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Generation of Monodisperse Liquid Droplets in a Microfluidic Chip Using a High-Speed Gaseous Microflow[1] POOYAN TIRANDAZI, CARLOS HIDROVO, Northeastern Univ — Over the last few years, microfluidic systems known as Lab-on-a-Chip (LOC) and micro total analysis systems (μTAS) have been increasingly developed as essential components for numerous biochemical applications. Droplet microfluidics, however, provides a distinctive attribute for delivering and processing discrete as well as ultrasmall volumes of fluid, which make droplet-based systems more beneficial over their continuous-phase counterparts. Droplet generation in its conventional scheme usually incorporates the injection of a liquid (water) into a continuous immiscible liquid (oil) medium. In this study we demonstrate a novel scheme for controlled generation of monodisperse droplets in confined gas-liquid microflows. We experimentally investigate the manipulation of water droplets in flow-focusing configurations using a high inertial air stream. Different flow regimes are observed by varying the gas and liquid flow rates, among which, the "dripping regime" where monodisperse droplets are generated is of great importance. The controlled size and generation rate of droplets in this region provide the capability for precise and contaminant-free delivery of microliter to nanoliter volumes of fluid. Furthermore, the high speed droplets generated in this method represent the basis for a new approach based on droplet pair collisions for fast efficient micromixing which provides a significant development in modern LOC and μTAS devices.

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