

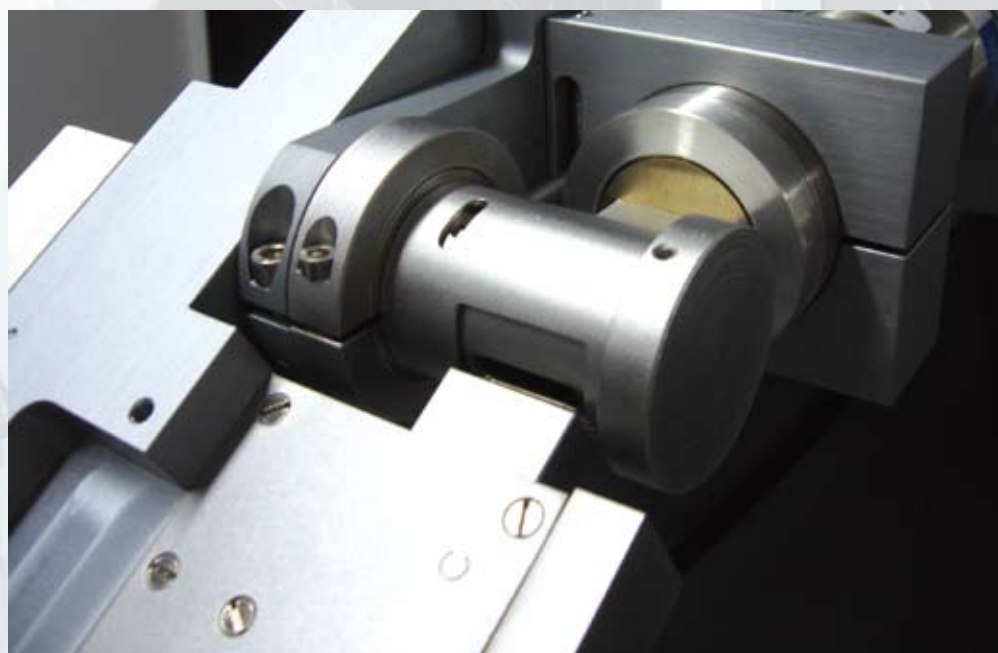


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Monochromators

Secondary flat and curved graphite monochromators suitable for Ag, Cr, Fe, Cu, Co and Mo radiations

This attachment is installed in the X-ray detection unit. It is designed to remove continuous X-rays, $K\alpha$ rays as well as fluorescent x-rays emitted from the sample. It can selectively take out monochromatized X-rays required for analysis ensuring diffraction patterns with an excellent signal to noise ratio.



Secondary graphite monochromator



Johansson $K\alpha$ monochromator

Johansson focusing germanium, quartz, silicon $K\alpha_1$ monochromators

By means of focusing monochromators it is possible to obtain powder diffractograms with strictly monochromatic peak profile. The use of focusing X-ray monochromators leads to a considerable decrease of the background scattering level as well as to an improvement in resolution. Many organic and inorganic compounds have complicated diffraction patterns with overlapping lines. For high precision crystallographic studies it is necessary to have pure $K\alpha_1$ radiation for optimum line separation. It is ideal for crystallographic analyses such as cell searching, indexing, unit cell refinement and structure solution from powder data.



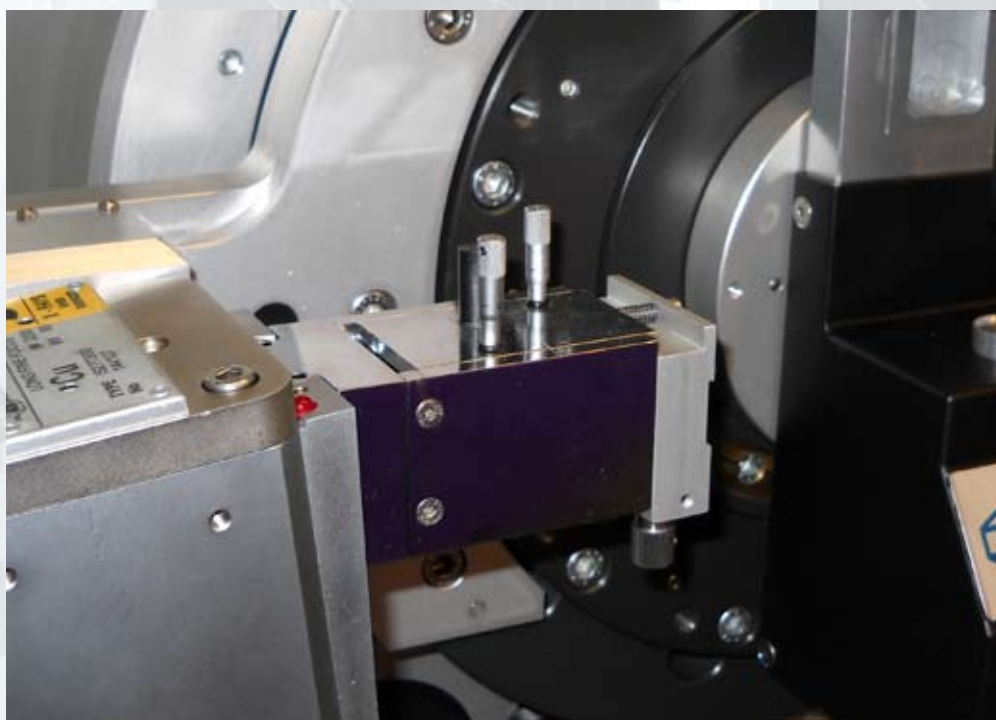
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Parabolic monochromators

For parallel beam applications, a single parabolic monochromator can be mounted as attachment on the incident beam. It makes the parallel beam in one dimension while letting it diverge in the other dimensions. The resulting parallel beam is directed onto samples mounted on the theta stage of the EXPLORER diffractometer.

The parabolic monochromator provides additional performances for grazing incidence diffraction (GID) and reflectometry measurements (XRR) with its high intensity beam.

With the parabolic monochromator, exact positioning of the sample is not necessary, and irregularly-shaped, non-flat specimens can be examined without difficulties.

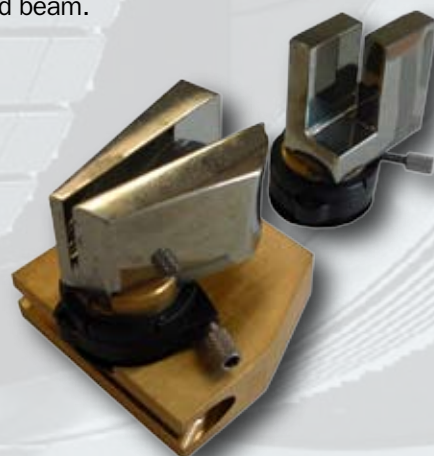


Parabolic monochromator

High resolution and high intensity 4-bounce channel-cut Ge (022) monochromators

V-shaped crystals with proper surface orientation allow to collect a larger X-ray photon flux from small X-ray sources, still keeping a very collimated beam.

Monochromator	4-bounce channel-cut Ge (022)
Diffracted beam	Cu α_1 parallel beam
Resolution (FWHM)	Theoretical: 12 arcsec; Observed: 15 arcsec
I/I BARTELS	7
$\Delta\lambda/\lambda$	$< 10^{-4}$





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Detectors

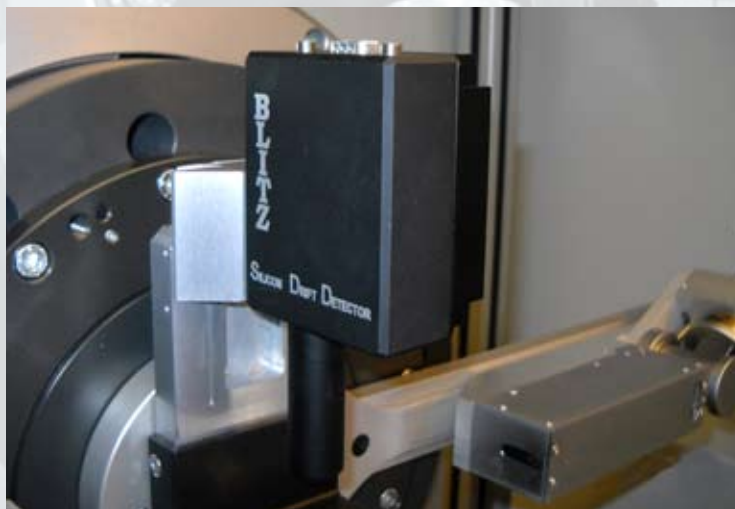
Dynamic scintillation NaI detector

The Dynamic Scintillation NaI Detector is our standard detector with low background (0.4 cps) and high dynamic range (up to 2×10^6 cps)



Dynamic scintillation NaI detector

BLITZ – Solid drift detector



BLITZ – Silicon drift detector

Sensor	SDD (silicon drift detector) droplet type
Active area	5 – 30 mm ²
Shaping time	Standard: 1μs or 250ns Customable: 10 μs – 100 ns
Energy resolution	Shaping time 1μs: 124eV FWHM @Mn Kα Shaping time 250ns: 136eV FWHM @Mn Kα
Cooling	Air



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CELERIX – One-dimensional silicon strip detector

Designed for simultaneous data collection, allows to reduce the acquisition time by a factor of 100 to 1000. It can measure the intensity distribution of a region of 20° or more with very good spatial resolution.

The CeleriX is a silicon strip detector operating in single-photon counting mode suitable for the applications, where an high dynamic range and an excellent data quality are required. It is like having several hundred of detectors working simultaneously. The silicon strip technology offers direct detection of the X-rays and the ability to efficiently process high count rates, without any sacrifice in resolution. It is a perfect solution for an application such as quantitative Rietveld analysis with short data collection times.

The CeleriX detector is air-cooled and therefore very simple in the operation and handling.

Main specifications:

Sensor	Reverse-biased silicon diode array
Active area	8 x 64 mm ²
Format	1280 strips
Strip size	50 μm +/- 3 μm
Energy range	5 – 30 keV
Quantum efficiency	5 keV: 90%; 8 keV: 96%; 15 keV: 49%; 30 keV: 8%
Counting rate per pixel	> 2 x 10 ⁵ per strip
Readout time	0.3 ms
Cooling	Air cooled
Power consumption	5 W



Features:

- Direct detection of X-rays in single-photon-counting mode
- High dynamic range
- High counting rate
- Adjustable threshold to suppress fluorescence
- Short readout time
- No cooling
- Maintenance free



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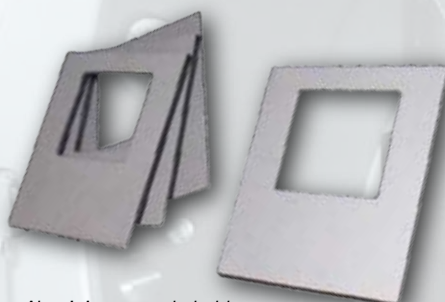
Sample holders

Standard sample holders

X-ray diffraction is a non-destructive analytical method which determines the properties of solid or fluid matter in a few microns and a nanometre length scale. In comparison with other complementary methods X-ray diffraction does not require any complex sample preparation.

The following aluminium and Si low background sample holders are supplied as standard with the EXPLORER diffractometer.

Description	Sample area	Application
Aluminium sample holder	20x15 mm	General purpose
Si low background sample holder	20x15 mm	Lattice constant



Aluminium sample holder



Si low background sample holder

Rotational sample stage

Usable to lower the scatter in diffraction pattern intensities attributable to the sample crystalline orientation, and therefore increase the precision in most type of quantitative analysis.

Main specifications:

Sample rotation speed	100 rpm
Sample size	40 mm dia. maximum



Standard, rotational and multi sample changer

Automatic sample changer for six samples

This stage is used in order to automatically measure maximum six samples.

Sample size
22 mm dia. maximum



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Capillary sample holder

The capillary technique is ideal for examining small sample quantities or air-sensitive samples in a closed environment.

Thanks to the parabolic mirror and the Linear Silicon Strip Detector the EXPLORER diffractometer produces high-quality diffractograms in an extremely short time, even with small sample quantities.

A precise goniometer head which is aligned under microscope control guarantees coincidence of capillary and diffractometer axis.



Specimen carrier for capillaries



Multipurpose Chi, Phi and Z sample holder

Multipurpose Chi, Phi and Z sample holder

The Chi circle segments allows to rotate the sample on a Chi circle for a range of $\pm 5^\circ$ with an angular resolution of $0.8 \mu^\circ$ and a velocity up to $4^\circ/\text{s}$.

The Phi circle goniometer allows to rotate the sample on a Phi circle for a range of 0-360 degrees with an angular resolution of $3 \mu^\circ$, a max velocity of $30^\circ/\text{s}$ and a step width between 0.3 m° and 3 m°

The Z-stage allows to move the sample on a zeta axis for a range of 21 mm with a sub-nanometer resolution, a max. velocity of $8 \text{ mm}/\text{s}$ and a step width between 50 nm and 500 nm.

It is very suitable for thin films alignment.

Thin film attachment



Thin film attachment

The thin film attachment is used in the EXPLORER diffractometer when polycrystalline samples in the form of thin film or multi-layers have to be analysed with the grazing beam geometry. The attachment consists of a special detector holder where a narrow horizontal Soller slit is mounted together with a flat monochromator. The incident angle remains fixed during the measurement while the detector is scanned on the 2-theta range. In the case of multilayers, the layer sequences are determined changing the glancing angle, the larger the glancing angle, the greater the X-ray penetration.

Another possibility is to use the parabolic monochromator instead of the Soller slit systems to reach the optimum condition of the parallel beam.



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High and Low Temperature Chambers



HTK 16 / HTK 2000 High Temperature Chambers

These High-Temperature Chambers are designed for non-ambient X-ray studies with direct sample heating.

Two thermocouples are available for temperature control and sample temperature measurement.

The new graphite heating filament with inert sample support platelets offers the advantages of a better temperature homogeneity in the sample and a higher chemical resistance.

The front cover of the chamber has a bayonet catch and can be quickly removed for sample exchange.

Investigations in the temperature range from room temperature to 1600 °C (HTK 16) can be carried out under vacuum, air or inert gas, depending on the experiment and the used heating filament (Pt, Ta, W, C or others on request).

Only under vacuum ($< 10^{-4}$ mbar), 2300 °C (HTK 2000) is possible.

Temperature range: Ambient to 1600° C (HTK16); Ambient to 2300°C (HTK 2000)



TTK 450 Low Temperature Chamber

The TTK 450 Low Temperature Chamber is designed for X-ray diffraction studies in the temperature range from -193°C to 450°C. Tests can be carried out either under vacuum, air or inert gas.

To work at low temperature liquid nitrogen is transferred by insulated hoses from a dewar to the chamber. The hoses are connected with a special designed two-pipe ball connector

which can be turned by approx. 180°, even if the apparatus is frozen.

The TTK sample holder is easily accessible. No realignment is necessary for high and low temperatures of for different sample holders.



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HTK 1200N / HTK 1200N Capillary

The HTK 1200N has been the attachment of choice for in-situ XRD studies on flat samples up to 1200 °C for many years.

The novel capillary extension turns this well-known oven-chamber into a powerful capillary heater.

Due to its environmental heater, there is virtually no temperature gradient in the sample, even in samples of up to 5 mm thickness.

The temperature sensor is located right underneath the sample in a protective ceramic sample holder, guaranteeing reliable and repeatable temperature measurement.

Sample spinning preserves good statistics of grain orientation distribution for reliable diffraction information and subsequent data

evaluation (e.g. Rietveld).

The alumina sample carriers can be easily exchanged and can accommodate various sample forms like flat samples, bulk samples as well as thin layers.

The HTK 1200N is suitable for different types of in-situ X-ray investigations including studies of phase transformations, structure determination and studies of chemical reactions.



Cryo and Humidity Chamber - CHC plus+

CHC plus+ is a unique combination of the multi-purpose CHC Cryo & Humidity Chamber for in situ X-ray diffraction (XRD) studies and an advanced humidity generator.

This new combined set-up is focussed on powder XRD studies of pharmaceuticals and building materials at low and high temperatures as well as under controlled humidity conditions.

The gas humidifier is controlled with a calibrated RH sensor located inside CHC plus+ close to the sample. The chamber housing is temperature-controlled with a water bath.

This set-up together with the excellent control performance of the MHG generator provides uniform and well defined humidity conditions around the sample.

Humidity	2 to 95%RH from 10 to 60°C 2 to 70%RH at 80 °C
Temperature range with compressed-air cooling	Dry air: -5 to 300 °C Vacuum: -5 to 400 °C
Temperature range with liquid nitrogen cooling	Vacuum: -180 to 400 °C Dry air: -120 to 300 °C
Atmospheres	Air, nitrogen, inert gas, vacuum
X-ray geometry	Reflection

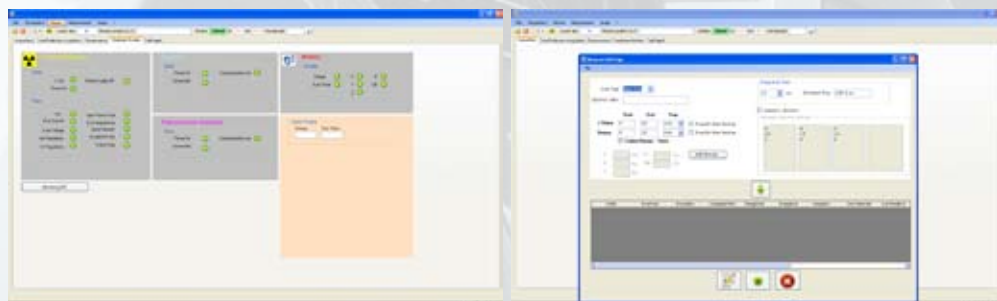


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Application software

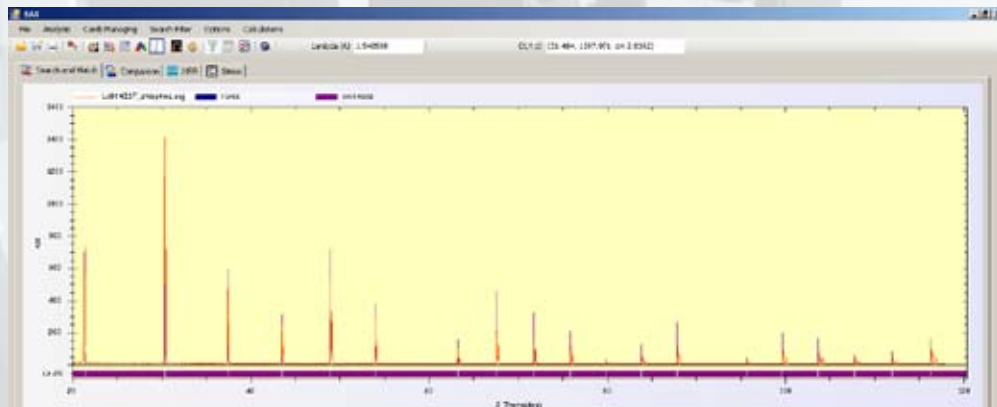
Data collection Programs

GNR offers a large variety of acquisition programs, for standard as well as for customized hardware configurations. The list includes the programs for powder and high resolution diffractometers, retained austenite, data acquisition of stress (plane and triaxial) and thin films (XRR and GID). The programs can control: X-ray generator and tube, instrumental alignment, multi purpose sample holder, scintillation counter, linear silicon strip detector, solid state detectors, high/low-temperature, humidity chambers and other devices.

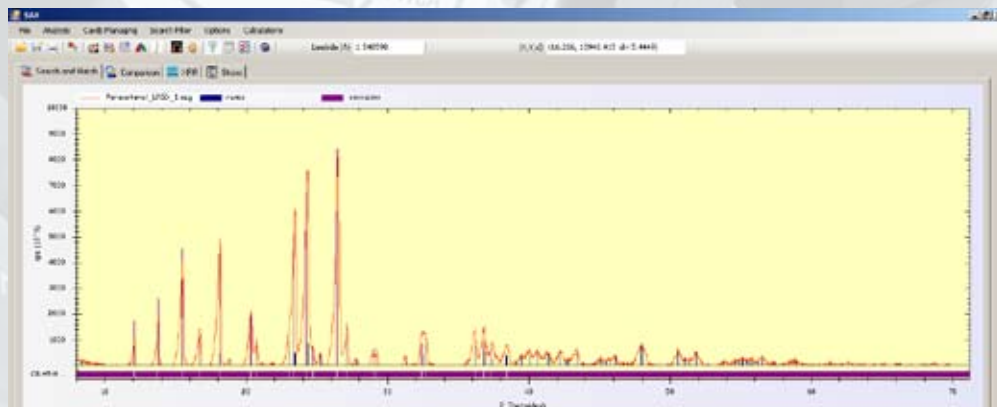


SAX

Single peak analysis; peak treatment. Background subtraction, smoothing, deconvolution and peak localisation. Structural Analysis, Crystallite Size, Lattice Strain, Reflectometry, Quantitative Analysis.



XRPD: LaB₆ NIST STD 660a / Detector: Dynamic scintillation NaI detector

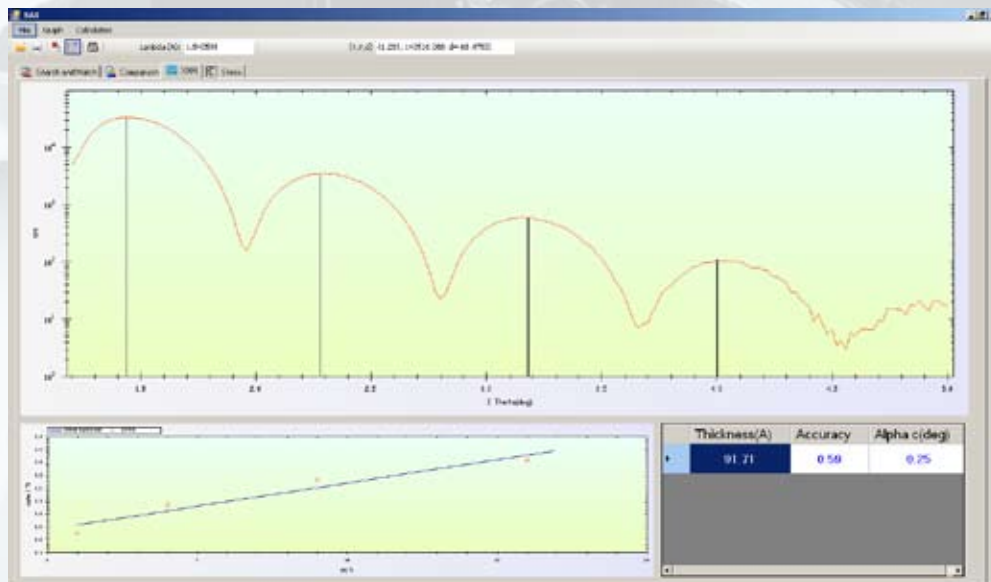


XRPD: Paracetamol form I

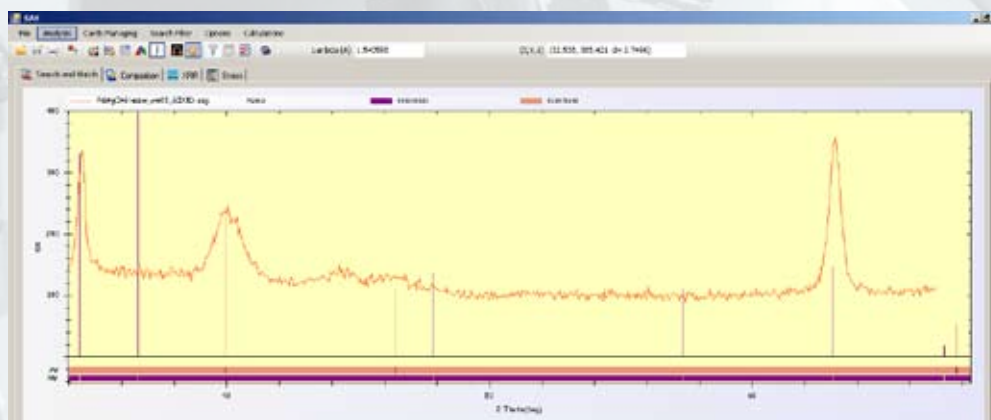
Detector: CELERIX - One-dimensional silicon strip detector. Acquisition time: 120s



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XRR: 10 nm HfO₂ on Si / Detector: Dynamic scintillation NaI detector



GIXRD: 002 and 103 texture on Pd/Mg/glass by sputtering

Stress analysis

It allows to measure and calculate residual stress on any polycrystalline material. Different peak position methods (centroid, chord, Marquardt Fit) are available. Plane and/or triaxial stress. Linear or elliptic interpolation.

