Simulation of a CFD based two-phase, 3-dimensional model for PEMFC with various flow fields

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This study focuses on a CFD model for modeling gas evolution and flow patterns in a PEMFC. The model is based on improved two-phase model with a new method for estimating the gas content without empirical mass transfer coefficients. New equations for the source term are derived using the equilibrium flash equation for multicomponent gas-liquid stream. The improved two-phase model allows studying the effect of flow field geometry on gas evolution and fuel cell performance without empirical correlations. The flow geometry of the anode side has important implication on gas evolution. The developed CFD model is valuable in simulation of PEMFC with different flow fields.

Case studies illustrate applications of the CFD model for modeling gas evolution and current distribution in a PEMFC with some kinds of flow-field designs. Simulation results with an improved two-phase model provide an explanation of experimental observations of a transparent PEMFC with similar channels. The improved three-dimensional CFD model includes all relevant phenomena and is valuable for gas management in a PEMFC design. Twelve different designs are developed and analyzed.