Microstructural analysis of a C/SiC ceramic based on tomographic 3d image data

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Micro-tomography using hard X-ray synchrotron radiation (SμCT) yields volume image data with high spatial resolution and outstanding material contrast. In this presentation, we will show results achieved by applying SμCT and quantitative 3d image analysis to study the microstructure of fibre-reinforced C/SiC ceramic [1].
Here, the segmentation of different material phases within the 3d data - an indispensable prerequisite for a quantitative analysis - is challenging since the four components (carbon, silicone carbide, silicone, and pores), can not be separated by only considering their grey value in the tomographic image. Methods based on complex grey value morphology concepts are required in order to segment the components. More precisely, we use self-dual geodesic reconstruction starting from a strongly smoothed version of the original grey value image, combined with hysteresis thresholding.
Given the segmentation, volume fraction and specific surface of each component are determined by an efficient algorithm for the measurement of intrinsic volumes. The thickness of the silicone carbide layer is quantified by the spherical granulometry distribution. These characteristics are required for optimizing the processing of C/SiC ceramics where e.g. cracks can occur which deteriorate the desired performance of the material.
[1] A. Rack, S. Zabler, B. R. Müller, H. Riesemeier et al., Nucl. Instrum. & Meth. A 586, 327 (2008)
[2] MAVI - Modular Algorithms for Volume Images, http://www.itwm.fhg.de/mab/projects/MAVI

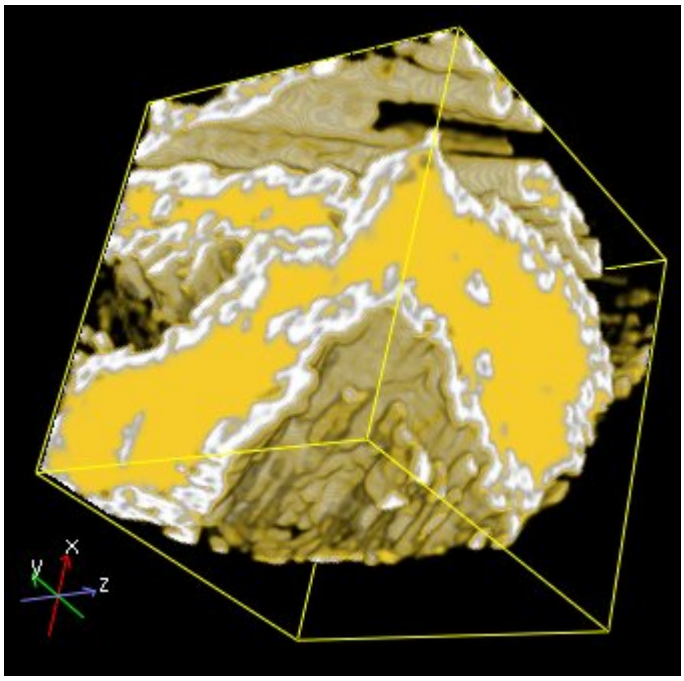

Figure 1: Volume rendering showing the 3d data set of a fibre-reinforced C/SiC ceramic (white: SiC, yellow: Si, other components are transparent) [2].