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Microfluidic step-emulsification in a cylindrical geometry[1] INDRAJIT CHAKRABORTY, ALEXANDER M LESHANSKY, Department of Chemical Engineering, Technion-IIT — The model microfluidic device for high-throughput droplet generation in a confined cylindrical geometry is investigated numerically. The device comprises of core-annular pressure-driven flow of two immiscible viscous liquids through a cylindrical capillary connected co-axially to a tube of a larger diameter through a sudden expansion, mimicking the microfluidic step-emulsifier (1). To study this problem, the numerical simulations of axisymmetric Navier-Stokes equations have been carried out using an interface capturing procedure based on coupled level set and volume-of-fluid (CLSVOF) methods. The accuracy of the numerical method was favorably tested vs. the predictions of the linear stability analysis of core-annular two-phase flow in a cylindrical capillary. Three distinct flow regimes can be identified: the dripping (D) instability near the entrance to the capillary, the step- (S) and the balloon- (B) emulsification at the step-like expansion. Based on the simulation results we present the phase diagram quantifying transitions between various regimes in plane of the capillary number and the flow-rate ratio. (1) Z. Li et al., Lab on a Chip 15, 1023 (2015).

[1]MICROFLUSA EU H2020 project

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