

Droplet Breakup Regime in a Cross-Junction Device with Lateral Obstacles

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Abstract: Numerical simulation using Ansys Fluent code is performed, to investigate droplet generation in cross-junction based VOF method. Droplets of water are generated by the shear stress applied by continuous phase (oil), two configurations of cross-junction are suggested; the first is a simple model no modification is performed at the outer channel, while the second model is characterized by a lateral obstacle. we study the effect of velocity ratio, viscous parameter, interfacial tension, flow condition on droplet size and frequency, the effect of lateral obstacles on droplets generation is also focused and analysed. The numerical simulations showed that the velocity ratio and interfacial tension play a significant role in determining the droplet breakup and non-breakup. On the other side, the increase of flow rate ratio can be effectively used to decrease the droplet size. In addition, droplets produced in cross-junction with lateral obstacles are generally found to be larger than that produced with the first model. Moreover, the frequency of droplet production was increasing by increasing of flow rate ratio. The numerical results show very good agreements with previous numerical and experimental works for the growth of droplet breakup, size and frequency.

Keywords : Water droplet, cross-junction, CFD, VOF, microchannel.