Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Two Phase Flow Visualization and Flow Regime Characteristics in Gas Diffusion Layer Integrated Microchannels EON SOO LEE, JULIE STEINBRENNER, FU-MIN WANG, CARLOS HIDROVO, KENNETH GOODSON, JOHN EATON, stanford university — Management of liquid water transported through the reactant-gas-supply channels is a significant problem in proton exchange membrane fuel cells. Typically these channels have three smooth, impermeable walls and a fourth wall consisting of a porous carbon paper called the gas-diffusion layer (GDL). This research addresses microchannel fuel cells where the channel height is comparable to the GDL thickness and both gas and liquid may move longitudinally through either the channel or the porous layer. Transparent test structures were built with 500 μm wide by 200 μm deep by 15 cm long channels with one of the 500 μm wide channel walls bounded by a 190 or 390 μm thick GDL layer. A controlled flow of water was injected into the backside of the GDL at 4 equally distributed points along the channel. Two phase flow regimes in the channel were observed to be a function of the water and gas flow rates, GDL hydrophobicity, GDL thickness and channel wall hydrophobicity. Generally the flow regime evolves from plug flow, to wavy annular flow, to stratified flow as the gas flow rate increases. The transition points are determined by the system parameters and the hysteresis of the flow regime is observed with the direction of gas flow variation. Modeling of the system requires correct accounting for a significant gas flow passing longitudinally through a partially-saturated GDL.

Eon Soo Lee
stanford university

Date submitted: 21 Jul 2006 Electronic form version 1.4