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Localization and Quantification of Phosphoric Acid in HT-PEFCs by X-Ray Tomographic Microscopy

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Abstract

High temperature polymer electrolyte fuel cells (HT-PEFCs) exhibit an increased CO-tolerance of up to 2% in the anode feed [1] due to faster CO-oxidation kinetics at operating temperatures of 160-190℃. The high CO tolerance, compared to low temperature PEFCs, is a significant system advantage of HT-PEFCs allowing to use H2 rich reformate gas without expensive clean-up. This gives rise to a thermodynamically favorable process of combined heat and power applications. In order to sustain the high temperatures specially designed membranes based on a polybenzimidazole backbone doped with phosphoric acid (PA) as an electrolyte [2] are used.
Acid evaporation and redistribution is exclusive to HT-PEFCs and its in-situ characterization is of importance to better understand the underlying mechanisms. Therefore, x-ray tomographic microscopy (XTM) has been applied to visualize the acid inventory and movement in the GDL for correlation with performance. The ability to quantify the amount of phosphoric acid as well as to distinguish between different concentrations are key factors for evaluating performance degradation.
XTM imaging is conducted at the TOMCAT beamline of the Swiss Light Source. Segmentation strategies of gray scale images and first results of PA calibration experiments will be presented.

[1] T.J. Schmidt, et al. (2006) Durability and reliability in high temperature reformed hydrogen PEFCs ECS Transactions, 3, 861-869.
[2] T.J. Schmidt, (2009) High Temperature Polymer Electrolyte Fuel Cells: Durability Insights in Polymer Electrolyte Fuel Cell Durability, F.N. Büchi, M. Inaba, T.J. Schmidt (eds) (pp. 199-221). Springer, New York.

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