Bruker AXS Microanalysis

QUANTAX CrystAlign

- Fully-integrated high-speed EBSD analysis system

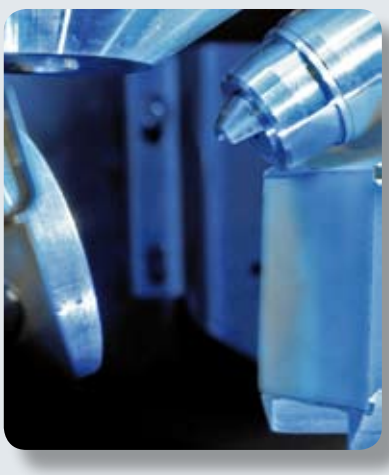
think forward

EBSD

QUANTAX CrystAlign - Easy to use EBSD

- In-situ vertically adjustable detector for maximum analytical flexibility
- Independent acquisition: Pattern Streaming with 630 patterns/s (160 x 120 pixels)
- LED detector position indicator and multiple features for safe operation
- Fully software controlled detector with all electronics integrated
- Simultaneous EDS and EBSD acquisition with up to 100 patterns/s
- Easy to use software with a single user interface
- Re-indexing with up to 16,000 points/s
- Signal Assistant for acquisition setup
- Calibration Assistant for geometrical setup

Internal view of a SEM chamber. On the left is the tilted sample. On the right are the screen of the EBSD detector (bottom) and the tip of the EDS detector (above). Visible at the top left is the SEM pole piece.



The *e⁻Flash* EBSD Detector

Imperatives for the ***e⁻Flash*** EBSD detector's design were speed, sensitivity, flexibility, reliability and high integration. The ***e⁻Flash*** is fully software controlled, positioning and setup can be done from the attached PC. Only a thin power supply and two signal cables are required to connect the detector.

Minimizing drift effects through pattern streaming

Certain samples or SEM stages are prone to drift phenomena. Therefore short acquisition times can significantly improve pattern quality. The detector is capable of recording 630 patterns/s using 4x4 binning. Due to pattern streaming, speed is independent of the number of phases contained in the sample, warranting that acquisition is always fast and sample contamination is kept at a minimum.

Unequaled accuracy at high speed

Due to its capability of recording 630 patterns/s with 160x120 pixels the ***e⁻Flash*** provides excellent angle resolution even for high speed measurements. Should the task at hand require the in-depth analysis of the sample's fine structure, the detector can be operated at the full 640x480 resolution and still acquire 210 patterns/s.

In-situ adjustment of vertical detector position

The ***e⁻Flash*** is vertically adjustable, even while the SEM is in operation. This is useful for optimizing the signal during acquisition setup and for adjusting the working distance to the current analytical task. Suitable SEMs will so permit scanning areas of up to 100 mm² without moving the stage. Switching to low working distances and high magnification is also possible without interrupting the session.

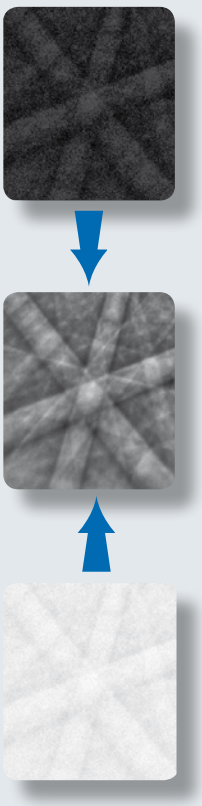
Safety features for worry-free operation

The blue LED position indicator shows how far the detector screen is currently inserted into the SEM chamber. An integrated touch sensor triggers immediate retraction of the detector screen with a speed of up to 10 mm/s. Nevertheless, should the screen be damaged, it can easily be replaced by the user.

EBSD for every SEM user

Signal Assistant

QUANTAX CrystAlign's unique Signal Assistant automatically adjusts the camera settings to produce optimum pattern quality.



Making EBSD accessible also to the non-expert operator

This was Bruker's main intention when writing the EBSD software package. One approach was the inclusion of automation features that take care of time-consuming tasks and simplfy operation.The other approach was the integration of all software options under a single user interface.

Signal Assistant

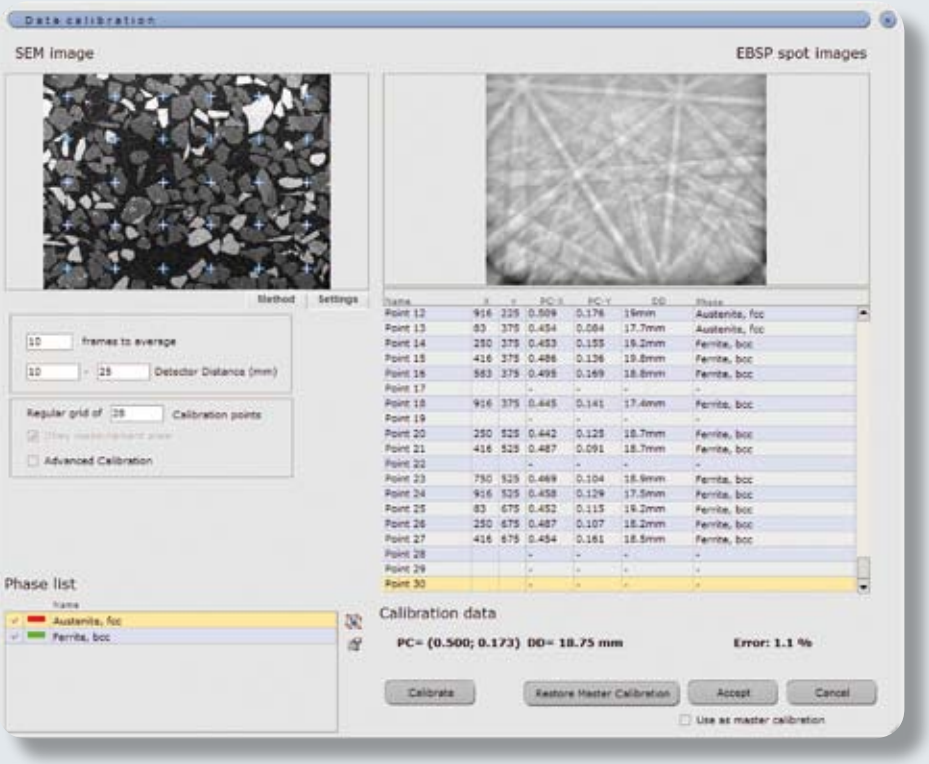
The Signal Assistant is the automatic software tool for adjusting camera settings at the beginning of an acquisition run. This results in optimally illuminated pattern images. Readjustment is only necessary if measurement conditions are changed.

Calibration Assistant

Exact pattern center calibration is an absolute necessity for correct indexing and for avoiding misidentification of phases. QUANTAX CrystAlign provides a sophisticated Calibration Assistant which automatically performs this task using the current sample (no calibration standard required).

Seamless integration for comfortable operation

The integration with the ESPRIT EDS software frees the operator from frequently changing programs for different analytical purposes. A single mouse click changes between EBSD and EDS analysis or between different tasks in the EBSD workspace.



Pattern center calibration dialog

ESPRIT software for EBSD

A variety of presentation tools for optimum visualization of results

The analyst often faces the challenge of how to present data, so that material properties of interest can easily be assessed. The ESPRIT software suite for EBSD offers a number of data representation tools to fulfill that need.

Pole figures

Pole figures are one of the most common representation tools for orientation data. They show the distributions of the selected poles {hkl} considering all orientation measurements. Pole figures provide important information on strength of texture and also on which texture components are dominant. ESPRIT for EBSD generates pole figures in high resolution and with unprecedented speed.

Inverse pole figures (IPF)

While pole figures display crystal orientations with reference to the stage coordinate system, the IPFs describe a chosen stage system axis as a crystallographic vector. Since there are many symmetry-equivalent vectors, the IPFs are reduced to the symmetry-specific sub-spaces (as shown in the figure below).

Pattern quality map

This is an important tool for judging the quality of a measurement, which is influenced by sample properties (e.g. phases, boundaries, lattice strain) and also by sample preparation. The quality at each point of the map is brightness coded to produce a gray scale image of pattern quality.

Phase map

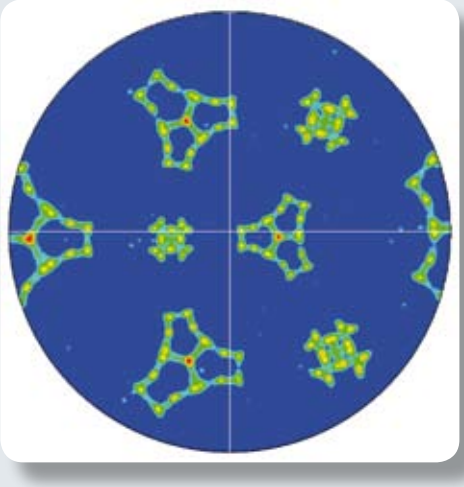
All identified phases are displayed in a color-coded phase distribution map.

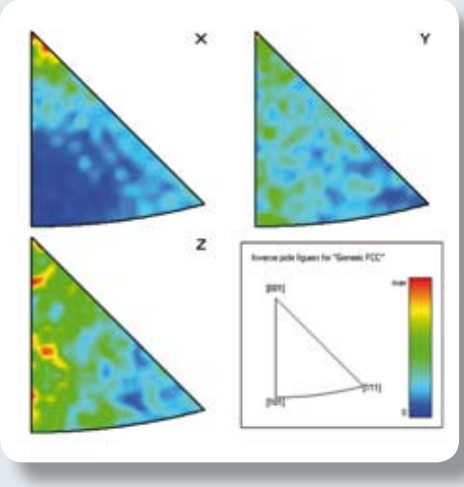
IPF map

The IPF map combines the locally detected orientation with the crystallographic description of a single reference direction. The color coding is scaled to the reduced size of the IPF.

Euler map

An Euler map displays the detected orientation at each point on the basis of the Euler angles which are encoded in RGB.

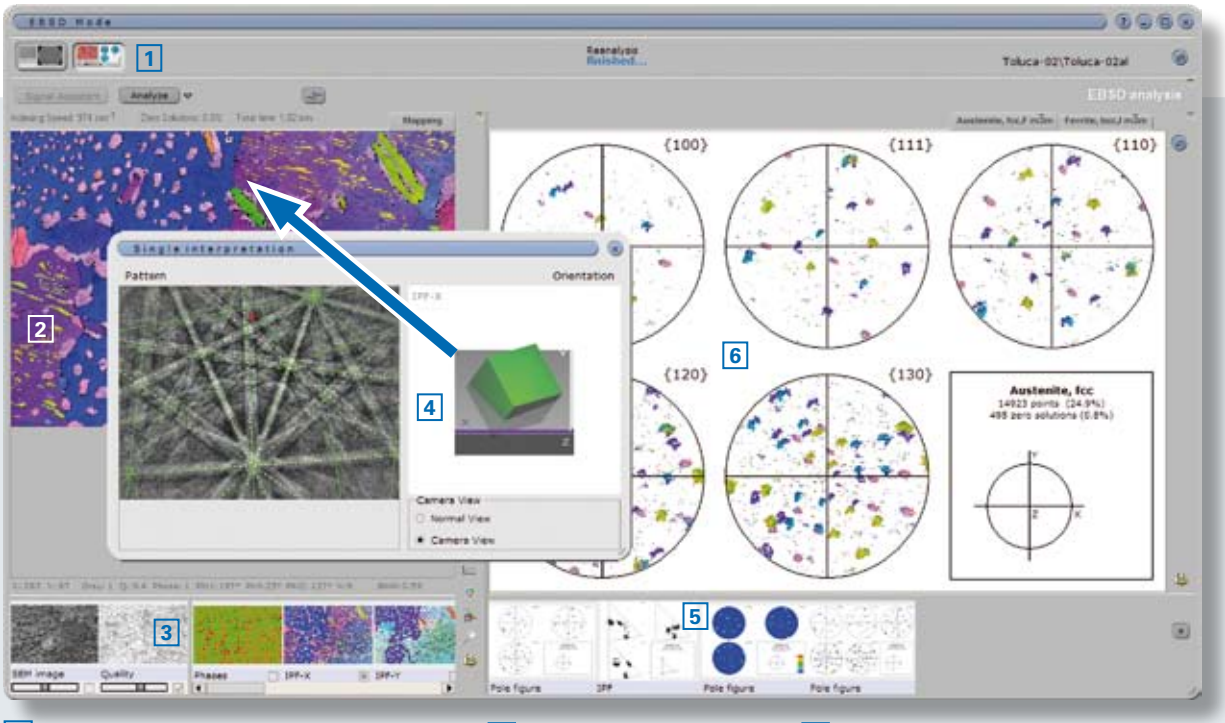




Left: High resolution pole figure for strong texture gradients (Kurdjumov Sachs orientation relationship).

Right: IPFs of the point group symmetry $m\bar{3}m$ for the three reference directions X, Y and Z.

Detailed crystallographic information is always only a mouse click away



1 Buttons to toggle workspace modes
2 Image and map window
3 Map selector
4 Pattern and orientation for every map point
5 Pole figure type selector
6 Tabbed pole figure window

ESPRIT for EBSD provides easy access to all data. The analyst can switch between two standard EBSD workspace displays. In acquisition mode it contains the SEM image, the phase list and a large area for maps and point information. A tool for free scan area selection is provided as well. In postprocessing mode the workspace enables useful interactions between orientation maps and pole figures (see screenshot above).

Result display for every mapping point

Detailed result information for individual measurements, corresponding to the current mouse cursor position, is given below the mapping. An extra window can be activated simultaneously to show the pattern, if available. A 3D figure of the derived unit cell orientation is displayed in relation to X, Y and Z.

Fast switching between representations

A bar containing miniatures of all available mapping representations can be found below the map window. Clicking on the miniature displays the according map in the large result window.

Similar miniatures can be found beneath the pole figure window, where the user can add self-defined pole figures and IPFs. The tabs contain the information specific to each phase.

All maps and pole figure representations are dynamically refreshed during acquisition. Both maps and pole figures can be displayed in fullscreen mode.

Fast indexing with up to 16,000 points/s

Deformed ferritic steel, original map size 1600 x 1200 (1,920,000) patterns, pixel size: 0.610µm, re-indexed in 2 min, 16,192 points/s, 1.6% zero solution

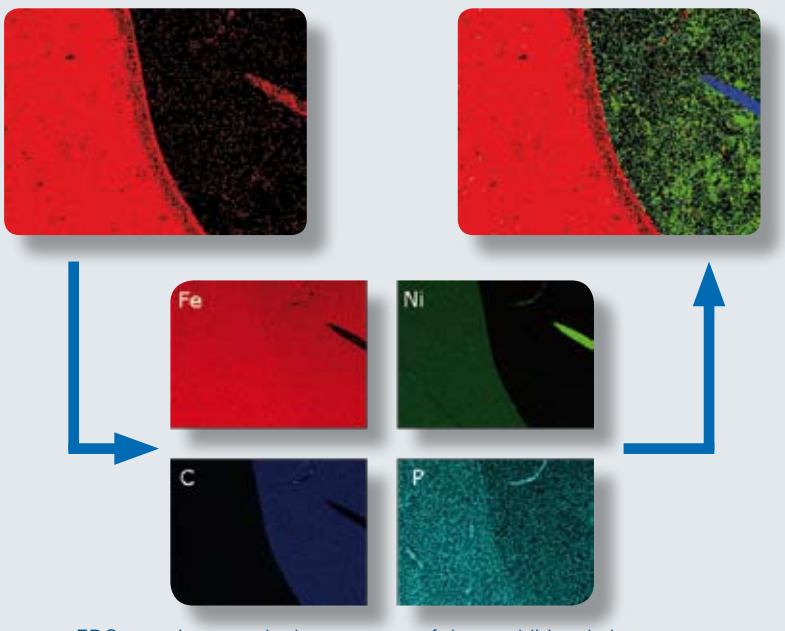
The EBSD software is capable of re-indexing measurements in incredibly short time. The employed procedure is more than an order of magnitude faster than a completely new measurement. Single phase materials can be re-indexed with around 16,000 points/s. The advantage of re-indexing is that measurements can be re-analyzed when not all phases have been known initially. Even if no phase at all is known, the detected band positions can be used to recalibrate the system later and use the fast re-indexing afterwards for a successive analysis of the microstructure. This works even better if EDS information can be used for further phase discrimination.

Simultaneous EBSD and EDS acquisition at highest possible speed

Due to the flexibility in positioning both EDS and EBSD detectors, optimum measurement conditions for both can be achieved. The count rate capability of the XFlash® EDS detector enables high speed of up to 100 patterns/s for simultaneous EBSD and EDS data acquisition. EDS information is collected in a hyperspectral database in form of point spectra, the so-called HyperMap. Like the EBSD data the EDS data is stored in a lossless format. It can therefore be presented in many different ways and is available for re-analysis anytime.

Original phase map of the Canyon Diablo meteorite, considering the bcc phase Kamacite

Re-indexing shows that Taenite (fcc) was misindexed as Kamacite, the missing phase is a carbide (Cohenite)



EDS mapping reveals the presence of three additional elements apart from the already known iron: nickel, carbon and phosphor. This information was used as input for re-indexing

eFlash EBSD detector

General specifications
Highly integrated UHV compatible detector with welded bellows
In-situ vertical adjustment for maximum SEM working distance variability
Motorized mechanism with LED position indicator, fully software controlled as well as push button operation (on encasement)
No moving parts outside encasement
Safety mechanism with audio and visual alarm and automatic retraction
Compact phosphor screen, user replaceable
640 x 480 pixels native resolution, 1 x 1, 2 x 2 and 4 x 4 binning available, up to 630 patterns/s (streaming only), max. 520 patterns/s with indexing
Compatible with most SEMs
Optional forescatter/ backscatter detection system

ESPRIT EBSD software

Feature overview
Signal assistant for optimization of detector settings for pattern detection
Automated pattern center calibration
Separation of acquisition and indexing for re-indexing with changed phase setup and band detection parameters without new measurement, maximum re-indexing speed 16,000 points/s
Supports all crystal symmetries
Simultaneous EBSD and EDS measurement
Various representation tools for EBSD data, including SEM images, pattern quality map, phase map, pole figures and inverse pole figures (IPF), IPF maps and Euler maps
Arbitrary user defined sample areas can be analyzed
CIF-compatible for crystal structure import
Point and click display of analysis details contained in maps
Infinite scalability of images
Graphic export via clipboard or image files

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