Improving segmentation of PEMFC x-ray tomographies

Abstract
Proton exchange membrane fuel cell (PEMFC) performance strongly depends on morphology. Within the past years analysis by tomographic approaches has emerged as a valuable tool to assess morphology. Segmentation, the physical interpretation of 3D images, is a crucial step of tomography. In this study we compare different methods for segmentation of a gas diffusion layer/micro porous layer compound. We find that a mere threshold leads to erroneous segmentation and present a combined approach to overcome this problem.

Introduction
A PEMFC consists of various layers [1]. The gas diffusion layer (GDL) and the micro porous layer (MPL) play a pivotal role in electron conduction, gas diffusion and liquid water management. The complex interplay of these porous layers is yet not fully understood [2]. To investigate this interplay we employ x-ray tomographic methods imaging the morphology of these crucial layers. Segmentation is the process of discriminating the existing phases of a tomography. After imaging, segmentation strongly influences analysis which we emphasize in the following.

Segmentation
The given x-ray tomography shows a GDL/MPL-compound (Fig.1 a). To investigate water transport, solid and void phase of the compound have to be differentiated.

Results
The erroneous segmentation hence leads to erroneous pore size distributions (PSD) and grain size distributions (GSD). This is due to too many big pores in void phase and too few big grains in solid phase (Fig. 3).

Conclusion and Outlook
Accurate segmentation is crucial for subsequent analysis of an x-ray tomography. Our novel approach proofs to be far more accurate than state-of-the-art segmentation by a threshold. However, the present approach represents a first step in the entire phase separation process. Future work includes identification of GDL fibers and binder as well as higher resolution imaging of microstructure.

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References