

Atom Probe Assist™ Mode

Recently, EDAX introduced Atom Probe Assist™, which was designed to acquire fast Transmission Electron Backscatter Diffraction (t-EBSD) or Transmission Kikuchi Diffraction (TKD) maps from needle-shaped atom probe specimens. Acquiring high quality,

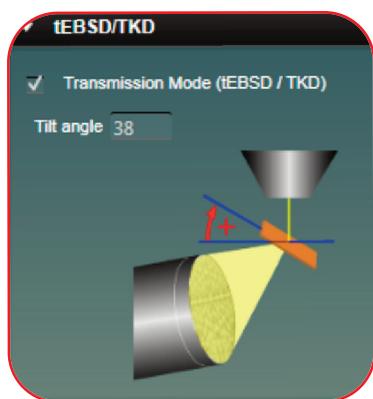


Figure 1. Mapping angle entry dialogue for t-EBSD/TKD mode. The electron beam is shown emerging from the top with the scattered TKD electrons emerging on the far side of the orange atom probe specimen as a yellow cone that is collected by the detector on the bottom left.

efficient maps is important for targeting specific grains in an atom probe sample during the focused ion beam (FIB) milling process. Here, a few tips are discussed that should improve mapping speed and quality. Although these tips and tricks are specifically for the atom probe specimen preparation process, many of them are also generally applicable to t-EBSD on flat specimens, such as Transmission Electron Microscope (TEM) lamellae.

Luckily, figuring out the t-EBSD mapping angle has been streamlined in Atom Probe Assist™ mode in the TEAM™ software version 4.3. The mapping angle in the software is defined as the angle between the plane orthogonal to the electron beam and the sample axis (red arrow in Figure 1). But be careful, this angle is often different from the ion-beam angle or the microscope stage-tilt. For example, the atom probe specimen axis is typically loaded in an orientation parallel to the electron beam. To begin the milling procedure, the stage is tilted so the specimen is parallel to the ion beam (52° from vertical for an FEI microscope). The mapping angle for this example then becomes 38°, or 90°-52°. Entering this angle and checking the “Transmission Mode” box in the software dialogue (Figure 1) allows the software to automatically do the angular corrections to properly reference the electron exit-surface as the normal direction during map acquisition.

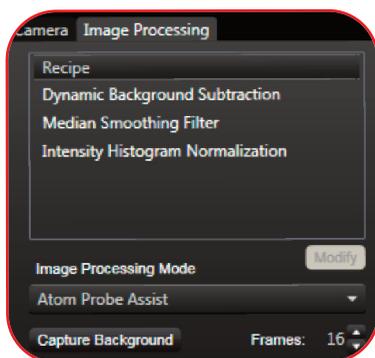


Figure 2. Default Atom Probe Assist™ background subtraction recipe.

Atom Probe Assist™ mode has a default recipe for background subtraction, which includes a Dynamic Background Subtraction, Intensity Histogram Normalization, and a Median Smoothing Filter (Figure 2). This helps when users are collecting patterns from vacuum regions outside of their sample, or when there is varying sample thickness, as is the case with cone-shaped atom probe specimens. Also, it is suggested that users adjust the contrast in the Intensity Histogram Normalization setting, which can help bring out patterns when they are faint. This is more often the case with t-EBSD samples than typical polished EBSD samples used for reflection mode.



Figure 3. Typical mapping parameters for atom probe specimens.

When selecting mapping parameters, first consider what the analysis goals are for the sample. If users simply want to verify that there is a grain boundary within a sample, it may be more prudent to use survey mode and not collect a full map. Atom Probe Assist™ mode comes with a default mapping step size of 20 nm, which most often will be sufficient to find the grains within a sharp specimen. Step sizes smaller than 5 nm often increase mapping time substantially, and risk contaminating the sample, so use them sparingly! Good maps for atom probe specimens can usually be collected in under five minutes using an accelerating voltage of 30 kV. Using the trapezoidal mapping mode also decreases the total mapping time by reducing the mapping region so that it more closely matches the specimen geometry (Figure 3). This minimizes the time spent collecting “vacuum” patterns on either side.

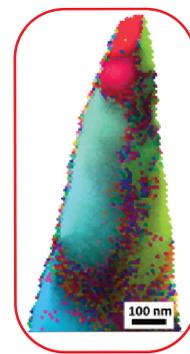


Figure 4. Steel with a mapping step size of 10 nm. Grains are easily seen throughout the atom probe specimen.

Generally, limiting exposure of the electron beam to the sample can minimize contamination. Adjusting camera parameters in a region off the tip apex, increasing binning, using a larger step size, and using survey mode can help keep samples free of contamination. Good luck!