Assessing the limits of water management with asymmetric micro-porous layer configurations

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Water management remains an important topic in polymer electrolyte fuel cell systems. Not only for prevention of flooding, but in high-power polymer electrolyte fuel cell (PEFC) systems, prevention of anode dry-out through enhanced back flux of water and restriction of evaporative losses is needed [1-2]. One potential method to engineer the back flux of water from the anode is to utilize an asymmetric anode and cathode micro-porous layer configuration. The objective of this work is to understand the range of ability to engineer net water drag through asymmetric micro-porous layer (MPL) configurations. As net water drag is a complex function of thermal and mass transport properties, another objective is to reveal the interaction between thermal and mass transport resistance in water management and net water drag.

Water transport across the PEFC occurs by several driving modes including gradients in potential, temperature, concentration, and pressure. Therefore, engineering the MPL thickness, thermal conductivity, or permeability will impact the thermal and mass transport resistance through the media.

In this talk, we present an extensive experimental study of the effect of asymmetric MPL configuration on the net water drag coefficient. Various combinations of cells were built and tested with different MPL thermal and mass transport resistances. The net water drag coefficient over a wide range of operating conditions for three combinations of anode/cathode MPL sets was determined from water balance measurements. We will discuss the relative influence of thermal and mass transport resistances in influencing the net water drag which help further elucidate the complex combined role of capillary action, diffusion, and thermal gradient driven water transport in PEFCs.

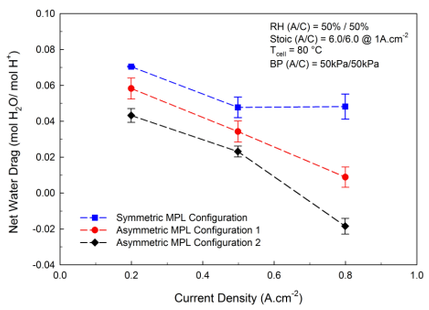

Figure 1: Net water drag coefficient for different MPL configurations

References

[1] L. J. Zheng, A. K. Srouji, R. Dross, A. Turhan, and M. M. Mench, Journal of The Electrochemical Society, 160(2), F119 (2013).
[2] A. K. Srouji, L. J. Zheng, R. Dross, A. Turhan, M. M. Mench, Journal of Power Sources, 239 (2013), 433.