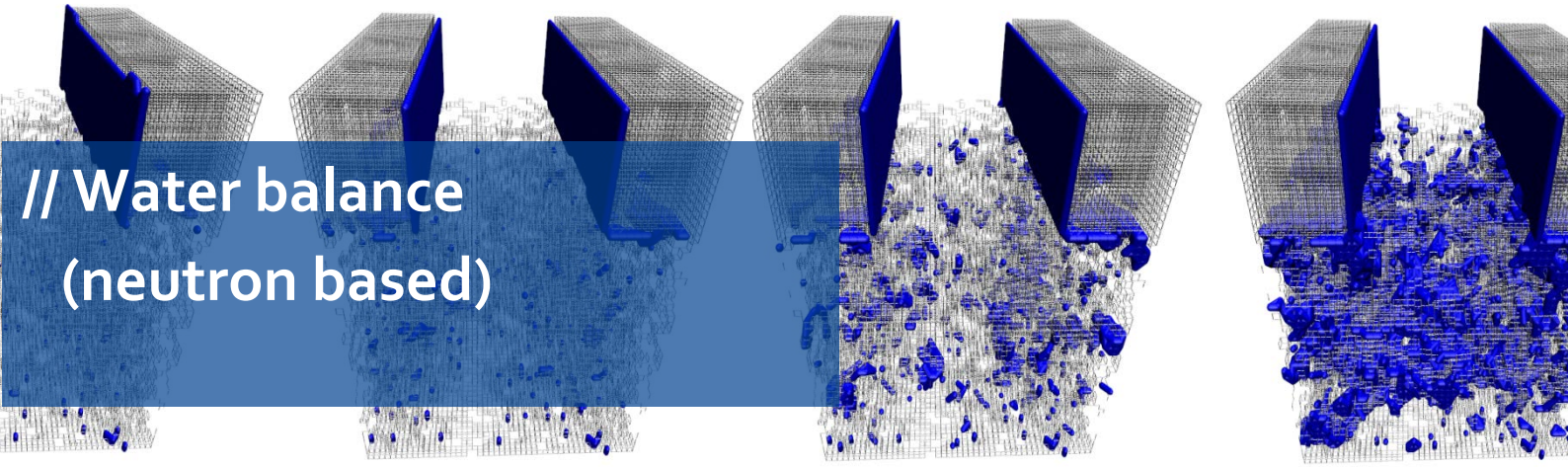

// Water balance (neutron based)

The issue of water management is of essential importance in the optimisation of flow field designs and for components as gas diffusion layers and gas diffusion electrodes of fuel cells. Water distributions within the flow field of entire cells or cell sections can be determined in situ under real-life operating conditions by using neutron radiography and tomography.

The technology jointly developed with our partners at Helmholtz-Zentrum Berlin (HZB) allows for time and spatial resolutions that are among the best values achieved anywhere in the world.

A mobile test bench has been developed at ZSW for all measurements with neutron or synchrotron (X-)rays (see figure).

Fig.: Mobile test bench (ZSW) used in neutron radiographic experiments

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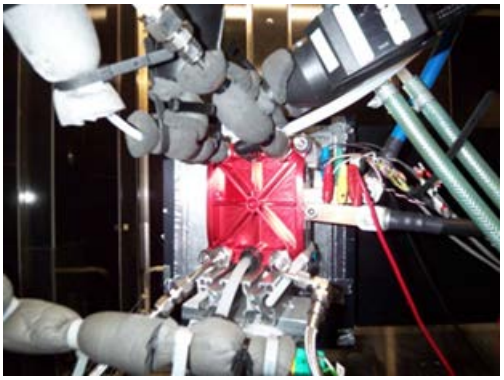
Radiographic investigations



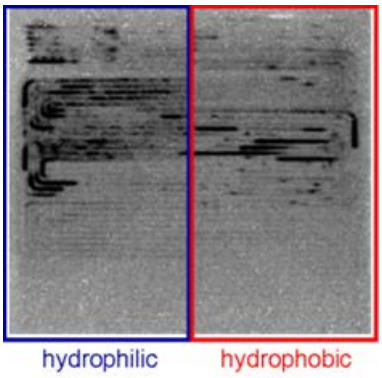


Fig.: Measurement cell for neutron radiographic experiments & radiography of gas diffusion layer with different hydrophobisations.

Radiographic examinations provide comprehensive information on water distributions, including dynamic properties within fuel cells, and thus facilitate the validation and optimisation of gas distribution fields so as to improve the condensate discharge behaviour. Furthermore, e.g. the influence of different gas diffusion layers (GDLs) on the water inventory of the cell can be determined.

Tomographic investigations

Tomographic examinations allow the determination of both, of structures and water distributions within gas distribution channels and gas diffusion layers to be depicted in high spatial resolution. Based on the resulting tomograms, a detailed analysis can be produced from "frozen" stack corresponding to present operation conditions and, as a result, the influence of GDL structures, surface conditions and operating conditions on water distribution can be determined, for example.

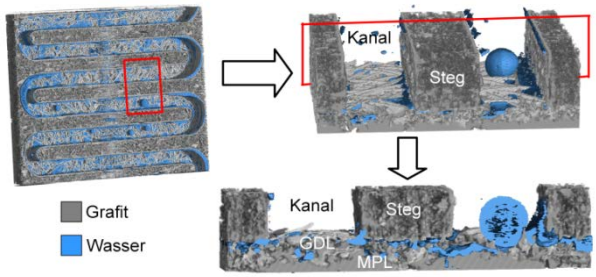


Fig.: Structures and water distributions within gas distribution channels and GDL substrate.

This technique also facilitates the validation of simulated water distributions, which can be obtained using Monte Carlo modelling (MC) model developed at ZSW. Please see the section "Water distribution in GDLs (MC)" in this regard.

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