NUMERICAL STUDY OF TWO-PHASE FLOW REGIMES IN SQUARE MICROCHANNELS WITH HYDRODYNAMIC FOCUSING

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Abstract: Flow of two immiscible fluids in a square microchannel passing hydrodynamic focusing system is investigated numerically by means of Density Functional method. The method uses continuous-field representation of liquid phases, interfacial boundary being smoothed. Basic concept of the method is that specific Helmholz energy of a multicomponent mixture is a function of not only component molar densities but also of their gradients. It leads to a modified expression for stress tensor in a medium with variable composition so that surface tension is taken into account. Supplemented by the Navier-Stokes expression for viscous stresses, the tensor is then put into the momentum balance equation, thus allowing one to model dynamical problems. We employ this method to study two-phase flow in the microchannel at various fluid viscosities, interfacial tensions and flow rates. Over a wide range of the parameters several regimes of flow were observed and located on a map based on the capillary number of each fluid. Numerical results are presented in comparison with previously published laboratory data. Good agreement with the experiment is observed.

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