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The Dynamics of Tipstreaming in Microfluidic Flow Focusing Devices SHELLEY L. ANNA, Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, PA, LYNN M. WALKER, WINGKI LEE, Department of Chemical Engineering, Carnegie Mellon University, Pittsburgh, PA — We have previously shown that a tipstreaming-like phenomenon occurs in microfluidic flow focusing experiments when dissolved surfactants are present in one of the liquid phases. This regime of droplet breakup leads to submicron droplets that are orders of magnitude smaller than the flow focusing orifice. The process is observed to be periodic, in which streams of tiny droplets alternate with the formation of a large (50 micron diameter) droplet at a frequency on the order of hundreds of cycles per second. In this talk, we report our observations of the dynamics of this process, including measurements of the relevant timescales for the formation of a cone-like interface, the drawing and disintegration of a fine thread, and the period with which the process repeats. We relate these timescales to dimensionless flow parameters such as the capillary number and the flow rate ratio, as well as the characteristic timescales for transport of surfactants to and along the interface. Through these observations and simple scaling analyses we suggest ways to extend the tipstreaming portion of the process to enhance the overall yield of submicron droplets.

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