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Francois Frenkiel Award Lecture: Folded micro-threads: Role of viscosity and interfacial tension[1]

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Viscous threads belong to a class of flow structures having common characteristics between miscible and immiscible fluid streams. Here, we examine the interplay between flows and microgeometries for passively destabilizing high-viscosity fluid threads. The shape and evolution of periodically folded threads are experimentally investigated in a microfluidic network. The fluidic system is designed for the production and lubricated transport of very uniform folds. To study the influence of viscosity and interfacial tension on buckling deformations, multiphase flows are scrutinized using both miscible and immiscible fluid pairs. The parameters used to analyze folding morphologies include thread diameter, arc length, fold amplitude, and wavelength. When fluids are immiscible, the onset of viscous folding is characterized as a function of the capillary number and the phenomenon of capillary unfolding where a corrugated thread straightens along the flow direction is demonstrated. The spatial transition from folding to coiling-like flow behavior of highly viscous capillary threads is also shown.

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