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Liquid Droplet Detachment and Entrainment in Microscale Flows CARLOS HIDROVO, FU-MIN WANG, JULIE STEINBRENNER, DAVID FOGG, EON SOO LEE, JAE-MO KOO, CHING-HSIANG CHENG, JOHN EATON, KEN-NETH GOODSON, Stanford University, MICROSCALE HEAT TRANSFER LAB-ORATORY (MHTL) FUEL CELL GROUP TEAM — In this talk we will present a first order study of liquid water detachment and entrainment into air flows in hydrophobic microchannels. Silicon based microstructures consisting of 23 mm long U-shaped channels of different geometry were used for this purpose. The structures are treated with a Molecular Vapor Deposition (MVD) process that renders them hydrophobic. Liquid water is injected through a side slot located 2/3 of the way downstream from the air channel inlet. The water entering the air channel beads up into slugs or droplets that grow in size at this injection location until they fill and flood the channel or are carried away by the air flow. The slugs/droplets dimensions at detachment are correlated against superficial gas velocity and proper dimensionless parameters are postulated and examined to compare hydrodynamic forces against surface tension. It is found that slug/droplet detachment is dominated by two main forces: pressure gradient drag, arising from confinement of a viscous flow in the channel, and inertial drag, arising from the stagnation of the air due to obstruction by the slugs/droplets. A detachment regime map is postulated based on the relative importance of these forces under different flow conditions.

> Carlos Hidrovo Stanford University

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