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Numerical Simulations of Droplet Dynamics in PEM Fuel Cell Microchannels ERIC CAUBLE, MARK OWKES, Montana State University — Proton exchange membrane (PEM) fuel cells are of beneficial interest due to their capability of producing clean energy with zero emissions. An important design challenge hindering the performance of fuel cells is controlling water removal to maintain a hydrated membrane while avoiding excess water that may lead to channel blockage. Fuel cell water management requires a detailed knowledge of multiphase flow dynamics within microchannels. Direct observation of gas-liquid flows is difficult due to the small scale and viewing obstructions of the channels within the fuel cell. Instead, this work uses a CFD approach to compute the formation and dynamics of droplets in fuel cell channels. The method leverages a conservative volume-of-fluid (VOF) formulation coupled with a novel methodology to track dynamic contact angles. We present details of the numerical approach and simulation results relevant to water management in PEM fuel cells. In particular, it is shown that variation of the contact hysteresis angle influences the wetting properties of the droplet and significantly impacts water transport throughout the a fuel cell channel.

Eric Cauble
Montana State University

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