Investigation of Gas Diffusion Layers of PEM Fuel Cells by X-Ray Computed Tomography

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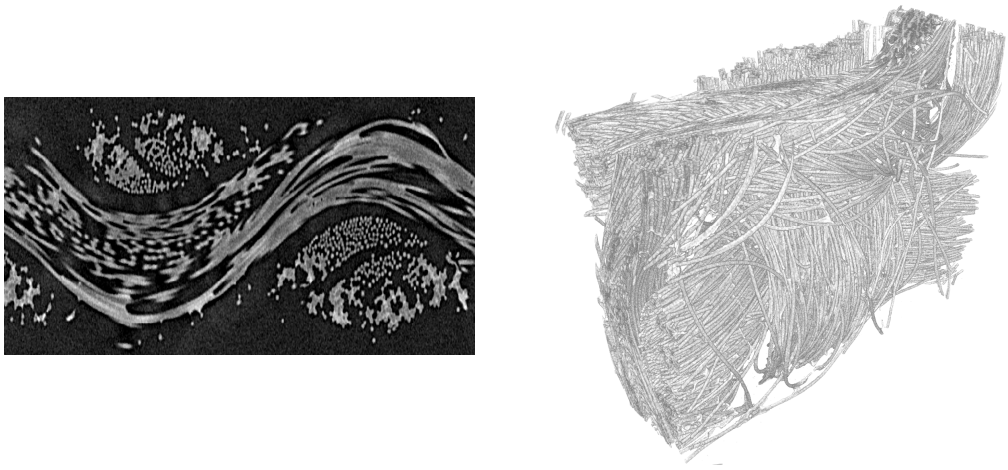
In proton exchange membrane fuel cells (PEMFC), gas diffusion layers (GDL) play a significant role for fuel cell performance as they have to serve multiple purposes like the provision of gases to the catalyst layer, the removal of the product water, the mechanical stabilization of the membrane-electrode assembly and finally the provision of electronic and thermal conductivity between catalyst layer and bipolar plate.

To improve the understanding of the relationship between 3D structure and physical properties, carbon cloth and carbon paper based GDLs were investigated by 3D x-ray computed tomography at a voxel size of 0.7 µm. This resolution is clearly sufficient to image the carbon fiber structure of gas diffusion layers in GDLs.



Carbon cloth EC-CC1-060T imaged by x-ray computed tomography: cross section (left) and 3D reconstruction (right).

Based on the 3D GDL structure, the macroscopic, anisotropic effective thermal conductivities of the gas diffusion layers were computed [1]. As expected, the calculated through plane thermal conductivities are lower than the calculated thermal conductivities in lateral direction. The effect of PTFE loading on thermal conductivity of the GDL is discussed.

[1] A. Pfrang, D. Veyret, F. Sieker, G. Tsotridis, X-Ray Computed Tomography of Gas Diffusion Layers of PEM Fuel Cells: Calculation of Thermal Conductivity, International Journal of Hydrogen Energy 2010, in press, doi:10.1016/j.ijhydene.2010.01.085.