XRD course e-learning

Applications of Powder and Thin film X-ray diffraction

XRD course name

Part number	JHDE003	Required time	approx. 2 hr

The fields of material research are diverse, with sample applications such as powder, liquid, nano material, and thin films. With XRD, powder shows material components identification, quantitative analysis, crystallite size and crystallinity, processed material shows residual stress and preferred orientation, thin film shows density and crystal quality. In this course, you will learn various sample evaluation methods by using XRD.

Ultima IV and SmartLab system Applications

X-ray analysis is a powerful and indispensable tool to investigate the structural properties of these diverse materials. Since the size and volume can be totally different from one material to the next, it is necessary to select appropriate attachments and optics to meet your purpose of measurement. In this training course, you will learn various powder applications from use case.

The Basics of X-ray Residual Stress Analysis

Residual stress analysis is applied to a wide range of industrial products. In addition to mechanical and automobile parts, it analyzes countless other types of products including coating materials, bonding materials, and electronic parts. In particular, it is essential to analyze the parts required in high quality and high reliability. Many industrial product researches employ the analysis. In this training course, you will learn the basics of X-ray residual stress analysis.

Pole Figure Measurement Transmission & Reflection Methods

Pole figure (PF) measurement is one method to reveal preferred orientation in a given crystallite of texture material which shows various characteristic properties depending on the aspect of the preferred orientation. Degree / direction of texture correlate with the properties such as mechanical characteristics, insulation resistivity and magnetic. PF analysis can evaluates these characteristics. In this course, you will learn the basics of PF measurement.

The Basics of Thin Film X-ray Diffraction

While the crystallinity of the measured object is relatively restricted in a powder sample or a single crystal sample, a thin film sample may include a wide range of crystallinity types. For example, in the case of a polycrystalline film and an epitaxial film on a single crystal substrate, the former film will sometimes have low crystallinity and a low preferred orientation, while the latter film has high crystallinity comparable to a thin single crystal. To analyze the thin film samples correctly, we must first acquire correct profiles by selecting the collimation (divergence angle) and monochromaticity of the X-rays according to the crystallinity or other properties of the sample. In this course, you will learn the basics of thin film X-ray diffraction.

Learning point and Required time*1

(Required time: approx. 2 hr)

Application of Ultima IV and SmartLab system (35 min.)	In this chapter, you will learn various sample applications from use case. (Phase Identification, Quantitative analysis, Crystallite Size, Crystallinity, Rough surface sample, Random orientation measurement, In-Situ, XRD-DSC, Micro-area, Nanoparticle size analysis, Pole figure, and Residual stress)
Basics of X-ray Residual Stress Analysis (35 min.)	In this chapter, you will learn the basics of X-ray residual stress analysis. (The Basics of X-ray Residual Stress Analysis, sin2ψ method - the basic stress analysis using X-rays -, Application measurements)
Pole Figure Measurement,Transmission & Reflection Methods (20 min.)	In this chapter, you will learn the basics of pole figure measurement. (Principles of Pole Figure Measurement, Decker transmission method, Reflection method (Schulz), Aspect of Preferred Orientation)
Basics of Thin Film X-ray Diffraction (40 min.)	In this chapter, you will learn the basics of thin film X-ray diffraction. (Basics of thin film X-ray diffraction, Advanced thin film characterization using X-ray diffraction, Optical system for high resolution X ray diffraction)

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 mininum period by taking consecutive programs from the beginning to the end of the chapters without any repetition.