-ray beam is normally extended in that direction (line focus). While the measurable diffraction is no longer limited in the diffractometer plane in a two-dimensional system. Instead, the whole or a large portion of the diffraction rings are measured simultaneously. Since the diffraction patterns in all directions are equally important, the ideal x-ray beam profile for XRD² is a circular spot (point focus).

Most conventional diffractometers use the Bragg-Brentano parafocusing geometry, in which the sample surface normal is always a bisector between the incident beam and the diffracted beam. In an XRD² system, the diffracted x-rays are measured in a two-dimensional range so that the Bragg-Brentano geometry can not be achieved. In a conventional diffraction system, the monochromator can be used either in the source side or the detector side, or both sides, while it is only possible to have a monochromator in the source side for an XRD² system. Therefore, x-ray optics for XRD² systems has different requirements in terms of the beam spectrum purity, divergency and beam cross-section profile.

The x-ray optics components commonly used for XRD² systems are monochromator, pinhole collimator, cross-coupled Göbel mirrors, and monocapillary. This presentation will discuss the geometry, x-ray optics requirements and features of various x-ray optics devices used for two-dimensional x-ray diffraction. The universal beam concept (UBC) device, which can be easily switched between line focus and point focus, is also introduced.