D4 ENDEAVOR

- Diffraction Solutions

Innovation with Integrity

XRD


D4 ENDEAVOR

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D4 ENDEAVOR


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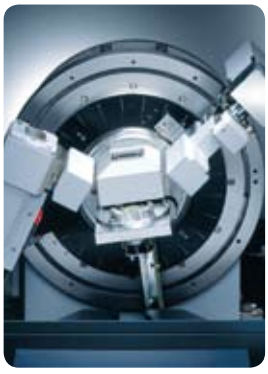


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D4 ENDEAVOR

The range of X-ray diffraction tasks is as broad as the variety of your samples. The combined solution for all these tasks is our D4 ENDEAVOR.

The D4 ENDEAVOR is designed for specific tasks but is still highly flexible. D4 ENDEAVOR masters all tasks for qualitative or quantitative phase analysis, peak profile analysis or residual stress determination or structure solution.

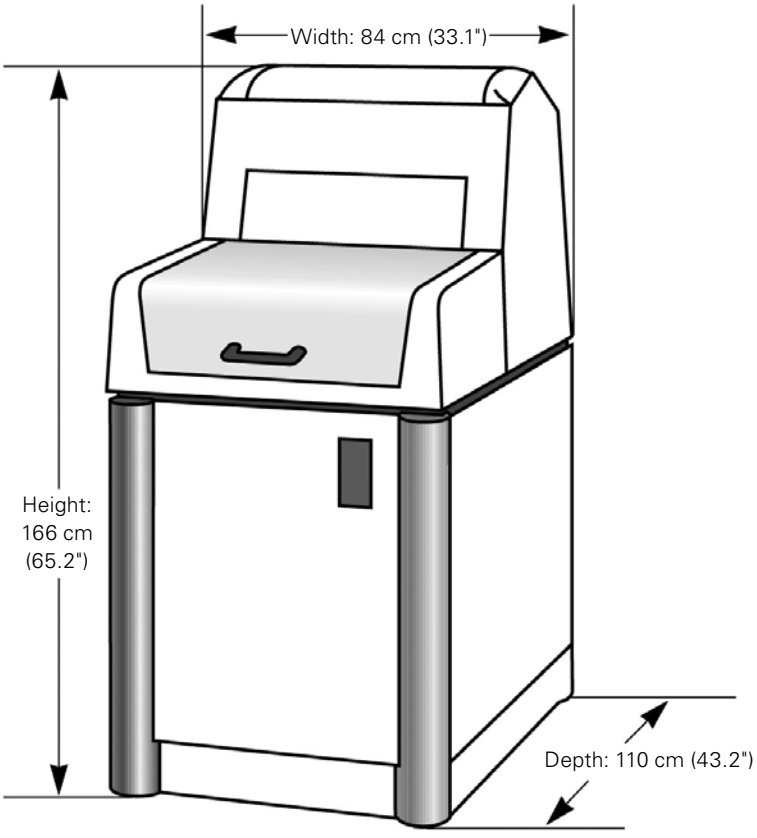
The D4 ENDEAVOR's high-precision 2-circle goniometer and modern X-ray optics and detectors guarantee excellent analytical results – with unrivaled speed and the capability to handle a wide variety of samples. Our revolutionary and unique sample handling concept opens up previously undreamt-of possibilities. You can load the D4 ENDEAVOR with samples of different dimensions and consistency and define a wide range of measuring jobs all at the same time.

The D4 ENDEAVOR and the modular DIFFRAC^{plus} measurement and analysis routines make a perfect team. Qualitative and quantitative phase analysis, fundamental parameter analysis of reflections, real space and crystal structure analysis and measurements via Internet are just a few of the pioneering highlights of the D4 ENDEAVOR with DIFFRAC^{plus}.

The D4 ENDEAVOR combines state-of the-art technology with easy operation and a very small footprint. In addition, as a Bruker AXS DIFFRACTION SOLUTION the D4's modularity ensures that you are optimally equipped for future needs and innovations. This guarantees that the instrument retains its value.

D4 ENDEAVOR – simply well designed.

D4 ENDEAVOR –
your perfect partner

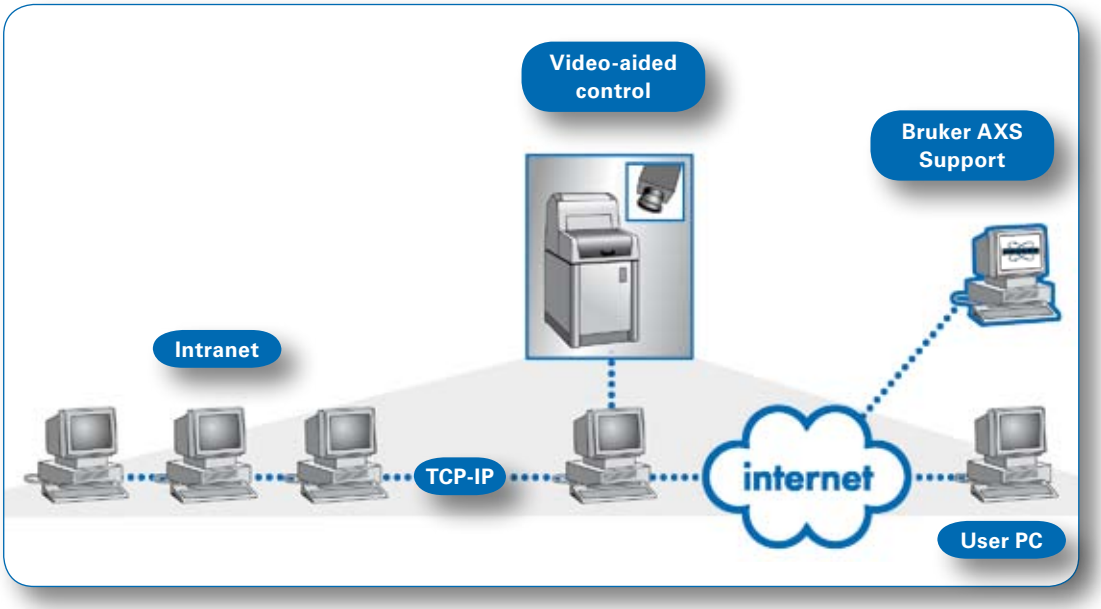


Everything under control, no matter where or when – D4 ENDEAVOR via networks

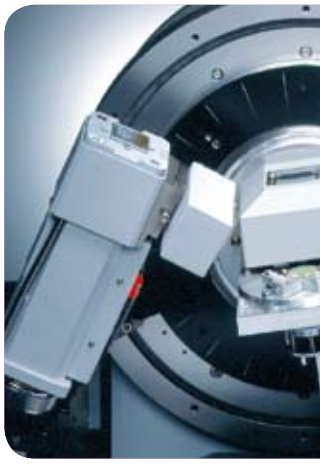
The technology and the software of our D4 ENDEAVOR allow fully automatic measurements, analyses and sample changing – in short, the entire analysis process is automatic. Data exchange between the equipment and the operator software uses the TCP/IP-based client/server principle. This means that you can start and monitor measurements from any computer in the network for use in your daily work. You can prepare your analysis reports directly in your office while other measurements are still running, even if your office is not on the same continent as your D4 ENDEAVOR.

You have constant worldwide access to measurements in progress via the Internet. Our D4 ENDEAVOR is equipped with a video camera. Whether you work over networks or the Internet, you miss nothing. You not only have access to all data, but can also "look over its shoulder" when the D4 ENDEAVOR is at work – as if you were standing next to it in the laboratory.

Perfect communication over networks opens up totally new possibilities. If required, either you or we can give the operator technical or analytical support – faster and easier than ever before.

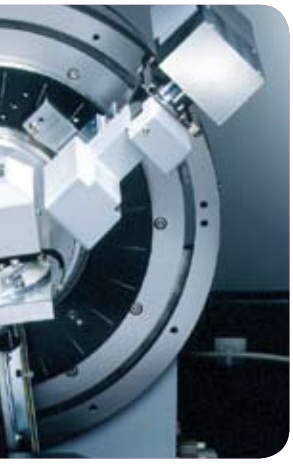


Instrument view via Webcam



Set-up with energy dispersive SOL-XE detector

Gripper handling sample cup



Unlimited freedom for your samples – sample handling with the D4 ENDEAVOR

No two samples are the same.

This is why we came up with a clever idea for the D4 ENDEAVOR – its revolutionary sample handling concept. This gives you the greatest possible flexibility for sample preparation and selection. Whether examining pressed powders, thin films, smallest sample amounts, liquids, or even small workpieces – they can all be inserted and analyzed at the same time in the up to 120 positions of our D4 ENDEAVOR magazine. The usual analytical limitations associated with the use of a sample changer are eleminated by our D4 ENDEAVOR.

The compact design of the D4 ENDEAVOR does not at all limit its new dimension of flexibility. This is reflected in the number of X-ray optics and detectors available for you to choose from. Your samples determine the optimum choice of components, with push-plug optics making changing simple without any realignment.

- **Ideal samples:** the established Bragg-Brentano geometry provides excellent data quality for all applications
- **Non-flat samples,** thin films or low absorption: parallel-beam geometry with Göbel Mirror and Soller Slit is the optimum combination
- **Fluorescent samples:** the energy-dispersive SOL-XE detector achieves excellent results in optimum measuring time
- **A vast number of samples** in the shortest possible time: the 1-dimensional LYNXEYE detector with simultaneous data acquisition cuts measuring time drastically without loss of quality

As versatile as your tasks: our D4 ENDEAVOR.

66 samples	72 samples	120 samples
∅ 51.5 mm (2.0")	∅ 40 mm (1.6")	∅ 35 mm (1.4")
8.5 - 40 mm (0.33 - 1.6")	14 mm (0.6")	4.7 mm (0.2)
Steel, PMMA, shaped sample	Steel	Steel
mechanical gripper	magnetic gripper	magnetic gripper

- **66, 72, or 120 sample positions with minimum space requirement**
- **Maximum sample flexibility**
- **Quick sample changing for high sample throughput**
- **Analytical versatility through push-plug optics**
- **Scintillation counter, energy-dispersive SOL-XE or 1-dimensional LYNXEYE™**

- **Minimum preparation effort, as a wide range of different sample sizes can be handled simultaneously**
- **Extremely rapid sample transfer to measuring position to minimize processing time**
- **66, 72, or 120 positions in the sample magazine can be loaded and unloaded at any time**
- **Powder, liquid, or solid samples – a wide variety of sample holders in**

Powder samples




Randomized fine powder is filled in sample rings. You can choose the ring size to suit the amount of material available.

Oriented powder



Powder samples of materials that tend to form a preferred orientation can be prepared in sample rings based on the "back-loading" principle.

Thin, small samples



Spring loaded cases are available for mounting samples that cannot be prepared as powder samples.

Maximum flexibility – sample handling with the D4 ENDEAVOR

Suitably shaped samples

If you have solid samples or samples that you can prepare compactly in the right dimensions, just insert them directly and get started.

Environment-sensitive samples

Rings are available for such samples. The rings can even be filled with liquids. The measuring surface is sealed by a thin foil.

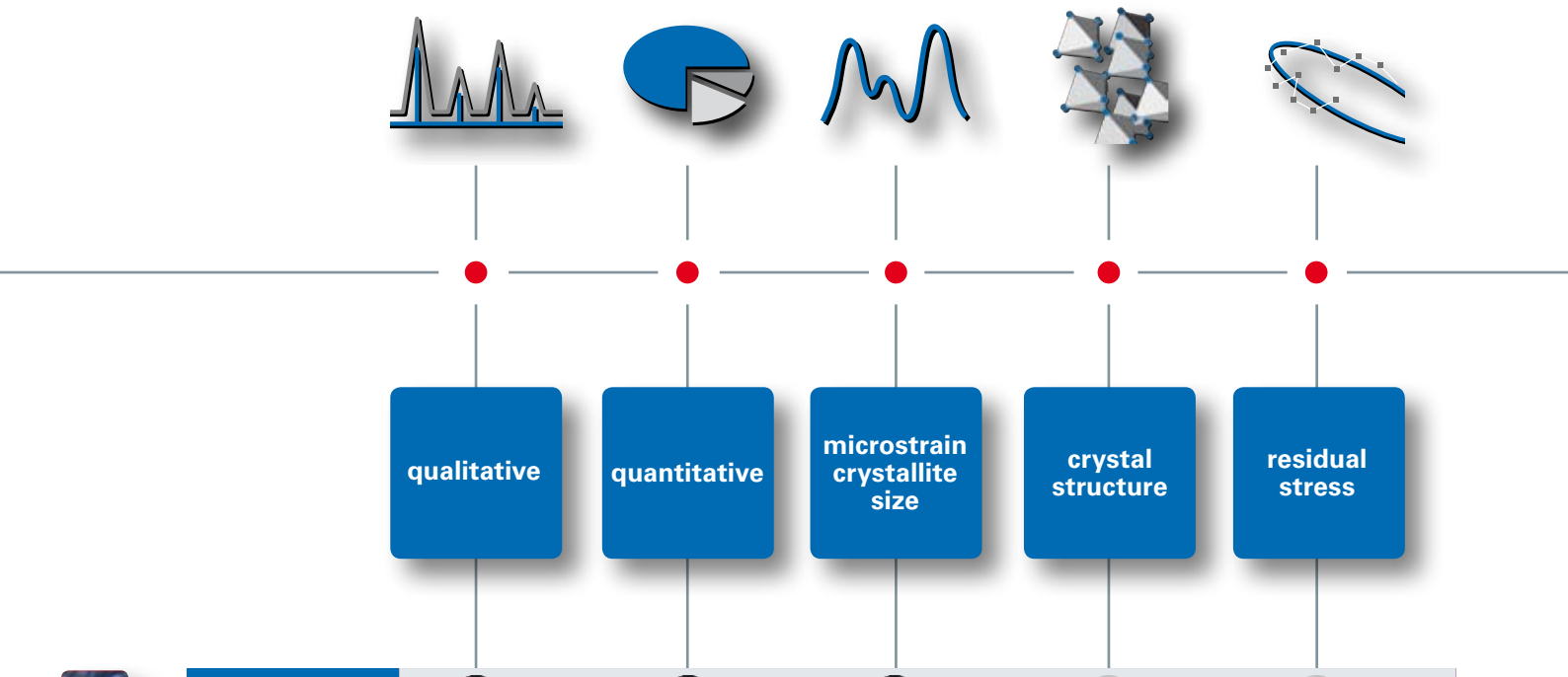
Irregularly shaped samples

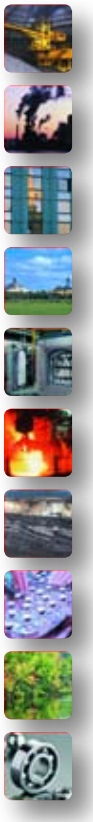
Workpieces can be examined non-destructively by placing them into suitable holder rings.

Small sample amounts

Rings providing a background-free silicon crystal permitting analysis of even the smallest sample amounts.

The entire analytical world of the D4 ENDEAVOR





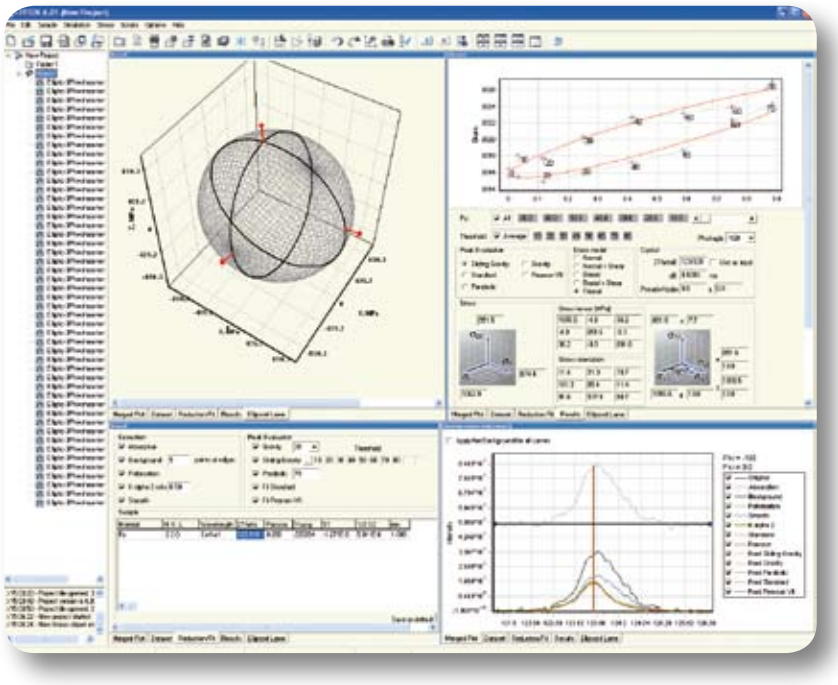
Construction materials	●	●	●	○	○
Chemistry	●	●	●	●	○
Thin films	●	●	●	○	●
Geology	●	●	●	●	○
Ceramics	●	●	●	●	○
Metals	●	●	●	●	●
Minerals & Mining	●	●	●	●	○
Pharma-ceuticals	●	●	●	●	○
Environment	●	●	○	○	○
Workpieces	●	●	●	○	●

On the trail of macroscopic properties – residual stress analysis

The macroscopic properties of many high-tech materials depend deliberately upon the direction chosen. X-ray diffraction is the definitive and most well established and non-destructive technique for the determination of the complete residual characteristics in materials and workpieces.

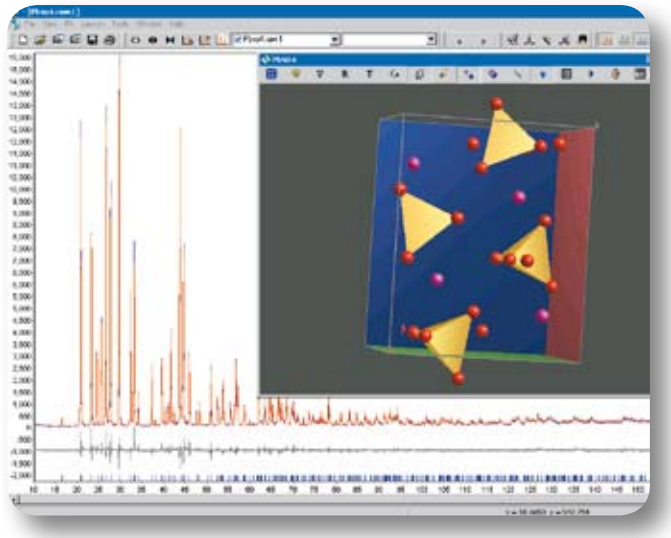
To determine the residual stress in a workpiece, the angular shift of a reflection must be reliably measured at the largest possible diffraction angle and as a function of the angle between the incident X-ray beam and the sample surface. For an accurate determination of the angular shift, the background is also often measured in addition to the complete reflection, due to the typically small reflection intensities at large diffraction angles.

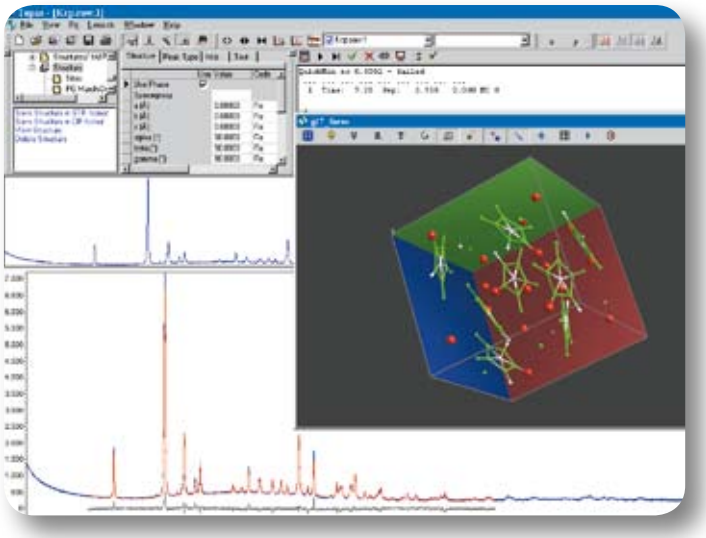
The reliability of the results as well as the speed of residual stress analysis depend largely on the optimum combination of the X-ray components and the measuring and analysis strategy. The D4 ENDEAVOR with its whole spectrum of modern X-ray technology is ideal for this task. You'll never want to do without the D4 ENDEAVOR with STRESS SE and LEPTOS S software in the future.



- **Fast and first-rate qualitative phase analysis using all data points**
- **Straightforward measuring and analysis strategies for effective quantitative phase analysis**
- **Standardless determination of crystallite sizes and microstrain with TOPAS by the perfect analytical consideration of the experiment**
- **Powerful crystal structure refinement and determination from powder diffractograms**
- **Efficient residual stress analysis using the latest X-ray technologies**

Crystal structures –
D4 ENDEAVOR with TOPAS





Crystal structure determination and refinement using powder diffraction are vital analytical methods in mineralogy and organic and inorganic chemistry. Our D4 ENDEAVOR partners TOPAS software for a highly efficient solution.

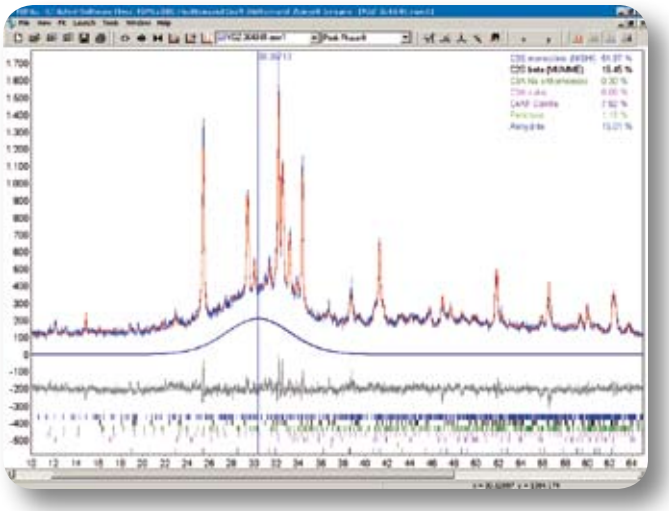
Mineralogical samples or chemical and pharmaceutical samples frequently provide very complex diffractograms or only weak scattering signals. This makes it important to combine the optimum X-ray optical components and detectors to suit the analytical requirements.

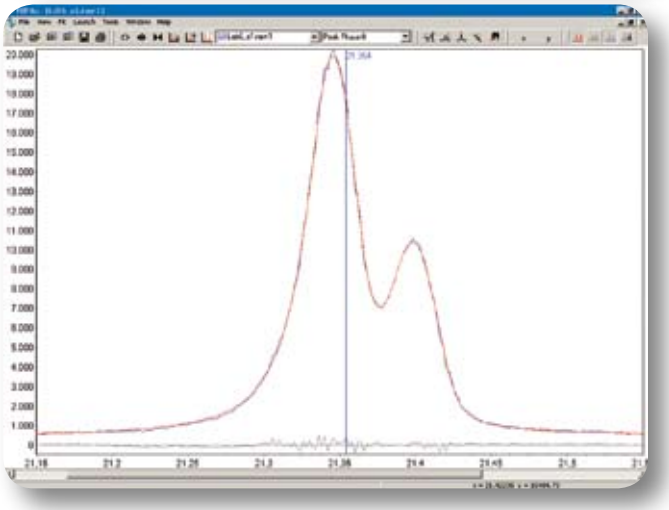
Your solution? Our D4 ENDEAVOR.

The D4 ENDEAVOR offers the ultimate solution for these crystallographic questions when combined with the extensive analytical capabilities of TOPAS. Only TOPAS opens up the possibilities of not only refining a 3-dimensional crystal structure from a 2-dimensional powder diffractogram but also determining the structure ab-initio.

Our D4 ENDEAVOR and TOPAS: an unbeatable DIFFRACTION SOLUTION.

Analysis down to the finest detail – microstrain and crystallite size





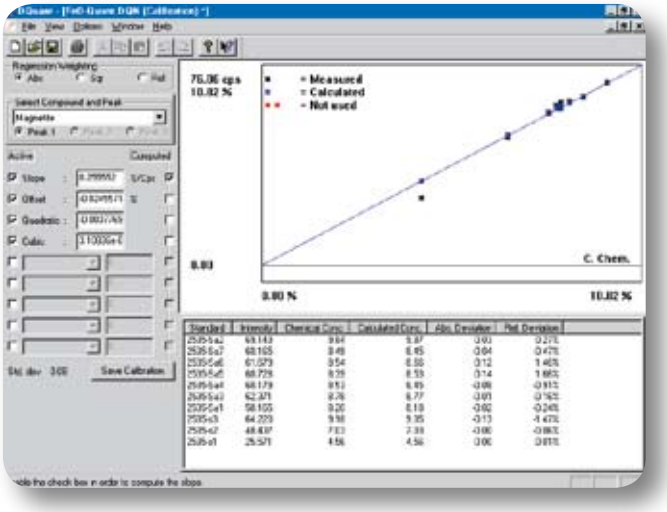
Thanks to the quality of the data measured with the D4 ENDEAVOR, a more detailed analysis of the individual reflection profiles reveals further important information such as crystallite size and microstrain. Pioneering, convenient and informative for this task – TOPAS.

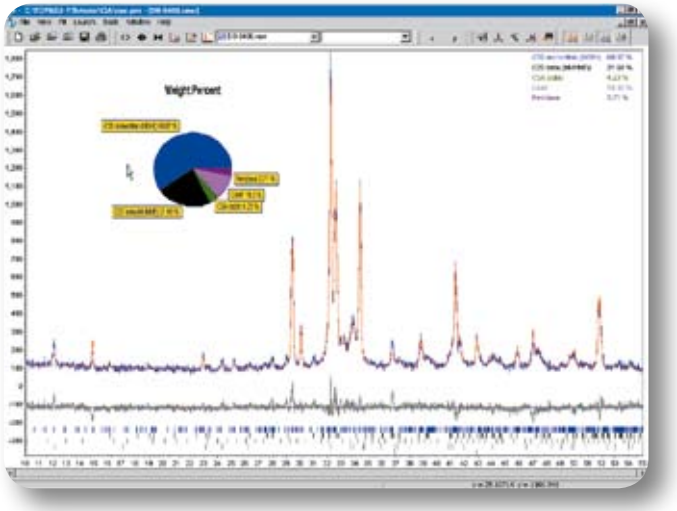
To determine the mean crystallite size within a sample with maximum accuracy, you perform a profile fitting to a measured reflection with TOPAS, the software considers all the effects of the instrument parameters on the profile shape. The result of this standardless fitting is the crystallite size. Standardless determination of the microstrain is achieved in exactly the same way.

If your sample is a complex composition of different phases and states, TOPAS can be used to determine the amorphous content and the various phase components can be separated or a lattice parameter refinement can be performed. TOPAS can do this because it exactly defines the complete diffractogram mathematically.

Get to the bottom of your sample properties with the D4 ENDEAVOR and TOPAS.

Quantitative phase analysis with the D4 ENDEAVOR – no trace gets lost





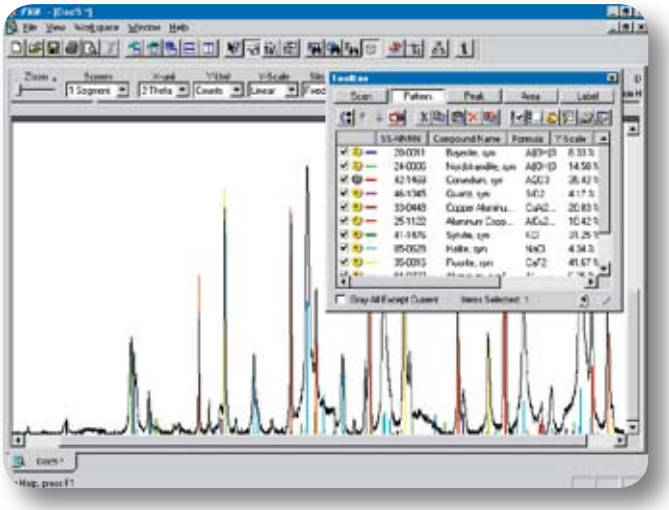
The D4 ENDEAVOR and DIFFRAC*plus* offer maximum flexibility for exact quantitative phase analysis, where the absolute reflection intensities of the phases examined must be determined. This is exactly the right job for either DQUANT or TOPAS.

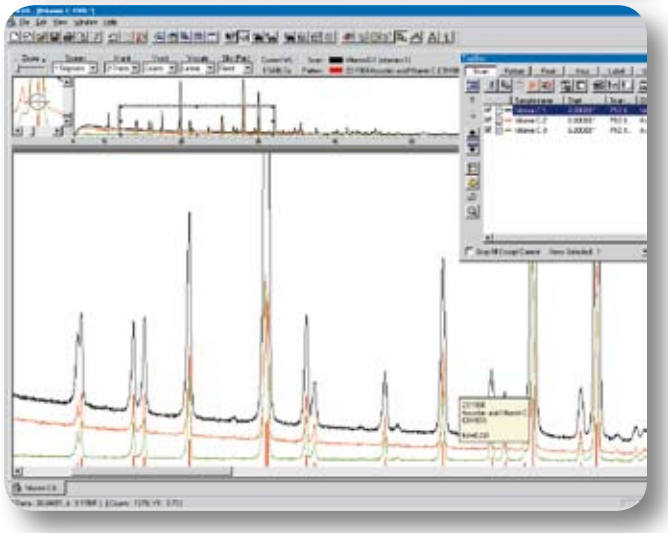
The outstanding efficiency of DQUANT is achieved by the clever combination of simultaneous dif fractometer control and measurement data analysis.

You can easily define the optimum measuring and analysis strategy for your analytical task. Depending on the complexity of the task, it may be necessary to determine the scattered intensity of a phase from background-subtracted, completely measured reflection profiles. If the peripheral conditions are known, you can let the quantitative analysis run as a routine operation fully automatically and time-optimized – you can't beat this for speed.

On the other hand, TOPAS opens up a totally new dimension of quantitative phase analysis. TOPAS enables you to fully take into account the effects of the experimental setup on the measurement result. The complete measured diffractogram is used for the analysis. TOPAS calculates diffractograms for various phase compositions in a matter of seconds until the calculation matches the measurement. The accuracy and reliability of this method is unsurpassed.

Qualitative phase analysis – it's so easy with the D4 ENDEAVOR and DIFFRAC^{plus}





The most important requirement for reliable qualitative phase analysis is the measurement of accurate powder diffractograms and a powerful data evaluation software: our D4 ENDEAVOR and DIFFRAC^{plus}.

And this is how you do a phase analysis with DIFFRAC^{plus}– well known simple and user-friendly:

- The first step is to define the measuring job and the corresponding sample positions in the magazine – DIFFRAC^{plus} takes care of the measurements automatically. You can define and measure priority samples at any time.
- In the next step you use our unrivaled SEARCH software to compare the complete diffractogram with the many thousands of entries in the ICDD database. SEARCH does not have any restrictions to high intensity reflections, nor does it neglect reflection asymmetries or shoulders. This ensures that even complicated phase mixtures with extreme reflection overlaps can also be analyzed in an optimum way.
- In the last step you select the appropriate phases from the list of suggestions or let DIFFRAC^{plus} take care of the work automatically, in line with your individual settings – finished.

You can transfer the analysis results to your usual word processing, spreadsheet or graphics program – so easy with drag and drop.

The D4 ENDEAVOR with DIFFRAC^{plus} – simply unsurpassed in speed, reliability and ease-of-use.

Technical Data	
Goniometer	
Operating mode	vertical configuration, Theta/2 Theta
Max. useable angular range (depending on accessories)	-8° < 2 Theta < 170°
Smallest selectable step size	0.0001°
Reproducibility	±0.0001°
Verifiable absolute accuracy	≤ ±0.01°
Max. speed (depending on accessories)	25°/s
X-ray optics	
Slits	plug-in or motorized
Secondary monochromator	Graphite
Axial Soller Slits	1.5°, 2.5°, or 4°
Göbel Mirror	for Cu- or Co-radiation
Detectors	
Dynamic scintillation counter	NaI
Proportional counter (Ca channel)	filled with Ne-CO_2
Energy-dispersive detector	SOL-XE (Li drifted Si detector)
Linear detector	LYNXEYE, high-speed and high-count rate
Sample magazine	66 sample positions for 51.5 mm Ø (2.0") 72 sample positions for 40 mm Ø (1.6") 120 sample positions for 35 mm Ø (1.4")
Automation interface	optional
General room planning	
Outer dimensions	166 x 84 x 110 cm (H x W x D) 65.2 x 33.1 x 43.2" (H x W x D)
Weight (without additional electronic units)	440 kg (970 lbs)
Cooling water supply	min. 3.5 l/min, 5 - 8 bar (72.5 - 116 psi) 10°C - 20°C (50 - 68°F)
Power supply	47 Hz - 63 Hz, 208 V - 240 V
Max. power consumption	5 kVA

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