This results in the following map. Note the correlation of the precipitates as identified by lighter shades in the IQ map and the red/yellow features in the color CMV map.
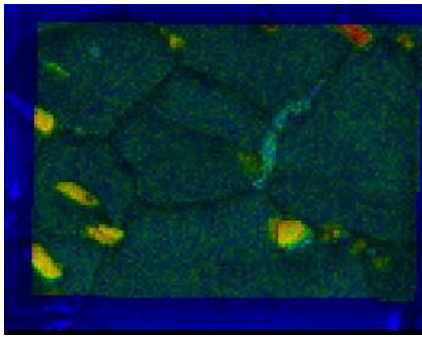
It should be noted that all of the point pairs are saved with the osc file. Thus, the points can be adjusted after the initial attempt at correlation. This can be helpful as the preview window is relatively small whereas full size CMV color maps can be overlaid on EBSD gray maps to check to see how good the correlation is and the user can return to the correlative microscopy tool to make adjustments. To do this, simply click the Correlative Microscopy button on the Standard Tool bar as before. This time, when the dialog appears, select the set to be adjusted as shown below.
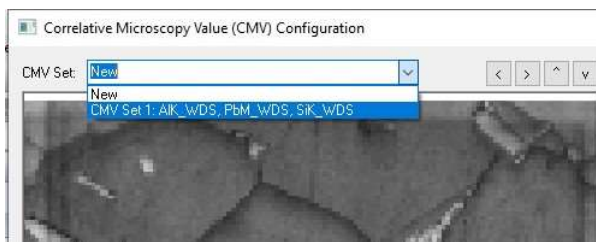
Technical Reference

Technical Reference

The Technical Reference section is encyclopedic, containing documentation on most of the operations, document objects, and concepts the user will encounter while using OIM™ Analysis for Windows. The entries in this section are sorted alphabetically in a flat organizational format.

.ang File Format

The .ang file contains the basic data produced during an OIM scan. This file is in ASCII format.

Header

The first few lines of this file contain descriptive lines pertaining to the parameters used by OIM when collecting the measurements in the file. These lines are preceded by the # sign. Additional comments can be added to the file if preceded by the # character. Some of these are actually used by OIM Analysis such as those associated with a phase.

Body

The fields of each line in the body of the file must have the following:

φ1 F φ2 x y IQ

φ1, F, φ2 [floats]: Euler angles in Bunge's notation for describing the lattice orientations and are given in radians. A value of 4 is given to each Euler angle when an EBSP could not be indexed. These points receive negative confidence index values when read into an OIM dataset.

x,y [floats]: The horizontal and vertical coordinates of the points in the scan, in microns. The origin (0,0) is defined as the top-left corner of the scan.

IQ [float]: The image quality parameter that characterizes the contrast of the EBSP associated with each measurement point.

These are the basic fields that must be in the .ang file for OIM Analysis to successfully read the file. However, the current version of OIM Analysis can handle more columns of data including the following (in order)

CI [float]: The confidence index that describes how confident the software is that it has correctly indexed the EBSP, i.e., confidence that the angles are correct.

Phase ID [integer]: The material phase identifier. This field is 0 for single phase OIM scans or 1,2,3... for multi-phase scans.

Detector Intensity [integer]: An integer describing the intensity from whichever detector was hooked up to the OIM system at the time of data collection, typically a forward scatter detector.

Fit [float]: The fit metric that describes how the indexing solution matches the bands detected by the Hough transform or manually by the user.

PRIAS top strip [float]: The average intensity of a strip of pixels at the top of the EBSD pattern.

PRIAS center square [float]: The average intensity of a small square of pixels at the center of the EBSD pattern.

PRIAS bottom strip [float]: The average intensity of a strip of pixels at the bottom of the EBSD pattern.

Custom [float]: Simply a user specified custom value

After the last field of data it is possible to have a string of data. However, this is not carried into OIM Analysis but discarded during the import of the text data.

Averaging - Area vs. Number

Two types of averaging are used in OIM when considering values associated with grains. One is the conventional numerical average. This is calculated as follows:

$$\bar{v} = \frac{1}{N} \sum_{i=1}^{N} v_i$$

where N is the total number of grains and vi is the value of the parameter of interest for grain i.

Another approach to averaging is to weight the value being averaged by the area of each grain:

$$\bar{v} = \frac{\sum_{i=1}^{N} A_i v_i}{\sum_{i=1}^{N} A_i}$$

where Ai is the area of grain i.

If the grain size is uniform these two values will be quite close to one another. However, if the grains are non-uniform then these values can be quite different. Consider the following case. A scan is made up of one very large grain surrounded by a matrix of 999 smaller grains. The one large grain consumes 50% of the total scan area. The large grain has a high confidence index (say 0.8) and the small grains have, in general, low confidence indexes (say 0.2). If we use the numerical average, the average image quality would be

0.2006 = (0.8 + 999*0.2)/1000

whereas the area weighted average would be

0.5 = (0.5*0.8 + 0.5*0.2)/1

In this case, the average CI for the "scan" is best represented the area average.

Depending on the parameter of interest, one averaging scheme may be more appropriate than the other.

Boundaries and Misorientations

In conventional metallography a grain boundary denotes the line separating two grains. Generally, in OIM a grain boundary refers to a line segment separating two measurement points in a scan. To completely describe a grain boundary 5 parameters are needed, two to describe the orientation of the boundary plane normal and three to describe the misorientation. The boundary plane cannot be recovered direction from OIM data. Since the OIM data is collected on a plane only a trace of the boundary can be observed. Thus, serial sectioning or other stereological approaches are needed to extract the complete boundary normal information. However, since the orientations at both points separated by the line segment are known, the misorientation associated with a line segment can be calculated.

Misorientations are similar to orientations, but instead of bringing the crystal lattice into coincidence with the sample axes, a misorientation refers instead to bringing the crystal lattice of one grain into coincidence with another grain. For any two crystal lattices of different orientation there exists a axis common to both crystal lattices. Two parameters are needed to describe the orientation of the axis with respect to the crystal reference frame (generally three are used, i.e. [uvw] but two angles can be used instead) and another parameter is needed to describe the rotation about this common axis required to bring the two crystal lattices into a coincidence. This axis/angle description is the most common for describing misorientations, but the misorientation can be represented as Euler Angles or Rodrigues vectors as well. The example below shows the misorientation as an axis-angle pair - a 45° rotation about the [100] crystal axis will bring the two cubes into coincidence.

45 degrees about [100]
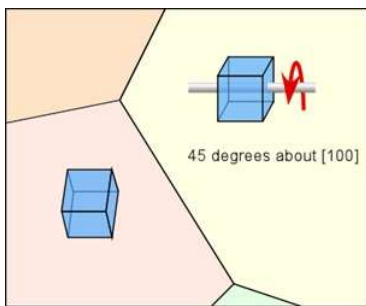
Consideration of the crystal symmetry of the two lattices separated by the boundary is important. The symbol Δg is often used to represent a misorientation (or alternatively disorientation or orientation difference). The misorientation Δg at the boundary separating two crystals with orientations gA and gB is given by the following expression when representing the orientations as orthogonal matrices:

$$\Delta g = g_B g_A^{-1} \qquad \Delta g = g_B g_A^{T}$$

Where the T represents the transpose. Because of symmetry a given misorientation Δg will have symmetrically equivalent orientations, Δge . Mathematically this is given as:

$$\Delta g = \Delta g^e = (g_B g_A^{T})^e = g_B^e g_A^{e\,T} = L_i^B g_B (L_j^A g_A)^{T} = L_i^B g_B g_A^{T} L_j^{A\,T}$$

where LiA and LjB are symmetry elements associated with the crystals A and B. For a given misorientation between two cubic crystals there 24x24 = 576 symmetrically equivalent misorientations. However, for cubic symmetry there are essentially 24 possible misorientation angles and for each angle 24 symmetrically equivalent rotation axes. This can be observed using the utility

In OIM there are several ways of defining boundaries for overlaying on maps. The distribution of various parameters relating to these different boundary types can be displayed as charts.

There is a good quote from the following paper that should be remembered when thinking about misorientations.