Transmission Kikuchi Diffraction (TKD), sometimes referred to as t-EBSD, is a very useful SEM-based technique for the rapid crystallographic orientation mapping and analysis of fine-grained materials at reasonably high spatial resolution. TKD is analogous to Electron Backscatter Diffraction (EBSD), but uses a thin foil (TEM specimen) instead of a bulk SEM specimen. The reduced interaction volume of the thin foil enables achievable resolutions of 10 nm or better.

We have developed this capability at CEMAS on the FEI XL-30 ESEM™, using a custom sample holder, and an EDAX Hikari™ camera. A wide variety of microscope environment geometries may be used; specimen tilt can vary between 0° and -60°, and working distance can vary from 3 to 15 mm. However, it has been shown that shorter working distances result in more interpretable diffraction patterns on the EBSD camera. The data for this work were all collected at working distances of either 4 or 5 mm.

A TKD map of α+β processed T-17, is displayed in Figure 1. These maps combine inverse pole figure (IPF) and image quality (IQ) maps, and display lattice icons representing crystallographic orientations. The sample was prepared using an FEI Helios Focused Ion Beam, and cleaned in the Nanomill™. Data were collected at a working distance of 4 mm, a specimen tilt of -20°, accelerating voltage of 30 kV, a 100 µm aperture, camera exposure of 15 ms, and 10 nm step size. Indexing was done automatically in the software via Hough transform peak indexing. Figure 1 shows the alpha-titanium and beta-titanium IPF maps overlaid with gray scale confidence index maps, displayed as the left and right images, respectively.