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Dynamics of liquid bridges inside microchannels subject to pure oscillatory flows MAJID AHMADLOUYDARAB, JALEL AZAIEZ, ZHANGXIN CHEN, University of Calgary — We report on 2D simulations of liquid bridges' dynamics in microchannels of uniform wettability and subject to external oscillatory flows. The flow equations were solved using the Cahn-Hilliard diffuse-interface formulation and the finite element method with unstructured grid. It was found that regardless of the wettability properties of the microchannel walls, there is a critical frequency above which the bridge shows perpetual periodic oscillatory motion. Below that critical frequency, the liquid bridge ruptures when the channel walls are philic and detaches from the surface when they are phobic. This critical frequency depends on the viscosity ratio, oscillation amplitude and geometric aspect ratio of the bridge. It was also found that the flow velocity is out of phase with the footprint/throat lengths and that the latter two show a phase difference. These differences were explained in terms of the motion of the two contact lines on the substrates and the deformation of the fluid-fluid interfaces. To characterize the behavior of the liquid bridge, two quantitative parameters; the liquid bridge-solid interfacial length and the length of the throat of the liquid bridge were used. Variations of the interfacial morphology development of the bridge were analyzed to understand the bridge response.

Jalel Azaiez
Univ of Calgary

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