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Imaging Liquid Water in Polymer Electrolyte Fuel Cells by XTM

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Polymer electrolyte fuel cells (PEFC) are electrochemical reactors, strongly governed by fluid mechanical processes. Heat, charge and multiphase mass transport on length scales from nanometers, up to meters are interlinked. Carbon fibre based gas diffusion layers (GDL) with a thickness in the order of 200 µm bridge the scale gap between the catalyst layer (sub-µm structures) and channel/rib domain of the flow field (mm to cm). The liquid water present in the pore network of the GDL can significantly influence the reactant gas transport and the related electrochemical losses (i.e. efficiency and/or power density of the PEFC).

X-ray imaging is sensitive to water and carbon. The achievable spatial and temporal resolution of synchrotron based X-ray tomographic microscopy (XTM) is sufficient to image GDL and the contained water in-situ so single fibers and the droplets of condensed water are visible . The high beam intensity allows for performing tomographic scans in the order of 10 s. The images can be segmented into the three distinct phases of solid water and void and the transport properties of these structures may be determined [1,2].

[1] J. Eller, T. Rosen, F. Marone, M. Stampanoni, A. Wokaun, F. N. Büchi, J. Electrochem. Soc. 158 (2011) B963–B970.
[2] T. Rosén, J. Eller, J. Kang, N. I. Prasianakis, J. Mantzaras, F.N. Büchi, J. Electrochem. Soc., 159 (2012) F536-F544

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