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Three dimensional simulations of viscous folding in diverging microchannels BINGRUI XU, Department of Aeronautics and Astronautics, Fudan Univ, JALEL CHERGUI, LIMSI, Univ. Paris-Sud, CNRS, Universite Paris-Saclay, SEUNGWON SHIN, Department of Mechanical and System Design Engineering, Hongik University, DAMIR JURIC, LIMSI, Univ. Paris-Sud, CNRS, Universite Paris-Saclay — Three dimensional simulations on the viscous folding in diverging microchannels reported by Cubaud and Mason are performed using the parallel code BLUE for multi-phase flows. The more viscous liquid L_1 is injected into the channel from the center inlet, and the less viscous liquid L_2 from two side inlets. Liquid L_1 takes the form of a thin filament due to hydrodynamic focusing in the long channel that leads to the diverging region. The thread then becomes unstable to a folding instability, due to the longitudinal compressive stress applied to it by the diverging flow of liquid L_2. We performed a parameter study in which the flow rate ratio, the viscosity ratio, the Reynolds number, and the shape of the channel were varied relative to a reference model. In our simulations, the cross section of the thread produced by focusing is elliptical rather than circular. The initial folding axis can be either parallel or perpendicular to the narrow dimension of the chamber. In the former case, the folding slowly transforms via twisting to perpendicular folding , or it may remain parallel. The direction of folding onset is determined by the velocity profile and the elliptical shape of the thread cross section in the channel that feeds the diverging part of the cell.

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