APPLICATION NOTE

3D Material Characterization with Scios 2 DualBeam FIB-SEM

The ability to perform a variety of 3D materials characterization applications is critical for obtaining complete understanding of material structure and composition. For some materials scientists, seeing not only what is at the surface but also what is below the surface is key for;

- determining root cause of failure or visualizing the distribution of certain elements within a matrix;
- analyzing the size and distribution of pores in a specimen;
- or accessing high contrast, three dimensional visual data that is critical for evaluating grain boundaries and structural properties.

The Thermo Scientific™ Scios™ 2 DualBeam™ was built with these research challenges in mind, and provides rapid access to subsurface defects, or information about material structure and composition within a volume, so that scientists can better predict a material's ultimate performance.

In this example of a common 3D characterization routine, we start with a FIB cross section through a defect in metal. This gives us an indication of its origin, but not the full information of its 3D structure. The Auto, Slice & View™ software package from Thermo Fisher Scientific enables the collection of images to generate a data cube from the sample. Images collected with the Trinity detection system enable better understanding and correlation between the data sets. The data sets can then be aligned, segmented and visualized using Thermo Scientific™ Avizo® software. This data set then is used to not only visualize the 3D nature of the defect, as seen here, but also determine whether pores form a network in the sample, and to determine the size and distribution of inclusions in metal.

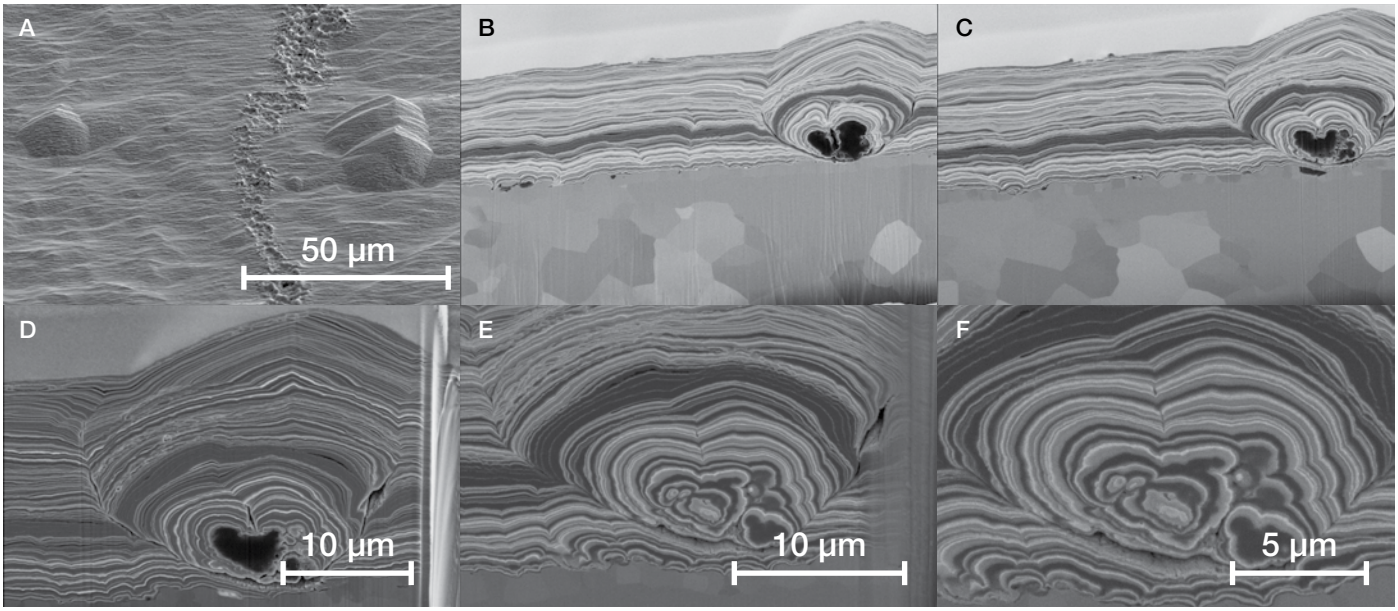

Figure 1. A: SEM image of defect in surface coating of metal sample. B&C: SEM images of slices generated with Auto, Slice & View software. D-F: SEM images of defect at various magnifications.

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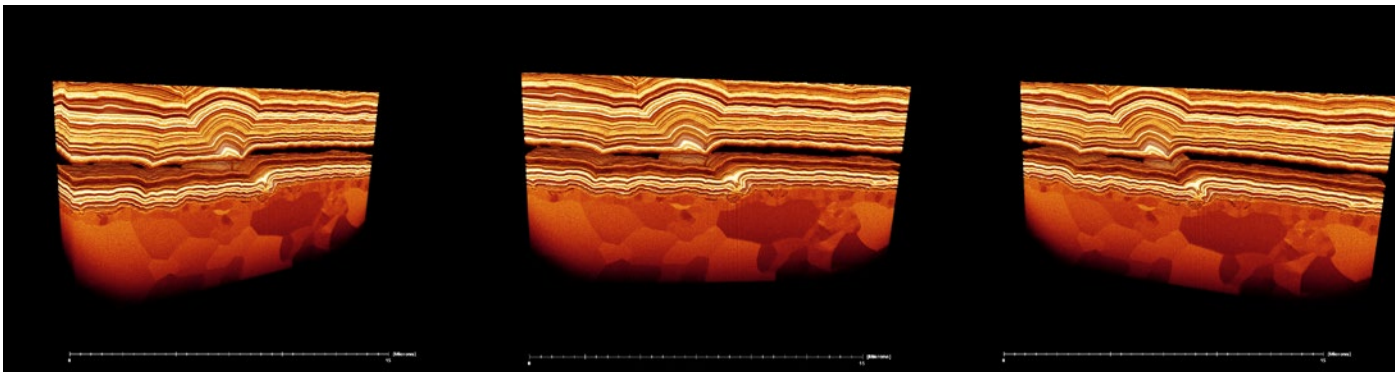

Figure 2. 3D reconstruction of defect in metal sample using Avizo® for Materials Science software.

Other *in situ*, automated 3D characterization packages from Thermo Fisher Scientific include:

- EDS3 for energy dispersive xray spectroscopy data in volumes and EBS3 for acquiring electron backscatter maps, also as volumes.
- With the Thermo Scientific™ EDS3 package, energy dispersive x-ray maps are obtained automatically during the FIB milling process, to collect elemental or phase distribution information from each successive slice.
- With the Thermo Scientific™ EBS3 package, electron backscatter diffraction maps are obtained automatically after the FIB milling process, to generate orientation or texture information from each successive slice.

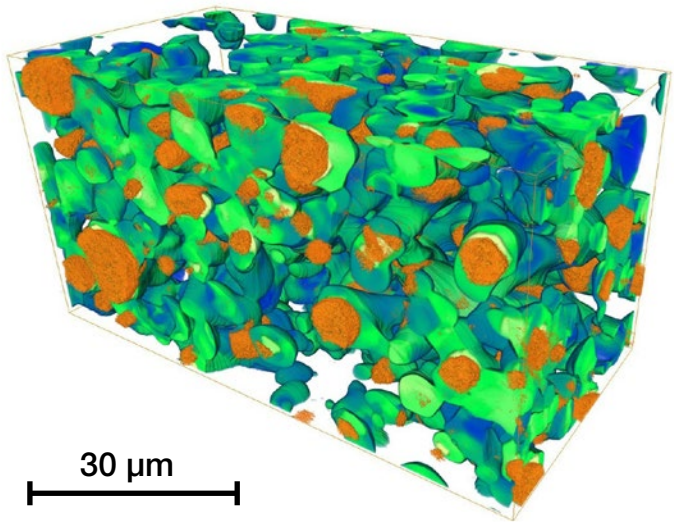

Figure 3. 3D reconstruction of W-Mo-Cu sample using a combination of BSE (green-blue) and EDS (orange) data, which has been produced with a Scios 2 DualBeam, Auto Slice and View 4 software and Avizo® for Materials Science software.

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