

Experimental report

14/09/2023

Proposal: 1-06-5

Council: 10/2022

Title: Impact of varying structures and surface treatments of gas diffusion layers (GDL) on water management processes within the lifespan of PEM f

Research area: Engineering

This proposal is a new proposal

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Samples:

Instrument	Requested days	Allocated days	From	To
NEXT	7	2	25/08/2023	27/08/2023

Abstract:

Water inventory inside a PEMFC significantly influences the cell's performance and lifespan. Microporous (MPL) coated Gas diffusion layers (GDL) facilitate a uniform distribution of the reactant gases to the catalyst sites and removal of the excess water accumulated inside the cell. The balanced water management will help to prevent the blockage in the gas diffusion paths. In this study, we will investigate the influence of the structure and the surface treatment variation of gas diffusion layers (GDL) on water management processes and performance within the lifespan of PEM fuel cells and the scale up from small cells to cells of full channel length. For different GDL materials, the cell's water management will be investigated at both the Beginning of Life (BOL) and the End of Life (EOL). By performing the measurements, we want to improve the water inventory and thereby the performance of the fuel cell. The scale up capability of the cell to full size channel length shall be investigated by performing measurements both with the small scale cell and the full channel length cell. By performing these measurements, we want to improve the methodology of measurements.

Experimental report for proposal number 1-06-05

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Objectives:

The motivation for this experiment was to evaluate the impact of different GDL/MPL structures on water management in the single-cell PEM fuel cell. By performing through-plane and in-plane radiography scans at different current densities, in addition to the tomography scan at high current density. It was intended to calculate the water thickness within different layers of the PEM fuel cell at the beginning of life, as well as the end of life. The planned investigation could lead to water management optimization, thus improving the power density of the PEM fuel cell.

General Report

Since not all requested experimental days could be allocated, only two samples were prepared to investigate the effect of different porous structures of GDLs on the water evolution at the beginning of life. A house-made portable test bench was brought to the ILL, and installed outside the beamline to operate the PEM fuel cells at the desired operating condition for experiments. However, the functioning of the test bench was disrupted due to software issues. Controlling the operational parameters were only possible by the specialized software, but unfortunately the corresponding laptop was damaged, thus proceeding the experiment was not possible. Despite all efforts that were done to replace a new laptop, supplying necessary ZSW-IT support for installation of software on the new laptop was not remotely possible due to two reasons: 1. Connection to the ZSW-VPN server was not possible from the ILL internet network, 2. The beam time was partly over the weekend and ZSW-IT specialist for the test bench software was not available. ZSW-IT department is investigating the reasons of damaging laptop.

Because of these technical problems, unfortunately, this experiment did not proceed.

It is planned to apply a continuation proposal, but considering another portable test bench, which has more up to date facilities and has been already successfully operated at ILL in NeXT and D22.