Smart CPS Mapping

Introduction

The quality of EDS data is often affected by variations in sample characteristics including topography, atomic number, density and surface anomalies which can result in changes in count rate. Previously, it has been left to the analyst to decide and interpret the effects these conditions have on the sample analysis. EDAX TEAM™ EDS Enhanced Software with Smart Features will now assist in these often difficult to understand interpretations.

EDAX's Counts Per Second (CPS) Mapping Smart Feature is the first ever of its kind. The exclusive map view provides a visual representation of the X-ray count rate at every pixel in the data set. The analyst is given a depiction of the count rate quality and fluctuations across the mapped surface. The brightest pixels indicate the highest count areas and dark or black areas indicate little or no X-ray counts. The benefit is a quick and easy check of the variations in count rate across the sample area. This information can unlock a wealth of characteristics about a sample.

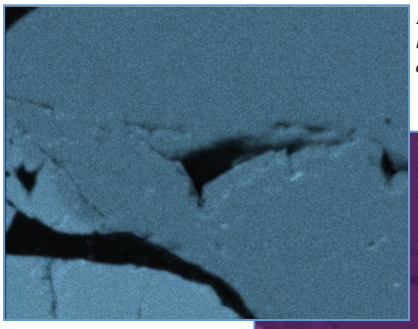

Figure 1. Al map showing lack of Al X-ray signal in dark areas.

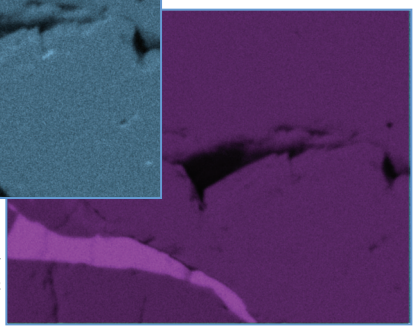

Figure 2. Si map showing lack of Si X-ray counts in center area.

Basic CPS Mapping

In the first elemental map, Figure 1, it appears that the Al concentration drops in the center and bottom left areas. When using only the elemental map, one might conclude that there is an unknown phase that does not include Al in both of these areas. When reviewing the Si map in Figure 2, the bottom left area indicates that the Si rich phase is missing from the Al map. However, the center area is also devoid of Si.

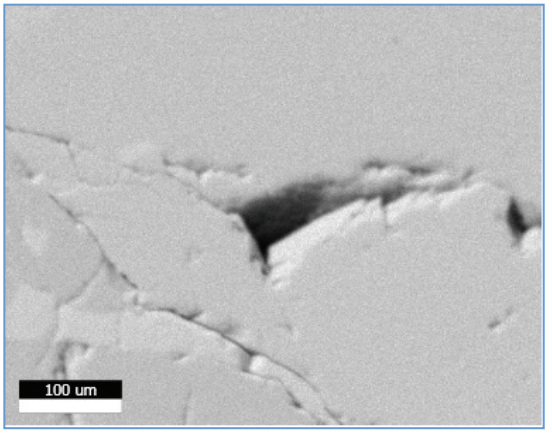

Figure 3. CPS map which now shows the darkest areas are void of any counts, while crack areas reveal lower intensity of counts.

When the CPS map, Figure 3 is reviewed, the map immediately reveals a notable characteristic, indicating a lack of counts in the center area. The black and dark pixels show that there is little to no X-ray signal in this area and, therefore, no amount of elemental investigation will provide an answer. Unlike a SEM image, a CPS map shows a unique view and confirms that there is no signal present to be analyzed.

CPS Count Rate Normalization

Another benefit of the CPS Smart Feature is count rate normalization. Each pixel represents a value of the count rate; therefore, an algorithm is able to be performed, which then normalizes the count rates of the entire data set. Loss in image quality due to count rate changes can then be overcome. In Figure 4, the cracks that are apparent throughout the original Al map are normalized out and the map elemental signal quality is optimized. Note that this normalization does not alter data – in the center area where there is virtually no data, a false signal is not created. Unlike a SEM image, a CPS map shows a unique view and confirms that no signal is present to be analyzed.

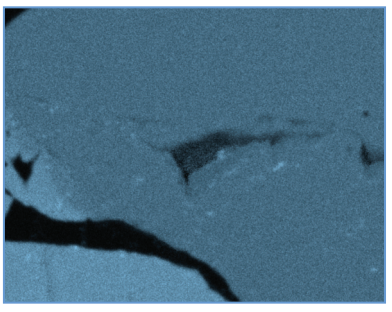

Figure 4. The reduced Al signal from the crack areas is normalized out showing the uniform presence of Al in most areas.

Figure 5 shows another example of the count rate normalization function. In this display of the oxygen elemental map, the standard map has some intensity changes due to topography. When the normalization routine is applied, the variations due to topography are omitted, resulting in a more easy to interpret oxygen elemental map. Count rate normalization enables the analyst to view elemental information without the interference of non-elemental anomalies.

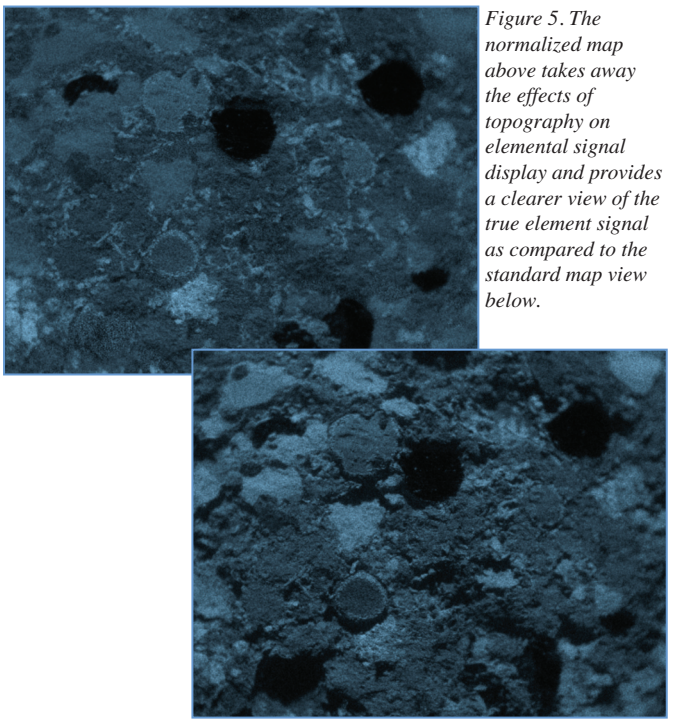

Figure 5. The normalized map above takes away the effects of topography on elemental signal display and provides a clearer view of the true element signal as compared to the standard map view below.

CPS Count Rate Deviation

A count rate deviation map is another function available in Smart CPS Mapping. This map will show the analyst where count rates deviate higher and lower than the average count rate. In the maps shown in Figure 6, it is immediately apparent where the regions of high and low count rates occur. This map set is not a remanipulation of the SEM BSE image, but is a direct measurement of the count rate at each pixel. The analyst will now be able to readily determine many characteristics such as where poorer statistics may occur or where to look for the possibility of artifact peaks in high count rate areas. In this example, the count rates vary from 33 kcps to 120 kcps, a significant difference that can easily be overlooked without this technique.

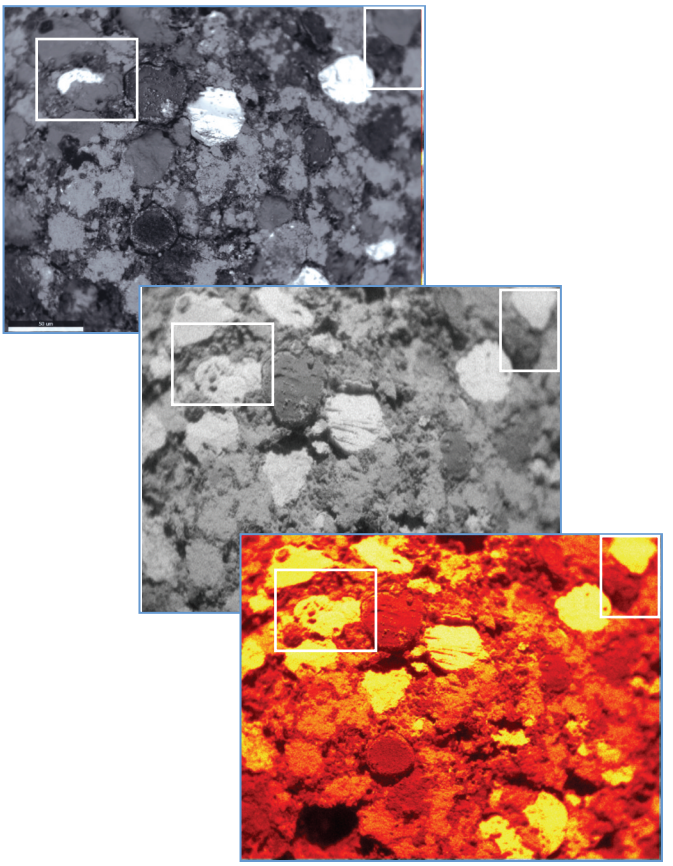

Figure 6. The BSE image on top shows atomic number contrast, while the middle CPS map shows count rate contrast which differs in several areas. The bottom CPS deviation map further highlights those differences.

Conclusion

Variations in sample conditions will often introduce undesirable or difficult to interpret artifacts into elemental maps. EDAX-exclusive Smart CPS Mapping facilitates more thorough sample analysis by highlighting and correcting for the differences seen in standard maps. These map routines can be applied to a variety of samples to allow the analyst to gain material insights that were previously unattainable.