Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Interface dynamics during the formation of bubbles and droplets at microfluidic junctions VOLKERT VAN STEIJN, CHRIS KLEIJN, MICHIEL KREUTZER, Delft University of Technology — We describe how the size of bubbles and droplets – created at microfluidic T-junctions – scales with the shape of the junction. The shape of the junction plays a crucial role as it sets the shape of the bubble. Due to interfacial tensions, the bubble cannot conform to the channel walls. Hence, fluid upstream and downstream of the bubble communicates via so-called gutters between the wall and the bubble. In this work, we show that – depending on the Capillary number and the ratio between the height and width of the main channel – significant flows of carrier liquid by-pass the bubble during its growth. We compared our experiments, in which we measured the interface evolution from high-speed micrographs for junctions with different shapes operated at Capillary numbers below 0.01, with a simple model. In this model, a geometrical description of the interface was coupled to a continuity and momentum balance. We balanced the pressure drop over the emerging bubble due to the difference in radii of curvature at the front and rear with the pressure drop due to the flow through the gutters. This model shows good agreement with the experiments, explains the rapid 3-D pinch-off, and shows how the size of bubbles and droplets scales with the T-junction geometry.

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Date submitted: 04 Aug 2008 Electronic form version 1.4