

Proton exchange membrane fuel cells (PEMFC) transform chemical energy into electricity and heat. Basically, PEMFCs convert hydrogen and oxygen to water using catalytic electrodes separated by a polymer-membrane electrolyte. The performance and lifetime of a cell strongly depend on how the water is managed within this complicated layered system. This makes it crucial to determine the water distribution in operating fuel cells.

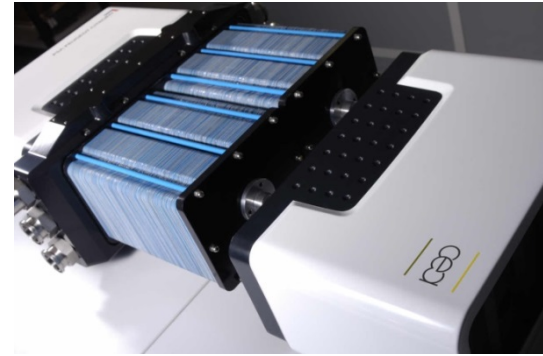


Figure 1. The stack inside a fuel cell (picture CEA)

Neutrons are sensitive to the hydrogen atoms in water. Using small-angle neutron scattering (SANS), the variation in the water content in both the vertical and horizontal planes throughout the cell can be measured simultaneously.

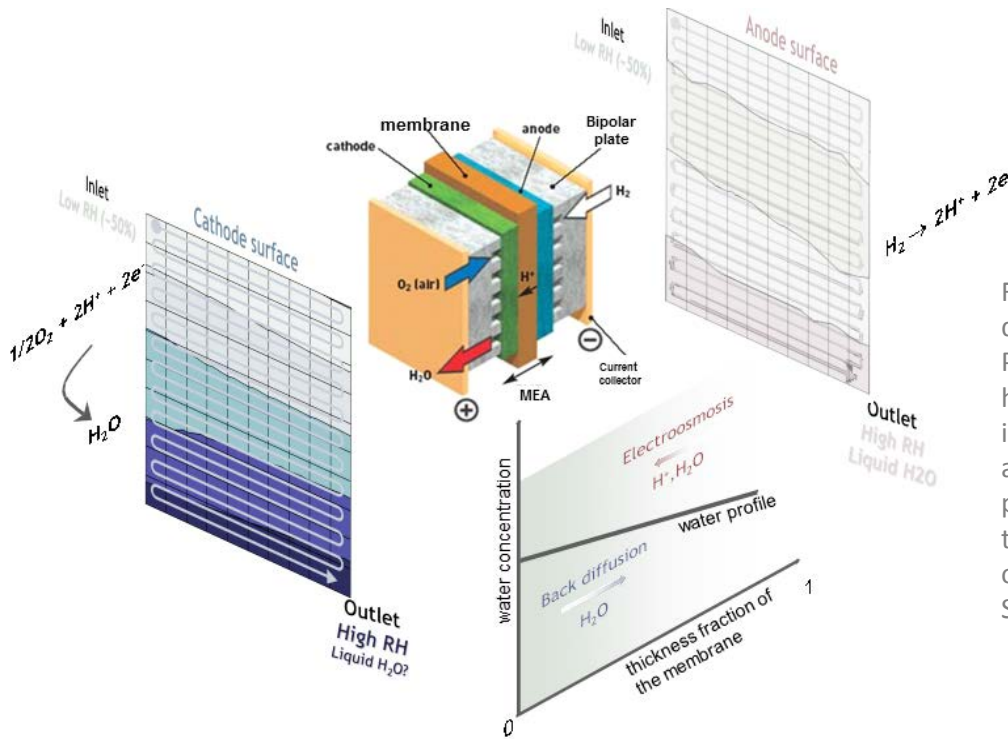


Figure 2. Three-dimensional distribution of water in a PEMFC single cell. Water is heterogeneously distributed in-plane (at the surface of anode/cathode) and through-plane (across membrane thickness). Results were obtained from in-operando SANS measurements.

It has been demonstrated, thanks to neutrons, that the local water content in the membrane is not directly correlated to the water content in the surrounding channel. Whenever thermal management produces higher temperatures in the heart of the cell, liquid water can be present in the channel even if the membrane is not fully hydrated.

➡ Results from neutron measurements provide unique information for optimising the design of high-performance fuel cells.

[Ref: H<sub>2</sub>FC newsletter (2015), Neutrons and Energy ILL (2015), A. Morin *et al.*, Fuel Cells (2012)]



SINE2020 Industry Consultancy is now open for requests.

# Proof-of-concept experimental beam time is being offered to Industry!

## RAPID ACCESS

Fast-stream processing for industrial applications, optimising result lead times.

## CONFIDENTIALITY

Activity covered by non-disclosure agreements. Only company name and measurement type to be published.

## FLEXIBLE SERVICES

In many cases industrial processes and conditions can be re-created in the test laboratory. Final data analysis and reporting are provided.



## EXPERT CONSULTANCY

Industrial R&D professionals in collaboration with experienced specialists from European neutron centres.

## PARTNERS FROM:

Czech Republic,  
France,  
Germany,  
Hungary,  
Netherlands,  
United Kingdom.



Science & Technology Facilities Council  
**ISIS**



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