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Imaging of membrane electrode assemblies of proton exchange membrane fuel cells by X-ray computed tomography

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X-ray computed tomography was applied for the 3D imaging of membrane electrode assemblies (MEAs) together with two attached gas diffusion layers. These samples were investigated as prepared and after voltage cycling. It was possible to achieve sub-µm resolution using a lab-based stand-alone tomography system as well as a tomography add-on for a scanning electron microscope. The carbon fibres of the gas diffusion layers could be clearly resolved and the catalyst layers could be visualized.

X-ray computed tomography data were also used for the validation of results from scanning electron microscopy of cross-sections of membrane electrode assemblies where the sample is exposed to significant mechanical loads during sample preparation. More specifically, it was shown that the cracks observed in catalyst layers by scanning electron microscopy already exist in the membrane electrode assembly as prepared and are not a result of sample preparation. Finally it was shown that the crack density in the catalyst layers does not significantly change during voltage cycling which suggests that crack formation is not a principal cause of the observed performance decay of the MEA.