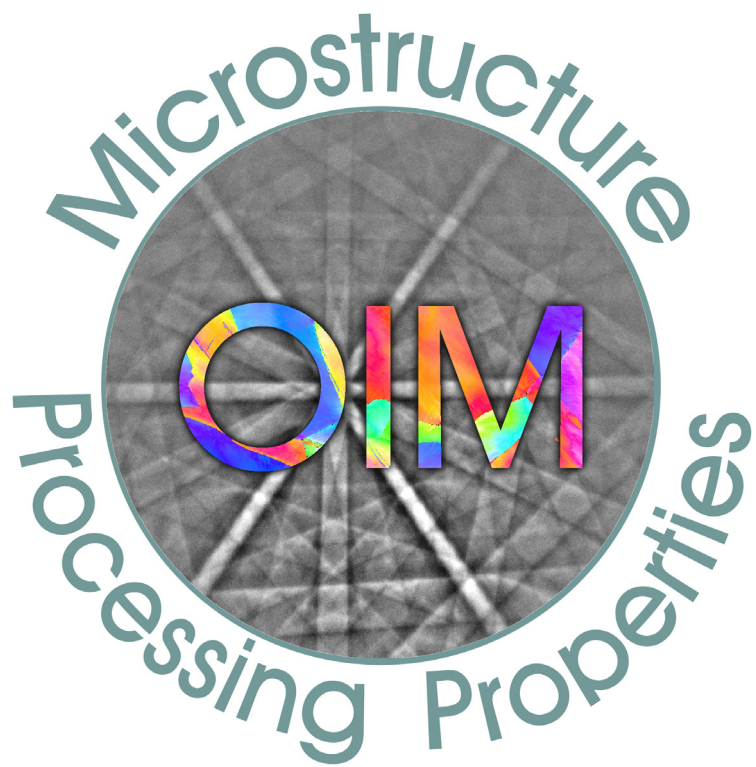GATAN
AMETEK®

# An Introduction to EDAX OIM Analysis

**Raising the standard for EBSD software**

**The most powerful, flexible, and easy-to-use tool for the visualization and analysis of EBSD mapping data**

Microstructure
Processing Properties

OIM

EDAX®

## Why EDAX OIM Analysis?

Orientation imaging microscopy (OIM) is a technique based on the automated collection and analysis of electron backscatter diffraction (EBSD) patterns. This mapping data provides information on the orientation, phase distribution, grain size and shape, grain boundary structure, and local deformation of crystallographic microstructures. EDAX OIM Analysis™ provides virtually unlimited potential for interrogating the wealth of information contained in OIM scans.

### OIM Maps

OIM Maps provide colorful and meaningful graphics, which give useful insight into material microstructures.

The features of OIM Maps include:

- Greyscale (>30 options), color (>40 options), or combined maps, including orientation, phase, and EBSD image quality maps

- Overlay of misorientations, grain boundaries, phase boundaries, twin boundaries, CSL boundaries, and reconstructed boundaries

- Customization of map colors and parameters

### OIM Charts

OIM Charts show numerical representations of the measured microstructure with statistical information for easy comparisons.

The features of OIM Charts include:

- More than 50 different chart options, including grain size, misorientation distribution, and local misorientations analysis

- Correlated plots of measured parameters

- Customization of chart display

### OIM Plots

OIM Plots offer visualization of measured orientation and misorientation distributions.

The features of OIM Plots include:

- Orientations are displayed in pole figures, inverse pole figures, Euler space, and Rodrigues space

- Misorientations are displayed in axis/angle space, Rodrigues space, and misorientation axis in pole figures

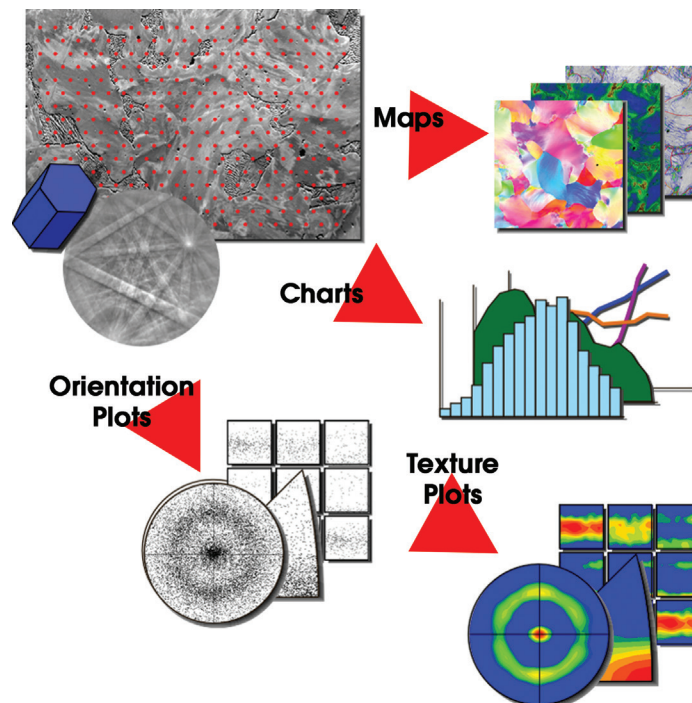- Discrete, contoured, or density plots



**Figure 1.** Features of OIM Analysis.

## QuickGen Toolbar

The QuickGen Toolbar is an intuitive starting point for analysis, offering quick access to commonly used maps, charts, and plots.

The features of the QuickGen Toolbar include:

- Quick orientation, image quality, grain, phase, and grain boundary maps
- Customized user-defined outputs
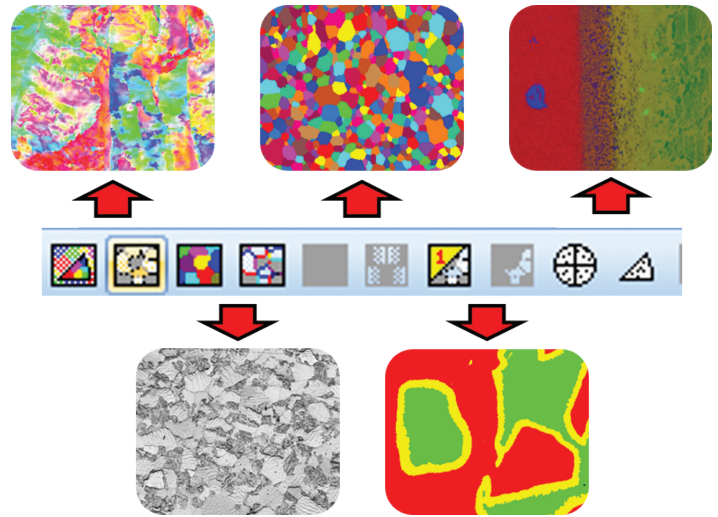- Partition and dataset level one-button analysis

## OIM Templates

OIM Templates offer an easy-to-use tool for performing repetitive, customized analysis of OIM data.

The features of OIM Templates include:

- Consistent reproduction of analysis and display parameters
- Templates for individual map/chart/plot, partition, and dataset levels
- Easy sharing of templates between users for improved collaboration

## Data Partitioning

Data Partitioning enables splitting OIM data into different microstructural subsets so that the different portions can be measured separately.

The features of Data Partitioning include:

- Partitioning by a point or by grain-based properties
- Boolean logic to combine partition definitions
- Partition definitions can be saved as a template for repeated use
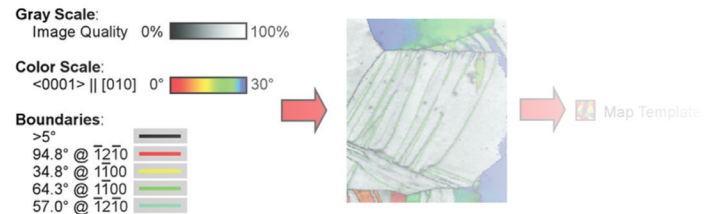


**Figure 2.** QuickGen Toolbar.



**Figure 3.** OIM Templates flowchart.



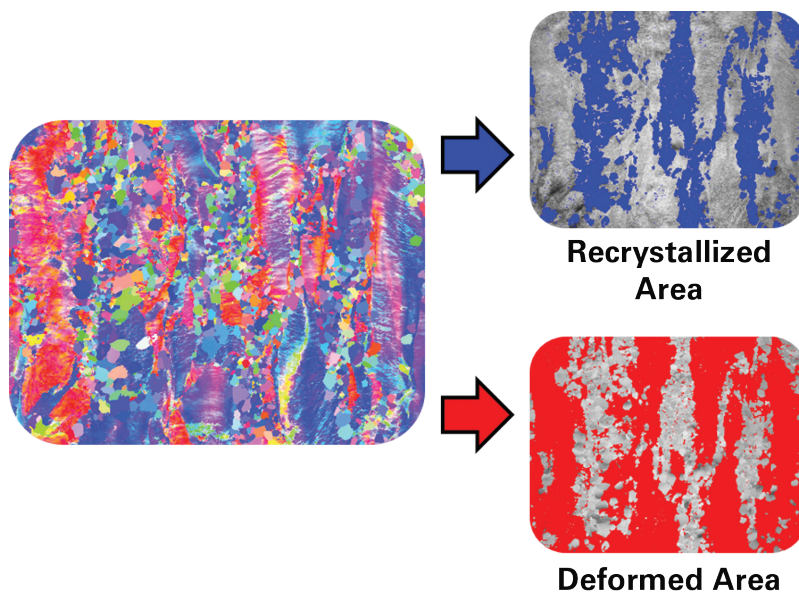**Recrystallized Area**

**Deformed Area**

**Figure 4.** Data Partitioning.

## OIM Project Tree

OIM Project Tree is an intuitive data management structure for novice and advanced users.

The features of OIM Project Tree include:

- Visual representation of current data analysis

- Cut and paste analysis within the project tree

- Creation and editing of maps, charts, plots, and templates

- Access to data import, export (including HDF5 support), clean-up, rotation, and other functions in the selected branch

- Both data and analysis can be saved together in the project

- OIM Data Miner for data management

## Comprehensive Analysis

Comprehensive Analysis offers grouped functions for a wide range of focused analyses within an integrated analysis package.

The features of Comprehensive Analysis include:

- Boundary analysis for characterization of misorientations, grain boundaries, inter-grain misorientations, twin boundaries, and reconstructed boundaries

- Grain analysis for the determination of grain size, grain shape, and average grain properties

- Materials properties characterization, including Taylor factors, Schmid factors, elastic modulus, and dislocation density

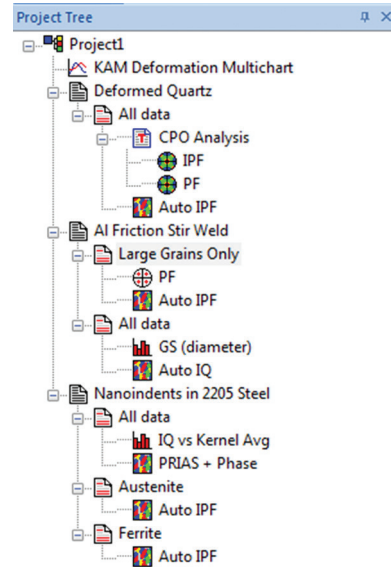- Quantitative texture analysis and calculation of full orientation distribution function
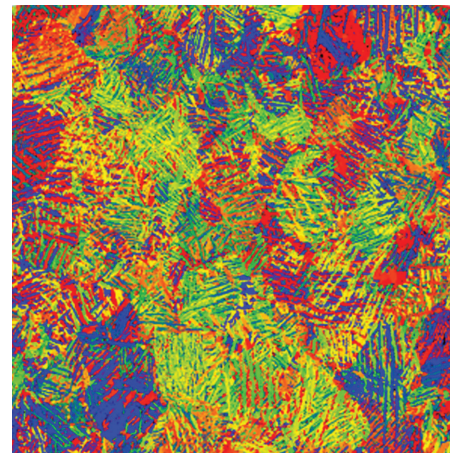


**Figure 5.** OIM Project Tree.



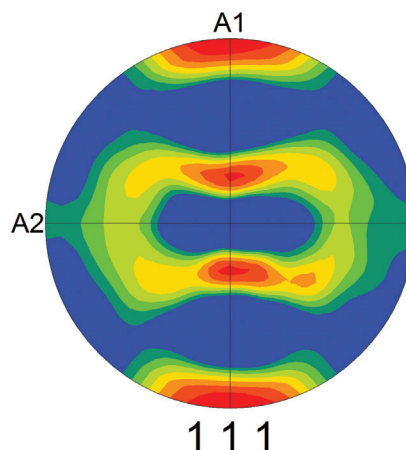**Figure 6.** Elastic stiffness map from additively manufactured titanium.



**Figure 7.** Pole figure from textured aluminum.

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## Data Highlighting

Data Highlighting enables the analyst to identify specific data ranges and the following microstructural features on other maps and plots.

The features of Data Highlighting include:

- Highlighting from charts
- Highlighting from plots
- Highlighting from maps
- Adjustable color gradients for customized visualization
- Creation of partitions based on highlighted and non-highlighted regions for further analysis

## Interactive Analysis

Interactive Analysis allows the analyst to manually interrogate data to extract the information of interest.

The features of Interactive Analysis include:

- Selection of specific points
- Selection of specific grains
- Selection of specific orientations
- Selection of specific regions of interest
- Measurement of point-to-point misorientations
- Measurement of triplet junction misorientations
- Measurement of vector point-to-point and point-to-origin data
- Demonstration of unit cell orientation and crystallographic plane geometry
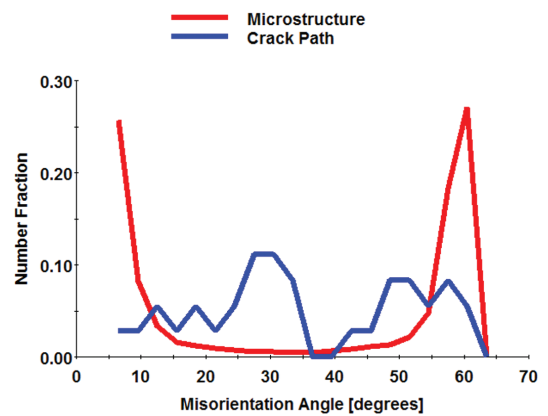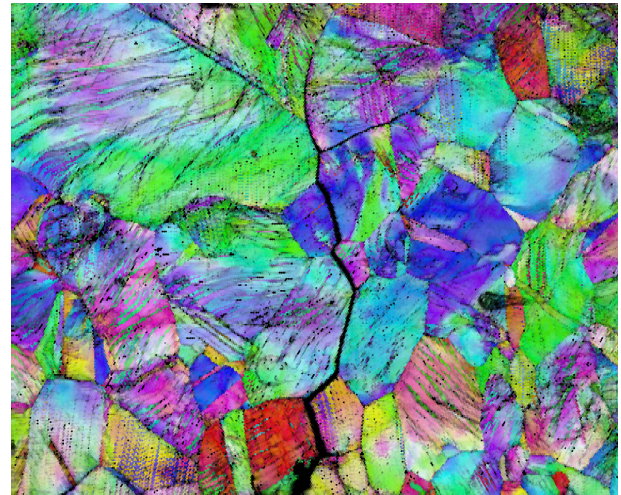- Ability to save and/or export interactive data



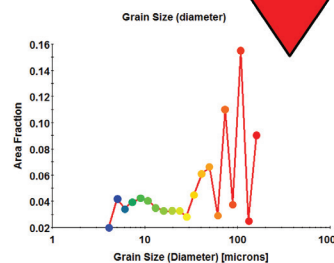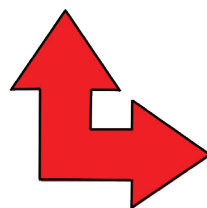**Figure 8.** Investigating cracking behavior in pipeline steels.
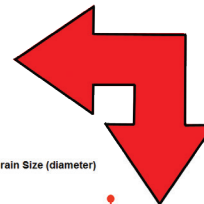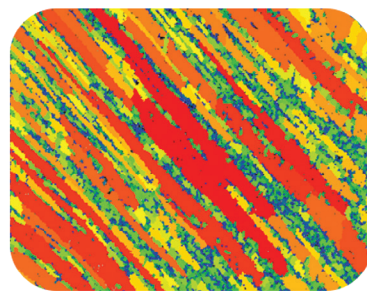


**Figure 9.** Visualizing grain size distribution in aluminum.

## OIM Analysis EBSD indexing

Even the best analysis tools may generate initial low-quality data. However, OIM Analysis has the resources to evaluate data quality and improve it using EBSD pattern reindexing.

The features of EBSD Pattern Reindexing include:

- Reindexing data by individual points, by defined partitions, by phase, or by all data

- Reindexing using either saved band positions (Hough peaks) or using saved EBSD patterns

- Optimization of EBSD pattern band detection and indexing parameters for each phase

- Ability to find and add phases not included in the initial data collection

- Creation of EBSD signal background from individual phases and application of background processing optimized for specific materials

- Reindexing of multiple datasets using batch processing, including ChI-Scan™ and NPAR™

## ChI-Scan

ChI-Scan offers a patented approach to improving phase differentiation and mapping, using simultaneously collected EDS and EBSD data.

The features of ChI-Scan include:

- Automatic or manual chemical phase classification

- Selection of elements used for differentiation

- Use of PRIAS™ imaging signals as differentiation input

## NPAR

NPAR is a patented approach for improving EBSD pattern indexing and mapping through local spatial pattern averaging.

The features of NPAR include:

- Improved EBSD pattern signal-to-noise ratio

- EBSD pattern acquisition at lower beam currents and/or faster camera speeds

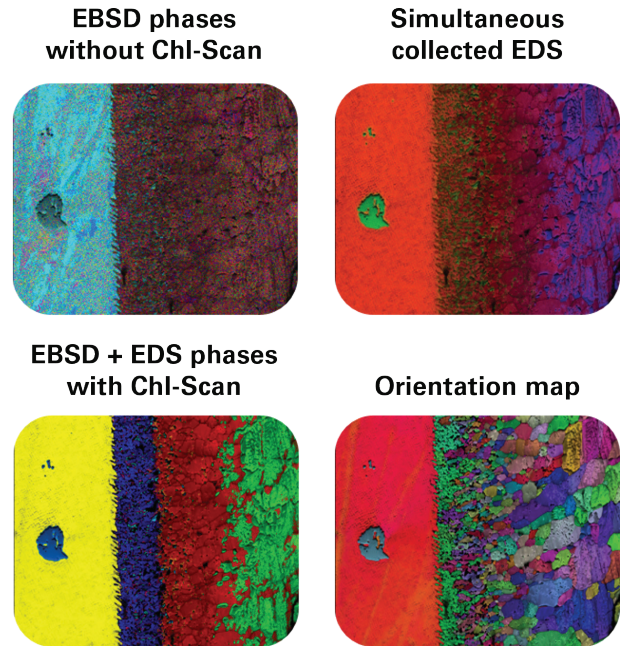- Higher EBSD mapping indexing success rates

**EBSD phases without ChI-Scan**

**Simultaneous collected EDS**

**EBSD + EDS phases with ChI-Scan**

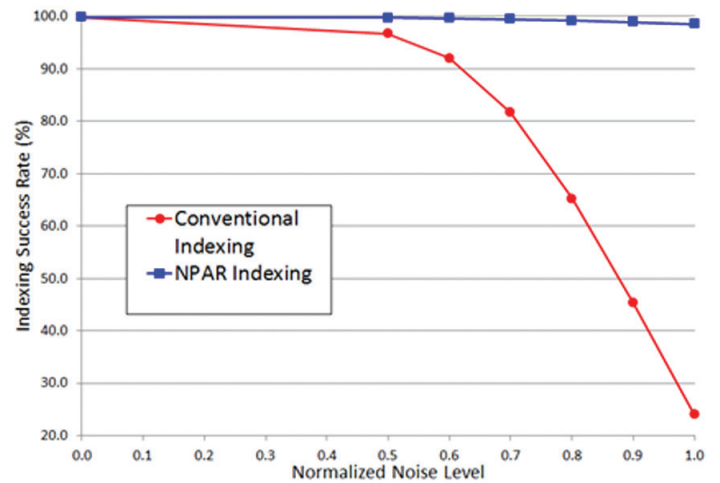**Orientation map**

**Figure 10.** ChI-Scan.

**Figure 11.** Improved indexing success with NPAR.

## OIM Batch Processor

OIM Batch Processor enables the preparation and analysis of multiple datasets easily and consistently in a single action.

The features of OIM Batch Processor include:

- Batch analysis using user-defined OIM templates
- Alignment of correlated datasets using orientation information
- Ideal tool for analysis of in-situ data (heating stage, deformation stage, 3D)
- Batch cropping, data cleanup, and orientation rotations are available
- Ability to save processed data as OIM Project for subsequent analysis
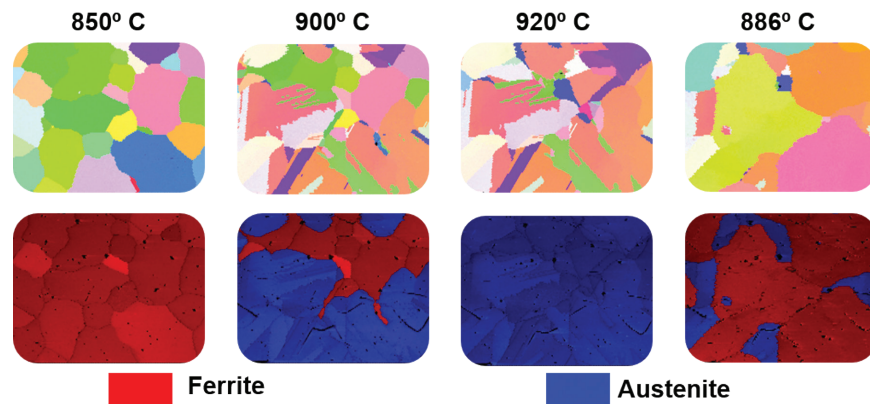


**Figure 12.** OIM Batch Processing used in conjunction with a heating stage.

## OIM 3D Visualization

OIM Analysis extends comprehensive EBSD characterization into 3D EBSD.

The features of OIM 3D Visualization include:

- Visualization of 3D EBSD data using OIM Map templates
- Orientations, EBSD image quality, phase, EDS elements, and local orientations
- Calculation of grains in 3D based on measured orientation information
- Calculation of grain size, grain average orientation, and grain orientation spread
- Transparency levels to visualize features within the microstructure
- Interactive selection and display of grains within the microstructure
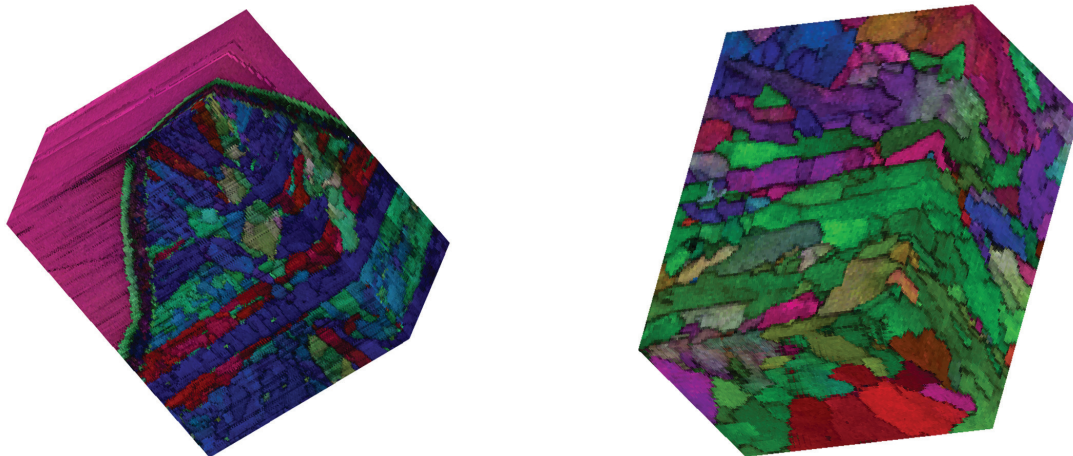
### OIM applications

OIM has been used worldwide in thousands of publications and a wide range of applications.

Examples of OIM applications include:

- Improving the strength and ductility of lightweight automotive alloys
- Understanding the fatigue behavior of aerospace titanium alloys
- Tracing the evolution of trilobite eyes
- Increasing the efficiency of solar cells
- Increasing creep resistance in nuclear reactor materials

### OIM Analysis training

EDAX provides many options to assist users in learning how to use OIM Analysis, including:

- Comprehensive manual
- Step-by-step tutorials
- How-to videos
- Training courses
- On-site training
- Topical webinars – live and on-demand



**Figure 13.** OIM applications.

## Conclusion

OIM Analysis is more than the sum of the functionality and specifications described in this brochure. In practice, it is a powerful characterization and analysis tool that enables researchers to better understand and evaluate a material's microstructure.

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