Experimental report SC3464

In these experiments we aim at determining the water content in the membrane in an operating proton exchange membrane fuel cell (PEMFC) using small angle X-Ray scattering using a microbeam.

The X-Ray beam goes across the thickness the membrane, e.g. through the membrane from the anode and to the cathode. We obtain isotropic 2D-images on the detector which is azimuthally averaged to obtain 1D spectra. These spectra are characterized by the presence of the pic, called ionomer peak, which is associated to the nanophase separation between hydrophilic and hydrophobic domains in the proton conducting membrane. Its position and intensity are univocally related to the water content in the membrane. This peak is located in the range of 0.1 and 0.2 A^{-1}.

Reference spectra have been recorded at equilibrium at different RH on the fresh and aged cell to establish the relation between the position of the ionomer peak and the RH. This helps in determining the averaged local RH knowing the position of the ionomer peak during operation.

The spectra have been recorded in 6 different areas (3 ribs and 3 adjacent channels) of the cell from gas inlets to outlets to establish the water distribution. The measurements have been conducted on a new cell at 0.1, 0.2, 0.3, 0.4, 0.6 and 0.8 A/cm². For each position, the kinetic have been followed after change in load. After correction spectra like those shown in Figure 1 are obtained. We have conducted the experiments in different operating conditions:

- 80°C_H2/Air_1.5 bars_50%RH_st. H2/O2 = 1.2/2.
- 105°C_H2/Air_1.4 bars_30%RH_st. H2/O2 = 1.2/2
- 105°C_H2/Air_1.86 bars_50%RH_st. H2/O2 = 1.2/2
- 95°C_H2/Air_1.67 bars_50%RH_st. H2/O2 = 1.2/2
- 105°C_H2/O2_1.5 bars_30%RH_st. H2/O2 = 1.2/2
- 105°C_H2/O2_1.5 bars_50%RH_st. H2/O2 = 1.2/2

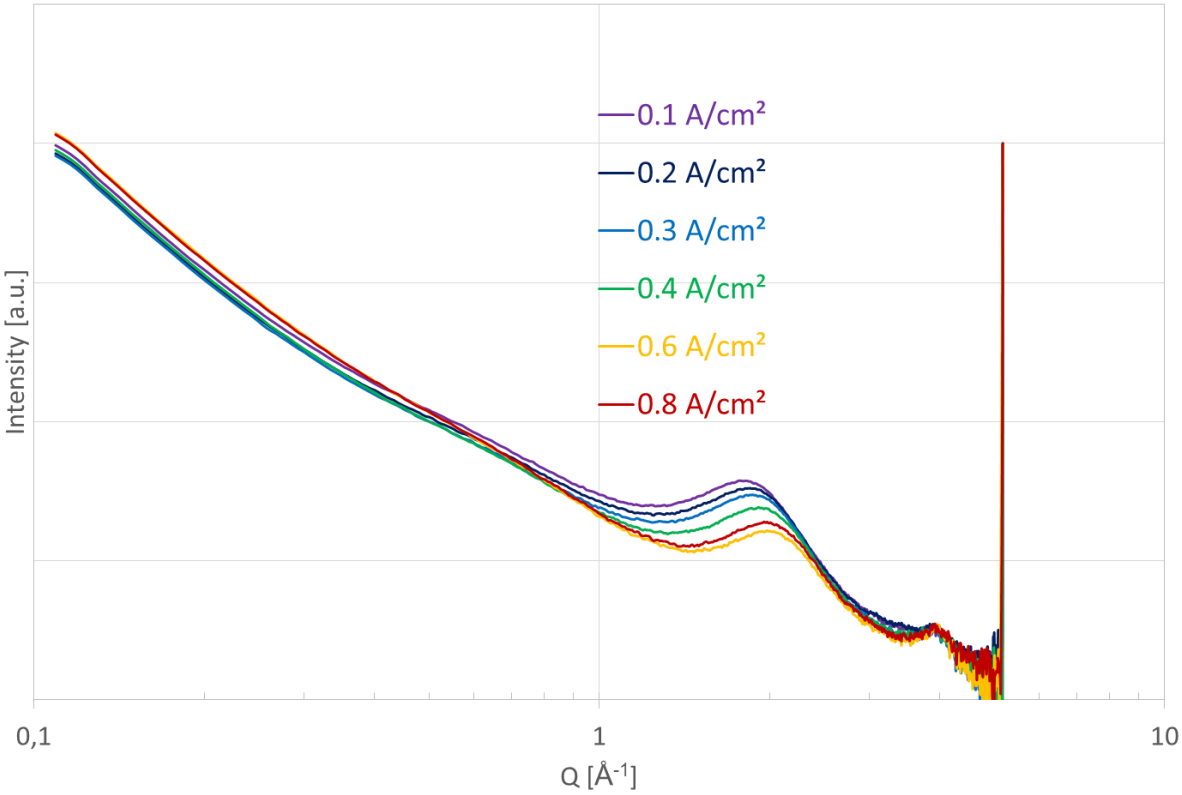

Figure 1: SAXS Spectra recorded at different current densities. 80°C_H_2/Air_1.5 bars_50%RH_st. H_2/O_2 = 1.5/2. In front of the channel close to Air inlet.