PEM Fuel Cell Dynamic Model With Phase Change Effect

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In this research, a system-level dynamic model accounting for the phase change effect is developed for polymer electrolyte fuel cells (PEMFCs). This model can illustrate the complicated transient behavior of temperature, gas flow, phase change in the anode and cathode channels, and membrane humidification under operating conditions. Simulation indicates that vapor in the cathode channel is more likely to be in the over saturated state and phase change (condensation under large load current situation) then takes place, which leads to higher temperature at cathode channel due to latent heat generation. In the anode channel, on the other hand, the phase change is less likely to occur even if the inlet hydrogen is humidified with a high relative humidity value. The model is partially validated using the experimental data from open literature. A series of analyses are carried out to investigate the underlying physical mechanisms. This model can be used in the optimal design and dynamic control of PEMFCs. [DOI: 10.1115/1.2041670]