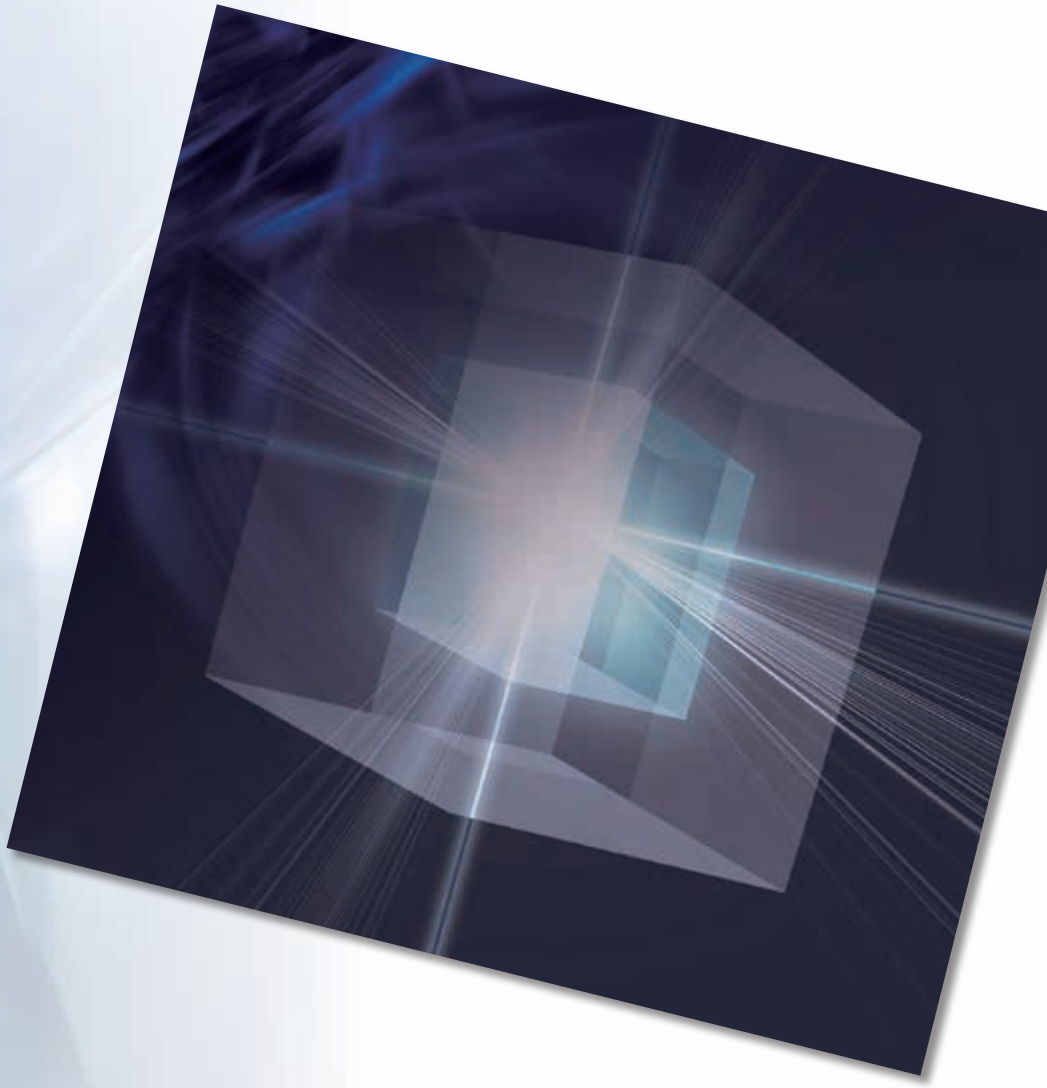
For further extension of the analytical field

Application Attachments

X-ray Diffractometer Attachment Series



Rigaku

Leading With Innovation

Enrich the spheres of application analysis and discover unlimited possibilities

Keeping pace with state-of-the-art analytical techniques,
Rigaku has continued to develop its application attachments to meet
a wide range of analytical needs.
Combined with Rigaku's basic X-ray systems, these sophisticated attachments are chosen
in a multitude of fields for R & D and quality control.
Rigaku offers a variety of options to fit your specific needs and goals.

Examples of attachments used with SmartLab

RxRy attachment head & ϕ attachment base

The combination of RxRy and ϕ attachments provides in-plane rotation of thin films for measurements such as X-ray reflectivity, *in-plane* diffraction, reciprocal space mapping and rocking-curve.

Specifications

RxRy	-5° to 5°
ϕ axis movable range	± 360°
ϕ axis oscillation speed	0.1°/min to 1000°/min

$\alpha\beta$ attachment

This attachment enables pole figure measurements (for both reflection and transmission methods) and strain measurements.

Specifications

α axis movable range	-5° to 95°
β axis movable range	± 360°
β axis spin speed	Max. 30 rpm
Oscillation axis	± 5 mm (reciprocation at 45°)

$\chi\phi$ attachment

This attachment enables pole figure measurements (for the reflection method), strain measurements, and reflectivity measurements of polycrystalline thin films.

Specifications

χ axis movable range	-5° to 95°
ϕ axis movable range	± 360°
ϕ axis oscillation speed	0.1°/min to 1800°/min

Auto Sample Changer ASC-6 attachment

This sample changer allows continuous measurement of up to six samples.
It can be used for reflection as well as transmission measurements.

Specifications

Number of samples	Max. 6 samples
Sample spin speed	Max. 120 rpm
Sample holder	Reflection sample holder Transmission sample holder

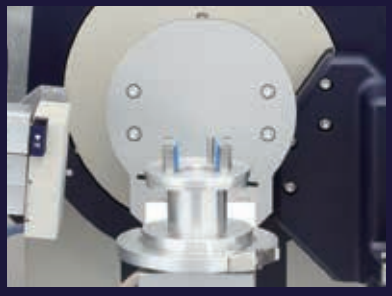
Capillary spin attachment head

With such a sample as a needle-shape or plate-shape crystal filled in a capillary tube, this attachment is designed for measurement while spinning the sample. So the effect of preferred orientation can be reduced.

Specifications

Sample spin speed	Max. 120 rpm
Capillary holder	for 1.0 mm/ 0.9 mm for 0.7 mm/ 0.5 mm for 0.3 mm

β attachment base

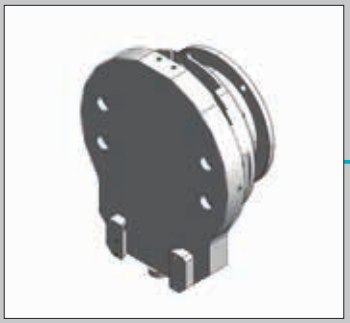


This attachment is designed to remove the effect of coarse crystal grains by sample surface spin of powder and increase of the number of crystallites that contribute to an apparent diffraction pattern.

Specifications

Sample spin speed	Max. 120 rpm

SmartLab (Powder)



Universal Z attachment platform

Standard ATT. base

ASC-6 ATT.

$\chi\phi$ ATT.

$\alpha\beta$ ATT.

β ATT. base

ϕ ATT. base

Attachment base

Battery cell ATT. head

Capillary spin ATT. head

Standard ATT. head

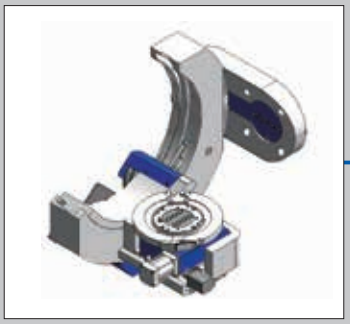
RxRy-ATT. head

XY20mm-ATT. head

XY 4-inch ATT. head

Attachment head

SmartLab (Thin Film)



$\chi\phi$Z attachment platform

Battery cell ATT. head

Capillary spin ATT. head

Standard ATT. head

RxRy-ATT. head

XY20mm-ATT. head

XY 4-inch ATT. head

Attachment head

4" wafer sample plate

4" wafer sample plate (9 mm)

6" wafer sample plate

8" wafer sample plate

Height reference sample plate

Transmission SAXS sample plate

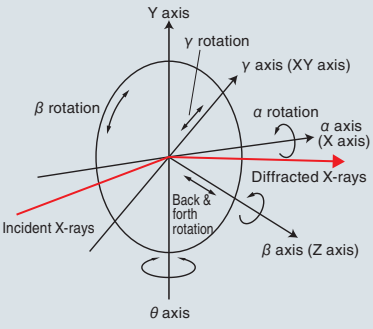
Sample plate

Multipurpose Measurement Attachment
MPA-ML4

When the purpose of measurement includes different types of measurements, this has so far required multiple attachments, each dedicated to a specific measurement.
The multipurpose measurement attachment introduced here is equipped with four driving axes to enable pole figure, thin film and stress measurement with a single unit. This innovative attachment eliminates the troublesome exchange of attachments, and thus helps saving costs, time, and space.

- **The attachment encompasses those functions performed by the pole figure attachment (reflection method, transmission method*, with γ oscillation), stress analysis attachment (iso-inclination method, side-inclination method), thin film attachment, and sample rotation attachment.**
- **Effective for low-angle incidence measurement and pole figure measurement of a thin film sample with the aid of an automatic sample back-and-forth positioning function (minimum translation: 1µm).**
- **Large and thick samples are also measurable (max. diameter: 40 mm, max. thickness: 10 mm). Even 4" wafer can be mounted by use of a vacuum chuck available as an option.**
- **Optical axis alignment with respect to the sample plane is automatically executed.**

Movement of each axis

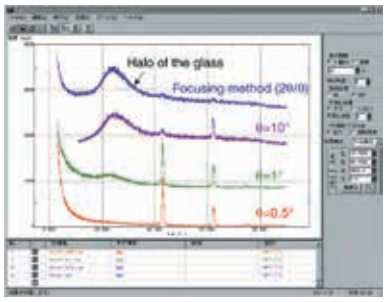


* For the transmission method, 2θ=20° or larger

Example of Measurement

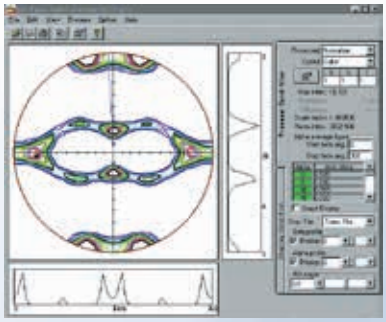
▶ MgO thin film on glass substrate (film thickness: 3000 Å)

This measurement result indicates that a smaller incident angle in the thin-film optical system reduced the intensity of halo caused by the substrate glass, thus raising the relative intensity of diffracted X-ray beam from the MgO film.



▶ Pole figure of aluminum film Al (111)

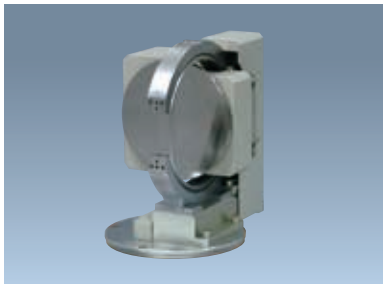
By using the α and β axes of the MPA-ML4, pole figure measurement can be conducted for the evaluation of metal sheet texture components such as rolled sheets.



Specifications

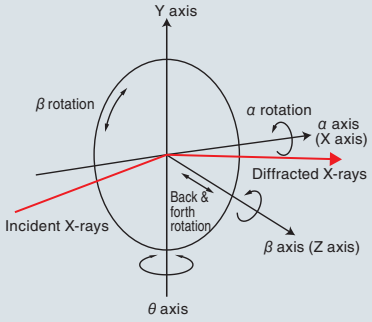
α axis (tilt)	movement range:15 to 120°, Minimum step: 0.001°/step
β rotation range (sample surface rotation)	movement range: 360°, Minimum step: 0.01°/step
Z axis (back and forth)	movement range: 10 mm, Minimum step: 0.001 mm/step
γ axis (reciprocation at 45°)	movement range: ± 5 mm
Sample size	Max. 40 mm diameter and 10 mm thickness 2" to 4" wafer (optional vacuum chuck required)
X-ray diffractometer	Ultima IV, D/MAX/PC

Multipurpose Measurement Attachment
MPA-U4



This sample spinner is designed exclusively for measurements based on the reflection method, such as pole figure measurement (reflection method only), residual stress measurement, thin-film measurement (grazing-incidence measurement), and reflectivity measurement.

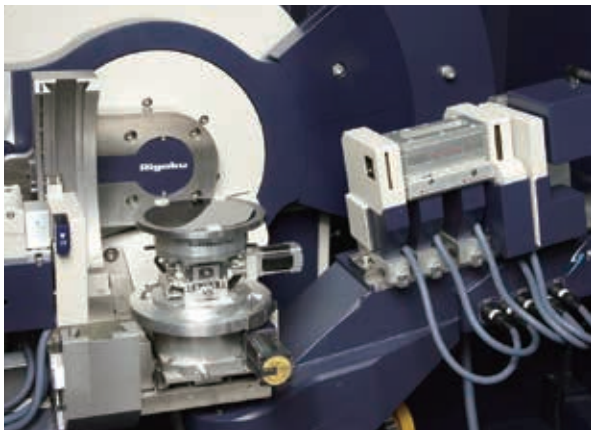
Movement of each axis



Specifications

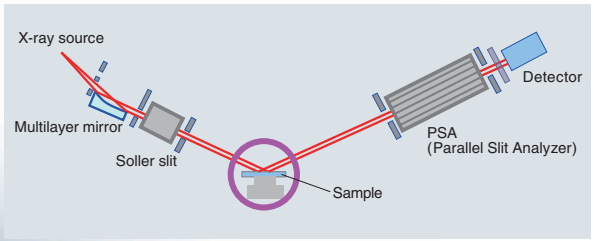
α axis (tilt)	Movement range:-5 to 92°, Minimum step: 0.002°/step
β axis (sample surface rotation)	Movement range: 360°, Minimum step: 0.005°/step
Z axis (fore and aft)	Movement range: - 6 to +1mm, Minimum step: 0.00025 mm/step
Sample size	Max. 100 mm diameter and 8 mm thickness (Including two sample plates of 0 to 5 mm and 3 to 8 mm)
X-ray diffractometer	Ultima IV

High Resolution Parallel Beam Optical System



The high resolution parallel beam optical system is an innovative configuration that widely expands the range of XRD applications. This optical system in X-ray diffractometers is used for measurements of thin films, bulk samples, and powder samples which are difficult to grind. In combination with a multilayer mirror and a PSA (Parallel Slit Analyzer), it offers very strong monochromatized parallel X-ray beams with high brightness.

- **Measurements without eccentric errors (back and forth of sample surface)**
- **High symmetry diffraction patterns**
- **Minimized angular errors, compared to the Bragg-Brentano focusing method**
- **Suitable for measurements such as: Precise measurements of lattice constants, *In-situ* measurements (e.g. measurements with temperature variations), Rietveld analysis, Random orientation measurements of samples with preferred orientation, Indexing, Measurements and profile analyses of organic samples, Thin film and in-plane measurements**



PSA (Parallel Slit Analyzer)

The high resolution parallel beam optical system employs two parallel slits: a PSA (Parallel Slit Analyzer) which directly determines angular resolutions and a Soller slit which reduces "Umbrella effects". In addition, it can be combined with the following components, each optimized for a specific measurement method:

- Sample rotation stage for the reflection method
- Capillary sample stage for the transmission method
- Large aperture PSA and large aperture scintillation counter for high resolution thin film measurements

Aperture angle	Window width	X-ray diffractometer
0.114deg.	4mm	Ultima IV, TTRAX III, D/MAX/PC
	8mm	SmartLab, Ultima IV, TTRAX III
	10mm	TTRAX III, D/MAX/PC
0.057deg.	4mm	TTRAX III, D/MAX/PC
	10mm	

∗ PSA varies depending on the instrument.

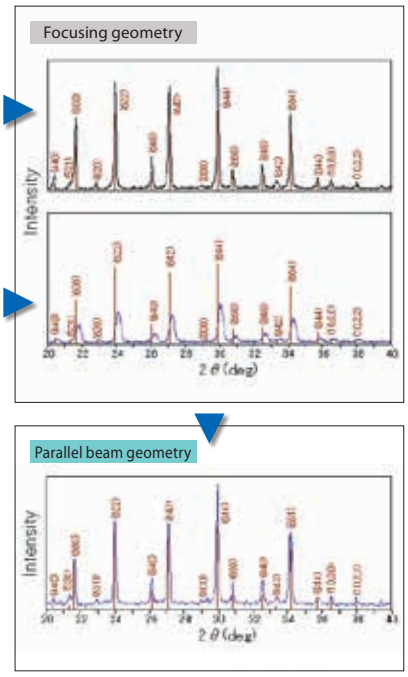
Eliminating error factors attributed to uneven sample surface

Parallel beam optics can eliminate errors attributed to uneven surface of samples.
When samples are prepared by those without much experience, or when dealing with samples that are particularly difficult to work with, sample surfaces can become uneven. In these cases, use of focusing geometry will result in a shift in the diffraction profile. With the parallel beam method, the unevenness of the sample surface does not cause the diffraction profile to shift, making it possible to obtain good data with high intensity and high resolution.

Flat sample surface

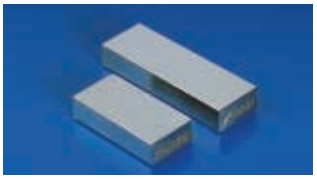
Uneven sample surface

(Sample: Zeolite)

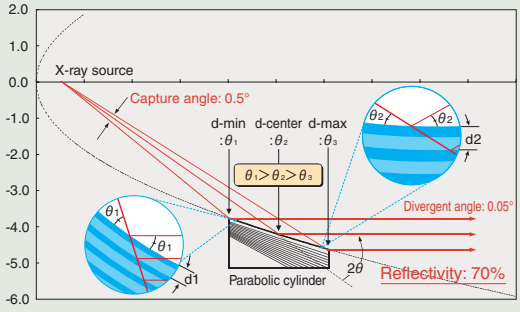


Multilayer mirror

Rigaku's patented multilayer mirror (graded d-spacing parabolic artificial lattice) is designed to convert a divergent X-ray beam and enhance its intensity for the specific measurement purpose by grading the d-spacing of the highly reflecting artificial lattice.



Principle Diagram of Multilayer Mirror
The graded d-spacing paraboric W/Si multilayer



Multipurpose High Temperature Attachment

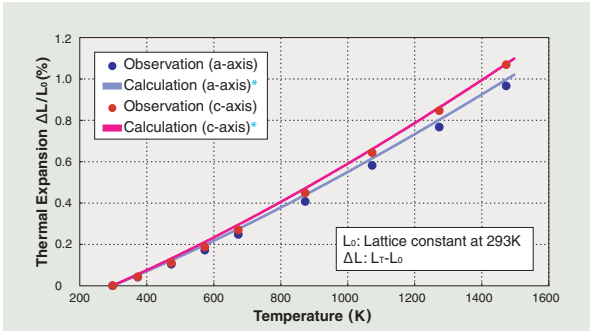
This attachment is designed to get information on crystal structure changes and changes of solubility (phase diagram) among various substances by heating a sample at high temperatures. The furnace design unique to Rigaku allows thin film and stress measurements. Al coated Kapton foil is used in the airtight case to minimize X-ray attenuation.

Example of Measurement

▶ Thermal expansion of Al_2O_3 (Corundum)

Temperature (K)	Lattice constant (Å)	
	a axis	c axis
298	4.75916 (05)	12.99212 (18)
373	4.76111 (08)	12.99761 (29)
473	4.76410 (04)	13.00638 (17)
573	4.76734 (03)	13.01630 (13)
673	4.77098 (05)	13.02716 (20)
873	4.77854 (09)	13.05035 (35)
1073	4.78686 (07)	13.07556 (27)
1273	4.79571 (11)	13.10166 (96)
1473	4.80514 (11)	13.13095 (42)

(Parentheses show the standard deviations for the 7 reflections of Al_2O_3)



* Y.S.Touloukian,et.al,Thermophysical properties of matter,13,176 (1977)

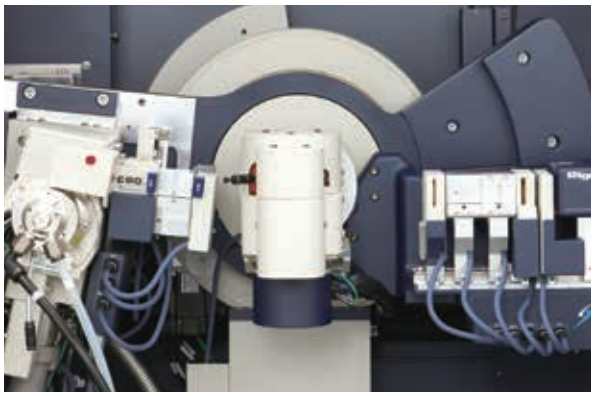
Specifications

Operating temperature range	Ambient to 1500°C in air, Ambient to 1450°C in vacuum Ambient to 1300°C in inert gas (He)
Measuring angle range	2θ = 0 to 158° (this range varies depending on a goniometer to be combined)
X-ray window	Al coated Kapton foil. Insulation drum material (window) Ni foil
Sample heating system	Side heating system
Thermocouple	JIS R type (Pt-PtRh13%) For temp. measurement: 0.2 mm dia. For control: 0.3 mm dia.
Sample size	Max. 13.5 mm x 25 mm, 0.5 mm thickness
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III, D/MAX/PC

* A program temperature controller is required.

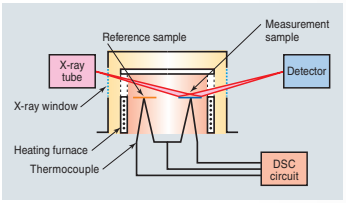
Simultaneous Measurement System of X-ray Diffractometry and Differential Scanning Calorimetry

X-ray DSC



An example of Installation in SmartLab

Crystals are continuously changing during transition, dehydration, fusion and solidification. The XRD-DSC system is capable of carrying out simultaneous measurements of both crystal changes and thermal changes. The system is highly effective for the evaluation of organic compounds, pharmaceuticals, polymers, inorganic compounds, ceramics, or electronic materials. Since X-ray diffraction and differential scanning calorimetry measurements are performed under the same conditions regarding sample, temperature and measurement atmosphere, substantially upgraded reliability of the analysis outcome as well as efficiency in working on R & D and quality evaluation can be achieved.

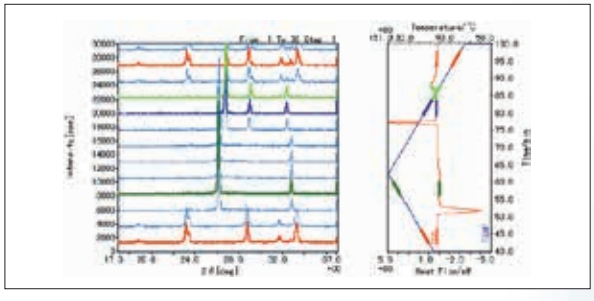


Principle diagram

Example of Measurement

▶ Phase transition of potassium nitrate (KNO_3)

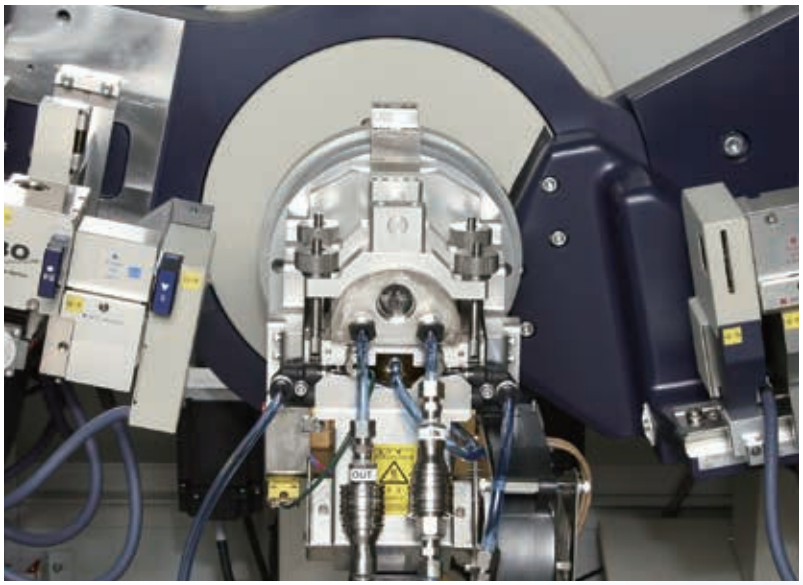
In the heating process, KNO_3 material changes from the orthorhombic system to the rhombohedral system at about 128°C. In the cooling process, it returns to the orthorhombic system after passing through an intermediate phase that is known to emerge only during the cooling process. The diagram shows KNO_3 measured in the heating and cooling process.



Specifications

X-ray diffractometer	Theta-theta type X-ray diffractometer
DSC section	Heat flow type DSC circuit
Sample container	Made of aluminum, 7 mm × 7 mm × 0.3 mm
Operating temperature range	Ambient to 350°C (option: low temp measurement from -40°C)
Measurement atmosphere	Air, inert gas (option: Humid atmosphere measurement from ambient to 60°C 5%RH to 95%RH by connecting to humidity generator HUM)
Measuring angle range	2θ = 1.5 to 60°
Heating and cooling rate	0.5 to 20°C/min, Held constant temperature depending on how the measuring angle range and the fixed-rate auto speed are combined.)
X-ray diffractometer	SmartLab

Infrared Heating High temperature Attachment Reactor X



An example of Installation in SmartLab

Installed to a theta-theta goniometer or a vertical goniometer, this attachment is deigned for X-ray diffraction measurement of a sample being heated. Employment of infrared heating system enables simulation of rapid heating and cooling. Further, since the heater section and the sample section are separated, this makes it possible to conduct measurements in various gas atmospheres. Accurate setting can be made easily by automatic control from systems.

Removable sample chamber

Specifications

Operating temperature range	Ambient to 1000°C
Sample atmosphere	Air, inert gas, etc.*
Measuring angle range	2θ = 0 to 158° ★
X-ray window	Metallic beryllium
Container material	SUS
Sample heating system	Infrared heating system
Thermocouple	JIS K type
Sample holder material	Made of quartz glass
Sample plate material	Made of quartz glass
Sample size	Max. 20 mm x 13 mm, 0.3 mm thickness
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III

* Consult Rigaku when the use of a special gas is wanted.
* A programming temperature controller 3kVA (Ultima IV, TTRAX III) or a programming temperature controller PTC-EVO + 4kW power unit (SmartLab) is required.

★ this range varies depending on a goniometer to be combined

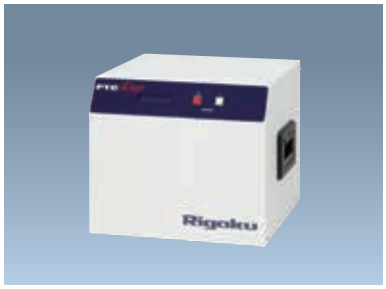
Humidity Generator
HUM-SL

Just setting a target relative humidity can obtain stable humidity by a feedback control. This unit is suitable for the generation of humid gas of several 100 mL/min which is relatively small flow rate, and optimal for thermal stability tests under humid atmosphere and continuous measurements of humidity absorption and dehydration changes.

Specifications

System	Diversion system (1 tank bubbling method) Feedback control with thermal and humidity sensors located near a sample under measurement.
Temp. & humidity control range	Ambient to 40°C 5%RH to 95%RH 40°C to 60°C 10%RH to 90%RH
Thermal stability	Within ±1.5%RH (excepting the transient state at a time of changing the setting)
Duration of operation	Approx. 100 hours at approx. 60°C, 90 %RH
Gas required	Dry air or nitrogen, approx. 0.05 MPa, Flow rate: Max. 500 mL/min, through pipe of 6 mm O.D.
External dimensions	Approx. 180 (W) × 420 (D) × 260 (H) mm
X-ray diffractometer	SmartLab

Programming Temperature Controller PTC-EVO



The PTC-EVO temperature controller is designed especially for use with the optional SmartLab temperature attachments, such as the high temperature attachment or the infrared heating high temperature attachment. The employed “Advanced Control” algorithm prevents overshooting during rapid heating and ensures a constant temperature control.

Specifications

Control	PID control
Power section	SCR control
Thermocouple	One each for sample and electric furnace, Supported for R (PtRh13) and K (CA)
Power consumption	100VAC±10%, 15A
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III, D/MAX/PC

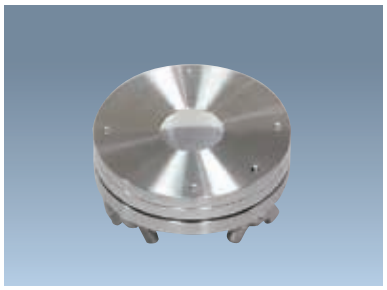
Airtight Sample Attachment

This attachment is designed to handle samples that react with air (oxygen, moisture vapor, etc.), enabling measurement under a controlled environment such as an inert gas environment.

Specifications

Atmosphere	Vacuum or inert gas Equipped with stop valve
Measuring angle range	2θ = 0 to 158° ★
X-ray window	Metallic beryllium
Sample size	Max. 20mm x 18mm, 1.5 mm thickness
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III, D/MAX/PC

Battery Cell Attachment



An example of Installation in Ultima IV

This attachment, equipped with a lithium-ion battery, is designed for XRD measurements of structural changes in electrode materials during charging and discharging cycles.

Specifications

Material	Stainless, Teflon
Number of poles	2 poles
Electrolyte inlet	1 inlet
Measuring angle range	2θ= 10 to 158° ★
Sample size	18 mm diameter
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III, D/MAX/PC

Exhaust Unit

This unit is used to be combined with a high temperature attachment.

Specifications

Pressure	Max. 0.67 Pa
Exhaust unit	135/162 (L/min) 50/60Hz
Power consumption*	100 to 120VAC ±10%, 7A
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III, D/MAX/PC

★ This range varies depending on an instrument to be combined.

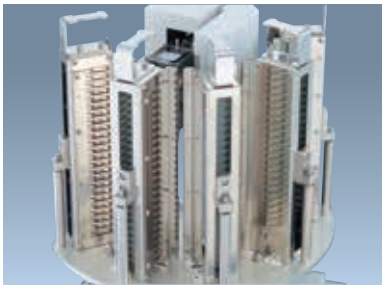
Counter monochromator

Installed on the counter arm of a wide angle goniometer, the counter monochromator removes interfering components such as continuous X-rays, fluorescent X-rays or scattered X-rays, that are included in the diffracted beams from a sample. With only the monochromated characteristic X-rays left that are required for XRD analysis, it is possible to obtain diffraction patterns with a high S/N ratio.

Specifications

Monochromated X-rays	Cu Kα line (option: Kα line of Cr, Fe, Co, Mo)
Analyzing crystal	Pyrolytic graphite (0002), switchable between Focusing method and Parallel beam method
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III, D/MAX/PC

Auto Sample Changer ASC-48



An example of installing five magazines

This sample changer allows a measurement of up to 48 samples. Due to the in-plane sample rotation employed, it is suitable for the measurement of samples with coarse crystal particles or preferred orientation.

Specifications

Number of samples	Standard: 48 samples, Max.: 120 samples
Measuring angle range	$2\theta = 3.2$ to 162° ★ (Effective angles centering on the sample position)
Sample rotation speed	Max. 120 rpm
Magazine	Max. 2 sets (Each magazine can accommodate up to 24 sample plates measuring 35 mm in width, 50 mm in height, 2 mm in thickness)
Sample holder	0.5-mm deep glass sample holder (Option: 0.2-mm deep glass sample holder)
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III

Auto Sample Changer ASC-6

This sample changer allows continuous measurement of up to six samples. It can also be used for thin-film measurements.

Specifications

Number of samples	Max. 6 samples
Sample rotation speed	Max. 120 rpm
Measuring angle range	$2\theta = 0$ to 158° ★
Sample size	Max. 24 mm diameter and 2 mm thickness
X-ray diffractometer	SmartLab, TTRAX III, D/MAX/PC

Auto Sample Changer ASC-10

This sample changer allows continuous measurement of up to ten samples.

Specifications

Number of samples	Max. 10 samples
Sample rotation speed	Max. 120 rpm
Measuring angle range	$2\theta = 0$ to 158° ★
Sample size	Max. 24mm diameter and 2 mm thickness
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III

Sample Rotation Attachment

This attachment is designed to remove the effect of coarse crystal grains by sample surface rotation, thereby increasing the number of crystallites that contribute to an apparent diffraction pattern.

Specifications

Measurement method	Reflection method
Sample rotation speed	Max. 120 rpm
Measuring angle range	2θ=3.2 ~ 158° ★
X-ray diffractometer	Ultima IV, TTRAX III, D/MAX/PC

Thin Film Sample Rotation Attachment

This attachment is used specifically for thin film sample measurements. Its sample back-and-forth moving mechanism allows low angle incidence with the stationary θ-axis.

Specifications

Sample rotation speed	Max. 120 rpm
Back-and forth mechanism for sample	-5 mm to 2 mm
Measuring angle range	2θ= 0 to 158° ★
X-ray diffractometer	Ultima IV, TTRAX III, D/MAX/PC

Capillary Spinner Attachment

This attachment is designed for measurements of samples such as a needle-shape or plate-shape crystal filled in a capillary tube while rotating the sample in the transmission method, thus reducing the effect of preferred orientation.

Specifications

Rotation speed	Max. 120 rpm
Oscillation	Within 0.2 mm diameter
Capillary sizes	0.8 to 2.0 mm diameter
X-ray diffractometer	SmartLab, Ultima IV, TTRAX III, D/MAX/PC

Fiber Sample Attachment

Mounted on a wide angle goniometer, this attachment is designed for measurements with fibers extended to observe the changes in their crystalline structures and evaluate the preferred orientation. Measurements can be made in the equatorial plane, the meridian plane or at any orientation angle.

Specifications

Sample rotation	Rotation with a pulse motor in the meridian direction
Measuring angle range	2θ= 0 to 60° ★
Geometry	Parallel beam method with a collimator
X-ray diffractometer	Ultima IV, TTRAX III, D/MAX/PC

★ This range varies depending on an instrument to be combined.

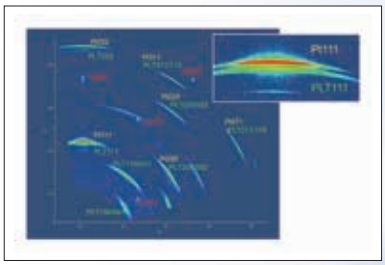
2D Hybrid Pixel Array Detector **HyPix-3000**

HyPix-3000 is a next-generation two-dimensional semiconductor detector designed specifically to meet the needs of the home lab diffractionist. One of HyPix-3000's unique features is its large active area of approximately 3000 mm^2 with a small pixel size of 100 μm^2, resulting in a high spatial resolution. Noise-free measurement mode with maximum background elimination and shutter-less measurement mode enable high-speed and high-resolution measurements.

All detection modes (0D, 1D, 2D) available
Extremely reduced background
Wide dynamic range
High spatial resolution
High-speed data collection with "zero dead time" mode
Short-time wide reciprocal lattice mapping

Example of Measurement

▶ **Reciprocal lattice mapping of PLT/Pt/Si**

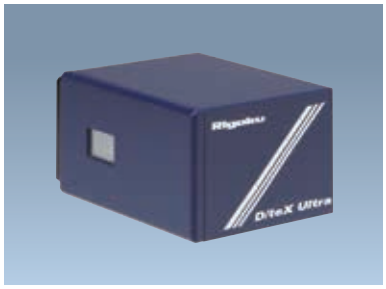


Sample: (Pb, La) TiO_3/Pt/Si substrate
Duration: 15 minutes

Specifications

Effective area	2,984 mm^2 (77.5 × 38.5 mm)
Detection element	2D silicon pixel semiconductor
X-ray diffractometer	SmartLab

High-Speed 1D X-ray Detector **D/teX Ultra**

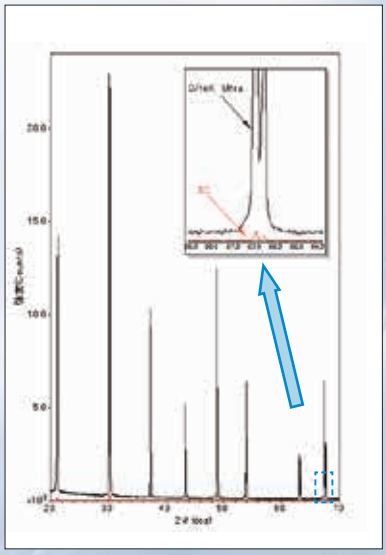


D/teX Ultra is a high-speed one-dimensional X-ray detector using a state-of-the-art semiconductor device. The detector enables a drastic reduction of the measurement time, while obtaining greater intensity in diffraction data and extremely low backgrounds. These features make D/teX Ultra the most suitable detector for high throughput analysis and on-site observation (*in-situ* measurements) of phase transitions caused by sample atmosphere changes (temperature, humidity).

Example of Measurement

▶ **High sensitivity measurement**

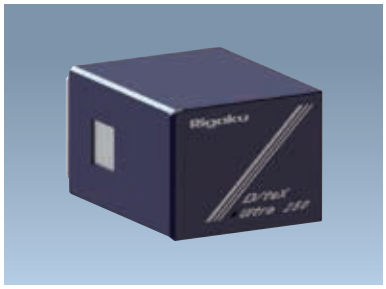
The capability of high sensitivity detection simplifies trace analyses.



Specifications

Effective area	256 mm^2 (20 × 12.8 mm)
Detection element	1D silicon strip semiconductor
X-ray diffractometer	MiniFlex, Ultima IV, TTRAX III, D/MAX/PC

High-Resolution and High-Speed 1D Detector **D/teX Ultra 250**



D/teX Ultra 250 is a high spatial resolution and high-energy resolution 1D semiconductor detector. It is equipped with 256 channels of 75-μm wide strips enabling high-angular resolution measurements as well as high-speed measurements. By using this detector, it is possible to obtain intensities about 150 times greater than that of conventional scintillation counters.

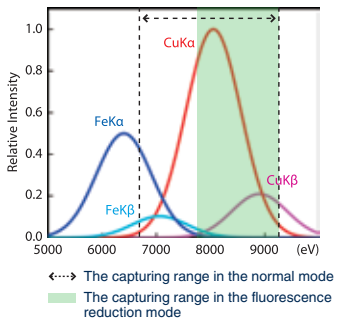
High intensity measurements with a wide sensitive area of 384 mm^2

Strip width: 75 μm
D/teX Ultra 250 has as many as 256 channels and a large active area, while still maintaining a high resolution.

Energy discrimination

This function makes it possible to specify an energy range and effectively reduce fluorescence X-rays emitted by a sample, thus obtaining a high P/B ratio (peak-to-background ratio).

Spectra with D/tex Ultra 250



Specifications

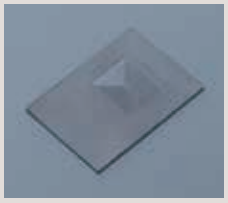
Effective area	384 mm^2 (20 × 19.2 mm)
Detection element	1D silicon strip semiconductor
X-ray diffractometer	SmartLab

Sample Holders

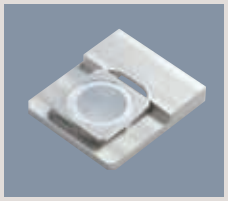

0.2 mm depth
Glass Sample Holder

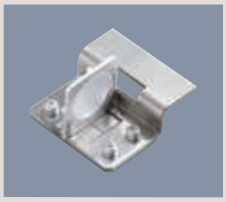

0.5 mm depth
Glass Sample Holder


Al Sample Holder


Si Zero-Background
Sample Holder


Block Sample Holder


General-Purpose Sample
Holder (Reflection)


General-Purpose Sample
Holder (Transmission)

Sample Holders for ASC-6 and 10


Ring-Shaped
Sample Holder for ASC


2 mm depth
Sample Holder for ASC


0.2 mm depth
Sample Holder for ASC


0.5 mm depth
Sample Holder for ASC


Zero-Background
Sample Holder for ASC


Trace Sample Holder
with 18-mm Glass


Trace Sample Holder
with 9-mm Glass


Substrate Standard
Sample Holder (Zn, Al)


Alumina Intensity Standard
Holder for Quantitative
Analysis for Asbestos

Sample Holders for High Temperature Attachments


Pt Shelf-Shaped
Sample Holder


Pt Flat-Shaped
Sample Holder

Atmosphere Separators


Atmosphere Separator


Air-sensitive
sample holder

An Unique Heating Attachment for Four-Circle Goniometers

DHS1100

The DHS 1100 is an advanced heating attachment for *in-situ* diffraction studies on four-circle goniometers up to 1100°C. It fits to all common four-circle goniometers instead of the standard sample holder. The unique dome-shaped X-ray window made of graphite allows sample analyses under vacuum and inert gas to avoid oxidation or other chemical reactions of the sample at high temperatures.

Specifications

Temp. range	Ambient to 1100°C
Temp. control	Temperature Controller Unit
Atmospheres	Vacuum, air, inert gas
Compatible stage	Universal Z attachment platform, $\chi\phi$Z attachment platform

Low-Temperature Attachment for Four-circle Goniometers and XYZ Stages

DCS 500[*1]

The DCS 500 is a novel attachment for *in-situ* X-ray diffraction studies between -180 °C and 500 °C on four-circle goniometers and XYZ stages. The clever design of the instrument provides for a high temperature uniformity and good position stability of the sample over the whole temperature range. The combination of a liquid nitrogen flow control unit and a temperature control unit guarantees short cooling and heating cycles. High-precision temperature measurement is performed in the sample holder.

Specifications

Temp. range	-180°C to 500°C
Temp. control	Temperature Controller Unit
Atmospheres	Vacuum, air, inert gas
Compatible stage	Universal Z attachment platform, $\chi\phi$Z attachment platform

Environmental Heating for Homogeneous Sample Temperature

HTK 1200N | HTK1200N 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 sample spinning option provides highly random grain orientation, which is necessary for good diffraction data quality and subsequent profile fitting routines.

Specifications

Temp. range	Ambient to 1200°C
Temp. control	Temperature Controller Unit
Atmospheres	Vacuum, high vacuum, air, inert gas, etc.[*2]
Compatiblestage	Universal Z attachment platform

Filament Heating up to 2300 °C

HTK 16N | HTK 2000N

The HTK 16N and HTK 2000N high temperature chambers are used for X-ray studies with direct sample heating. Investigations can be carried out in vacuum or various gases depending on the experiment and the used heating filament (Pt, Ta, W, C or others on request).
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.

Specifications

Temp. range	Ambient to 1600°C (HTK 16N) Ambient to 2300°C (HTK 2000N)
Temp. control	Temperature Controller Unit
Atmospheres	Vacuum, high vacuum, air, inert gas
Compatible stage	Universal Z attachment platform

Products of Anton Paar

*1 For thin film system (X-ray diffractometer: SmartLab, Ultima IV, TTRAX III)
*2 Consult Rigaku when the use of a special gas is wanted.

In-situ XRD Investigations of Solid State Reactions

XRK 900

The XRK 900 is the only reactor chamber for X-ray diffraction experiments on the market. Its robust and sophisticated design allows performing studies of solid state and solid state-gas reactions from room temperature to 900 °C. For solid state-gas reactions defined atmospheric conditions are an important precondition. The design permits homogeneous flushing with reaction gas and gas flow through the sample. The housing can be heated up to 150 °C to prevent condensation of reaction products.

Specifications

Temp. range	Ambient to 900°C
Temp. control	Temperature Controller Unit
Atmospheres	Vacuum (1hPa), air, inert gas Reaction gases from 1 hPa to 1 mPa
Compatible stage	Universal Z attachment platform

Low-Temperature XRD Studies between -190 °C and 600 °C

TTK 600

The TTK 600 Low-Temperature Chamber is a versatile XRD sample stage for in-situ X-ray diffraction from -190 °C to 600 °C. Accurate temperature control along with fast heating and cooling in reflection or transmission geometry make this chamber equally well suited for routine measurements and scientific research.

Specifications

Temp. range	-190°C to 600°C
Temp. control	Temperature Controller Unit
Atmospheres	Vacuum, high vacuum, air, inert gas, N_2
Compatible stage	Universal Z attachment platform

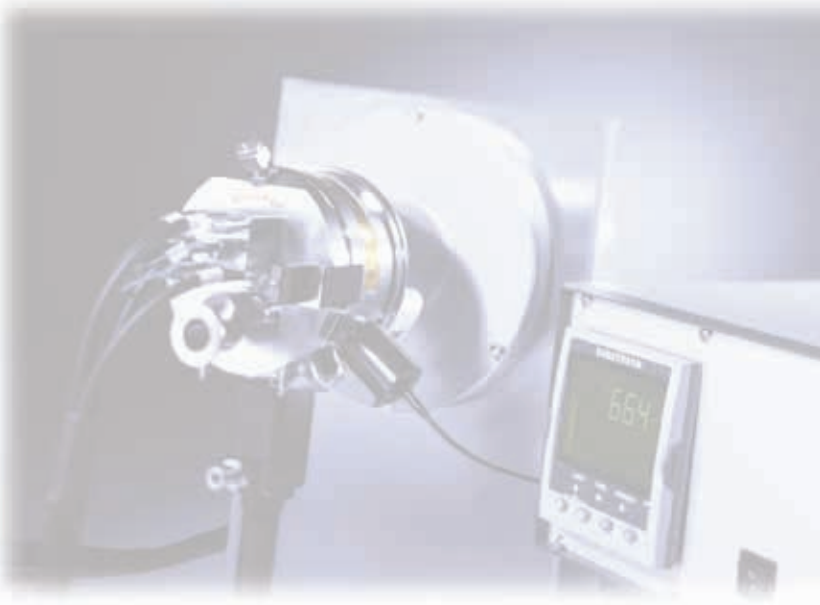
Studies Under Controlled Temperature and Relative Humidity Conditions

CHC plus+

With the CHC Cryo & Humidity Chamber the effects of temperature and relative humidity (RH) on materials can be studied with X-ray diffraction experiments. The housing of the CHC and the transfer hoses for the humid gas are heated above sample temperature by a circulating water bath, to prevent any condensation inside the system.

Specifications

Humidity range	2%RH to 95%RH (10 to 60°C)
Temp. range	-180°C to 400°C (in vacuum) 10°C to 80°C (in humid atmosphere)
Temp. control	Temperature Controller Unit
Atmospheres	Vacuum, inert gas Humidity atmosphere (air or nitrogen)
Compatible stage	Universal Z attachment platform



* The numeric values of performance indicated in this brochure are based on the test results at Rigaku. Rigaku does not warrant that the identical values can always be obtained regardless of different operational environments.
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