Convective drying of a mixed wet porous medium bounded with a gas purge channel

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ABSTRACT

A fundamental understanding of drying processes in porous media is of great importance to not only the scientific research but also the industrial applications. In proton exchange membrane fuel cells (PEMFCs), dry gas is usually flowed into the gas channel (GC) to remove liquid in the gas diffusion layer (GDL) through the evaporation mechanism after the cell shutdown, Fig. 1. The GDL shows mixed wet characteristics, i.e., hydrophobic and hydrophilic pores coexist. The hydrophobicity of the GDL reduces as the cell operates. Hence, it is needed to understand the drying processes in the GDLs with various wettabilities. In this contribution, a pore network model is developed to understand how the GDL wettability influences the drying processes in the GDL with a gas purge channel. The developed model, which considers the capillary valve effect induced by sudden geometrical expansion and the effect of the liquid viscosity, is validated by comparing the numerical results with the experimental data. Based on this developed model, the drying processes in the GDL are revealed, Fig. 2.

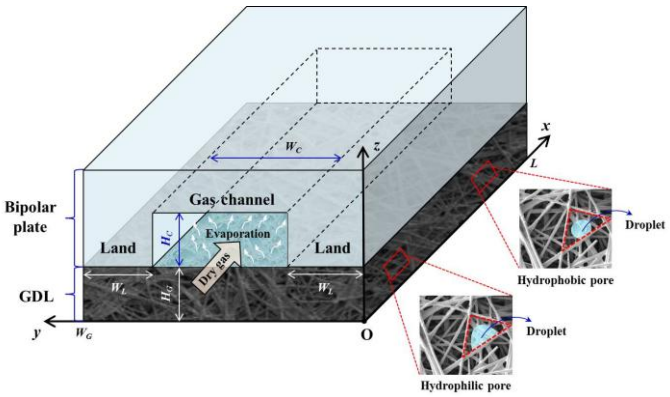

Fig. 1 Drying process in GDL

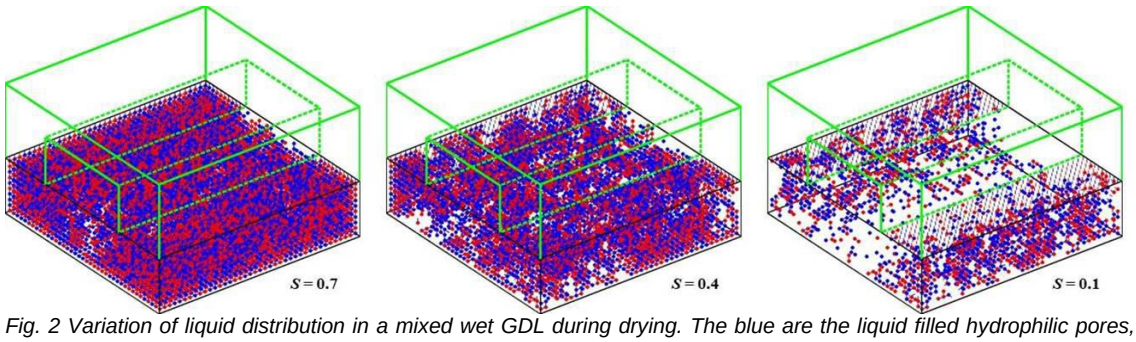

Fig. 2 Variation of liquid distribution in a mixed wet GDL during drying. The blue are the liquid filled hydrophilic pores, and the red are the liquid filled hydrophobic pores.