Bruker **AXS**

D8 DISCOVER

● Diffraction Solutions

think forward

Meet "Da Vinci" –
D8 DISCOVER

"Experience is required in order to design every instrument."
(Leonardo da Vinci)

Driven by the Bruker AXS philosophy – always try to outperform the expectations of the market – we have continuously extended the capabilities of our X-ray diffractometers throughout the last decade. By using this experience and by incorporating our users' feedback and needs, our systems have evolved to the most advanced solutions for X-ray analysis. This statement is proven each and every day, as over four thousand instruments are in use by scientists, researchers, developers, and process managers all over the world, because they trust in the analytical performance and reliability of our diffractometers.

"Poor is the pupil, not surpassing his master."
(Leonardo da Vinci)

The time has come for the next generation to take over. We proudly present the successor to the most popular materials research system over the last decade – our new D8 DISCOVER!

We are convinced that users in materials research and development will benefit from the advanced capabilities of the new D8 DISCOVER immediately – getting better results, faster and easier with unlimited possibilities.

"Simplicity is the ultimate sophistication."
(Leonardo da Vinci)

Microelectronics, photonics, Micro Electro Mechanical Systems (MEMS), energy generation and storage, data storage, nanotechnology, soft matter, thin films and coatings … whatever field of materials research you are active in, our new D8 DISCOVER offers the future-proof technological innovation to master your next challenge with unmatched ease of use.

Move up to the next dimension in X-ray diffraction and meet "Da Vinci" – with D8 DISCOVER!
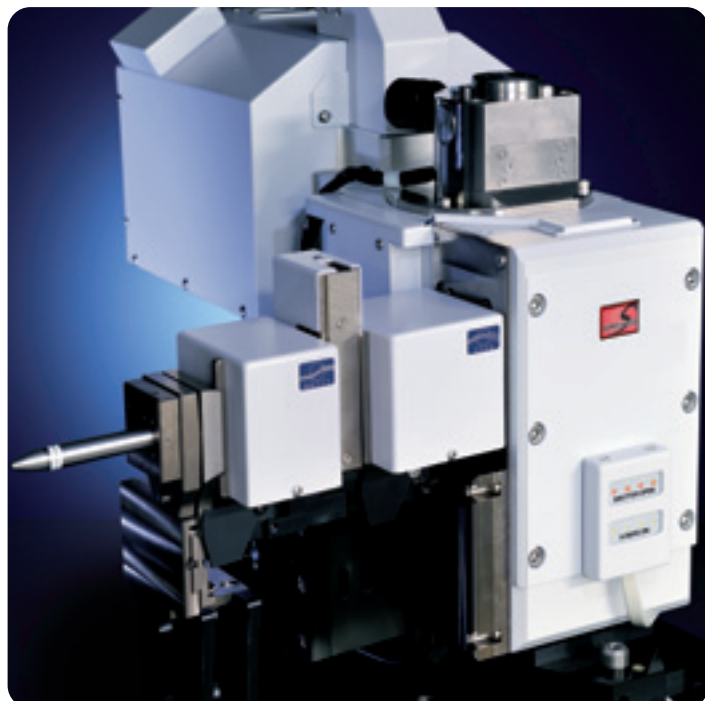
VÅNTEC-1 1-D detector

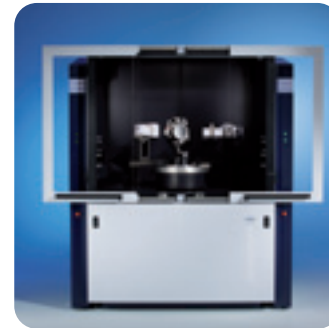VÅNTEC-500 2-D detector

TURBO X-RAY SOURCE

LYNXEYE 1-D detector

Storage rack for optics & components

LED cabinet illumination

Patented door opening: sliding

DAVINCI.SNAP-LOCK

SUPER SPEED components
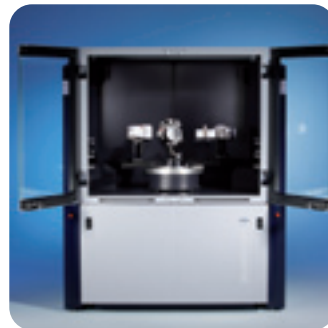

Smart screen key display

LED shutter display

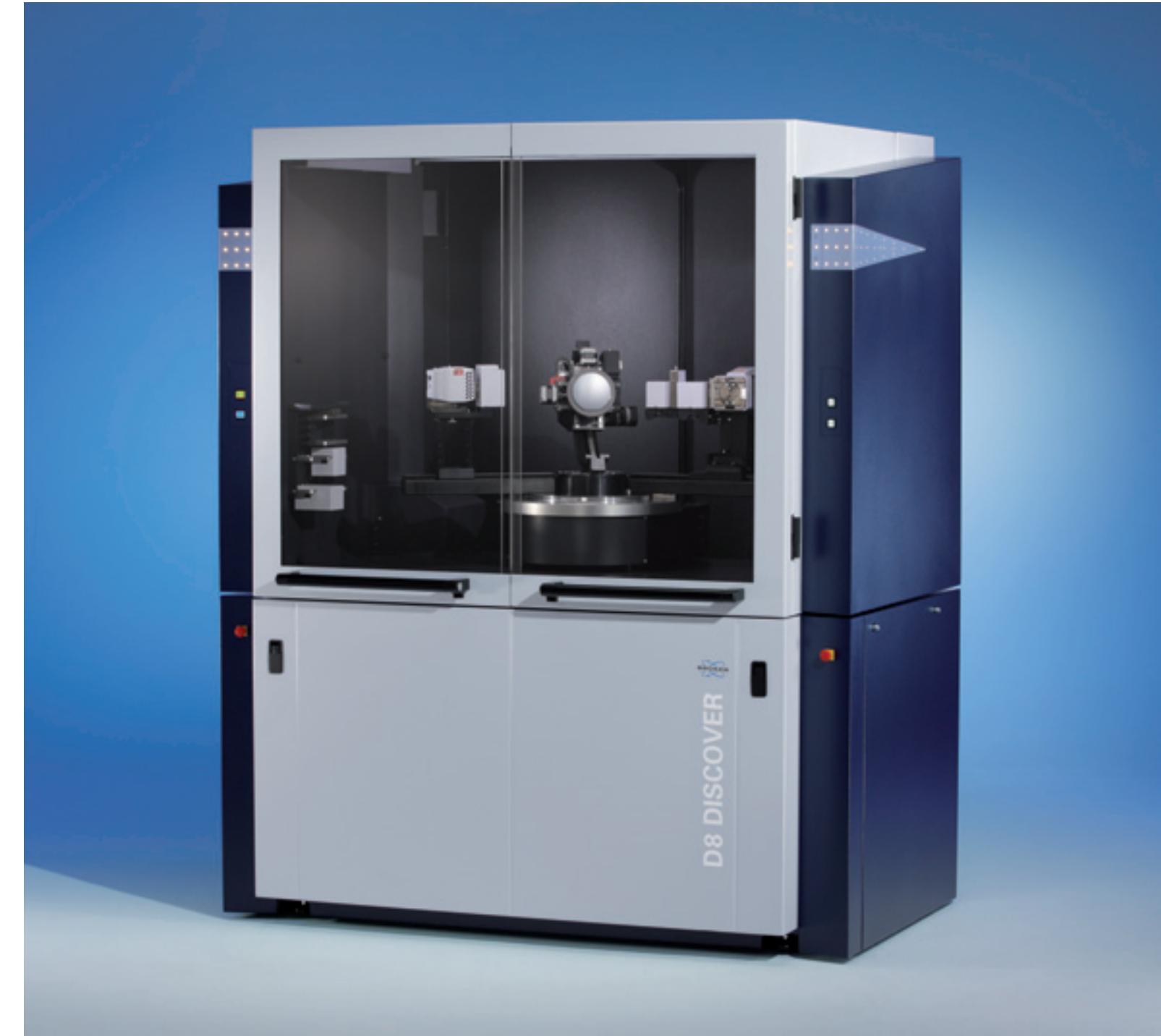X-ray ON status

Patented TWIST-TUBE

Patented door opening: swing

Patented door handling

Cabinet on casters

D8 DISCOVER – the must-have solution for X-ray analysis

Materials analysis, by means of X-rays, covers almost every scientific field.

This also includes compelling research areas like nanomaterials, photonics, microelectronics, energy generation and storage, soft matter …

The enormous breadth of research areas results in a wide variety of materials properties:

– Consistency: solids, liquids, gels, powders, faults, defects
– Size: from barely visible to large machined parts
– Nano-scale order: from amorphous to long-range perfect order, and anywhere in-between
– Orientation: from random, epitaxial to single crystal
– Composition: chemical, crystalline phases
– Quality: porosity, faults, voids, defects, strain

Depending on the sample properties, particular parameters can be determined by X-ray analysis:

– Thickness, composition, mismatch, relaxation, and defects of epitaxial layers
– Thickness, roughness, and density of crystalline or amorphous layers
– Orientation identification and quantification of crystalline, textured layers or bulky samples
– Residual stress in crystalline layers or bulky samples
– Qualitative and quantitative phase composition, d-spacings and strains of crystalline powders and bulky samples
– In addition, the reaction of the parameters to environmental conditions such as temperature, pressure, humidity, applied voltage or stress, etc. can be investigated

Our D8 DISCOVER is the most capable X-ray solution for these materials research topics, and the D8 DISCOVER provides these advanced capabilities – with our Best-Data Guarantee and shortest time to result.

This is due to our sophisticated platform design that facilitates optimized workflow from instrument setup to results.

DIFFRAC.SUITE, the latest and most comprehensive software suite for X-ray analysis, is integral to the D8 DISCOVER. Our DIFFRAC.SUITE empowers you to meet any analytical task – unparalleled in terms of accuracy, reliability and ease of use.

DISCOVER your samples' secrets with DIFFRAC.SUITE!

DIFFRAC.SUITE

DIFFRAC.MEASUREMENT CENTER with:

- DIFFRAC.COMMANDER
- DIFFRAC.CONFIGURATION
- DIFFRAC.DAVINCI
- DIFFRAC.D8 MANAGER
- DIFFRAC.TOOLS
- DIFFRAC.WIZARD

DIFFRAC.EVALUATION PACKAGE with:

- DIFFRAC.EVA
- DIFFRAC.TOPAS
- DIFFRAC.LEPTOS
- DIFFRAC.MULTEX
- DIFFRAC.POLYSNAP
- DIFFRAC.NANOFIT

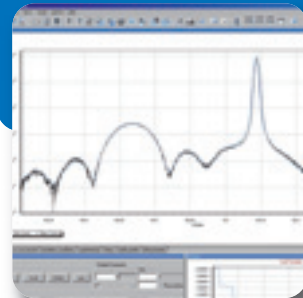
High-Resolution X-ray Diffraction (HRXRD)

- thickness
- lattice parameter
- lattice mismatch
- composition
- strain & relaxation
- lateral structure
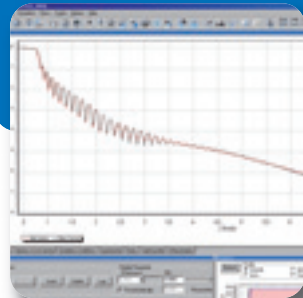- mosaicity
- defects

Epitaxial multilayers

X-ray Reflectometry (XRR)

- layer thickness
- composition
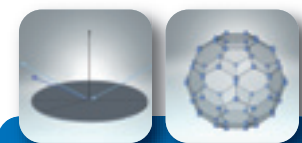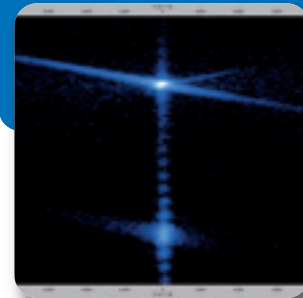- roughness
- density
- porosity

Coatings

Reciprocal Space Mapping (RSM)

- lattice parameter
- lattice mismatch
- composition
- orientation
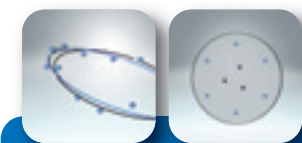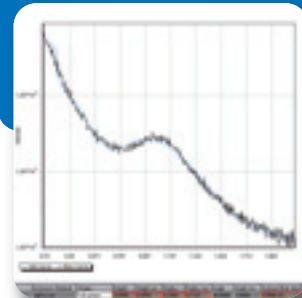- relaxation
- lateral structure

Patterned wafers

In-Plane Grazing Incidence Diffraction (in-plane GID)

Grazing Incidence Small Angle X-ray Scattering (GISAXS)

- lattice parameter
- lateral correlations
- roughness
- orientation
- phase composition
- porosity
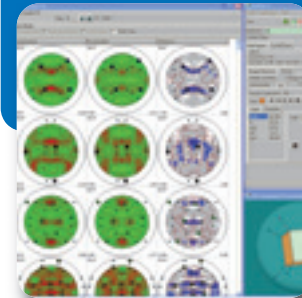- particle size

Multilayer nanostructures

Stress and Texture

- orientation distribution
- orientation quantification
- strain
- epitaxial relationship
- hardness

Machined items

Phase Identification (Phase ID)

- phase composition
- d-spacing
- preferred orientation
- lattice symmetry
- crystallite size

Coatings

DAVINCI design –
advanced ideas
last forever

"Leonardo da Vinci is revered for his techno-logical ingenuity and his extraordinary powers of invention. Leonardo developed a unique new attitude towards machines. He reasoned that by understanding how each separate machine part worked, he could modify them and combine them in different ways to improve existing machines. Leonardo set out to write the first systematic explanations of how machines work and how the elements of machines can be combined."

Any qualified engineer is well-advised to take Leonardo's principles to heart, for over the centuries they have lost none of their universal validity or relevance. It is clearly apparent which ideals our engineers adhered to when they developed our new D8 DISCOVER.

Like no other analytical method, X-ray diffraction is characterized by a wide variety of samples, applications and evaluation methods. This then results in the most stringent demands on a state-of-the-art X-ray diffractometer: an absolutely open design and unrestricted, uncompromising modularity; coupled with maximum user-friendliness, operating convenience and safe handling. If, on top of this, the system relieves the user of many of his routine tasks and supports his activities, then an outstanding solution has been found for all X-ray diffraction tasks:

Our new D8 DISCOVER with DAVINCI design!
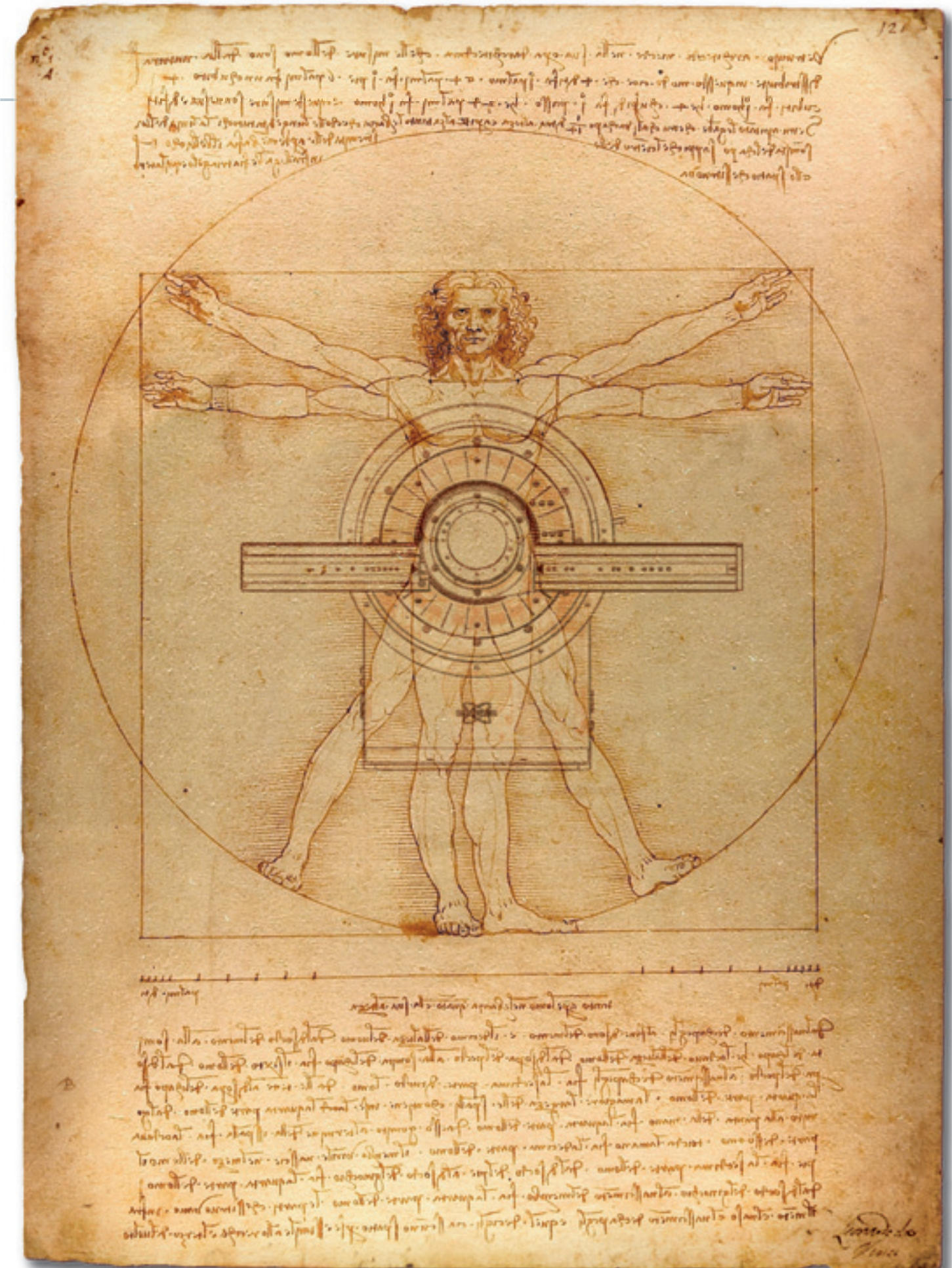
- True plug'n'play functionality with fully automatic component recognition and configuration
- Alignment-free switch of configurations – whatever your sample, whatever your application
- Absolutely open design with maximum flexibility for future adaptations

D8 DISCOVER with DAVINCI design – choose the best setup in a snap

We are proud to present the new generation of our D8 DISCOVER with an abundance of unparalleled innovations.

The D8 DISCOVER with DAVINCI design defines a pioneering diffractometer concept, which eliminates the problems of awkward configuration and adjustments once and for all. It becomes trivial to exchange all components and geometries.

The D8 DISCOVER with DAVINCI design is a uniquely modular system, incorporating all parts of the beam path without any restrictions. From the X-ray source through the optics and sample stages all the way to the detectors, any user is capable of changing from one beam geometry to another or exchanging individual components with no trouble at all. Therefore, our D8 DISCOVER offers unparalleled adaptability to any conceivable application in X-ray diffraction. Our multilevel design is especially revolutionary and allows you as a user to concentrate on your applications and not on the system configuration.

Rely on the "Da Vinci trio"!

**DAVINCI.MODE –
real-time component recognition.**

**DAVINCI.SNAP-LOCK –
changing components without tools.**

**DIFFRAC.DAVINCI –
the virtual goniometer.**

Virtual Goniometer

0-D – highest resolution

Real-time component recognition

Changing components without tools

Virtual Goniometer

1-D – fast and flexible

Real-time component recognition

Changing components without tools

Virtual Goniometer

XRD² – all information in one shot

The "Da Vinci trio" for one purpose: uncompromised ease of use

DAVINCI.MODE

In the DAVINCI.MODE, your D8 DISCOVER monitors and controls itself in all details. The system knows its own state at all times. Each component, each component replacement, and each change of status is automatically recognized. Every component registers itself with its specific characteristics on the system and is then configured automatically. Thanks to DAVINCI.MODE, it is no longer necessary to make any adjustments after exchanging a component.

DAVINCI.SNAP-LOCK

DAVINCI.SNAP-LOCK is our unique, high-precision SNAP-LOCK mechanism, which enables all of the optics to be exchanged within just a few seconds, without tools and – due to DAVINCI.MODE – without any adjustments. All optics return to perfect alignment every time. Never before has it been so easy, fast and reliable to change configurations.

DIFFRAC.DAVINCI

DIFFRAC.DAVINCI is the intelligent virtual goniometer, which completes the DAVINCI design and opens up new, previously unknown possibilities. DIFFRAC.DAVINCI is a graphical representation of the actual goniometer showing all beam path components plus their status and provides automatic validation of the instrument configuration with real-time conflict detection. DIFFRAC.DAVINCI offers two modes of operation:

1. The Instrument Control Mode to configure the instrument for immediate measurements using the DIFFRAC.COMMANDER software.

2. The Measurement Planning Mode allows creation of measurement methods using the DIFFRAC.WIZARD software and provides a graphical representation of the instrument configuration.

D8 DISCOVER with DAVINCI design:
Intelligent – intuitive – fail-safe.

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① **DAVINCI.MODE –** real-time component recognition

- Instant component registration with all specific properties
- Fail-safe component positioning
- True plug'n'play

② **DAVINCI.SNAP-LOCK –** changing components without tools

- Fast and easy
- Alignment-free: optics retain their alignment

③ **DIFFRAC.DAVINCI –** the virtual goniometer

- Real-time component recognition and status display
- Push-button switch between high-resolution and high-flux beam path
- Detection of missing, misplaced or unsuitable components
- Choice between all components configured for the present system
- Parameterization of all fixed and motorized components: e.g. slit sizes, absorber thickness, instrument geometry
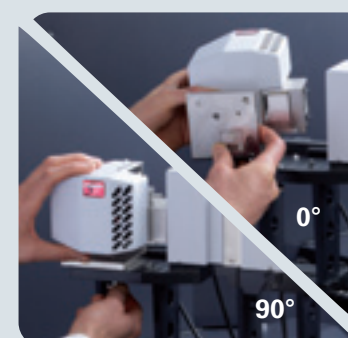

Choose and snap in – whatever you need!

- Choose optimum component from the storage rack
- Snap in the component, adjustments are done automatically
- Switch of LYNXEYE orientation in accordance with your application

0°
90°

Virtual Goniometer

Real-time component recognition

0-D – highest resolution

Changing components without tools

Step to the next dimension – zoom out to see more, even faster!

- Simply mount the VÅNTEC-1 detector on the track
- Position close to the sample to see more, or far away for high-resolution investigation
- Select fast scanning mode or unique snap-shot mode for time-saving RSM

Virtual Goniometer

Real-time component recognition
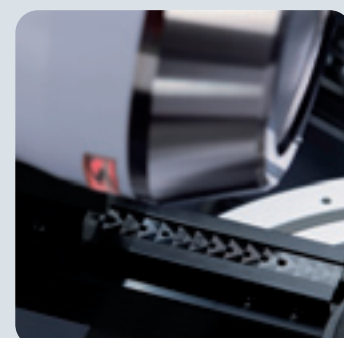
1-D – fast and flexible
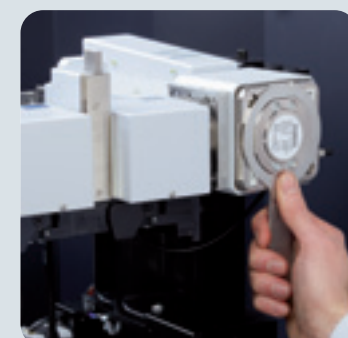
Changing components without tools

Add the ultimate dimension of XRD² – the eye-opener for details!

- Simply mount the VÅNTEC-500 detector on the track
- Position close to the sample to see more, or far away for high-resolution investigation
- Switch the TWIST-TUBE from line to spot focus and start measuring

Virtual Goniometer

XRD² – all information in one shot

- Ultimate X-ray, machine and electric safety in compliance with the latest directives
- Audit-proven quality management system
- Ergonomic, clearly visible fail-safe warning and operator control elements
- Traceable measurement conditions – experiments can be repeated years later with exactly the same instrument configuration and measurement parameters
- Fast and cost-efficient technical service or analytical support thanks to remote control access
- Intensive and custom-made training courses by Bruker AXS' experts

Good Diffraction Practice – absolute safety is our top priority

Before we ever release a new instrument, we have already passed all audits regarding safety and standards. Each instrument always complies with the world's highest requirements regarding X-ray, machine and electrical safety. This confidence is obtained after stringent scrutiny by independent institutions.

Regarding X-ray safety, the following applies: Even under extraordinary test conditions, any location outside the cabinet of our D8 DISCOVER will exhibit significantly less than one micro-Sievert per hour, in accordance with EURATOM instructions. Regardless of the instrument configuration the radiation level is in the nano-Sievert range.

Two independent, fail-safe safety circuits with separate shutter and "X-ray ON" monitoring guarantee that the most recent radiation and personnel safety regulations are observed. Furthermore, all warning and operating elements are installed ergonomically, clearly visible, and coordinated with one another in an elegant and state-of-the-art design.

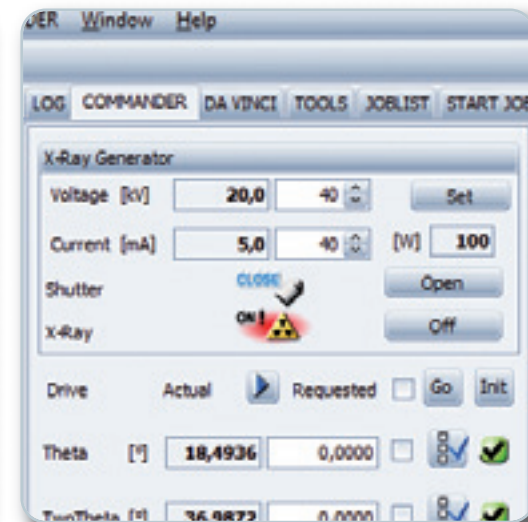Design and development of our systems comply with certified ISO 9001:2008 and GAMP processes and procedures.

X-ray tube LED status display

X-ray ON status

Smart screen keys for instrument status display

Instrument status display in software

Conforms to:
- 2006/42/EC
- 2006/95/EC
- 2004/108/EC
- 96/29/EURATOM
- RöV
- DIN EN 954-1 Cat. 3
- DIN EN 61010-1/-2
- CSA C22.2 No. 1010
- EN 61000-6-1/-2/-3/-4
... and more

Approved by:
- TÜV
- PTB
- BfS
- NEMKO

- Solid and maintenance-free goniometer design for mechanical strength and long life

- Instrument performance verification with NIST corundum standard SRM 1976a

- Instrument alignment ≤ ±0.01° 2θ over the whole angular range

- Optional IQ/OQ procedures for regulated industries such as the pharmaceutical industry

- LYNXEYE compound silicon strip detector with all channels fully functional

- VÅNTEC-1 and VÅNTEC-500 detectors with patented MIKROGAP technology for large 1-D and 2-D coverage respectively without defective areas

Best-Data Guarantee – on the fast lane to the micro cosmos

X-ray Sources

To start you need light to see your samples' properties. As you may expect from the DAVINCI design, our D8 DISCOVER offers seamlessly integrated X-ray sources: from the industry standard X-ray tubes to our high-brilliance TURBO X-RAY SOURCE.

X-ray Optics

The resolution in the reciprocal space depends on the incident beam divergence, as defined by the primary optics, and the angular acceptance of the secondary beam path. Whether you need high resolution to study nearly perfect samples or less resolution to study structures with a high number of defects, our D8 DISCOVER can easily be tuned using dedicated optics to achieve the required resolution.

X-ray Detectors

A particular challenge is to maintain the data quality at a very small spot size. To measure down to the low micron-level spatial resolution, the D8 DISCOVER can be equipped with our unique large-area detector – the VÅNTEC-500.

To gain the full benefit from the intrinsic properties of a detector, such as a high dynamic range or low noise level, proper manufacturing design is essential. Thanks to extensive experience and in-house detector development, the Bruker AXS detectors are guaranteed to be exemplary and without any defective detector areas.

Best-Data Guarantee – unique at Bruker AXS.

The Reciprocal Space

The reciprocal lattice is an alternative description for the crystal, showing the same symmetry as the direct lattice. In the case of epitaxial materials, the relationship between the different layers is easily seen in reciprocal space. Most information can be extracted from Reciprocal Space Maps (RSM). Depending on the detector dimensionality, different volume elements are probed.

A 0-dimensional point detector sees only a small point in reciprocal space. Consequently, a large number of Omega-2Theta positions are required to construct the RSM. A 1-dimensional detector collects a large number of 2Theta-positions simultaneously, which means the interaction volume represents a line in reciprocal space. Therefore, a scan in one direction of reciprocal space is sufficient.

With a 2-dimensional area detector, information in the gamma direction is also gathered, which represents a slice through the reciprocal space. Combining a few of these detector slices in fact creates a 3-dimensional reciprocal space map.

Navigation in reciprocal space
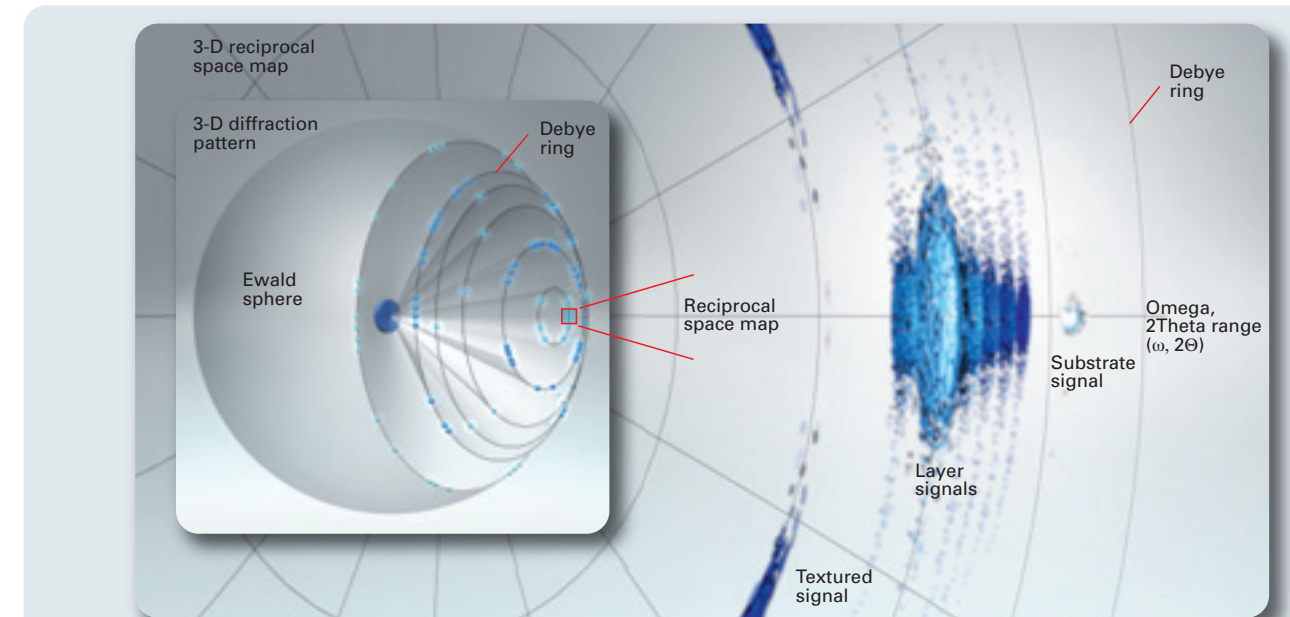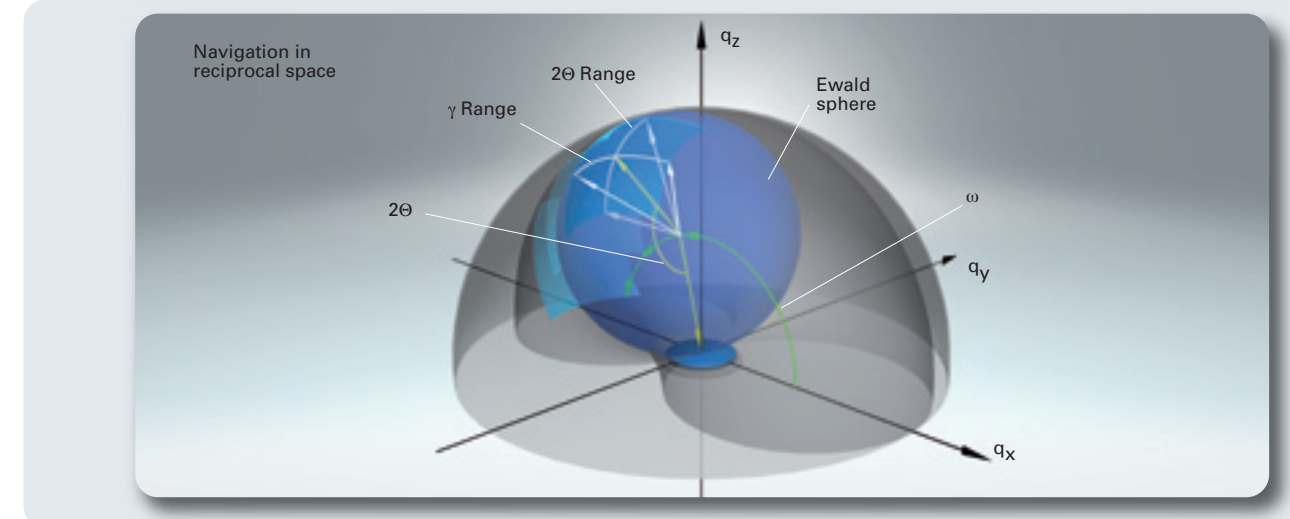
Detectors

0-D – highest resolution

Scintillation counter

SOL-XE

Traditional one point detection

Scintillation counter 0-D detector
- Cost-effective solution

SOL-XE 0-D detector
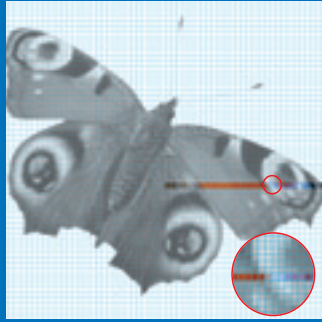- true energy-dispersive solid state detector for superb energy resolution

1-D – fast and flexible

LYNXEYE

VÅNTEC-1

192 measuring points LYNXEYE
1,500 measuring points VÅNTEC-1

LYNXEYE 1-D detector
- Covers 14.4 x 16 mm² with 192 channels
- Compound silicon strip technology
- Rotated 90° for huge count rates or GISAXS

VÅNTEC-1 1-D detector
- Covers 50 x 16 mm² with 1,500 channels
- Patented MIKROGAP technology
- Ultra-low noise levels
- Rotated 90° for GISAXS
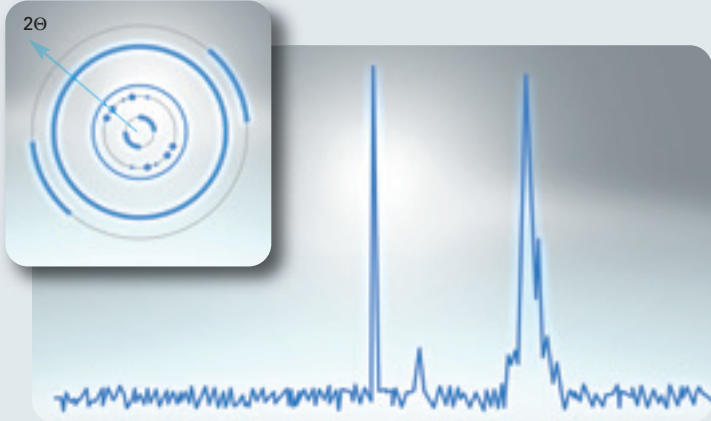
XRD² – all information in one shot

VÅNTEC-500

Single Photon Detection
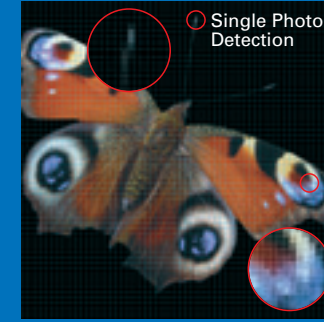
4,000,000 channels with one XRD² pattern

VÅNTEC-500 2-D detector
- 135 mm diameter active area with 4,000,000 channels
- Patented MIKROGAP technology
- Ultra-low noise levels
- Very high dynamic range
- Optimized design for achieving highest diffraction angles
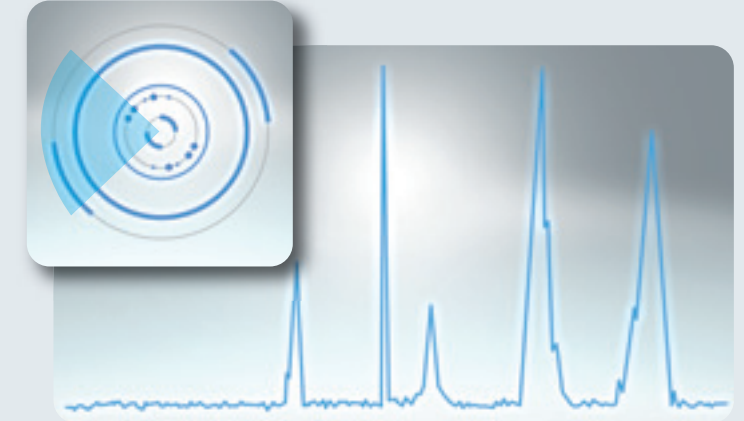
Powders

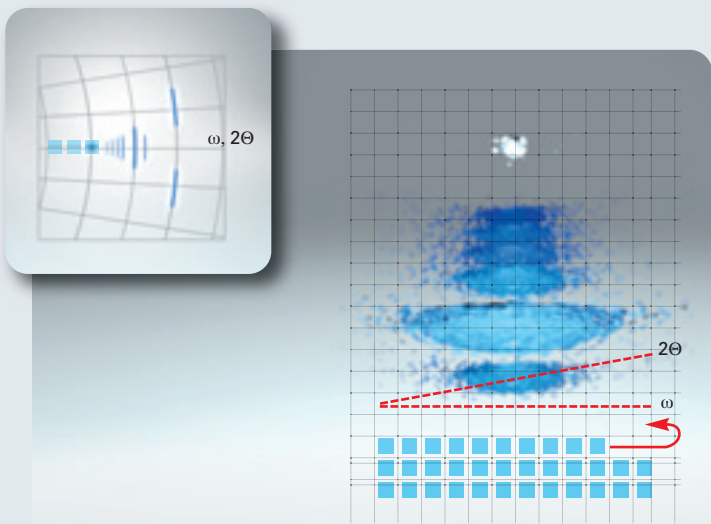Theta/2Theta scan with 0-D detector, cut through Debye cones

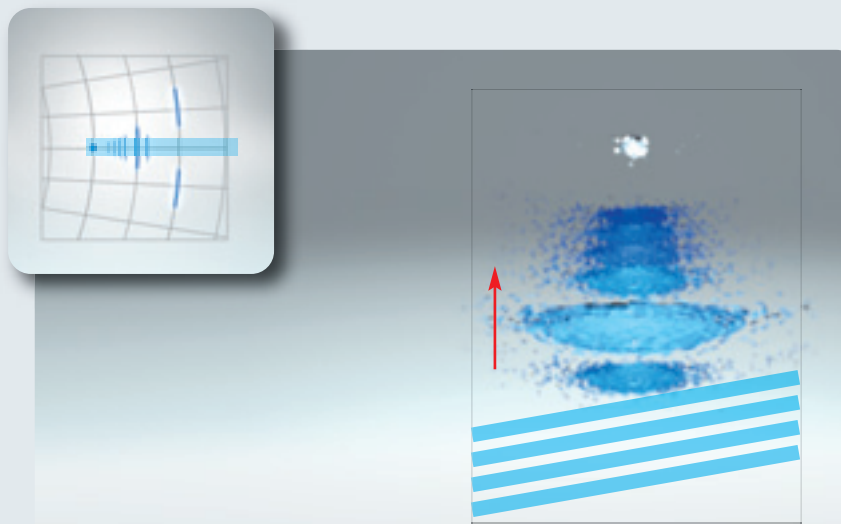Theta/2Theta scan with 1-D detector, cut through Debye cones

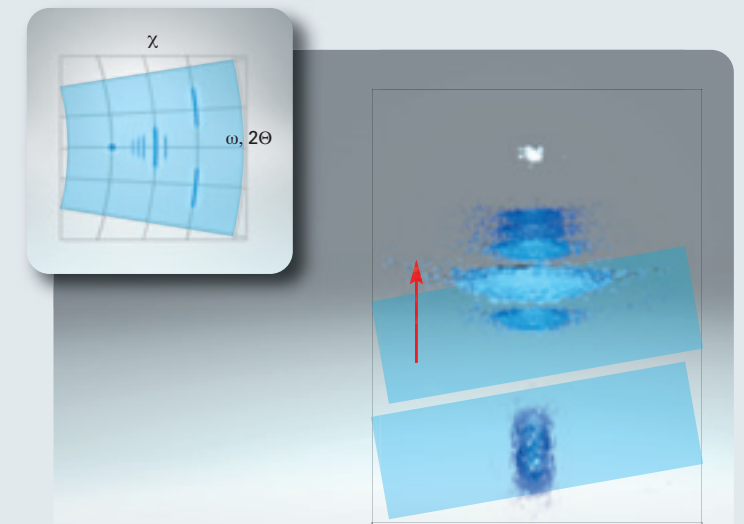Theta/2Theta plot with 2-D detector, integration over Debye cones

Thin Films

Reciprocal space mapping with 0-D detector

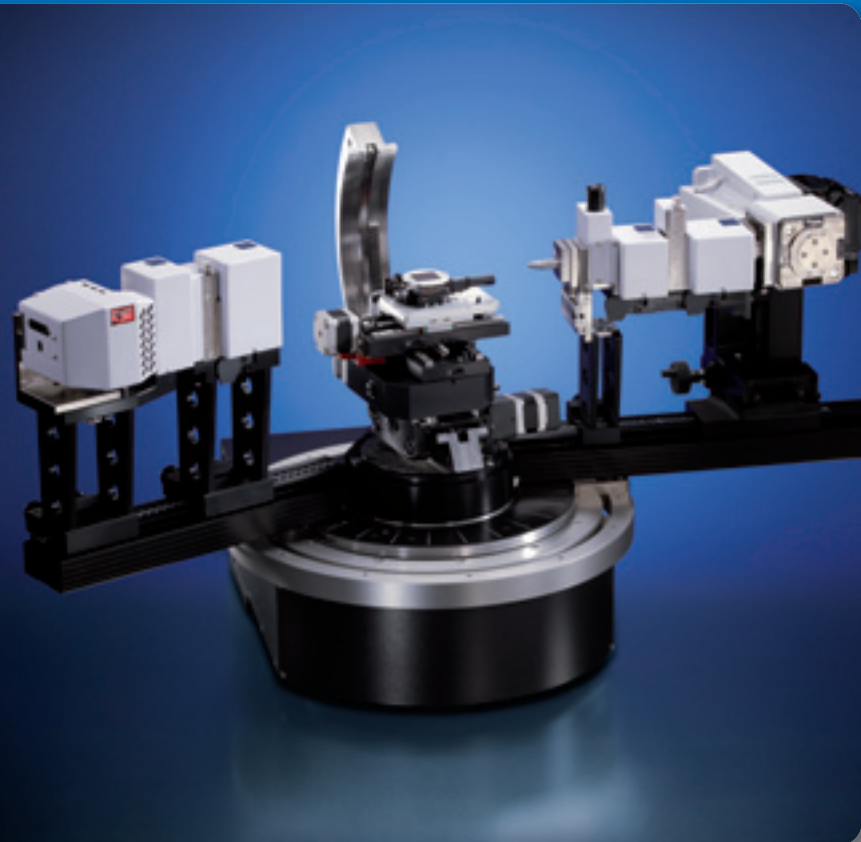Reciprocal space mapping with 1-D detector

Reciprocal space mapping with 2-D detector

Residual stress setup with vertical goniometer, UMC stage and VÅNTEC-500

Grazing incidence diffraction setup with horizontal goniometer and Eulerian cradle

Always more than you expected – D8 DISCOVER

At the heart of each D8 DISCOVER is our market-leading goniometer, which guarantees fast and extremely accurate positioning. The combination with for example our Universal Motion Concept (UMC) stages or our Eulerian cradles enable flexible sample handling, whatever the size or shape of the sample.

Various fully integrated and state-of-the-art X-ray sources are available to generate the X-rays: the cost-effective ceramic sealed tube, our unique TWIST-TUBE for easy switching from line to spot focus or our TURBO X-RAY SOURCE for ultimate speed and power.

Depending on the application, particular X-ray optics, such as Göbel mirrors, channel-cut crystals and polycapillary optics condition the beam in the most efficient way. For the most demanding applications, the unique Cu Göbel mirrors on prefigured substrates provide cutting-edge beam characteristics.

To ensure not a single diffracted X-ray photon is lost, you can count on our in-house developed detectors. Make your choice between highly efficient 0-D detectors, fast 1-D LYNXEYE or VÅNTEC-1 detectors, or obtain an extra dimension with the 2-D VÅNTEC-500 detector – for all information in one shot.

The most stunning feature of our D8 DISCOVER is that all these high-end components simply click into the unique SNAP-LOCK bench. It combines the best of two worlds: easy and reproducible switching of components and variable positioning of the whole SNAP-LOCK bench along the tracks. The components are automatically identified, configured and adjusted. This results in unrivaled flexibility.

Is there anything more? Yes, whatever new technology the future will bring, the D8 DISCOVER offers the best platform for seamless integration. That's our proven tradition!

"The book of the science of mechanics must precede the book of useful inventions."
(Leonardo da Vinci)
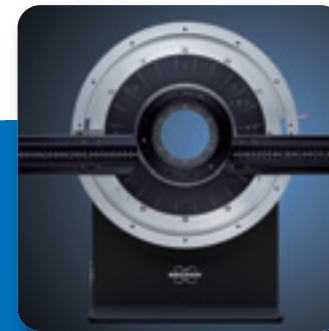
High-precision goniometer
- Solid and maintenance-free design
- Vertical or horizontal goniometer, Theta/Theta or Theta/2Theta geometry
- Stepper motors with optical encoders
- Fast and reliable positioning

Brilliant X-ray source
- TURBO X-RAY SOURCE rotating anode generator
- From 1.2 to 18 kW, depending on focus size and anode type
- Fully integrated in the D8 platform
- Spot, line and micro focus
- Variable sample-source distance
- Unique source alignment with 5 degrees of freedom
- Cr, Co, Cu and Mo anodes

TWIST-TUBE
- Patented TWIST-TUBE design
- Compatible with standard sealed tube dimensions
- Fast and easy switching between line and spot focus
- Automatic focus orientation detection thanks to DAVINCI.MODE
- No realignment, no need to disconnect cables and hoses

Flexible sample handling
- Universal Motion Concept (UMC) stages
- Eulerian cradles
- Tilt stages
- Vacuum chucks
- Sample spinners for capillaries and flat powder samples
- Automatic sample changers
- Non-ambient chambers

Cutting-edge X-ray optics
- Göbel mirrors
- MONTEL mirrors
- Johansson monochromators
- POLYCAP lenses
- TWIN dual optics
- PATHFINDER triple optics
- 2-bounce and 4-bounce channel-cut monochromators

Advanced components
- Knife-Edge Collimator (KEC)
- Laser-Video microscope
- Manual control box
- Anti-scatter screen
- Rotary-Absorber
- Universal Beam Concept (UBC) collimators

- Choice of 2- and 4-bounce Ge channel-cut monochromators to tune the resolution
- LYNXEYE in 0-D mode and rotated 90° to cover an extremely large dynamic range
- Patented PATHFINDER optics for push-button switching between a high-resolution and two high-flux beam paths
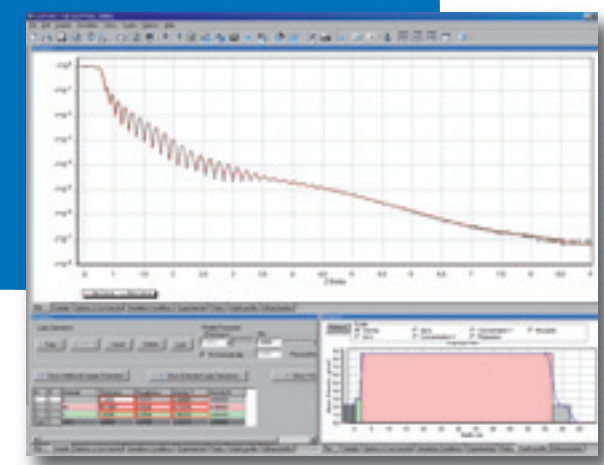- Wafer mapping
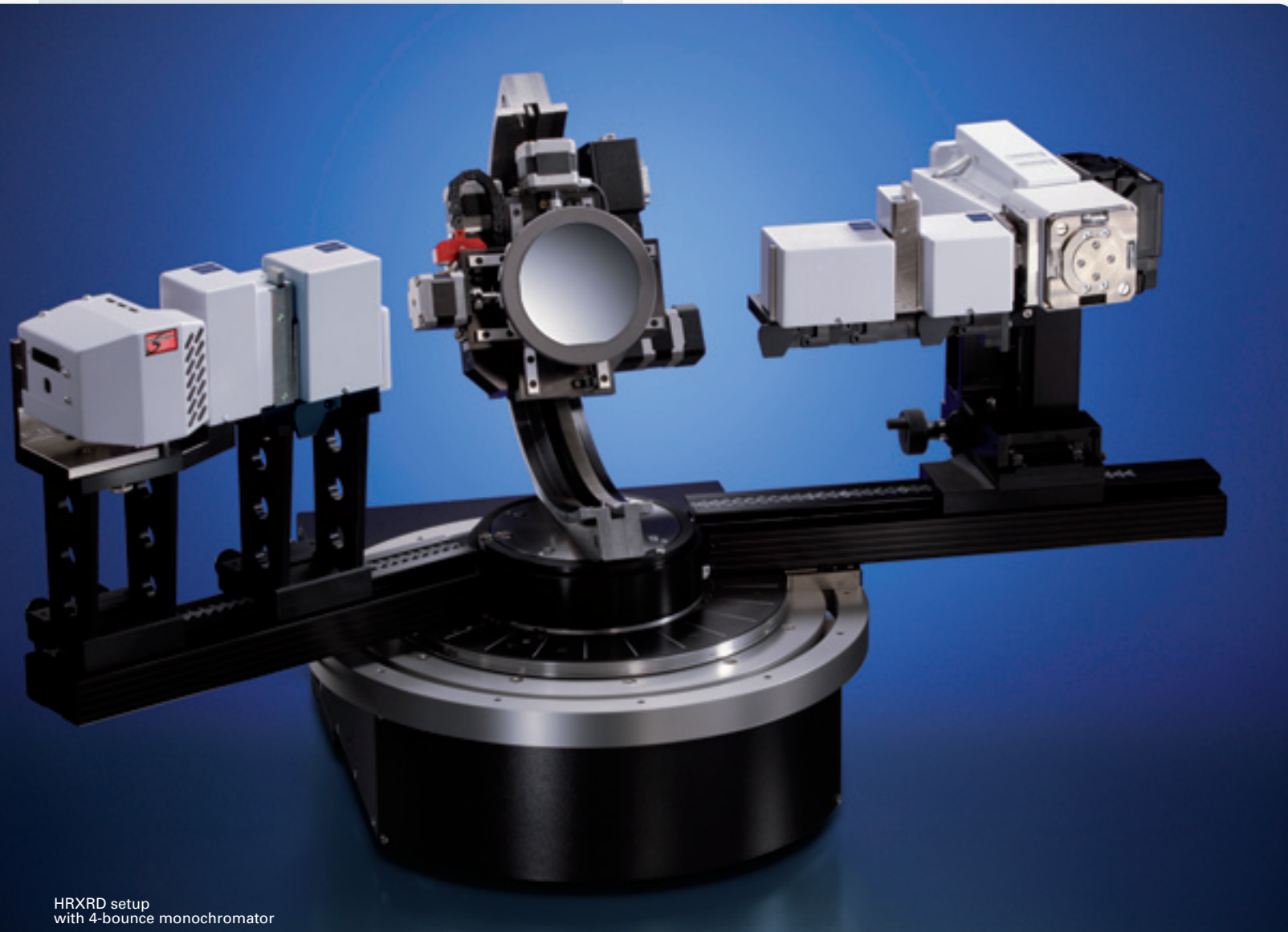
HRXRD setup
with 4-bounce monochromator

Eulerian cradle

X-ray source

LYNXEYE, rotated 90°

Motorized slits

4-bounce monochromator

Göbel mirror
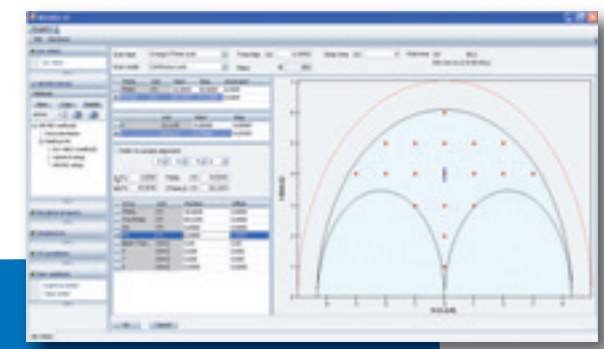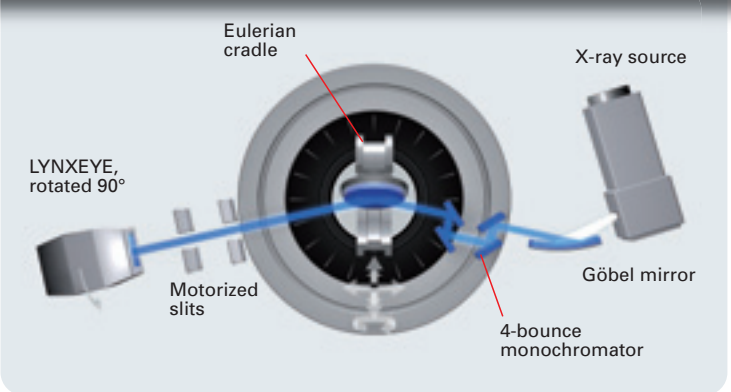
Straightforward measurement planning with DIFFRAC.WIZARD
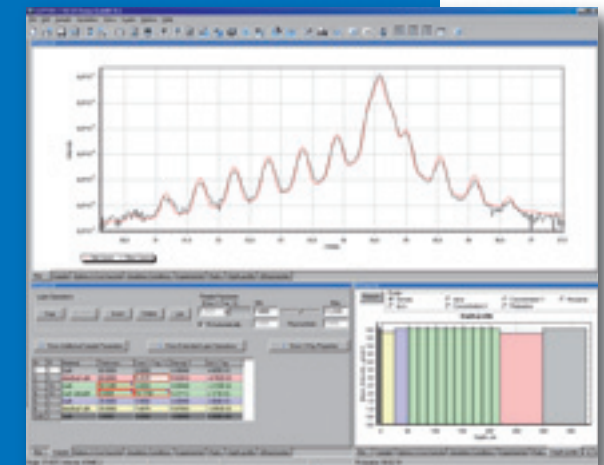
HRXRD data evaluation with DIFFRAC.LEPTOS

Reflectometry analysis with DIFFRAC.LEPTOS

D8 DISCOVER –
tune your resolution in a snap

The requirements for resolution and flux can be very different depending on the type of sample you need to analyze. For example, the upper limit for the film thickness that can be evaluated by reflectometry (XRR) is determined by the angular resolution of the instrument, whereas the lower limit is determined by the available dynamic range and sensitivity. These apparently exclusive requirements exist also for high-resolution X-ray diffraction (HRXRD). Perfect epitaxial samples, such as III/V semiconductors, require a very high resolution to resolve the fine details. Less perfect epitaxial samples, such as oxides or nitrides, have a higher need for flux than for resolution.

Our D8 DISCOVER is the perfect answer to address these very different requirements. Thanks to DAVINCI design, you can easily create the diffractometer setup that is most suited to your needs. Simply snap in the required DAVINCI.SNAP-LOCK component, for example the channel-cut monochromator, and that's it. Identification, configuration and adjustment take place automatically.

With our patented PATHFINDER, you can even select a different beam path without touching the optics at all. These intelligent optics enable motorized switching between different beam paths. It takes just a single mouse click to change between the high-resolution and two high-flux beam paths.

D8 DISCOVER – snap in and start measuring!

D8 DISCOVER –
## introducing a **telescope** for **X-ray diffraction**

The exploration of reciprocal space is an excellent method for checking the quality of epitaxial layers grown on crystalline substrates. A Reciprocal Space Map (RSM) gives more comprehensive information about an epitaxial layer or hetero-structure than simple high-resolution scans, which are just cuts through reciprocal space. The measurement of an RSM is easily set up with DIFFRAC.WIZARD, your route planner for diffraction space.

If an RSM with very high angular resolution needs to be measured, a combination of PATHFINDER and point detector reveals the subtle diffraction details.

A much faster and more elegant option is data collection using one of our 1-dimensional detectors: LYNXEYE or VÅNTEC-1. These 1-D detectors collect the diffracted signals from a large angular range simultaneously. Hence it is much faster and more efficient for collecting an RSM.

The job can be done even faster, easier and with a larger view of reciprocal space with our superb VÅNTEC-500. Being a true photon counting detector with a large active area, a huge part of the reciprocal space is covered by a single shot. The resulting images can be used in a variety of ways. Live viewing of the measurement enables effective navigation and thanks to the low background noise, even extremely weak signals can be recorded. The resulting reciprocal space slices can either be individually analyzed or used to quickly generate a 3-dimensional reciprocal space reconstruction.
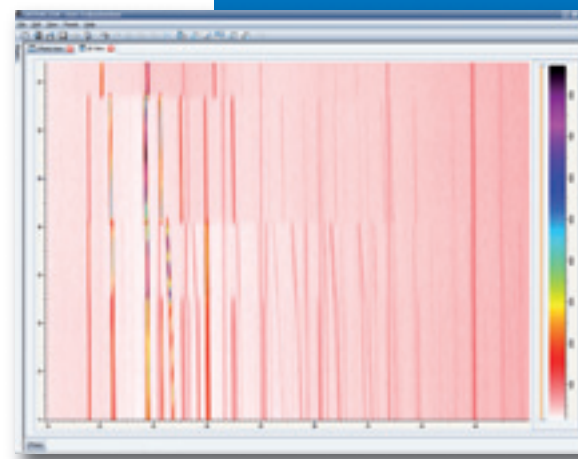
D8 DISCOVER – the only system with fully integrated 0-D, 1-D and 2-D detectors.
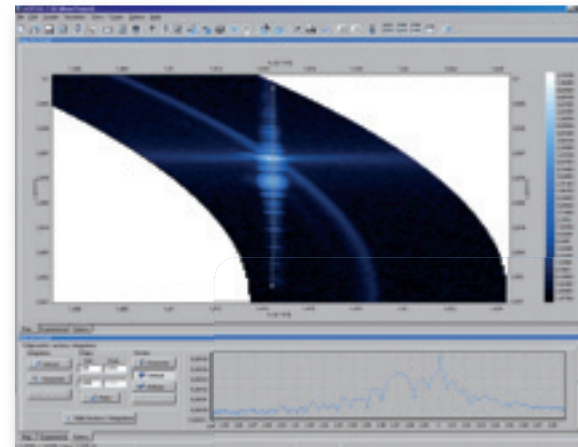
DIFFRAC.LEPTOS, evaluation of RSM measured with 1-D detector
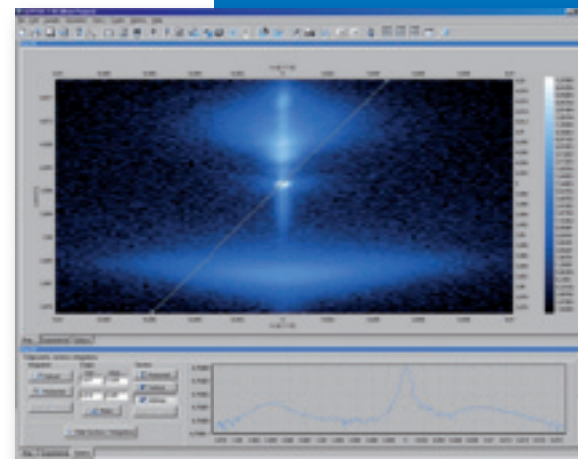
Evaluation of reciprocal space maps with DIFFRAC.LEPTOS

Iso-intensity view with DIFFRAC.EVA of a high-temperature diffraction experiment

- High-resolution reciprocal space mapping with 0-D detectors
- Fast reciprocal space mapping with LYNXEYE and VÅNTEC-1 1-D detectors
- VÅNTEC-500 2-D detector for ultra-fast reciprocal space mapping
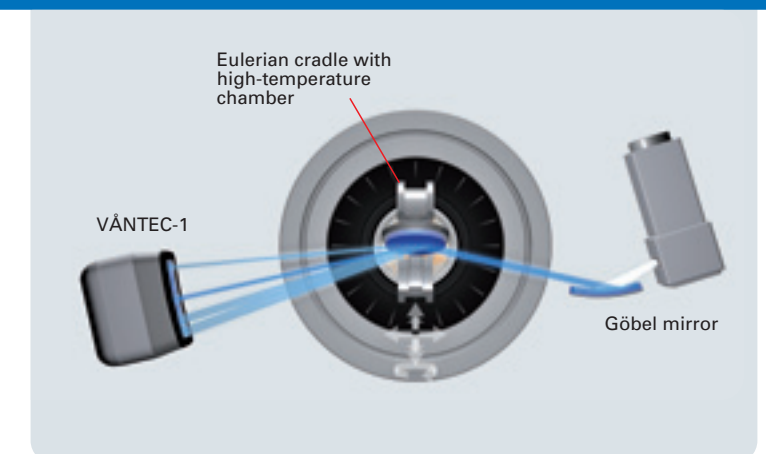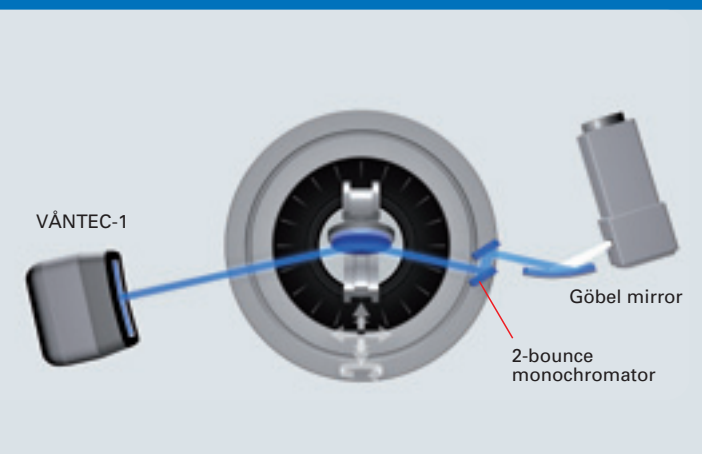- X-ray diffraction topography for imaging based on diffraction contrast

- Non-ambient measurements with dome heating stages between −100 °C and 1400 °C
- Temperature-dependent reflectometry from −180 °C up to 800 °C
- 1-D LYNXEYE and VÅNTEC-1 detectors for both scanning and SNAPSHOT mode

Fast RSM with 2-bounce channel-cut monochromator and VÅNTEC-1 detector

Non-ambient with DHS1100 dome heating stage and VÅNTEC-1 detector

VÅNTEC-1

Göbel mirror

2-bounce monochromator

Eulerian cradle with high-temperature chamber

VÅNTEC-1

Göbel mirror

# Grazing incidence the right way – D8 DISCOVER

Modern thin-film technology deals with increasingly thinner and more complex layered structures. The analysis of such challenging samples pushes classic diffraction methods to their limits. The D8 DISCOVER has a winning combination of powerful X-ray sources, dedicated optics, the most sensitive 1- and 2-dimensional detectors, and a tilt stage to assure that no reflections are lost. This means that in-plane grazing incidence diffraction (IP-GID) can be performed in the lab with sychrotron performance.

Directly evaluate the in-plane lattice parameters (perpendicular to the sample surface), determine the in-plane crystallite size or measure the in-plane texture and the domain structure. As an added feature, these parameters can be determined as a function of depth.

Furthermore, you can collect the out-of-plane scattering signal in the vicinity of the direct beam and extract information about the nanostructure at the layer surface and interfaces.

A Grazing Incidence Small Angle X-ray Scattering (GISAXS) experiment covers the out-of-plane direction. A successful measurement therefore requires at least a highly sensitive linear detector, such as our LYNXEYE or VÅNTEC-1, rotated 90°. With our 2-D VÅNTEC-500 detector, you can even probe the nanostructure in a single shot, without needing to move the detector.
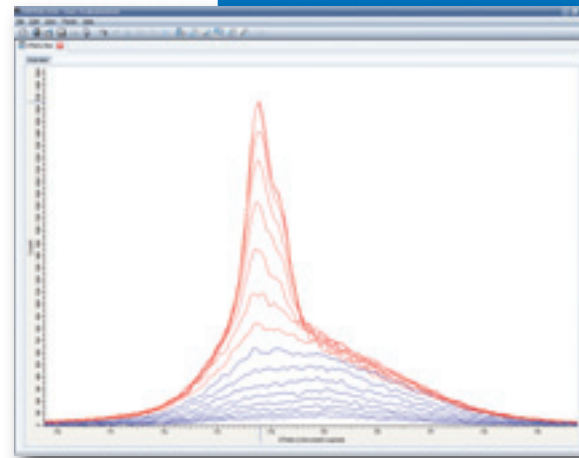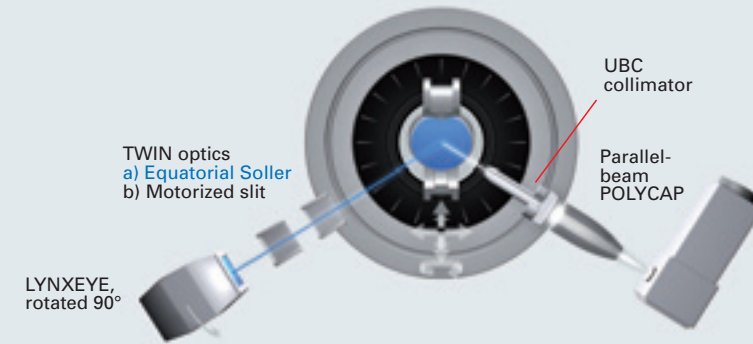
D8 DISCOVER – take a look from a different angle.
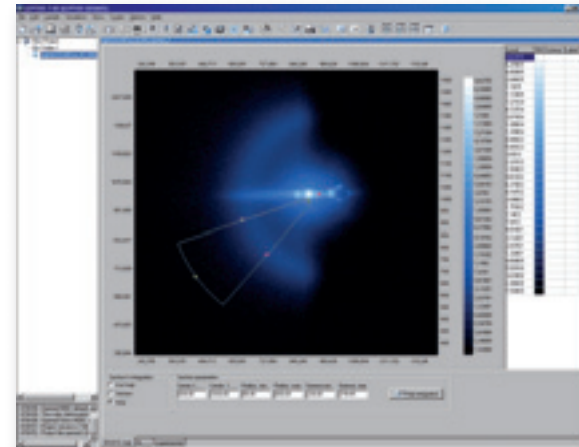
GISAXS data displayed with DIFFRAC.LEPTOS
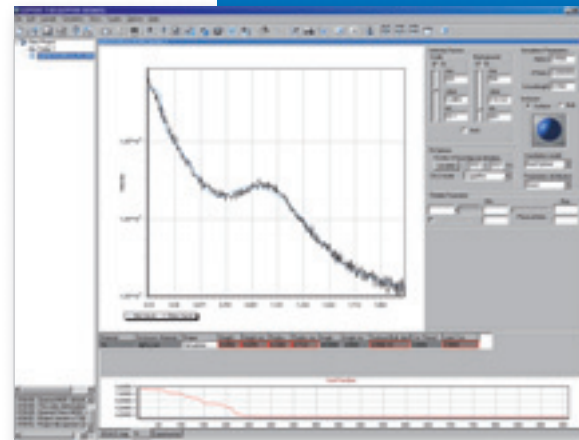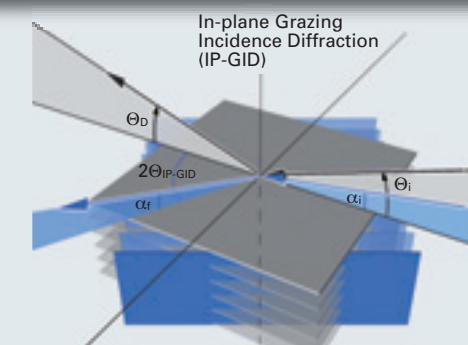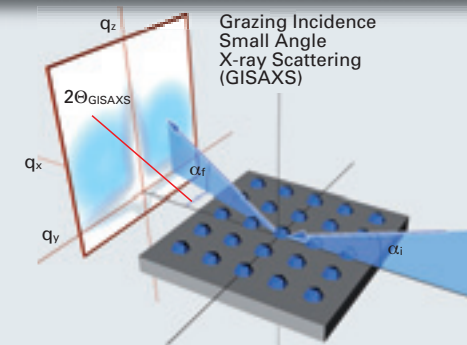
GISAXS data evaluation with DIFFRAC.LEPTOS

Scans at different α, angles, depth-dependent variation of the in-plane lattice parameter

UBC collimator

TWIN optics
a) Equatorial Soller
b) Motorized slit

Parallel-beam POLYCAP

LYNXEYE, rotated 90°

- Motorized tilt stage with two tilt axes, ± 7.5° each

- POLYCAP or MONTEL point focusing optics for in-plane measurements

In-plane setup with centric Eulerian cradle and tilt stage

Grazing Incidence Small Angle X-ray Scattering (GISAXS)

q_z

$2\Theta_{GISAXS}$

q_x

α_f

q_y

α_i

In-plane Grazing Incidence Diffraction (IP-GID)

Θ_D

$2\Theta_{IP-GID}$

α_f

α_i

Θ_i

- LYNXEYE and VÅNTEC-1 1-D detectors rotated 90° to collect GISAXS signal in scanning mode

- VÅNTEC-500 2-D detector to collect GISAXS signal in SNAPSHOT mode

VÅNTEC-500

Parallel-beam
POLYCAP

UBC collimator

Texture analysis with
DIFFRAC.MULTEX

Residual stress analysis of
2-D data with DIFFRAC.LEPTOS

- POLYCAP lens for high-speed, high-flux texture or stress analysis
- Intelligent setup of measurement schemes with DIFFRAC.WIZARD
- Texture determination based on the component method or the traditional spherical harmonics method

Random texture component   Fiber texture component   Preferred texture component   **Texture with XRD²**

D8 DISCOVER –
the extra dimension of XRD²

Turbine blades of fuel-efficient jet engines, gear wheels for gear boxes with minimal internal friction and high torque resistance, ferroelectric memories and organic solar cells … for any type of high-performance component, stress and/or texture information is crucial for the functionality of the final product.

The technical requirements imposed on residual stress or texture analyses of these samples can be very challenging. This is not because of the diffraction method as such, which is well-established. Challenges arise due to the sample size and shape, the need for a small spot size or high sample throughput. Consequently, data collection with point detectors, line detectors or small area detectors is not practical and simply takes too long.
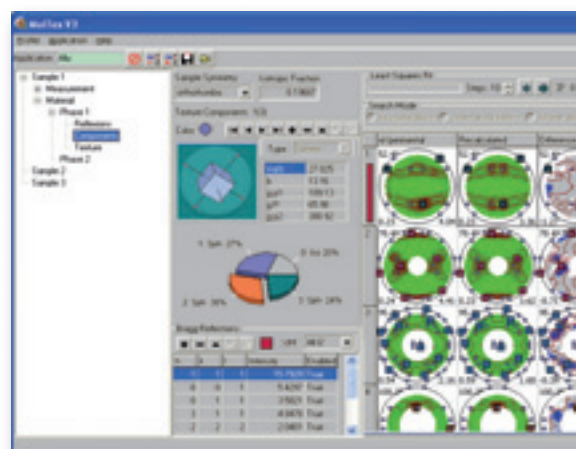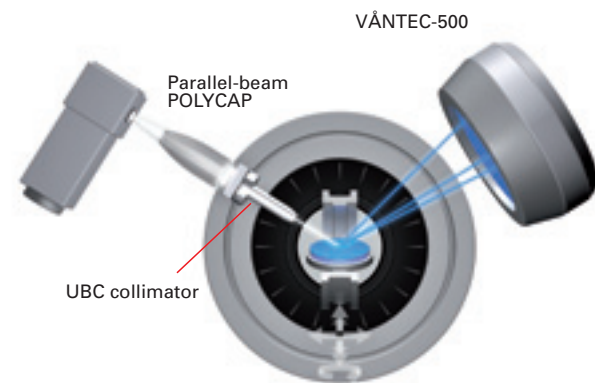
Adding the extra dimension of XRD² is the way to master these challenges!

Our 2-dimensional VÅNTEC-500 detector is the obvious choice for stress and texture applications. The VÅNTEC-500 has a very large detector window capturing a large area. This covers very broad residual stress peaks and several wide sections of Debye cones at once. The VÅNTEC-500 is a true photon counter that guarantees an excellent signal-to-noise ratio due to the virtually absent intrinsic detector noise.
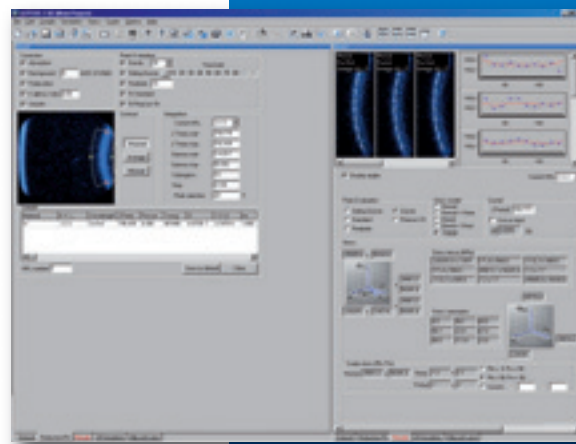
Having pioneered 2-D detector technology for almost 30 years, Bruker AXS' brand-new VÅNTEC-500 represents the latest detector development.

This detector is combined with our sophisticated measurement strategies and top-class DIFFRAC.LEPTOS and DIFFRAC.MULTEX analysis software.
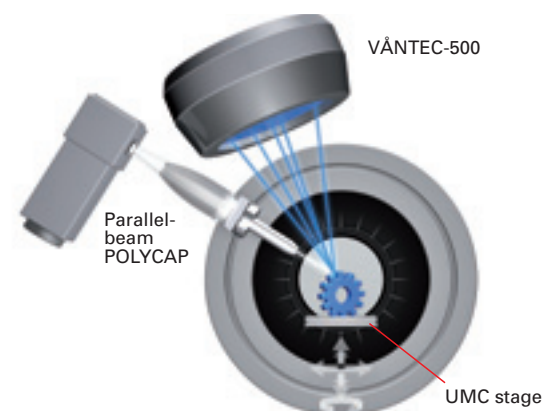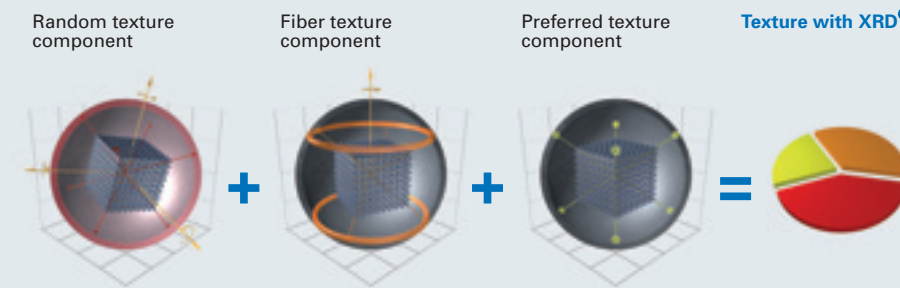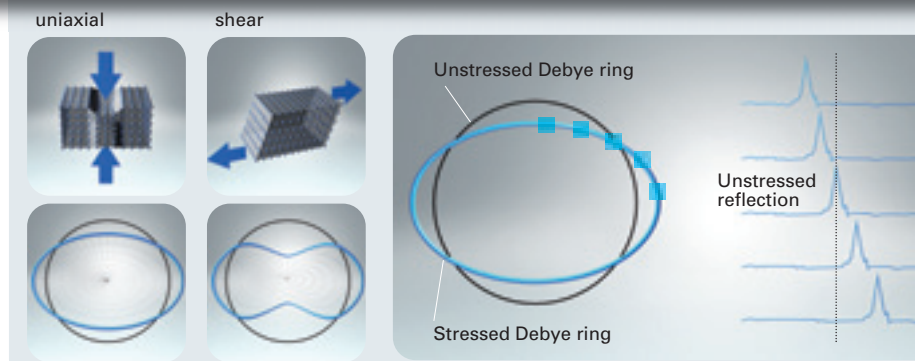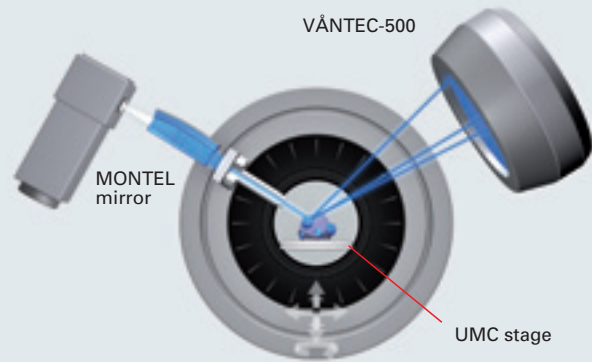
D8 DISCOVER – the integrated solution to XRD².

Residual stress setup with VÅNTEC-500 and UMC stage for up to 50 kg sample load

VÅNTEC-500

Parallel-beam POLYCAP

UMC stage

- Stress measurements in iso-inclination (omega) or side-inclination (psi) mode
- Ultra-fast 2-D stress measurements with the VÅNTEC-500
- Residual stress determination according to the traditional $\sin^2(psi)$ method as well as the multi hkl evaluation method
- From normal and shear stress up to the complete stress tensor

uniaxial   shear

Unstressed Debye ring

Unstressed reflection

Stressed Debye ring
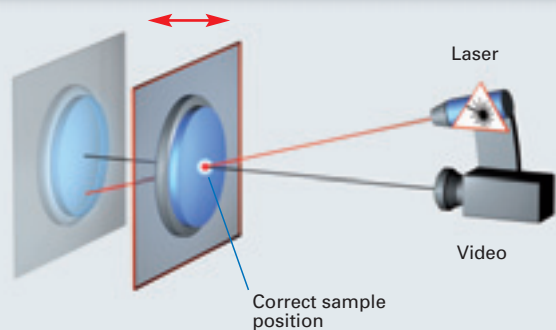
VÅNTEC-500

MONTEL mirror

UMC stage

- Patented Laser-Video system for exact sample positioning
- MONTEL mirror for highest flux on small spot
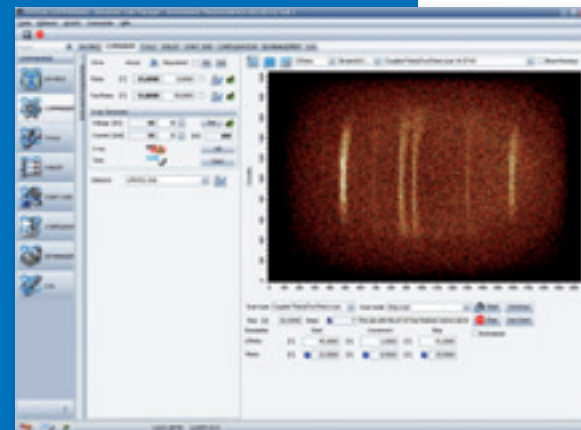- Tool-free, reproducible collimator exchange for ultra-fast beam size optimization

Micro diffraction setup with VÅNTEC-500 and UMC stage for up to 50 kg sample load

Laser
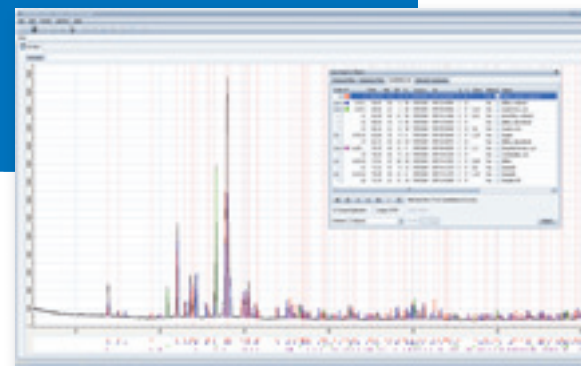
Video

Correct sample position

Laser-Video microscope
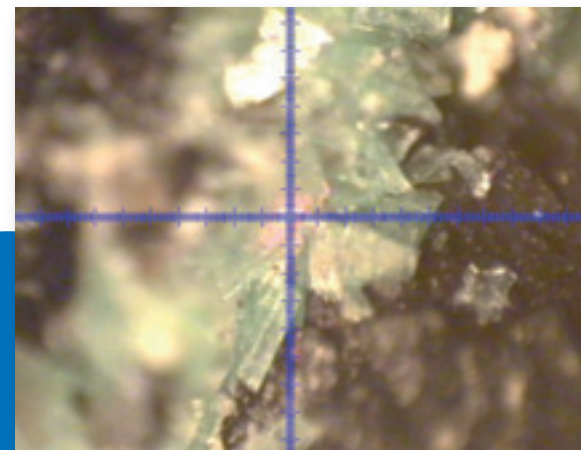
Measurement position localization with Laser-Video microscope

Data acquisition with DIFFRAC.COMMANDER

Phase ID on integrated 2-D patterns with DIFFRAC.EVA

D8 DISCOVER –
get right to the point

Patterned wafers, forensic samples, inclusions in geological materials … these very diverse samples all have one thing in common: the area of interest is very small. For these applications, our patented Laser-Video microscope and accurate precise sample stages guarantee that you exactly measure the area of interest – regardless of sample size or shape.

If an X-ray beam is collimated down to a micro spot size, obviously only a few crystallites are hit by the incident beam and diffract the X-rays. This results in spotty diffraction patterns and in very weak diffraction signals.

Our 2-dimensional VÅNTEC-500 is the detector of choice to measure such poor quality diffraction patterns. Its unparalleled signal-to-noise performance and extra large active area enables detecting even the weakest diffraction signals. Another benefit is that the simple integration of a diffraction pattern along the Debye cones converts this measurement into conventional diffractograms for further evaluation. In this respect, our VÅNTEC-500 offers superior capabilities compared to conventional 0-D, 1-D and tiny 2-D detectors, while allowing you to perform any data treatment the way you are used to. Hence, the significance and quality of your results are just better.

To even further boost primary beam intensity, just use our high-flux TURBO X-RAY SOURCE in combination with dedicated MONTEL optics.

D8 DISCOVER – the only true micro diffraction!

Technical Data

Configurations	Horizontal or vertical goniometer, Theta/2Theta or Theta/Theta geometry
Measuring circle diameter (depending on setup)	Any intermediate setting between 500 mm and 1,080 mm
Angular range (without accessories)	360°
Max. usable angular range (depending on accessories)	$-110° < 2Theta \leq 168°$
Angle positioning	Stepper motors with optical encoders
Smallest addressable increment	0.0001°
Maximum angular speed (depending on accessories)	20°/s
Detectors	**0-D:** Scintillation counter SOL-XE: true energy-dispersive solid state detector **1-D:** LYNXEYE: covers 14.4 x 16 mm² with 192 channels VÅNTEC-1: covers 50 x 16 mm² with 1,500 channels **2-D:** VÅNTEC-500: 135 mm diameter active area with 4,000,000 channels All detectors guaranteed without defective/dead strips or areas
X-ray sources	Sealed tube TWIST-TUBE: fast and easy switching between line and spot focus TURBO X-RAY SOURCE: from 1.2 kW up to 18 kW, depending on focus size and anode type
General space and infrastructure requirements	
Exterior dimensions (h x w x d)	202 x 168 x 129 cm 79.5 x 66.0 x 50.6 inch
Weight (without optional accessoires)	945 kg 2,085 lbs
Cooling water supply (without optional internal water chiller)	Min. 4 l/min, pressure 4 bar to 7.5 bar, no pressure on outlet side, temperature: 10 °C to 20 °C
Power supply	Single phase: 208 to 240 V Three phases: 120 V, 230 V, 240 V 47 to 63 Hz
Maximum power consumption (without controllers for optional equipment)	6.5 kVA

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TWIST-TUBE:
EP 1 923 900 B1 patent and US 7 421 064 patent
PATHFINDER:
US 6 665 372 and DE 10 141 958
MIKROGAP technology, VÅNTEC-1 and VÅNTEC-500:
US 6,340,819 B1 patent
LYNXEYE turned 90°:
EP 1 647 840 A2 patent and EP 1 510 811 B1 patent
D8 DISCOVER door:
DE102 008 020 729 patent and DE102 008 020 730 patent