Transmission-EBSD

With the decreasing size of grains and other microstructural features in crystalline materials the introduction of transmission-EBSD (t-EBSD) in the Scanning Electron Microscope (SEM) offers a characterization technique to close the gap between analysis in a SEM and a Transmission Electron Microscope (TEM). The benefit of t-EBSD is that it offers near TEM resolution, while still enabling the analysis of larger areas than is possible in the TEM. While the EBSD system used with standard EBSD (also called reflective EBSD) is the same for t-EBSD, the user selected settings used to scan a sample vary from standard EBSD.

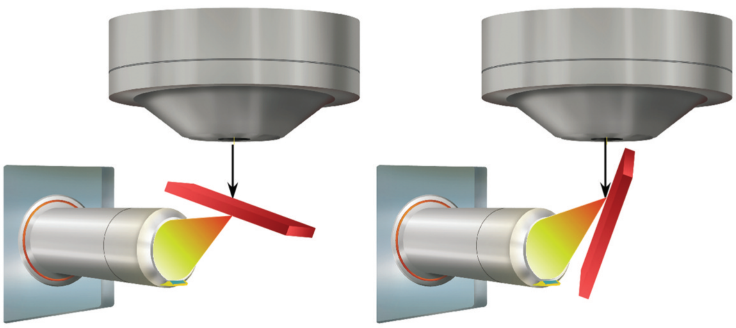

Figure 1. Schematics of t-EBSD (left) and standard EBSD (right).

Sample preparation – TEM/thin sample, resolution

An important part of sample preparation is first deciding if a sample is right for t-EBSD. While any crystalline sample that can be analyzed with standard EBSD can also be analyzed with t-EBSD, this technique was developed to analyze materials with features smaller than could be accurately studied with standard EBSD. Among others these features can include nanometer scale grains, small inclusions, and thin twins found in many developing materials. Additionally, preparation of specimens for t-EBSD requires the same processes as those for TEM, which produce samples thinner than ~200 nm.

SEM/EBSD/specimen geometry – tilt, working distance, specimen mount

With standard EBSD the SEM/EBSD/specimen geometry has been established for many years, but still operates within flexible tolerances of these parameters.

Recent studies with EDAX equipment have shown similar optimal geometry conditions for t-EBSD (see table).

	Standard EBSD	Transmission EBSD
Tilt Angle	70˚	-45˚
Working Distance	14 mm	5 mm
Accelerating Voltage	5 to 30 kV	15 to 30 kV

Figure 2. Typical conditions for standard EBSD vs. t-EBSD.

SEM e-beam parameters – kV, spot/current

In addition to geometry considerations, SEM e-beam parameters such as accelerating voltage (kV) and beam current significantly affect the quality of data collected with t-EBSD. Because the electron beam must pass through the sample in order to generate a signal on the EBSD detector, higher kV values are recommended. As samples become thinner, a lower kV is advised to create sufficient signal from the sample. A large enough current will also be required to create enough signal for the EBSD detector, but it should be kept low enough to avoid detrimental charging.

Image processing – background removal

Once the sample is prepared and in place, the EBSD images will require some image processing to optimize the pattern quality for data collection. One of the most important parts in this process is to collect and subtract a good background image due to the high intensity of the background image created with t-EBSD. With TEAM™ software this process is handled automatically by the smart camera features.

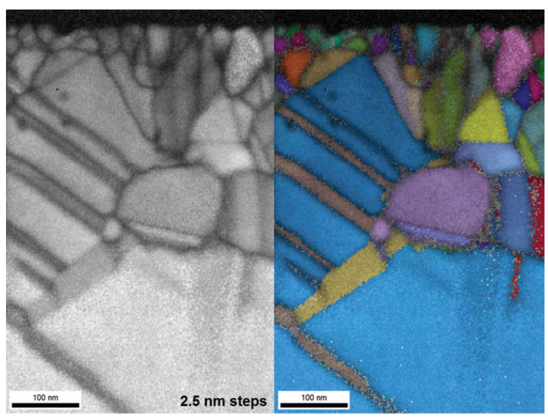

Figure 3. Image quality (left) and inverse pole figure (right) of a t-EBSD scan of Cu using a 2.5 nm step size.