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Comparing Contrast in nano-CT and FIB/SEM Tomography of an Al Cast Alloy – A Correlative Microscopy Study

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Aluminum alloys with silicon as the main alloying element are widely used materials for general machine and automotive parts. The microstructure of hypereutectic Al-Si-alloys (>12 wt.% Si) comprises primary Si particles and a complex Al-Si eutectic. Elements such as Cu, Mg an Ni are added to form hard intermetallic precipitates which improve the mechanical properties at elevated temperatures. Size, shape and connectivity of these complex-shape intermetallic particles play a decisive role for the properties and are thus of special interest. As classic 2D methods cannot capture connectivity, a 3D analysis of the microstructure is necessary. Due to the particle size in the µm range, high-resolution 3D imaging techniques are required.

The x-ray computed tomography (XCT) has made strong progress in the past years enabling a resolution of ~ 50 nm in lab-scale instruments. In the field of focused ion beam (FIB) serial sectioning, the introduction of the xenon plasma source has significantly increased the upper volume to an edge length of ~100-200 µm. Thus, both techniques overlap in terms of volume and resolution and correlative studies become possible.

In this work we use both XCT and FIB serial sectioning to image the microstructure of an AlSi13 cast alloy. Data was partly acquired from the same sample volume to compare the information given by the different techniques. Pros and cons of both techniques are discussed.

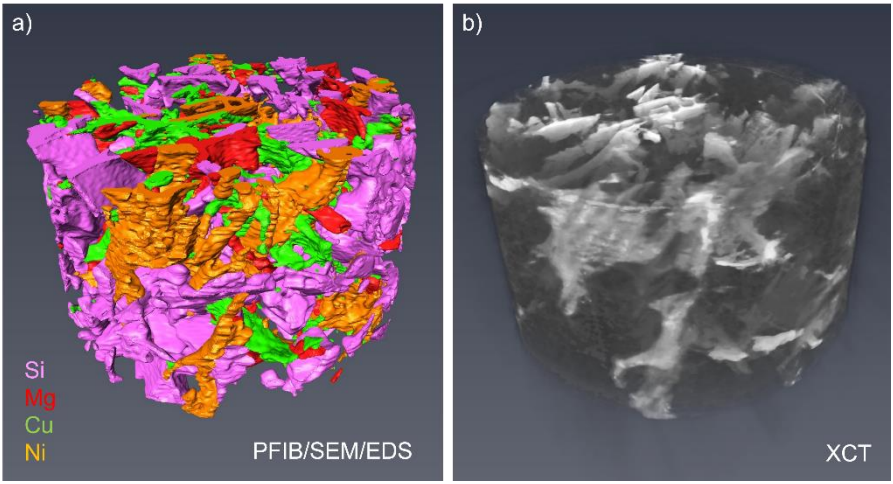

Figure 1: a) Reconstructed phases based on EDS data. Al matrix phase not shown for clarity, coloring according to principal elements. b) Volume rendering of XCT absorption contrast data. Phases containing heavy elements (Ni, Cu) appear bright.