Abstract Submitted for the DFD13 Meeting of The American Physical Society

Critical behavior of droplet breakup in T-junction microchannels VOLKERT VAN STEIJN, DUONG HOANG, LUIS PORTELA, CHRIS KLEIJN, MICHIEL KREUTZER, Delft University of Technology — The critical behavior of droplet breakup in T-junction mirochannels is studied using three-dimensional numerical simulations. Two scenarios can happen when a droplet flows into a Tjunction: (i) if the flow is strong enough, it breaks into two daughter droplets and (ii) otherwise, it drifts away into one branch of the T-junction owing to flow perturbations. Whether a droplet breaks or not is determined by the ratio between two timescales: breakup time and drifting time. Symmetric-boundary-condition simulations allow us to study the breakup time without any flow perturbations, thus to accurately compute the critical capillary number below which the droplet does not break. We study the drifting using full-T-junction simulations, identifying three phases in drifting process: (i) an exponential drifting, (ii) a transition phase and (iii) a linear drifting. Combining the understanding of the breakup and drifting behavior, we found that the critical capillary number below which the droplet drifts away increases more than 10% with respect to the one obtained in free-perturbation flow systems.

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Date submitted: 02 Aug 2013

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