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Diffusion Layer Saturation Analysis of PEM Fuel Cells

The Diffusion Layer Saturation Analysis (DLSA) procedure previously developed by the Anderson lab has been used to investigate the effect of saturation on a Proton Exchange Membrane (PEM) fuel cell's performance by introducing a dry anode stream to reduce excess water via evaporation. This analysis correlates the averaged anode pressure drop signal within the PEM fuel cell to the exit relative humidity of the anode gas stream, which would normally require an expensive instrument to be measured. Knowing this relative humidity, saturation of the porous layers on the cathode side can also be estimated. This methodology is expanded to create a transient solver in MATLAB to find the change in saturation over time and quantify the water being removed from the porous layer by the anode channel stream. The protocol investigated utilizes a consistent ramp of the anode flow rate over various lengths of time. Multiple gas diffusion layer configurations are also investigated in order to analyze their individual contributions to the overall water transport resistance. By experimentally studying the correlation between saturation and fuel cell performance, important transport parameters are determined which can be used to validate previously published fuel cell models. DLSA is therefore shown to be a useful diagnostic and investigative tool for understanding and quantifying water transport in the PEM fuel cell and helping to make the technology more efficient and cost effective.

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