3D Characterisation of Microstructures

An example: The 3D characterization of intermetallics

In many cases, traditional (2D) optical metallographic techniques do not provide adequate information regarding shape, texture, distribution and three dimensional (3D) connectivity of the microstructure. A 3D analysis of the microstructure will give better insight to the real microstructure.

3D reconstruction

MATinspired is able to make 3D reconstructions of the microstructure by making several dozen 2D sections at various depths and combine them with special 3D software to a 3D image of the microstructure. A few of these 2D micrographs at various depths are presented in Figure 1. The making of these 2D sections is very labor intensive and requires experienced skills. The figures on the top of this page shows surface rendered 3D reconstructions of the intermetallic microstructure of aluminium 6005A alloy. These figures show that the 3D intermetallics are lathlike, while the structure of the 2D section appear to be needlelike. Therefore this example shows clearly that 3D reconstruction leads to better insights to the real 3D microstructure.

3D analysis of the microstructure

We are able to analyze the 3D reconstruction to give even further insight. For example we can quantify the curvatures of the microstructure which indicates the coarseness of the structure (see upper right figure).

More applications

3D reconstructions can be applied to all kind of (metallic) microstructures such as grains, inclusions, intermetallics, precipitates, fractures etc. All these 3D reconstructions can unveil an unexpected different view of the real microstructure. For example, an apparent small inclusion in a 2D microstructure can be a small part of a very large 3D inclusion that was hidden below the surface. The given example was performed by diamond polishing at various depth and optical microscopy. 3D reconstruction can also be performed by serial sectioning by Focused Ion Beam (FIB) and scanning electron microscopy (SEM).

![Figure 1. Example of a few 2D serial sections (by optical microscopy) used for 3D reconstruction of the microstructures in a partially homogenized 6005A aluminium alloy. The photomicrographs show the microstructure after 30 minutes homogenisation at 540°C. Note, the Vickers micro hardness indentations, used for alignment of the micrographs, are also visible.](image)