MATERIALS

FUEL CELLS

Water inside an operating fuel cell

The proton exchange membrane fuel cell (PEMFC) converts chemical energy into electricity and heat. The PEMFC has a complicated layered system. It converts hydrogen and oxygen to water using catalytic electrodes separated by a polymer-membrane electrolyte.

THE PROBLEM TO SOLVE:

The performance and lifetime of PEMFC strongly depend on the water management. Therefore it is crucial to determine the water distribution in operating fuel cells.

A STEP TOWARDS THE SOLUTION

Neutrons are sensitive to the hydrogen atoms in water. Using Small Angle Neutron Scattering (SANS) it is possible to measure simultaneously the variation in water content in both vertical and horizontal planes throughout the cell.

THE RESULT

Thanks to neutrons, it was demonstrated that the local water content in the membrane is not directly correlated to the water content in the surrounding channel. Liquid water can be present in the channel whereas the membrane is not fully hydrated because of the thermal management leading to a higher temperature in the heart of the fuel cell.

Results from neutron measurements provide unique information that can be used to optimise the design of the next-generation of high performance fuel cells.

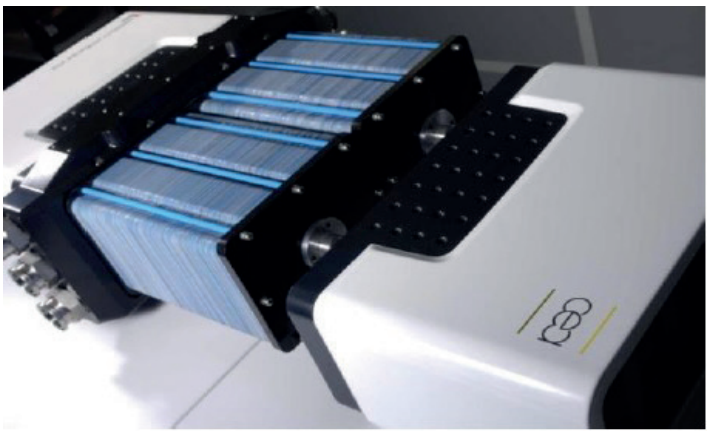

Fig. 1 A stack of a fuel cell. Credit: CEA

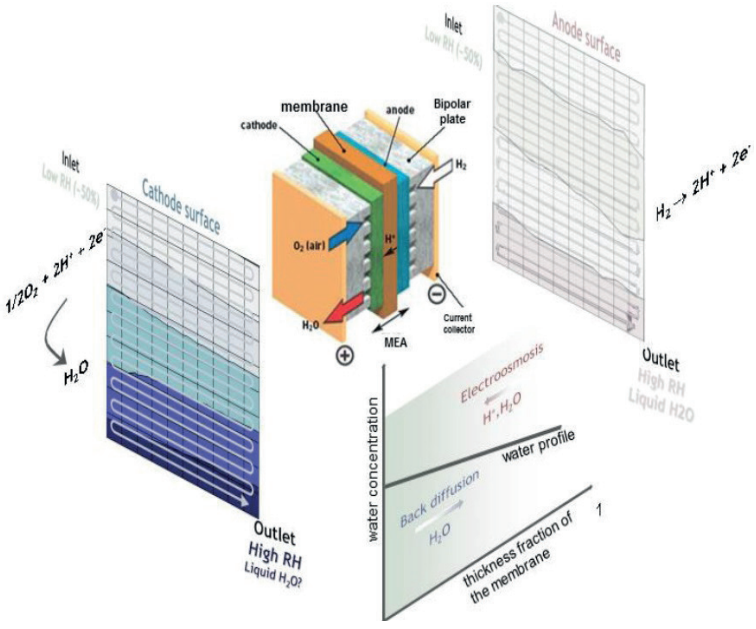

Fig. 2 Schematic representation of the 3D water repartition in a PEMFC single cell. Water is heterogeneously distributed in-plane (at the surface of the anode/cathode) and through-plane (across membrane thickness). Results were obtained from in-operando SANS measurements.

NEUTRONS FOR INDUSTRY
http://sine2020.eu/industry.html

Reference: H2FC Newsletter (2015), Neutrons and Energy (ILL), A. Morin et. al., Fuel cells (2012)

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SINE2020 receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 654000.