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Dynamics of High-speed Droplet Generation in Gas-liquid Microfluidic Systems[1] POOYAN TIRANDAZI, JULIAN D. ARROYO, CARLOS H. HIDROVO, Northeastern University — In this work we study the interaction of liquid and gas in flow-focusing microchannels with the goal of reproducible generation of microscale droplets in air. The microfluidic channels are fabricated in Polydimethylsiloxane (PDMS) based on established lithography techniques and feature a non-planar architecture to enable the formation of liquid jets and droplets within air. A comprehensive flow map is developed based on the interaction of liquid and gas for a wide range of flow conditions and different channel sizes. In particular, we focus on the characteristics of the Dripping and Jetting modes of droplet formation and present information regarding droplet and jet sizes and breakup frequencies in this system. We show that the microfluidic chips reproducibly generate droplets with frequencies in the order of 10kHz and droplet sizes between 160μm and 50μm in the Dripping mode, whereas, for the Jetting we obtain droplets from 50μm down to 15μm at frequencies higher than 100 kHz. Finally, we briefly discuss some applications of high-speed gas-liquid microfluidics, namely for oil-free polymer particle fabrication and gas sensing using sample digitization with microdroplets.

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