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Numerical analysis of mixing by sharp-edge-based acoustofluidic micromixer NITESH NAMA, PO-HSUN HUANG, TONY JUN HUANG, FRANCESCO COSTANZO, Pennsylvania State Univ — Recently, acoustically oscillated sharp-edges have been employed to realize rapid and homogeneous mixing at microscales (Huang, Lab on a Chip, 13, 2013). Here, we present a numerical model, qualitatively validated by experimental results, to analyze the acoustic mixing inside a sharp-edge-based micromixer. We extend our previous numerical model (Nama, Lab on a Chip, 14, 2014) to combine the Generalized Lagrangian Mean (GLM) theory with the convection-diffusion equation, while also allowing for the presence of a background flow as observed in a typical sharp-edge-based micromixer. We employ a perturbation approach to divide the flow variables into zeroth-, first- and second-order fields which are successively solved to obtain the Lagrangian mean velocity. The Langrangian mean velocity and the background flow velocity are further employed with the convection-diffusion equation to obtain the concentration profile. We characterize the effects of various operational and geometrical parameters to suggest potential design changes for improving the mixing performance of the sharp-edge-based micromixer. Lastly, we investigate the possibility of generation of a spatio-temporally controllable concentration gradient by placing sharp-edge structures inside the microchannel.

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