Water condensation in Gas Diffusion Layers of PEM Fuel cells

B. Straubhaar[1], J.Pauchet[2], M. Prat[1]

[1] INPT, UPS, IMFT (Institut de Mécanique des Fluides de Toulouse), Université de Toulouse, Allée Camille Soula, F-31400 Toulouse, France and CNRS, IMFT, F-31400 Toulouse, France
[2] CEA, LITEN, LCPEM, Laboratory of Fuel Cell Components, Electrolysers and Modeling, 17 rue des Martyrs, 38054 Grenoble, France
benjamin.straubhaar@imft.fr

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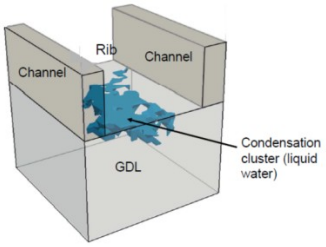

Figure 1. 3D pore network simulation of liquid water (in blue) invasion by condensation in GDL for moderate condensation condition. A water cluster forms and develops by condensation under the rib.

The fundamental understanding of water transport in PEMFCs is still a major challenge in direct relation with the water management issue, i.e., the ability to maintain a good dynamic balance of water in the membrane-electrode assembly during operation. In the present effort we concentrate on the water transfer mechanisms occurring in the gas diffusion layer (GDL) on the cathode side. In – situ visualizations of liquid water in GDL [1] and evaluations of temperature variations across the GDL [2] suggest that water condensation plays a major role in the water transfer and the flooding of GDL. In this work, condensation in the GDL is studied numerically from three dimensional pore network simulations. As illustrated in Fig.1, the simulations predict that water condenses under the rib, in qualitative agreement with the experimental visualizations [1]. The condensation process leads to the formation of growing liquid clusters progressively invading the GDL from the rib. This mechanism of flooding by condensation is markedly different from other scenarios assuming flooding by liquid water from the active layer – GDL interface, e.g. [3]. This new pore network model opens up the route to determine the exact water invasion mechanisms, which is crucial for improving both performances and durability of PEMFCs.

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