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Capillary focusing in the microfluidic Hele-Shaw channel ALEXANDER LESHANSKY, Dept of Chemical Engineering, Technion-IIT, YULI HALUPOVICH, Taub Computer Center, Technion-IIT, LEN PISMEN, Minerva Center for Nonlinear Physics of Complex Systems, Technion-IIT — For many droplet-based mircofluidic applications it is desirable to create monodisperse droplets with adjustable volume and production rate directly in the microfluidic device. In this work we address the recently developed "step emulsification" technique that relies on an abrupt change in the aspect ratio of a single shallow and wide microchannel that merges into a deep reservoir. Such geometry yields a rapid and well controlled destabilization of confined co-flowing streams of immiscible liquids at the step separating the channel and the reservoir forming highly monodisperse droplets of the size comparable to the channel depth. The distinctive feature of the process is the capillary focusing effect, whereas the interface between the two fluids takes the shape of a tongue narrowing in the flow direction just ahead of the step; at the step the tongue tip becomes unstable generating droplets. We present theoretical modeling of the capillary focusing effect. The developed small-capillary-number asymptotic theory and the results of VOF numerical simulations show a good agreement with the experiments and provide some important insights into the underlying physics of the phenomenon.

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