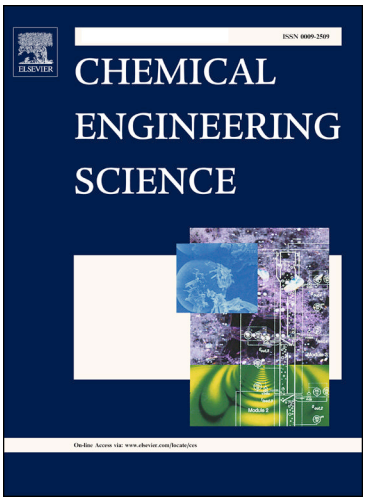

Droplet breakup in an asymmetric bifurcation with two angled branches

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Droplet breakup in an asymmetric bifurcation with two angled branches

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Droplet breakup in an asymmetric bifurcation with two angled branches is studied experimentally and theoretically in this paper. In order to tune the droplet size and droplet velocity separately, a diluting channel is added and its influence on droplet generation is confirmed to be negligible. The underlying physics of the droplet generation is revealed as compared with other works. Effects of the droplet parameters, including the initial droplet length and the droplet velocity, on breakup characteristics are analyzed. The regime diagram of the droplet breakup and the critical conditions between different regimes are provided. It is found that the splitting ratio is largely influenced by the initial droplet length and the droplet velocity, which proves that the breakup process is an inter-dependent process between the splitting junction and droplets themselves. At last, a simple but effective prediction model is constructed by considering the hydrodynamic resistance of the branches with the presence of the daughter droplets, which also proves the similar motion of the droplets with low viscosity ratio of the two phases and the bubble.

Keywords: droplet breakup, bifurcation, the regime diagram, the splitting ratio, the prediction model

1. Introduction

Due to the advantages of low cost, low cross-contamination, high efficiency and high-throughput, droplet-based microfluidics has been successfully applied in enzymatic kinetic assays,[1, 2] cell/organism culture,[3, 4] cell based sorting,[5] biochemical screening,[6, 7] particle synthesis,[8, 9] etc. For these applications, the droplet size and droplet polydispersity are two input parameters of the droplet system, through which output characteristics are determined.[10, 11] So the droplet size should be controlled precisely. Droplet breakup is one of the most effective methods to tune the droplet size but do not change the volume fraction of the dispersed phase. By various splitting junctions, the volume of daughter droplets could be varied to almost any value, with the minimum