Water transport in a gas diffusion layer of polymer electrolyte fuel cells in the presence of polytetrafluorethylene

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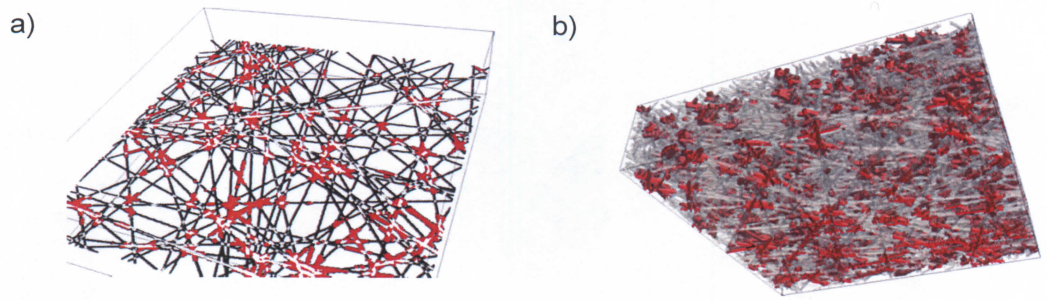
With polymer electrolyte fuel cells (PEFCs), the transport of liquid water is highly relevant for the efficient operation of the stack. The water is produced on the cathode side and must be transported through the thin porous structure of the gas diffusion layer (GDL). This medium is typically made of carbon fibers, and for hydrophobicity it is often treated with polytetrafluorethylene (PTPE). The total amount of PTFE in the thin layer is specified by the manufacturer, but the local distribution is usually not known. On the other hand, it is known that the PTFE distribution on the outer surfaces and inside the GDL is not homogeneous [1].

The impact of PTFE distribution inside the GDL on transport properties will be discussed herein. Local preferences of PTFE accumulation have already been observed by Daino and Kandlikar [2], while Rofaiel et al. [3] found inhomogeneities in the global distribution of PTFE. In this work, the PTFE is distributed across the fibers of the micro-structure by two stochastic models. Globally, the PTFE can be homogeneously distributed in the through-plane direction of the GDL, or non-homogeneously: the PTFE can concentrate in the outer regions of the GDL. Locally, it is assumed that PTFE preferably concentrates at positions where two fibers cross each other. Different parameter settings of both distribution models are discussed. The Figure shows a representation of the PTFE distribution.



PTFE distribution (in red): a) in a fiber layer; b) in the 3D micro structure.

In this presentation, previous work presented by Yu et al. [4] is further developed by analyzing the macroscopic impact of PTFE on water transport from a statistical point of view. Transport simulations are running on the hardware of the Jülich Supercomputing Centre, grant CJIEK30.

Keywords: PEFC, GDL, PTFE distribution, two-phase simulation, stochastic evaluation.

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