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Effect of The Relative Humidity on The Porosity of PEM Fuel Cell Catalyst Layers

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The anode and cathode catalyst layers of proton-exchange membrane fuel cell, a thin porous media of approximately 10 μ m thickness and 50% porosity, have a complex solid structure composed by a support matrix to conduct electrons and provide structural integrity, ionomer films to conduct protons, open pores to transport gases, vapor, and liquid water; and dispersed catalyst particles, typical Platinum. The behavior of the ionomer films adds complexity to the solid phase as it can retain water which causes swelling and therefore changing the porosity and the mass transport behavior for both gases and condensed liquid water. In this study, an experimental setup is used to investigate mass transport in catalyst layers at different relative humidity (RH). To decouple swelling and liquid water percolation phenomenon, an ionomer swelling neutral liquid, fluorinert FC-3283, is utilized as the working liquid. The RH is then controlled by changing the water vapor content in the gas phase. The experimental results show that when fluorinert is injected into the catalyst layer at a constant flow rate, as the RH in the gas phase increases the injection pressure for both the liquid and gas increases due to swelling and reduction in porosity. Paradoxically, at high RH it takes a longer time to reach bubble point than at low RH. This unexpected observation could be a key feature in understanding the complex relationship between mass transport, swelling, and porosity in the catalyst layers.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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