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Ultrahigh throughput microfluidic platform for in-air production of microscale droplets[1] JOHN HEALY[2], POOYAN TIRANDAZI, CARLOS H. HIDROVO, Northeastern University — In-air droplet formation inside microfluidic networks is an alternative technique to the conventional in-liquid systems for creating uniform, microscale droplets. Recent works have highlighted and quantified the use of a gaseous continuous phase for controlled generation of droplets in the Dripping regime in planar structures. Here we demonstrate a new class of non-planar droplet-based systems which rely on controlled breakup of a liquid microjet within a high speed flow of air inside a confined microfluidic flow-focusing PDMS channel. We investigate the physics of confined gas-liquid flows and the effect of geometry on the behavior of a liquid water jet in a gaseous flow. Droplet breakup in the Jetting regime is studied both numerically and experimentally and the results are compared. We show droplet production capability at rates higher than 100 KHz with droplets ranging from 15-30μm in diameter and a polydispersity index of less than 15%. This work represents an important investigation into the Jetting regime in confined microchannels. The ability to control jet behavior, generation rate, and droplet size in gas-liquid microflows will further expand the potential applications of this system for high throughput operations in material synthesis and biochemical analysis.

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