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Droplet Detachment in Confined Gaseous Microchannel Flows

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Multiphase flows are ubiquitous in microfluidic applications for lab-on-a-chip and micro total analysis systems, particularly those with micromixing capabilities. Significant advancement has been achieved recently for both active and passive micromixers. Increasing the Reynolds number prior to mixing, however, remains relatively unchartered due to the large fluid viscosities typically involved. By using a gaseous flow to detach and transport liquid droplets, Reynolds numbers in excess of 100 can be achieved. This allows droplet interaction and mixing to take place under highly inertial conditions with potentially increased mixing rates. Since droplet detachment and entrainment is a prerequisite for droplet mixing, an experimental investigation is performed and presented for liquid droplet detachment in confined microchannel gas flows. Gas flow rate and channel aspect ratios were varied to determine influence on detached droplet characteristics. Preliminary results indicate that two distinct force balance regions exist and are delineated according to Reynolds number. Increasing the Reynolds number increases the droplet aspect ratio, yielding longer slug-like droplets that may oppose favorable mixing conditions.

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