conferenceseries.com

J Adv Chem Eng 2018, Volume 8
DOI: 10.4172/2090-4568-C2-009

Bubble splitting under gas-liquid-liquid three-phase flow in a double T-junction microchannel

Chaoqun Yao[1], Yanyan Liu[1], Jun Yue[2], Shuainan Zhao[1] and Guangwen Chen[1]
[1]Chinese Academy of Sciences, China
[2]University of Groningen, Netherlands

Gas-liquid-liquid three-phase flow is frequently encountered in various chemical and biochemical processes, which usually requires effective dispersion of reactants for process intensification or better fluid manipulation. This work presents an experimental investigation into the bubble breakup process in a gas-water-oil flow in a double T-junction microchannel. Gas-oil segmented flow with slender bubbles was generated at the first T-junction (T1). The bubbles were then squeezed and split by the dispersed aqueous phase at the second T-junction (T2). Information about the breakup regime, flow fluctuation, breakup time, critical bubble breakup length and size laws are presented and discussed. When interfacial tensions are dominant in the evolution of interfaces, the bubble breakup regime is Breakup with Permanent Obstruction (BPO). As shown in Figure-1, the instantaneous upstream bubble velocity (U_{up}) and aqueous flow rate fluctuate in the opposite phases, while the downstream bubble velocity (U_{down}) keeps constant because the fluctuations are exactly compensated. When viscous force or inertial force plays an important role, the flow regime turns to Breakup with Temporary Obstruction (BTO). U_{down} and U_{up} vary in synchronization due to the part compensation of the fluctuations. Compared to the 2D model of Leshansky, et al., a modified capillary number is introduced to predict bubble breakup time. Then the critical bubble length and size laws for the generated daughter bubbles/droplets are also obtained accordingly. The revised model provides very good predictions against experimental results. These results provide an important guideline for designing microchannel structures for a precise manipulation of gas-liquid-liquid three-phase flow.

superyao@dicp.ac.cn