EFFECT OF MICROSTRUCTURES IN MICROCHANNEL FOR MIXING INTENSIFICATION

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ABSTRACT

Most of the passive rectangular micromixers designs utilizes the wide base of the channel to place the mixing enhancing structures for maximizing the mixing performance within the shortest distance possible. High pressure drop due to the very low channel dimensions, passive mixing structures and the domination of the liquid apparent physical properties like viscosity, is considered a serious drawback that limits the expected future improvement in the mixing performance. In the present work, microriblets (V-shaped) with the size ranging from 20 to 100 µm are designed, fabricated and placed at the narrow side-walls of the rectangular micomixer to test its flow enhancement and mixing performances. The micromixers were fabricated through direct writing method where polymethyldisiloxane was used as the substrate. The flow behavior of single and multiphase flow systems was investigated through monitoring the flow rate of the fluids flowing through the system. The flow profile in the system was evaluated using micro-particle velocimetry (µ-PIV). The results indicated a flow enhancement up to ~29% for a 60 µm of base-to-height riblet at an operating pressure of ~200 mbar for a single-phase flow system. Larger microriblets were found to produce a thicker laminar sub-layer within the devices that narrowed the active core of the solution. When a two-phase flow system is introduced, the flow enhancement was clearly observed in the water phase at operating pressure > 600 mbar and riblets dimension > 60 µm. On the other hand, the mixing performance was intensified at the non-flow-enhancement pressure range which led to the conclusion that within the investigated operating conditions, high mixing performance cannot occur at the same time as the flow enhancement.

Keywords: Passive micromixer ; microriblets; mixing; µ-PIV

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