

Electron Backscatter Diffraction

Pattern Collection and Analysis

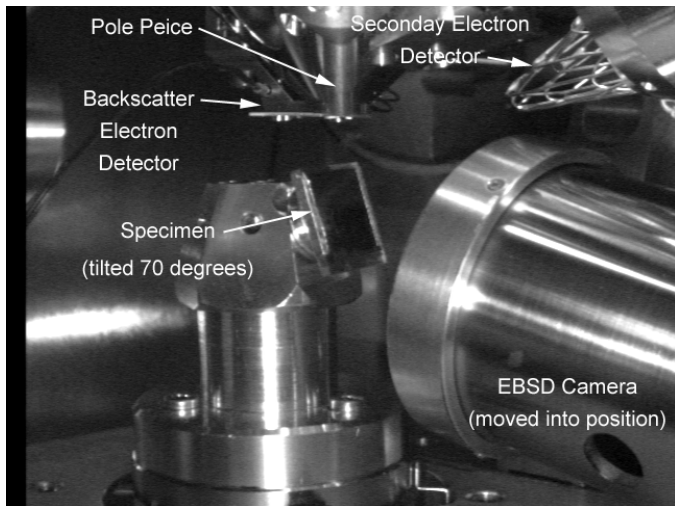


Figure 1 A view of the inside of the SEM's specimen chamber showing the specimen and the SE, BSE and EBSD detectors.

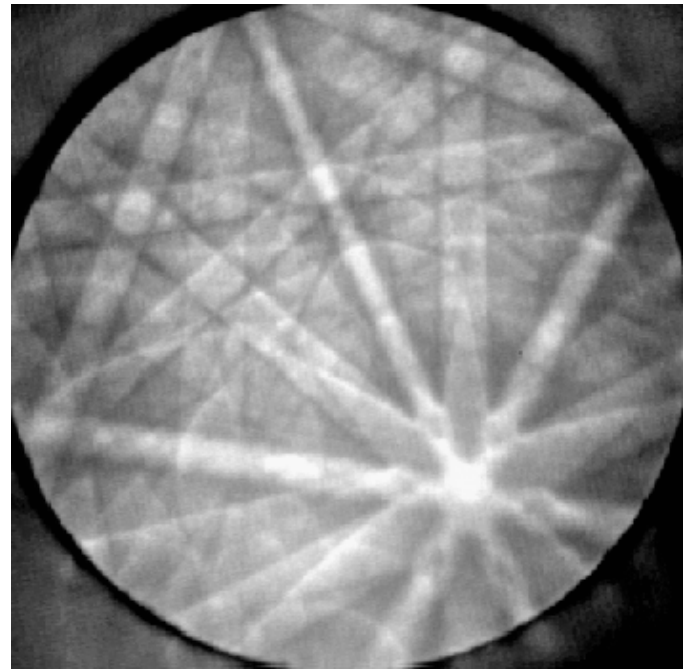


Figure 3 The EBSD pattern obtained from the position in figure 2 marked by the green cross. Each band in this pattern is produced by a specific set of crystallographic planes. The angles of the bands tell us the orientation of these planes, the width tells us the d-spacing, the angles of the intersections of the bands tell us about the crystal's symmetry and the intersections themselves identify poles.

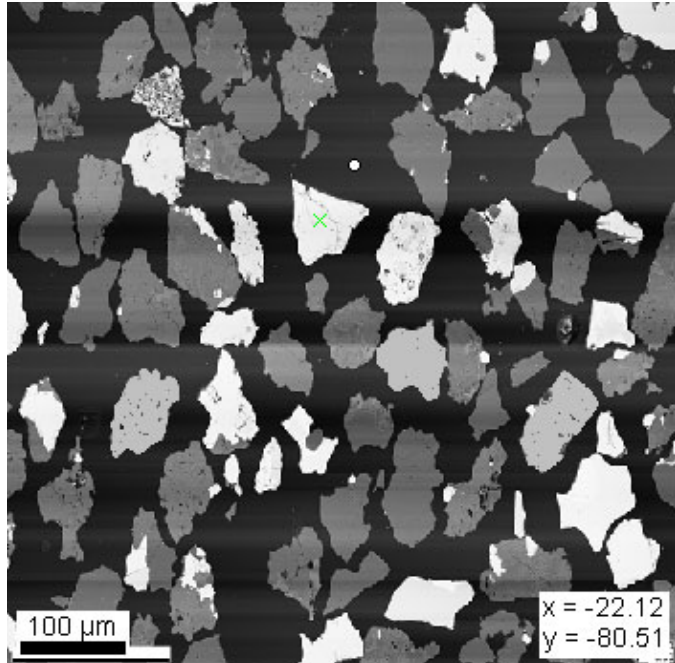


Figure 2 Simulated image. There is an EBSD pattern associated with each point in this image. The green cross marks the location where the pattern in figure 3.

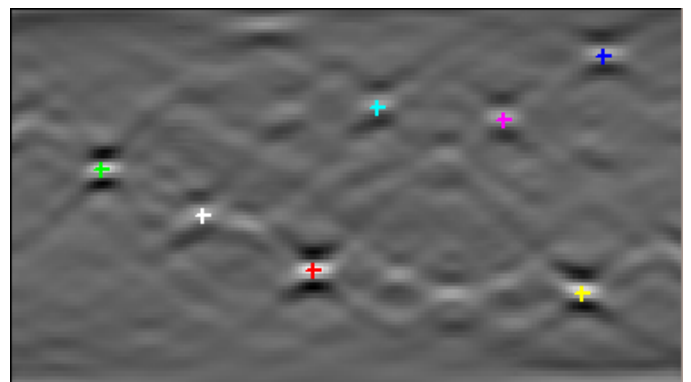


Figure 4 The Hough transform of the pattern in figure 3. Hough transforms transform lines in real space into spots in Hough space. Each of the spots can then be analyzed to identify the crystallographic plane.

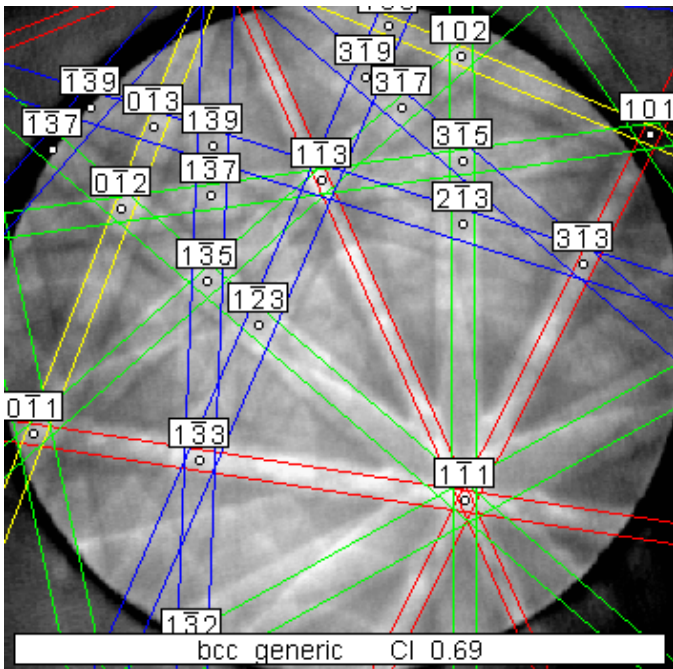


Figure 5 This is the indexed pattern shown in figure 3. It has been identified as a generic bcc structure that is oriented just off the $[1 -1 1]$ direction. Note the high confidence index of 0.69.

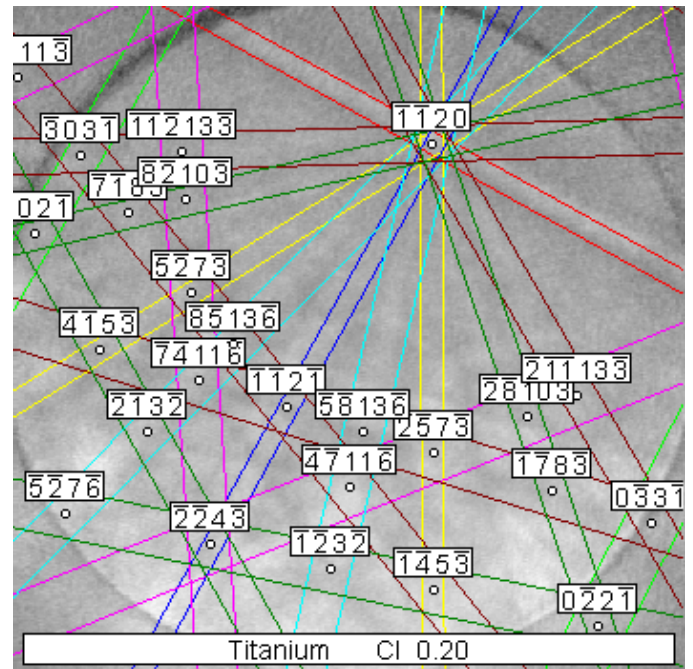


Figure 6 Here is the indexed pattern for another region of the specimen. It has been identified as titanium (hexagonal) oriented slightly off the $[-1 -1 2 0]$ direction. Even with a low confidence interval the agreement is good.

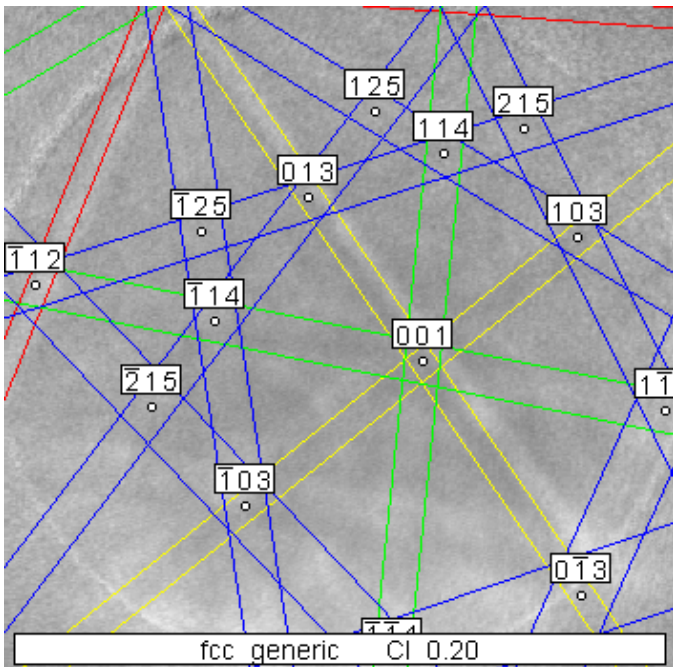


Figure 7 This is the indexed pattern for yet another region of the sample. This region has the fcc structure and is oriented nearly on the $[0 0 1]$ direction.

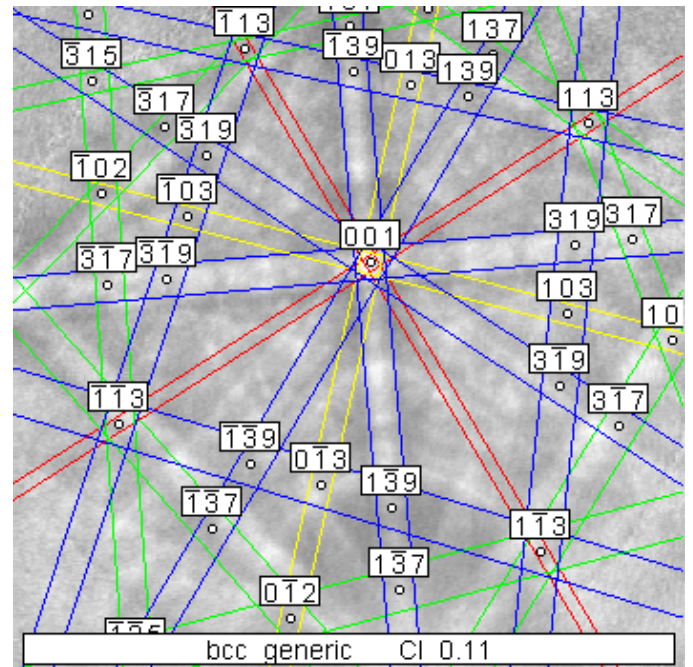
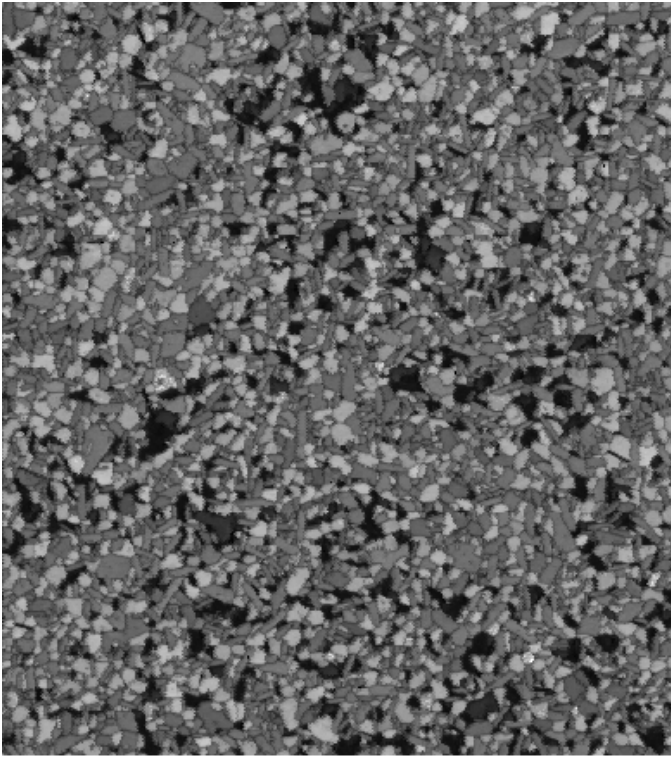


Figure 8 This is the indexed pattern where the confidence index is even lower than for the two previous examples. Experience has shown that low confidence indices can still generate good results.

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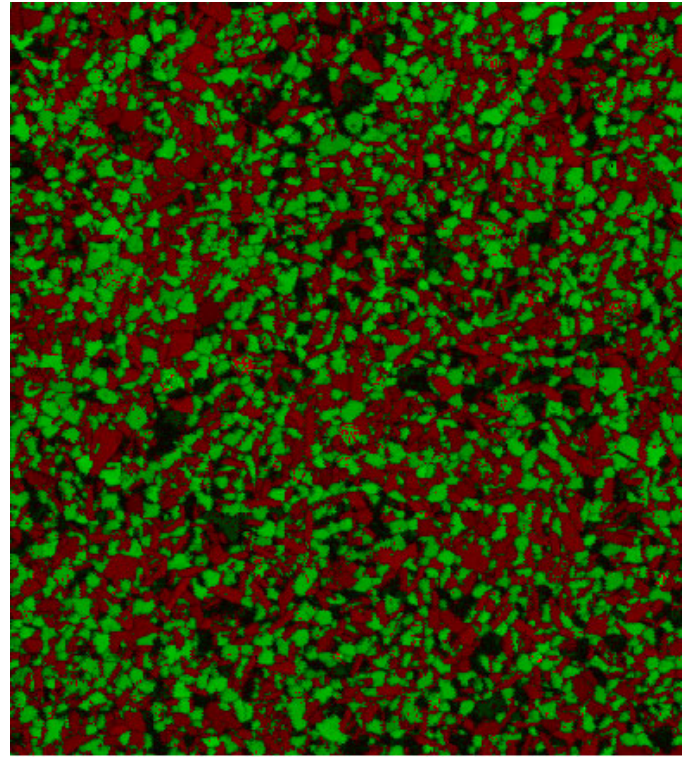
Orientation Mapping, Phase Identification and Analysis

Sample TiN-TiB₂ Data from TexSem Laboratories Delphi Software



35.00 μm = 70 steps IQ 5.2...154

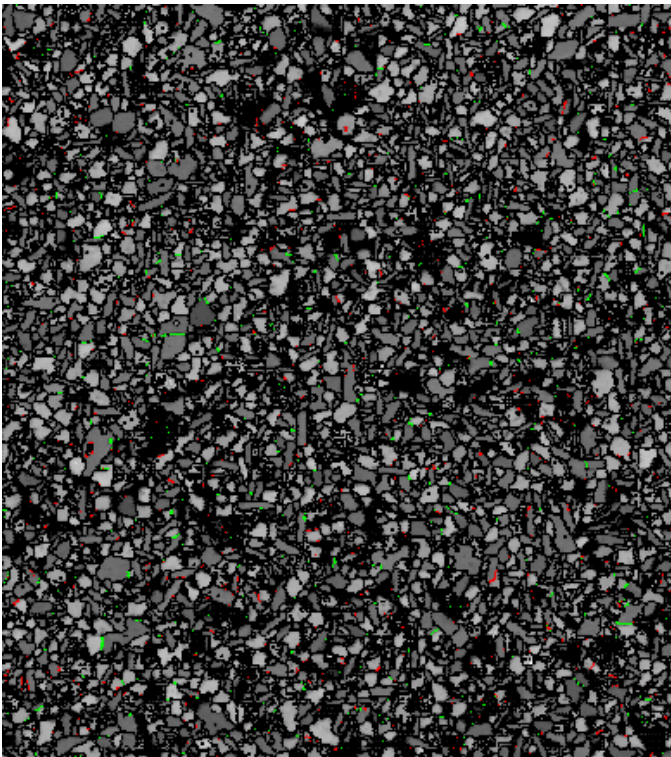
Figure 9 The pattern image quality map for a TiN-TiB₂ specimen produced by combustion synthesis. Lighter colored areas represent higher image quality and darker areas represent lower image quality. The darkest areas in this sample are either at grain boundaries, where two or more patterns are obtained simultaneously, and in the specimen's pores.



35.00 μm = 70 steps IQ 5.2...154, Phase

Figure 10 The phase map for the TiN-TiB₂ specimen. The green areas represent the TiN phase (cubic) and the red areas represent the TiB₂ phase (hexagonal). The black represents areas of poor pattern image quality, such as at grain boundaries and in the pores.

Coupling EDS and EBSD Analyses



Boundary levels: 1° 5° 10°
 35.00 μm = 70 steps IQ 5.2...154

Figure 11 A grain boundary map for the TiN-TiB₂ specimen. The red spots represent grain boundaries where the tilt between grains is less than 5 degrees. The green spots represent boundaries where the tilt is between 5 and 10 degrees and the black boundaries represent all other high-angle boundaries. 98 percent of all boundaries are high-angle boundaries.

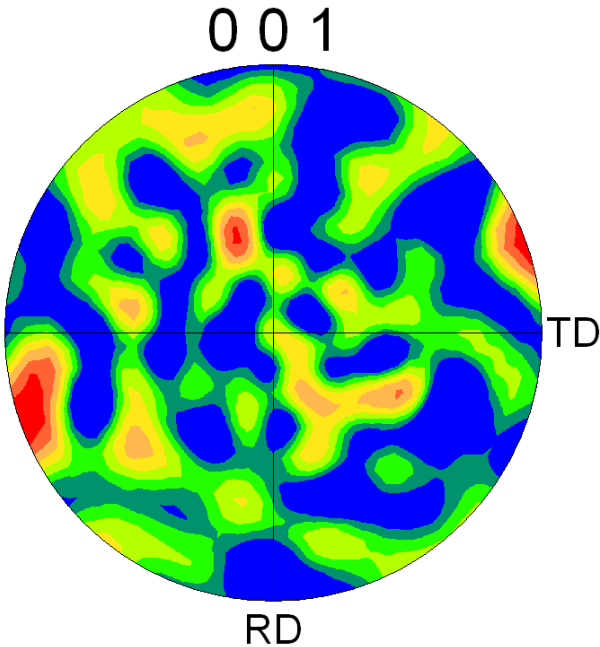


Figure 12 Pole figure plot showing the crystallographic texture in a calcium cerium titanate ceramic.

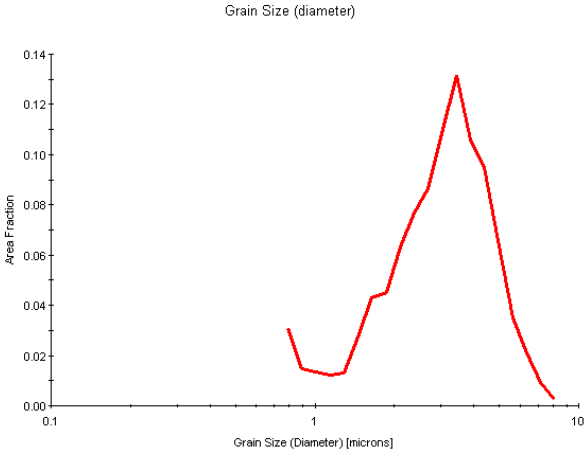


Figure 13 Once the phases and the grain boundaries are found on can easily determine volume fraction of phases, grain size distributions, etc.

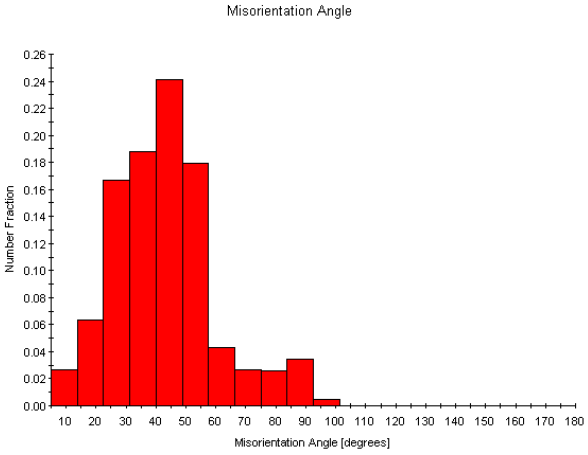


Figure 14 This graph shows the distribution of grain misorientations across all grain boundaries.

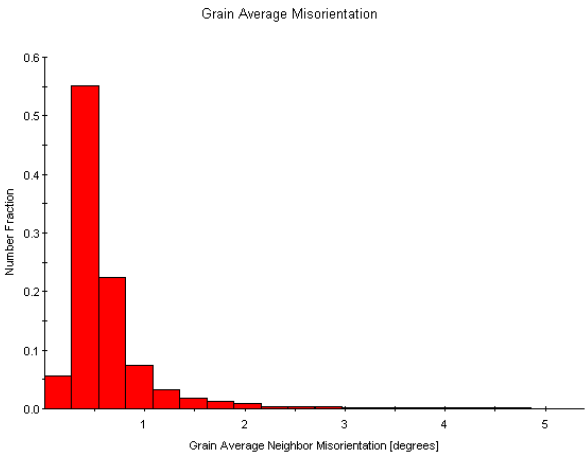


Figure 15 This graph shows the distribution of the average misorientation of all neighboring grains.