Experimental report

Proposal:	9-11-2010
Council:	4/2020
Title:	Structure of new performant and stable anion exchange membranes (AEM)for H2/O2 fuel cells.
Research area:	Soft condensed matter

This proposal is a new proposal

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Samples: Anion exchange membrane

Instrument	Requested days	Allocated days	From	To
D22	2	2	05/03/2021	07/03/2021

Abstract:

Structural analysis of new perfluorinated anion exchange membranes varying the water content and separating the different contributions by contrast variation. Small molecules analogs will be also studied in addition to different ion exchange capacities.

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Three different types of anion exchange membranes have been characterised: two commercial membranes from Fumatech and Sustainion, and one membrane from Lawrence Berkeley National Laboratory (LBNL). With the latter two samples were characterised: One membrane as received (Cl- form), and the same exchanged in 1M NAOH and then rinsed (OH- form).

The sample holders allow measuring five different samples equilibrated with the same flow of humidified gas.

The measurements were performed in the following conditions: DRY, H2O at RH=50%, 75%, 85%, 95%, D2O at 95%RH, H2O/D2O 30/70 (match point), all at T=25°C.

All membranes show a phase separation at the nanoscale more pronounced as the RH increases (Figures 1-3). The phase separation seems to be less pronounced and less organised in the Fumatech membrane. The membrane from LBNL shows the clearest organisation and phase separation. The behaviour is quite similar in Cl- and OH- forms, but details of swelling law has to be established (ionomer peak position and shape).
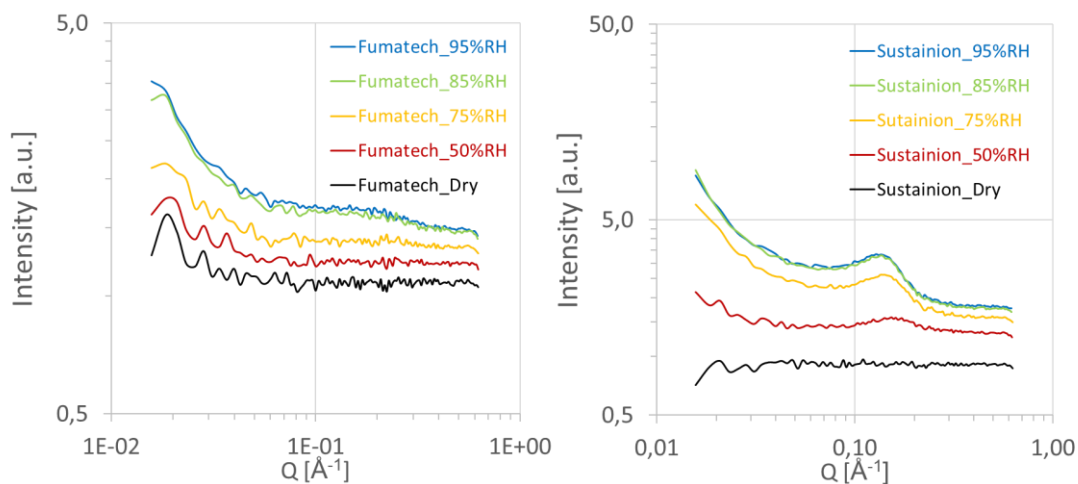

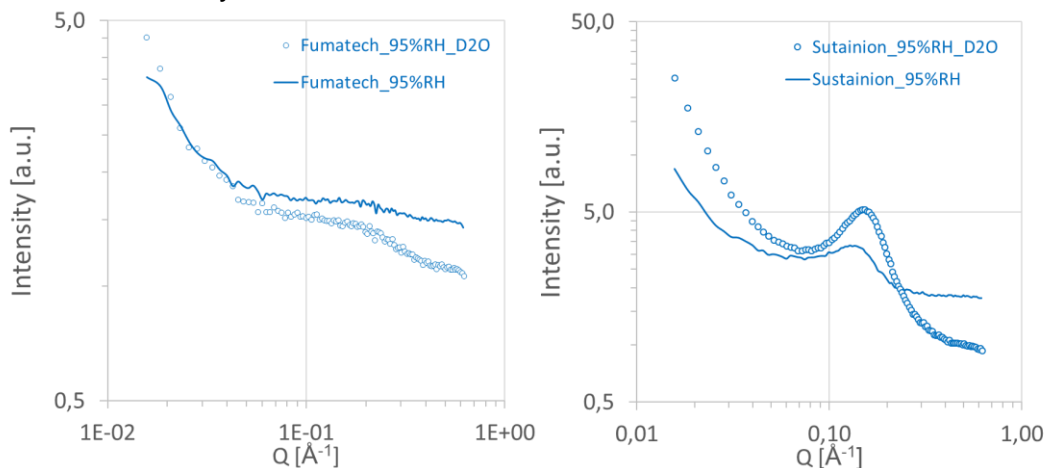Figure 1: 1D SANS profiles of the Fumatech and Sustainion membrane as a function of relative humidity.

Figure 2: 1D SANS profiles of the Fumatech and Sustainion membrane equilibrated at 95%RH with H$_2$O and D$_2$O.
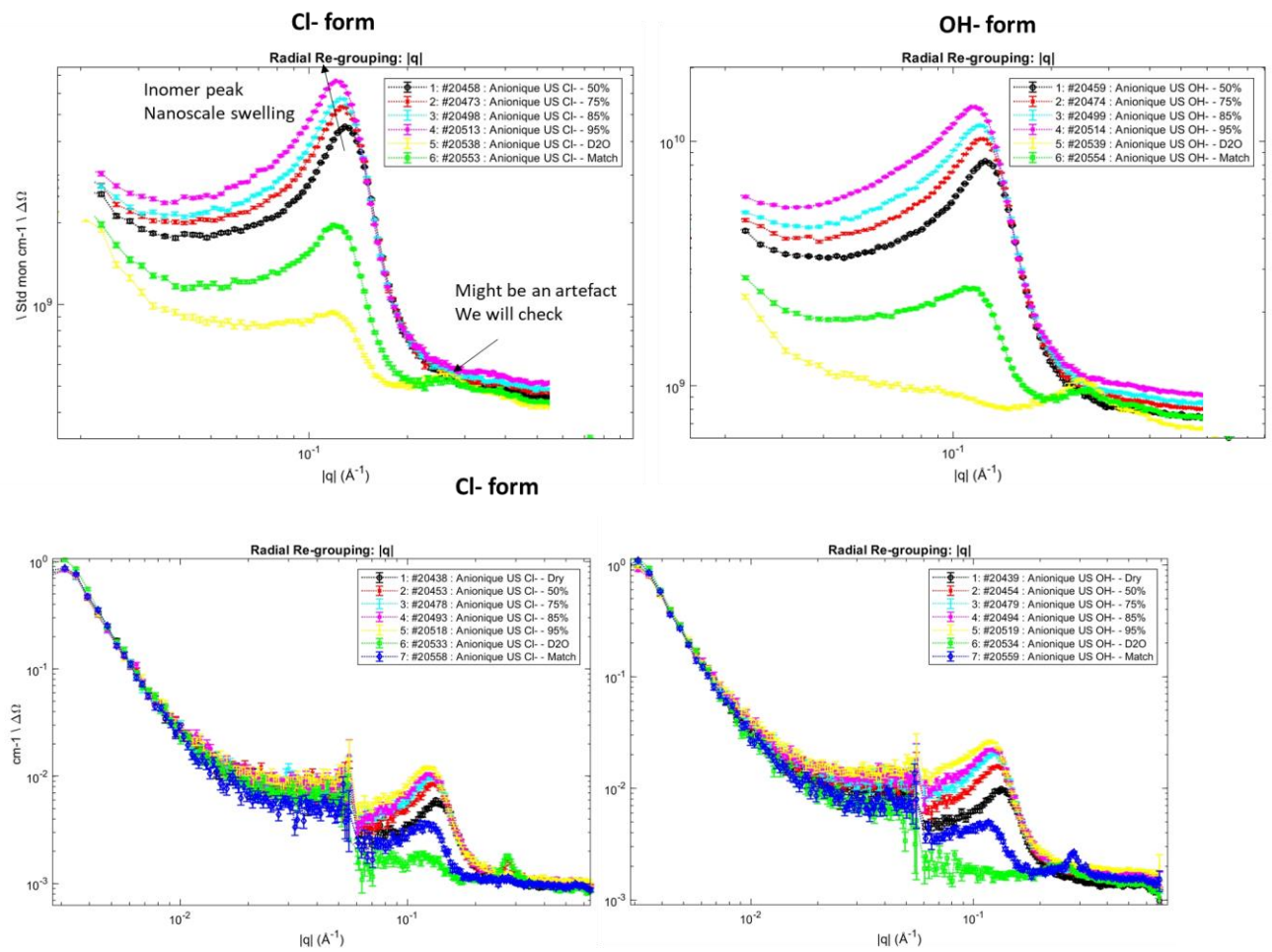
Figure 3: 1D SANS profiles obtained with the membrane from LBNL in Cl⁻ or OH⁻ form in two different Q ranges