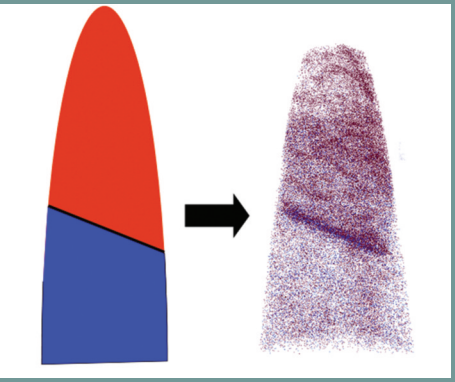
EDAX Smart Insight

AMETEK MATERIALS ANALYSIS DIVISION

Product Bulletin - EBSD

Atom Probe Assist



- Enhanced APT specimen preparation for grain boundary segregation analysis
- Enhanced grain boundary contrast ensures boundary is recognized & positioned within the first 200 nm of an APT sample apex
- OIM™ results identify grain boundary character to facilitate site-specific sample preparation of different grain boundary types
- Optimized analysis of APT specimens using t-EBSD
- Fast specimen preparation and validation using only FIB & t-EBSD with less risk for specimen damage or loss

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Atom Probe Tomography (APT) is a material analysis technique that provides 3D chemical composition and imaging at the atomic scale and is uniquely suited to analysis of grain boundary segregation. APT analysis requires sample preparation similar to Transmission Electron Microscopy (TEM), but instead of a thin lamella, a needle geometry is required. For the analysis of site specific features, the feature must be within ≈ 500 nm of the tip apex. Generally a Focused Ion Beam (FIB) instrument is used to prepare this type of specimen. In the final steps of the specimen sharpening, contrast in the FIB can become very low or negligible, making site specific analysis challenging.

The Atom Probe Assist tool provides an innovative means of monitoring grain boundary position between FIB milling steps. Because the APT sample tip is a small 3D cone, transmission-EBSD (t-EBSD) can be used to measure and image the crystallographic orientation and determine grain boundary position. This tool is optimized for t-EBSD measurements of APT tips, including defaults map shapes corresponding to APT tip profiles and images processing procedures to enhance t-EBSD patterns from samples with varying sample thickness.

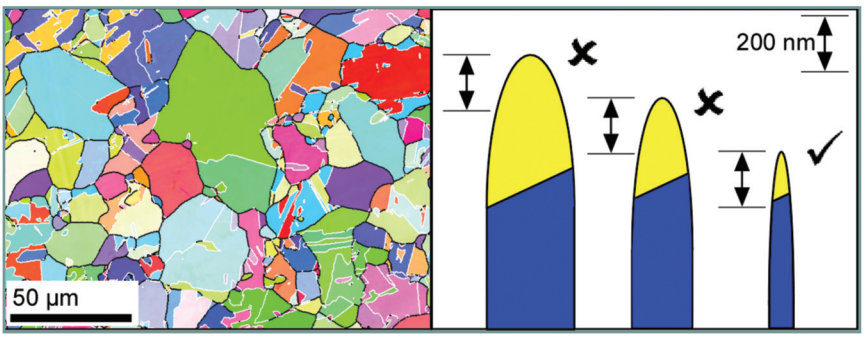

Figure 1: The Atom Probe Assist tool can (1) identify different grain boundary types (left) where random grain boundaries are shaded black and special twin boundaries are shaded white to assist in site-specific FIB liftout sampling and (2) determine grain boundary position between annular FIB milling steps (right). The preparation is complete when the grain boundary between the two different orientations (colored yellow and blue) is located within 200 nm of the sample tip.

Traditional EBSD can be used to determine the grain boundary position and character of a sample prior to initial site specific FIB liftout preparation, allowing for investigation of specific grain boundary types. This is important as different boundary types have different segregation behavior affecting material performance. By collecting t-EBSD datasets between milling steps, the grain boundary position can be easily identified, and the milling procedure stopped when the boundary is within 200 nm of the sample tip. Preparation and validation can be completed in the FIB, eliminating the need to transfer the sample.

Specifications

Hikari Plus EBSD Camera

- Data collection rates up to 1,000 indexed points per second
- Orientation precision <0.1°
- Low noise detector for high quality EBSD and t-EBSD pattern collection
- Phosphor screen optimized for high speed/high sensitivity operation
- PRIAS compatible

TEAM™ EBSD Software

- Customized Atom Probe Assist data collection mode
- Transmission-EBSD mode
- Smart systems for consistent optimization of dynamic data collection parameters
- Custom APT map shape with automatic or user-defined step size down to 1 nm

OIM™ Analysis Advanced Software

- Comprehensive suite of EBSD data analysis tools for visualization and quantification of crystalline microstructures
- Grain boundary character determination for site-specific APT sample preparation

Features and Benefits

Smart Background Processing

- T-EBSD background processing designed specifically for optimized patterns from APT specimens of varying thickness to alllow accurate characterization of orientations and grain boundary position

Smart Camera Optimization

- Automated setup of camera parameters for acquisition of high-quality t-EBSD patterns from APT specimens for accurate data collection

Smart Indexing

- T-EBSD pattern analysis using unique Triplet Indexing for improved indexing rates and spatial resolution on small-scale APT specimens

APT Specimen Tip Mapping Mode

- Map shape template designed to match APT specimen tip shape for fast and efficient setup and data collection
- Map shape easily adjustable for consistent mapping after specimen milling
- Spatial indication of mapping dimensions to determine if grain boundary is within required distance from specimen tip apex

Transmission-EBSD Mode

- T-EBSD mode sets up acquisition parameters to automatically collect quality data from t-EBSD specimens
- Easily switch from t-EBSD to traditional EBSD collection to handle both APT specimen analysis and site-selection analysis

Hikari Plus EBSD Camera

- High performance/high sensitivity EBSD camera for operation across the widest range of operational conditions

Conclusion

The Atom Probe Assist enables users to both prepare specimens for and get quality results from APT analysis faster and more easily than using standard methods. This tool allows for the selection of specific grain boundary types for preparation as APT specimen tips and monitors the grain boundary position during the FIB preparation to ensure APT analysis of the desired region of interest. The Atom Probe Assist allows APT users to push the boundaries of grain boundary segregation research more rapidly.