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CFD Modeling of Mixing Enhancement in a Pitted Micromixer by High Frequency Ultrasound Waves

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Abstract : Use of ultrasound waves is one of the techniques for increasing the mixing and mass transfer in the microdevices. Ultrasound propagation into liquid medium leads to stimulation of the fluid, creates turbulence and so increases the mixing performance. In this study, CFD modeling of two-phase flow in a pitted micromixer equipped with a piezoelectric with frequency of 1.7 MHz has been studied. CFD modeling of micromixer at different velocity of fluid flow in the absence of ultrasound waves and with ultrasound application has been performed. The hydrodynamic of fluid flow and mixing efficiency for using ultrasound has been compared with the layout of no ultrasound application. The result of CFD modeling shows well agreements with the experimental results. The results showed that the flow pattern inside the micromixer in the absence of ultrasound waves is parallel, while when ultrasound has been applied, it is not parallel. In fact, propagation of ultrasound energy into the fluid flow in the studied micromixer changed the hydrodynamic and the forms of the flow pattern and caused to mixing enhancement. In general, from the CFD modeling results, it can be concluded that the applying ultrasound energy into the liquid medium causes an increase in the turbulences and mixing and consequently, improves the mass transfer rate within the micromixer.

Keywords : CFD modeling, ultrasound, mixing, mass transfer
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