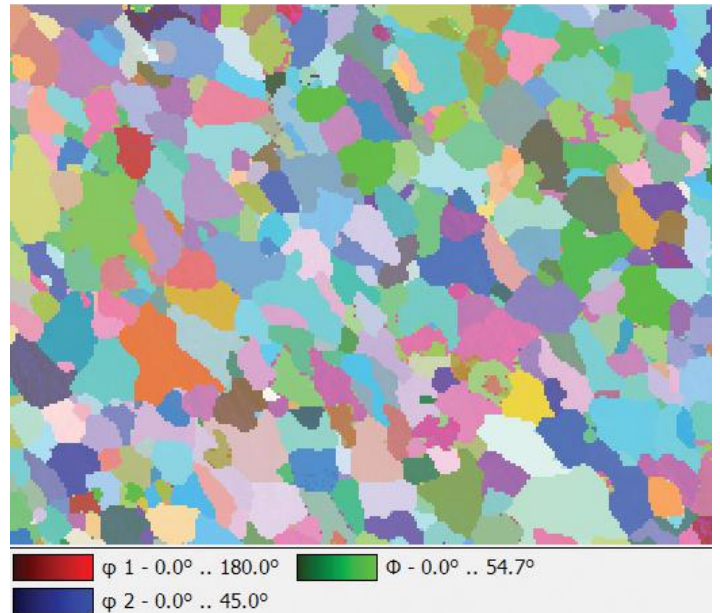
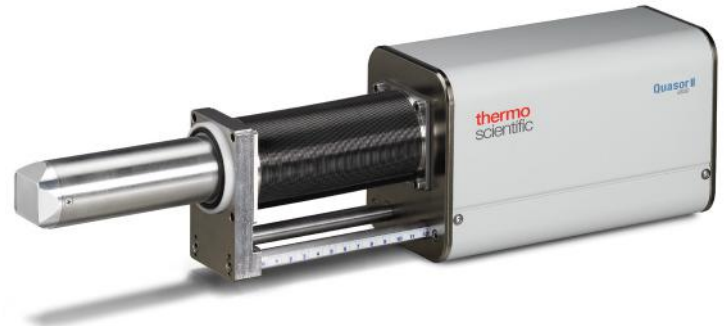


Microstructural characterization in the SEM

Examine the microstructure of metals with the most productive EBSD technology available. The Thermo Scientific™ Quasor II™ Electron Backscatter Diffraction (EBSD) system features a CMOS sensor that provides highly efficient characterization in the SEM. Designed to speed up productivity with clear images, fast collection rates, and accurate indexing of electron backscatter diffraction patterns, even under low light conditions, the Quasor II EBSD system includes integration within our acclaimed Thermo Scientific™ Pathfinder™ X-ray microanalysis software, enabling the simultaneous analysis of the elemental chemistry and the microstructure of the material. The Quasor II system with its revolutionary CMOS camera brings metallurgists the ideal tool to increase throughput in their SEM lab and gain a richer understanding of the materials that they study.



Euler map obtained from low carbon steel composed of ferrite grains. This data was collected with a 1 millisecond per pixel dwell time.

Making EBSD a reality

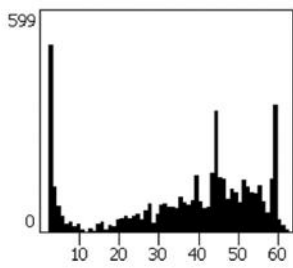
- Collection rates up to 600 frames per second with > 99% pixels indexed
- Three times better signal-to-noise than other CMOS cameras
- Integrated with Pathfinder X-ray microanalysis for simultaneous EDS/WDS and EBSD data collection
- One measurement provides both structural and chemical information about the sample

Designed for metallurgy

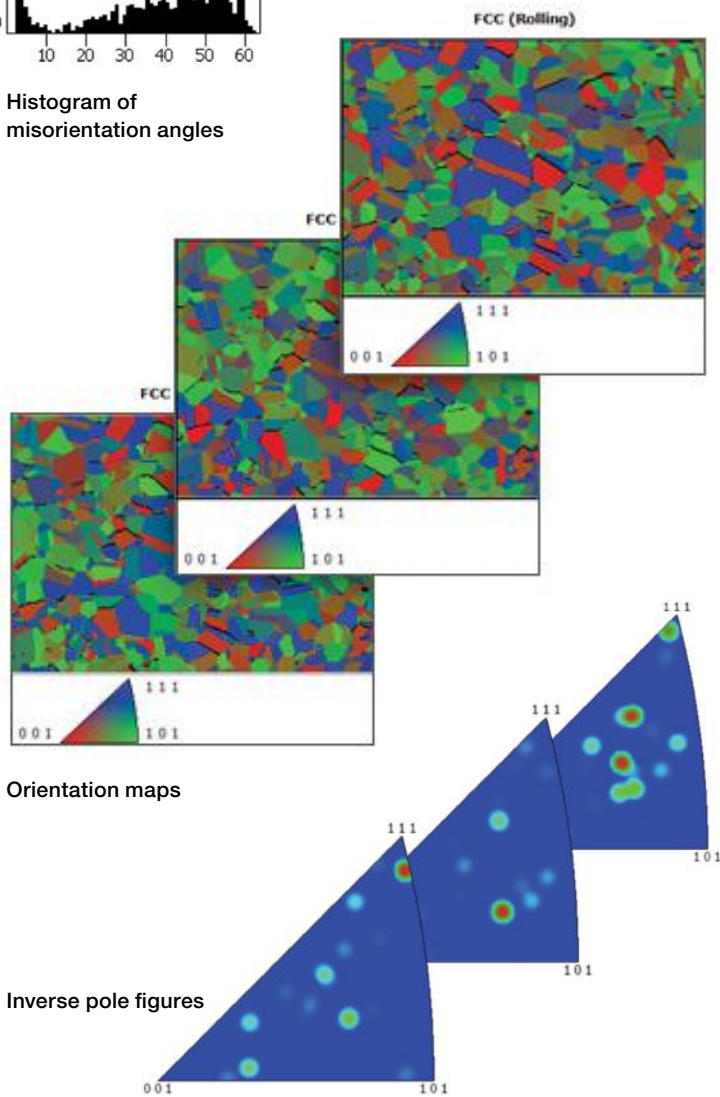
- Develop SEM-based methods for quality control and failure analysis
- Perform phase identification and transformation analysis following heating and cooling
- Identify phases and size grains
- Monitor heat affected zones after welding
- Run predictive fracture analysis in metals
- Validate additive manufacturing processes

Putting EBSD data to work

By implementing new CMOS camera technology, the Quasor II EBSD enables the rapid collect of diffraction patterns and converts them into usable data such as Euler maps, orientation image maps, inverse pole figures, grain boundary maps and histograms detailing the relative misorientation between grains. This development is a major advantage over other techniques because the SEM-based Quasor II system provides grain sizing down to sub-micron levels and reveals the relative orientation of each grain. In the example here, a stainless steel was analyzed at a collection rate of 500 frames/second, generating a complete picture of the grain size, distribution and orientation in less than 2 minutes.

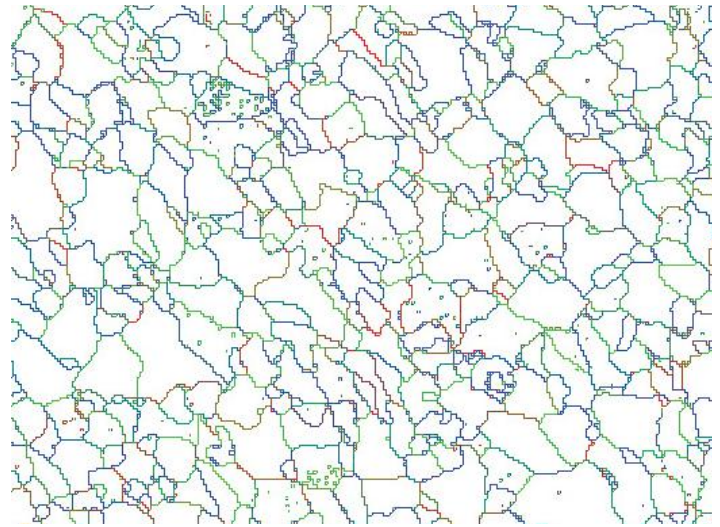


Histogram of misorientation angles



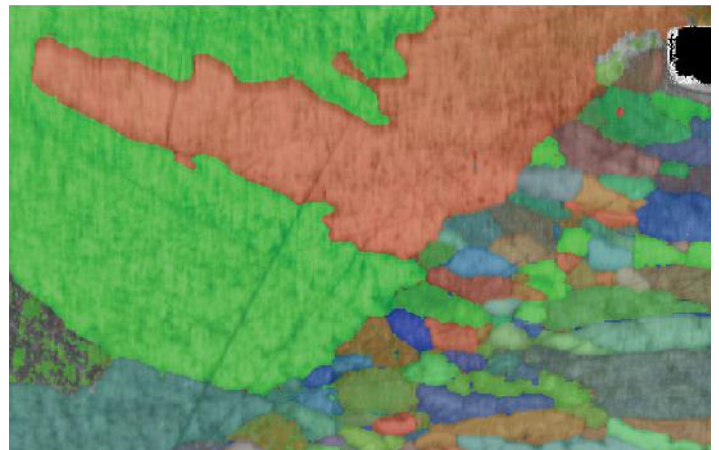
Orientation maps

Inverse pole figures



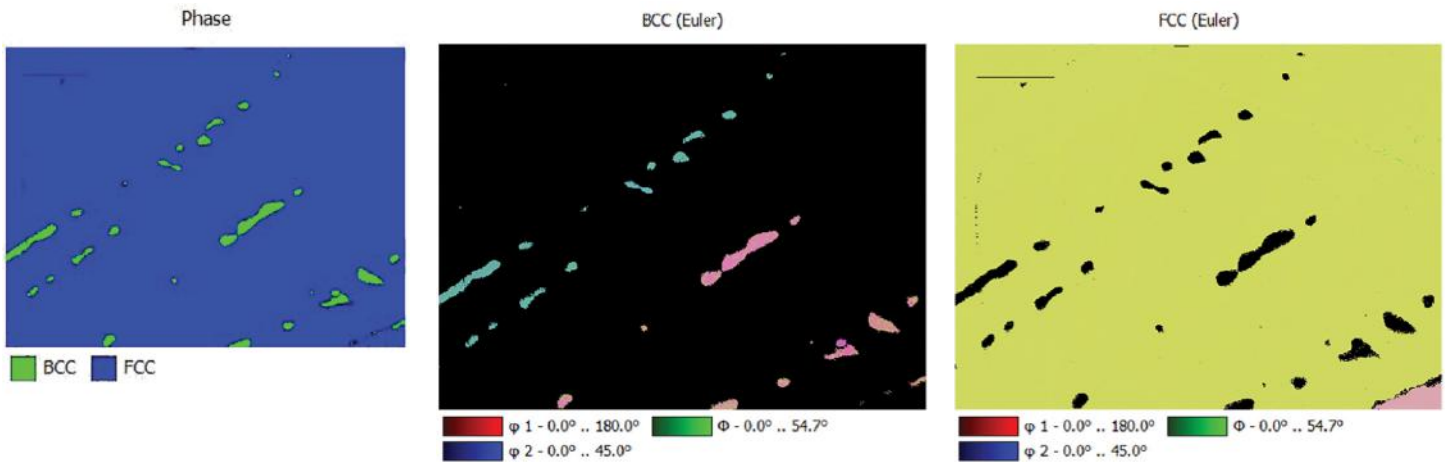
Grain boundary map from an annealed stainless steel

The backscatter electron image shows the welded joining of an aluminum piece (top left) and a 20% Cu infused aluminum piece (bottom right). A crack (top right) in the material has propagated right up to the boundary of the joining. The orientation image map acquired by the Quasor II system clearly defines the grain size, distribution and orientation of the two joined sections relative to the crack. The detailed structure shown in the electron image is too fine to be viewed with an optical technique. The orientation information is not available without EBSD.

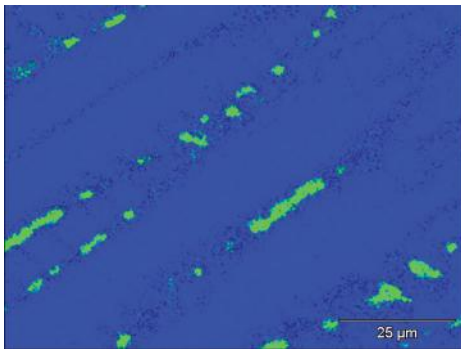


The Quasor II system completely integrates within Pathfinder X-ray microanalysis software. Sample characterization becomes a quick and complete process thanks to fast and accurate elemental analysis provided by a Thermo Scientific™ UltraDry™ EDS detector coupled with

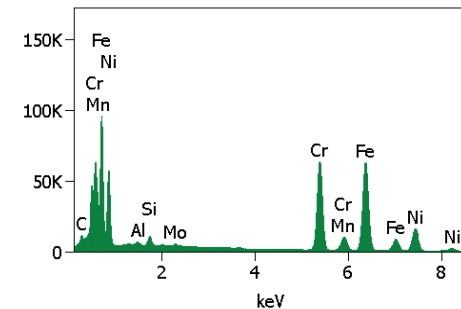
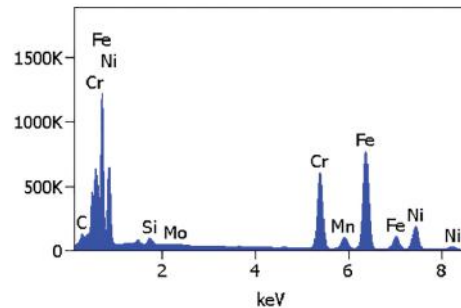
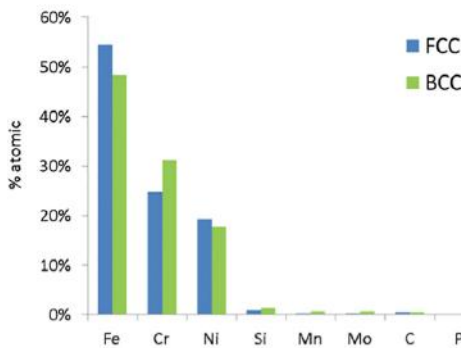
the speed and flexibility of the Quasor II EBSD system. Our exclusive Thermo Scientific™ COMPASS™ phase mapping enables you to visualize both the structural phase and the chemical phase of the material in one shot.



EBSD orientation image map result: (left) EBSD phase maps overlaid (center) Euler map for BCC (right) Euler map for FCC



COMPASS phase map generated from simultaneous EDS X-ray analysis.



Element	FCC	BCC
C	0.50 %	0.50 %
Si	0.94 %	1.44 %
P	0.03 %	0.08 %
Cr	24.76 %	31.16 %
Mn	0.30 %	0.64 %
Ni	19.34 %	17.72 %
Mo	0.22 %	0.56 %
Fe	54.42 %	48.40 %

Combining COMPASS phase mapping (EDS) with orientation phase mapping (EBSD) in the analysis of a quenched stainless steel sample enables the correlation of both chemical and structural information for a detailed understanding of the underlying kinetics of the material. In this example, the COMPASS phase mapping clearly highlights the rejection of Cr from and the accumulation of Ni into the FCC phase.

Specifications

Camera specifications

- Camera dwell time from 0.1 to 5000 milliseconds
- Collection speed up to 600 fps
- Diffraction pattern image resolution at 320 x 240 pixels
- Camera binning up to 2x2
- Software controlled motorized insertion / retraction with < 0.1 mm variance
- Dynamic gain up to 24x

Acquisition specifications

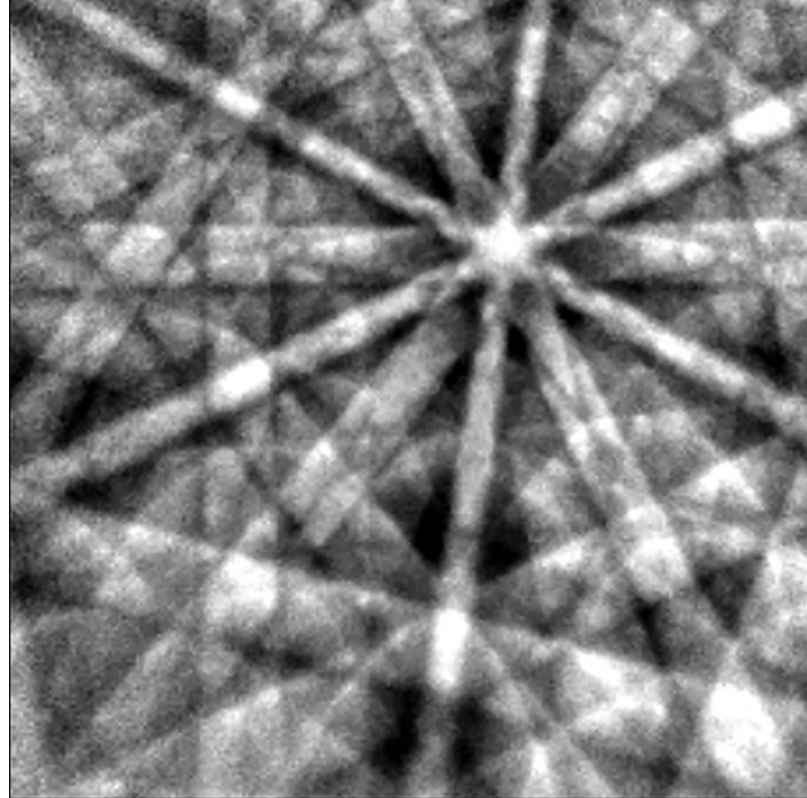
- Electron Image acquisition up to 4096 pixels at 1 microsecond dwell time per pixel
- Tilt corrected imaging at 70 degree tilt
- Simultaneous EBSD, EDS and WDS
- EDS & EBSD map collection up to 1024 pixels with minimum dwell time of 100 microseconds

Operating system compatibility

- Windows 10, Windows 8.1, Windows 7 compatible, 64-bit compatible
- Editable crystal database (CIF format)
- Single click reporting to Microsoft Word
- Export and import entire map of detected Kikuchi bands to *.ang or *.csv files (2)

Data processing and display

- Index and Pattern quality map
- HKL orientation map
- UVW orientation map
- Euler orientation map
- Crystal structure Phase maps
- Grain boundary axis and angle maps
- Grain size analysis
- Grain shape analysis
- Grain boundary CSL and special boundary maps
- Pole figures
- Inverse pole figures



Diffraction pattern processing and Band detect

- Background removal by subtraction or division
- Image cropping
- Flat Fielding with FFT or parabolic
- Choice of number of bands detected up to 30
- Image normalization by line length or Hough background
- Hough filtering with balanced image
- Hough filtering with Sharp, balanced or smoothed image
- Hough circle adjustment to screen pattern quality
- Hough transform display with editable line selection
- Choice of number of lines to index up to 30
- Allow elimination of bands from index scheme up to 25%
- Automatic ranked index by band intensity
- Crystal selection from pre-established library with over 10,000 crystals
- Re-processing of saved diffraction patterns
- Pattern center calibration search
- Ability to save diffraction patterns for later reanalysis

Find out more at thermofisher.com/quasor