



# e-learning

## Fundamentals of X-ray diffraction

### XRD course name

Part number

JHDE001

Required time

approx. 4 hr

X-ray analysis is one of the key tools in non-destructive way to analyze all kinds of matter - ranging from liquids to solids, and is essential for material characterization and quality control in research, engineering and production line. In this course, starting from what X-rays are, you will learn the crystal system, Miller index, the principle and application of powder X-ray diffraction measurement, and general X-ray diffractometers (XRD) how to configure and use.

### Learning point and Required time\*1

(Required time: approx. 4 hr)

Properties of X-rays (30 min.)	The topic is the properties of X-rays, which is closely related to what X-rays are. You will also learn five properties by the interactions of X-rays and matter.
X-ray generating (20min)	You will learn the generating white/characteristic X-ray mechanism.
Interaction of X-rays with matter (25 min.)	You will learn absorption coefficients, next, fluorescent X-rays, then, scattered X-rays, and Bragg's Law.
Geometry of crystals, miller indices, and direction indices (30 min.)	You will learn a few but crucial key points in the fundamentals of X-ray diffraction theory. So, you will learn what a crystal is, what a unit cell is and what crystal systems are.
Basic applications of X-ray powder diffractometry (20 min.)	This is the chapter which covers X-ray powder diffractometry and its applications in the fundamentals of X-ray diffraction.
X-ray diffractometer (20 min.)	This is the chapter about the X-ray diffractometer. You will learn the features of the theta-theta type of X-ray diffractometer mainly configured by X-ray tube, goniometer and detector (Scintillation Counter).
Focusing Method (20 min.)	This is the chapter which covers the focusing method based on Bragg Brentano geometry.
Parallel Beam Method (15 min.)	This is the chapter which covers the arrangement of the optical geometry for the parallel beam method.
Diffraction Angle (30 min.)	This is the chapter to explain the diffraction angle errors. You will learn some causes that change diffraction angles, namely errors which occur by using the goniometer.
Precautions on Handling the X-ray Diffractometer (15 min.)	You will learn some precautions while using an X-ray diffractometer.

### Appendix [XRD] X-ray detectors

(Required time: approx. 0.5 hr)

X-ray detectors  
(35 min.)

To detect X-rays, X-rays need to be converted into a quantifiable signal by using interactions between X-rays and selected materials. In this chapter, after reviewing various detectors that have been used up to now, You will learn the features of semiconductor detectors that have become common in recent years.

- X-ray detectors (0D, 1D, and 2D detector)
- 2D Hybrid Pixel Array Detector "HyPix-3000"

\*1: Please note: required time is estimated as minimum period by taking consecutive programs from the beginning to the end of the chapters without any repetition.