**Parametric study of customizable 3D-printed droplet-microfluidic device**

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**Highlights**

* 3D printed droplet generator is enough accurate to produce droplets with single modal PSD.
* Clear effect of output channel geometry at the same flow conditions.
* Individual and collective behavior of droplets–limiting flow rate ratio of O/W phase.
* Correlation of droplet size on to the volumetric flow rater ratio.

**1. Introduction**

Droplet-microfluidic devices are becoming more and more powerful platform in chemical, material, biological and pharmaceutical applications where small, highly controllable droplets and particles with uniform size are essential. 3D printing provides effective tool for rapid production of cheap and complex 3-dimensional droplet generators. We apply FDM (fused deposition modeling) 3D printing technology to fabricate customizable microfluidic device [1] with droplet chips which allows production of highly monodisperse droplets, emulsions and double emulsions (droplet-in-droplet) in this work. By varying the channel diameter and droplet chips geometry we are able to generate W-O-W and O-W-O droplets with defined parameters. Several types of material have been tested to find optimal transparency of droplet fluidic chips. Customizable 3D printed microfluidic device with different types of fluidic chips was successfully tested over a range of flow conditions.

**2. Methods**

Water droplets was prepared in the flow of oil continuous phase. Density, viscosity and interfacial tension was determined for both used liquids. FDM 3D printing technology was used for manufacturing microfluidic chips with various width of output channel. High speed visualization and advanced image analysis [2] was used for droplet primary data treatment.

**3. Results and discussion**

Four 3D printed microfluidic chips was evaluated under similar flow conditions. CT scan of each channel was performed to obtain actual information about channel profile geometry. Primary geometrical parameters of droplet was detected and statistical evaluation of results was performed. Droplet size normalized by channel width as a function of ratio of volumetric flow rate of dispersed phase to the volumetric flow rate of continuous phase gives single line (1) showed in Figure 1.

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| --- | --- |
| $$\frac{d}{h}≈1.8\left(\frac{Q\_{D}}{2Q\_{C}}\right)^{0.2}$$ | (1) |



**Figure 1.** Equivalent droplet size normalized by channel width as a function of volumetric flow rate ration of dispersed to continuous phase.

**4. Conclusions**

Simple method of 3D printing was used for manufacturing of droplet generator with sufficient accuracy. Image analysis was used to evaluation of experiments. Effect of surface tension, viscosity and effect of different surface active agents was evaluated and satisfactory correlation of droplet size on the volumetric flow rate ratio was obtained.

**References [Calibri 10]**

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