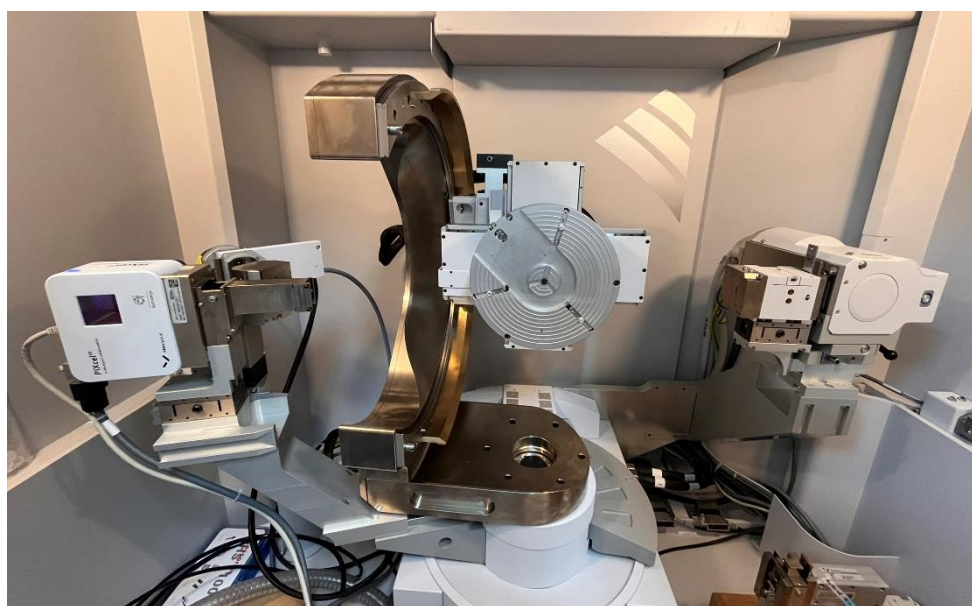# NM-021 High resolution X-ray Diffractometer – HR-XRD

I.   System Specifications and Model:

1.   Model: PANalytical X'Pert'3 MRD XL

2.   X-ray Light Source: Copper target (Kα; λ= 0.154nm)

3.   Detector: Proportional counter

4.   Beam Size: 12mm × 0.4mm

5.   Specimen Size: Chips from 1.2cm × 1.2cm to 8 inches

6.   ω/2θ Highest Resolving Power: 0.0001°

7.   Operating Environment: An atmosphere of 1atm

8.   First Optical Module: hybrid monochromator Ge (400), cross-slit collimator (X-ray lens)

9.   Second Optical Module: the triple axis (optional).
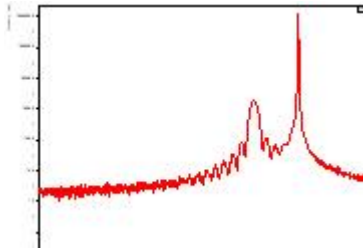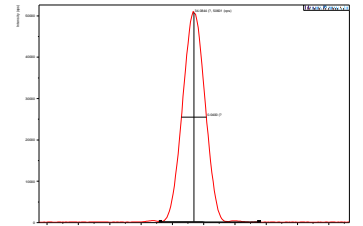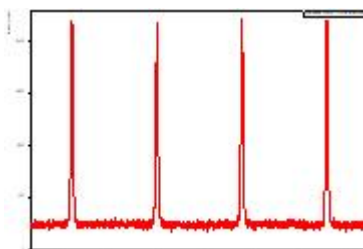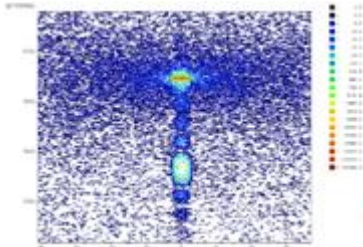
II.   System Appearance:

The system mainly consists of 5 parts: (1) X-ray tube; (2) first optical module; (3) sample cradle; (4) second optical module; (5) detector. (The structure is depicted in the following image)

III.   Function Description:

Crystals are solids in which atoms or atomic groups are arranged in repeating patterns. When an X-ray enters a crystal, it is scattered by the atoms. When there is a certain phase relationship (phase difference) where two or more scattering waves overlap, the diffraction phenomenon occurs. The XRD uses the detector to collect diffraction signal intensity to get the diffraction pattern of the tested sample. The epitaxial thin film requires high-resolution X-ray diffraction for measurement and analysis due to its excellent crystallinity. The key feature of this equipment is

non-destructive measurement, and with the 2D detector, it can quickly and accurately assess the crystallization status of the epitaxial thin film. Common HR-XRD analysis methods are as follows:

	Analysis Item	Test Description	Example
1	High resolution theta-2theta scan for Epitaxial layers	Epitaxial material composition and thickness determination.	
2	Rocking curve (RC, omega scan)	The quality (FWHM) analysis of the epitaxial layer.	
3	Phi Scan	Observation of relative rotation angles of material crystals	
4	Reciprocal Space Mapping (RSM) or Ultra-fast Reciprocal Space Mapping (URSM)Measurement	Determination of the composition, strain, and relaxation of epitaxial materials as well as material mismatch analysis	

IV.　Notes on Specimen Sampling:
1. Analysis specimen sampling specifications: 1.2cm × 1.2cm to　8-inch chips
2. Rocking curve: The crystal planes to be observed, number of epitaxial layers, approximate thickness of each layer, and film composition must be provided.
3. Reciprocal space mapping (RSM) or Ultra-fast Reciprocal space mapping (URSM) : The crystal planes to be observed must be provided.

4. Contact information, charge plan, and commission link

✓ Contact Information:

Contact Person	Ext.	Email	Instrument Location
Yi-Ching Huang	7773/7409	1505015@niar.org.tw	R204

✓ Charge Plan:

Instrument No.	Instrument Name		Charge Plan		Note
			Charge Plan for Self-operation (NTD/hr.)	Charge Plan for Commission for Operation (NTD/hr.)	
NM-021	High resolution X-ray Diffractometer (HR-XRD)	θ-2θ scan/ RC (omega scan) / RSM or URSM	5,000	8,000	The academic fee rate is 10%
Note: If the time commissioned for operation is less than an hour (1H), it is counted as an hour.					

✓ Commission Link:

To request commission services, please go to: **MES System and External Service System and make a request**