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Microfluidic destabilization of viscous stratifications: Interfacial waves and droplets[1] XIAOYI HU, THOMAS CUBAUD, Stony Brook University — Microfluidic two-fluid flows with large differences in viscosity are experimentally investigated to examine the role of fluid properties on hydrodynamic destabilization processes at the small scale. Two- and three-layer flow configurations are systematically studied in straight square microchannels using miscible and immiscible fluid pairs. We focus our attention on symmetric three-layer stratifications with a fast central stream made of low-viscosity fluid and a slow sheath flow composed of high-viscosity fluid. We quantify the influence of the capillary and the Reynolds numbers on the formation and evolution of droplets and wavy stratifications. Several functional relationships are developed for the morphology and dynamics of droplets and interfacial waves including size, celerity and frequency. In the wavy stratification regime, the formation and entrainment of thin viscous ligaments from wave crests display a rich variety of dynamics either in the presence or in the absence of interfacial tension between liquids.

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