EXPLORER

MULTI-PURPOSE AND HIGH RESOLUTION
THETA/THETA X-RAY DIFFRACTOMETER

Flexibility and modularity without limits

GNR is a worldwide market leader in supplying advanced X-ray (XRD, XRF) and optical emission spectrometer (OES) systems for complete solutions in structural and elemental analysis.
We can fit well the analytical needs of customers in material research, quality control, process analysis and life science.
These analytical methods provide elemental composition of solids and liquids as well as structural parameters of powders, thin films and bulk materials.

The modularity and the flexibility of the GNR X-ray equipments allows to start with an entry-level system which can be upgraded to meet new requirements.
We can supply a wide range of X-ray sources, optics, sample holders, detectors and configurations to satisfy all the analytical needs.

With no limits to its applications, EXPLORER modular system offers high performances in all analytical areas, ranging from phases quantification of mixtures, to the determination of microstructural properties as residual stress and preferred orientation of crystallites on bulk materials as well as on thin films.

The combination of direct drive torque motors with optical encoders ensures fast and extremely accuracy of the drives.

Thanks to the modularity, all the hardware components can be changed allowing seven five independent degrees of freedom and investigations on a whole range of powders, bulk materials and thin layers.

EXPLORER offers solutions for a wide range of analytical requirements, from routine crystalline phase identification and quantification, crystallite size/lattice strain and crystallinity calculations, retained austenite quantification, polymorph screening, crystal structures analysis, to residual-stress analysis, thin films, depth profiling, non-ambient analyses, phase transition textures and preferred orientation, nanoparticles.

The optics permit switches between Bragg-Brentano, focusing and parallel beam geometry using Johansson or parabolic mirror monochromators.

The high resolution reflectometry studies can be performed with EXPLORER to characterise layer thickness (from 1 to 500 nm with an accuracy better than 1%), density (with an accuracy better than ± 0.03 g/cm³), surface and interface roughness (from 0 to 5 nm with an accuracy better than ± 0.1 nm).

Measurements at low angles and a thin film attachment for parallel beam geometry allow the study of thin films and multilayers.

The coupling between a parabolic mirror monochromator and a channel-cut crystal mounted on the incident beam allows to realise a monochromatic parallel beam with high intensity and low divergence, suitable for high resolution measurements.

Powerful, user-friendly software makes measurement easier than ever and includes many sophisticated features to aid the interpretation of the results.

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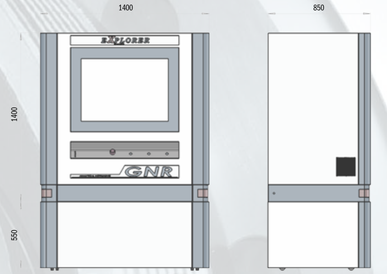
INSTALLATION REQUIREMENTS

Electrical system
Power connection: 220 Vac +/- 10%, 50 or 60 Hz, single phase
Maximum mains current: 40 A
Main fuse: 32 A
Maximum power consumption: 5 kVA
Ground terminal: 6 mm²
Power supply voltage fluctuation must not exceed 10%

Cooling water
Minimum flow rate: 4 l/min
Maximum pressure: 6 bars
Maximum inlet temperature: 35° C (minimum depends on dew point)
If the flow rate is lower than 4 l/min, the safety circuit for protection of the X-ray tube is activated, disabling the X-ray generating circuit. When minimum conditions of flow-rate cannot be fulfilled, use the water chiller, available as an optional extra.

EXTERNAL DIMENSIONS



Total weight: 350 Kg

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NEW

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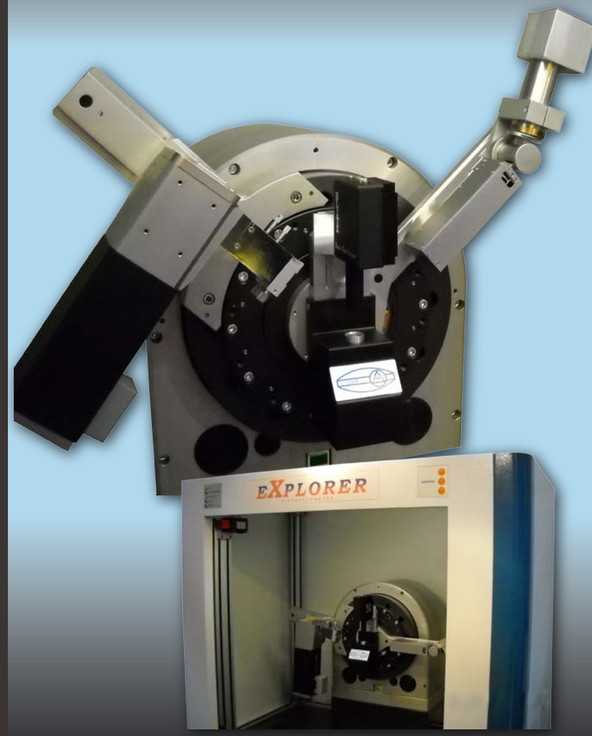
GNR OPTICA

ANALYTICAL INSTRUMENTS GROUP

25 years of technology



Precision engineered and optimum performance...
...thanks to the direct drive torque motors

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A new concept of movement

The **EXPLORER** high resolution diffraction system incorporates the high efficiency of the direct drive torque motors controlled by optical encoders, allowing to reach an angular accuracy of 0.00001°.

The direct drive technology offers a lot of benefits compared with the other well known technologies like worm gear, gear train, reducer or timing belt.
The load is directly coupled to the motor's rotating part, resulting in an efficient and effective gearless construction.

EXTENDED LIFETIME, RELIABILITY AND RIGIDITY: torque motors are inherently simple, with an absolute minimum number of moving parts which are not subject to wear.

HIGH ACCURACY AND REPEATIBILITY: the backlash and the hysteresis inherent in mechanical transmission elements are suppressed.

HIGH DYNAMIC PERFORMANCE AND HIGH EFFICIENCY: no energy is used in driving power transmission parts. Direct drive torque motors provide the highest torque-to-inertia ratio where it counts at the load.

Explorer - technical data

X-ray generator	Maximum output power	3 kW (option: 4 kW)
	Output stability	< 0.01 % (for 10% power supply fluctuation)
	Max. output voltage	60 kV
	Max. output current	60 mA (option: 80 mA)
	Voltage step width	0.1 kV
	Current step width	0.1 mA
	Ripple	0.03% rms < 1kHz, 0.75% rms > 1kHz
	Preheat and ramp	Automatic preheat and ramp control circuit
	Input voltage	220 Vac +/- 10%, 50 or 60 Hz, single phase
	Size	Width 48.3 cm, height 13.3 cm, depth 56 cm
X-ray tube	Type	Glass (option: ceramic), Cu anode, fine focus (options: any kind of X-ray tube)
	Focus	0.4 x 8 mm FF (options: 0.4 x 12 mm LFF; 1 x 10 mm NF; 2 x 12 mm BF)
	Max. output	3.0 kW
Goniometer	Configurations	Horizontal and vertical Theta/2Theta and Theta/Theta geometry
	Measuring circle diameters	400 - 500 - 600 mm or any intermediate setting
	Scanning angular range	- 110° < 2 theta < + 168° (depends on accessories)
	Smallest selectable stepsize	0.0001°
	Angular reproducibility	± 0.0001°
	Modes of operation	Continuous scan, step scan, theta or 2 theta scan, fast scan, theta axis oscillation
	Divergence slits	4°; 2°; 1°; 1/2°; 1/4°
	Anti-divergence slits	4°; 2°; 1°; 1/2°; 1/4°
	Receiving slits	0.3; 0.2; 0.1 mm
	Soller slits	2°
Detector	Type	Scintillation counter NaI (options: YAP(Ce); multi strip and CCD detectors)
	Countrate	2 x 10^6 cps
	HV/PHA	High voltage supply 600 - 2000 V, gain, low, central and high level control
Case	Dimensions	Width 1400 mm, heigh 1800 mm, depth 850 mm
	Leakage X-rays	< 1 mSv/Year (full safety shielding according to the international guidelines)
Processing unit	Computer type	Personal Computer, the latest version
	Items controlled	X-ray generator, goniometer, sample holder, detector, counting chain
	Basic data processing	Qualitative and quantitative phase analysis. Rietveld analysis, crystalline structural analysis, crystallite size and lattice strain, crystallinity calculation, strain, reflectometry.

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Theta-Theta with a parabolic monochromator

In Theta-Theta geometry, the tube and the detector are moved. The sample remains horizontal during the entire measurement. It is helpful when examining loose powders and liquids.
The coupling of a Theta-Theta goniometer with a parabolic monochromator allows to have high flexibility in sample type, shape, handling and preparation.
Now, in addition to conventional samples, it is possible to examine even large, bulky or heavy samples.

X-RAY POWDER DIFFRACTION (XRPD)
Phase analysis and identification is the study of the different polycrystalline materials within an analytical samples. One phase is separated from another due to its unique powder diffraction pattern which arises from its unique combination of composition and crystal structure.
The analysis is applicable to all types of crystalline materials and can be restricted to identification only or extended to full quantitative analysis.

REFLECTOMETRY (XRR)
The EXPLORER can accomplish in a single measurement the characterisation of thin film layer thickness, density, surface and interface roughness. If the films are single or multilayer, only a few atoms or up to about 0.5 microns thick, the procedure is fast, easy and completely non destructive.
The knife edge collimator ensures optimum collimation of the primary beam without the intensity reduction typical of crystal monochromators.

GRAZING INCIDENT DIFFRACTION (GID)
In phase analysis of thin films or multilayers, measurements can be done at low glancing angles of the X-ray beam to increase the intensity of the signal from the layers and to decrease the substrate reflections. During the measurement the incident angle remains fixed while the detector is scanned through the 2-theta range. In this configuration a parallel beam optic is attached on the reflected beam.

HIGH RESOLUTION X-RAY DIFFRACTION (HRXRD)
HRXRD is used to determine sample properties like lattice spacing and mismatches, thickness, layer tilt, curvature, mosaic layers, dislocations, defects and stacking faults. Thanks to the high resolution 4-bounce monochromator, HRXRD can easily map across the sample surface.

Features:
- High stability X-ray generator through precision feedback control circuits
- Automatic ramp of the high voltage and emission current to preset values
- Brilliant X-ray sources, glass and ceramic tubes plus parabolic mirror
- Microfocus tubes and policapillary collimators
- Parallel beam optics using parabolic monochromators
- HRXRD due to asymmetrical, 4-bounce channel-cut Ge (022) monochromator
- Johansson focusing $K\alpha_1$ monochromators
- Precise axial motion using torque motors controlled by optical encoders
- Spinner, multisample, glass capillary, and multipurpose sample holders
- Automatic change between transmission and reflection geometry
- Secondary monochromators for Ag, Cr, Fe, Co, Cu and Mo radiations
- Scintillation counters, silicon strip, energy dispersive and area detectors
- High, low temperature and humidity chambers
- Motorized sample holder with CHI, PHI and Z movements
- XRR and GIXRD with an incident and a diffracted parallel optic
  Absorber and knife edge collimator for XRR measurements
- SDD detectors for EDXRF and TXRF analysis
- Small angle X-ray scattering using speed silicon strip detector
- Radiation enclosure with high accessibility and visibility of the goniometer
- Double safety circuit