Contribution ID: **384** Type: **Oral Presentation**

Operando Determination of Pore-filling Mechanism and Saturation of PEFC Catalyst Layer using Small-Angle X-ray Scattering

Wednesday, 1 June 2022 16:30 (15 minutes)

Shortcomings in the water management of polymer electrolyte fuel cells (PEFC) need to be overcome for successful market penetration. Proper membrane humidification relies on ionomer hydration, which in turn affects the performance. In contrast, excess water retention in the pores results in blockage of the gas diffusion to the active sites of the electrochemical reaction, thus reducing performance and efficiency.
Various measurement techniques suitable with the length scale of PEFC components have been explored to address the PEFC water management challenge. For the gas diffusion layer (GDL), technological advances have permitted operando water saturation quantification and its mechanism with X-ray tomography with few microns resolution (1-4). Furthermore, sub-voxel information contained in the X-ray tomography data has demonstrated accurate water quantification in the nanoporous microporous layer (MPL) (5). However, in the nanoscale regime of the catalyst layer, the quantification of water and the pore-wetting mechanism remains nontrivial. Studies involving imaging techniques dedicated to understand the water management in the catalyst layer have been carried out albeit with limited spatial resolution (6).
Small angle X-ray scattering (SAXS) is proposed as suitable candidate for a diagnostic tool to investigate the catalyst layer saturation under operating conditions. SAXS is well suited for diagnosing the presence of liquid water during operando experiments because of its sensitivity to electron density contrast, nanoscale observation window, high temporal resolution and adequate spatial resolution to distinguish the components in PEFCs. SAXS intensity profiles measured at the cSAXS beamline of the Swiss Light Source at the Paul Scherrer Institut with a recently developed SAXS-compatible operando PEFC (Figure 1 middle and right) are interpreted using representative morphology models and assuming different water filling mechanisms (Figure 1 middle and left). The presentation will summarize the structure morphology fitting approaches and provide insights on the actual pore filling mechanism.

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Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Unsure

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Session Classification: MS13

Track Classification: (MS13) Fluids in Nanoporous Media