

DNS using CLSVOF method of single micro-bubble breakup and dynamics in flow focusing

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Abstract: Numerical simulations are performed to investigate the breakup of air bubble in flow focusing configuration; the CLSVOF (coupled level set with volume of fluid) method is employed to track the interface, which allows a better identification of the liquid–gas interface via a function called level set. The CFD simulations showed that the velocity ratio, the interfacial tension, the outer channel diameter, the continuous phase viscosity, the orifice width and length play an important role in the determination of the air bubble's size and shape. However, at low capillary number, increasing the flow velocity ratio gives a smaller bubble size in shorter time, while the increase in interfacial tension leads to a bigger bubble. Moreover, the carrier fluid is found to slightly affect the bubbling mechanism, while the smallest bubbles were obtained with the smallest orifice size. In addition, three breakup regimes are observed in this device: disc-bubble (DB), elongated bubble (EB) and the slug bubble (SB) regime flows. This work also demonstrates that the CLSVOF is an effective method to simulate the bubbles breakup in flow focusing geometry. In addition, a comparison of our computational simulations with available experimental results reveals reasonably good agreement.

Keywords : Bubbling, Multiphase flow, CLSVOF, CFD and flow focusing