The Formation of Droplets in 3D-Printed Device by Density-Induced Flow-Focusing

황유호, 홍지우, 김동표†
포항공과대학교
(dpkim@postech.ac.kr†)

Microdroplets have attracted considerable interest because of their great number of opportunities in terms of chemistry, food, biology, and pharmaceuticals. They provide a confined space in which heat/mass transfer and reaction can be isolated in femtoliter to microliter volumes, and offer an ideal system for studying such as reaction kinetics, biochemical screening, and crystallization. In this regards, well-defined drop size is very significant because it directly affects reaction on timescale, interfacial properties, and mixing of reagents. Here, we overcome the critical barrier by presenting a newly designed 3D-printed device without complex inner structure, while preserving monodispersity with precision control of the droplet size. We suggest that droplet formation, aided by density-induced flow-focusing, is efficient for broad range of droplet size from 36 μm to 614 μm with CVs less than 1.5%. In addition, we demonstrate the size control and scaling-up of crystallization of active pharmaceutical ingredients (APIs) from water-in-oil (W/O) emulsions in parallelized (n=4) droplet generators, which have different angle at cone shape of outlets, while keeping the same flow rate.