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Analysis of pumpless liquid transport on a wettability-patterned track ARITRA GHOSH, KEN BRENNER, SOUVICK CHATTERJEE, PALLAB SINHA MAHAPATRA, University of Illinois at Chicago, RANJAN GANGULY, Jadavpur University, CONSTANTINE MEGARIDIS, University of Illinois at Chicago
— Pumpless liquid transport can be achieved by tuning curvature of liquid volumes (Laplace pressure) on a diverging superhydrophilic track surrounded by a superhydrophobic background. The liquid, which starts in the form of a deposited droplet, propagates on the track as a well-defined bulge (bulk liquid) followed by a trailing liquid film conforming to the track geometry. In this work, we present a semi-analytical model to explain the trends of observed phenomena as well as the liquid transport dynamics (velocity, acceleration, flow rate) with respect to track geometry, solid wettability contrast, and feed volume. High speed image analysis of the motion of the bulk liquid is performed using a droplet shape tracking algorithm; dominant forces are identified and model predictions are compared with the experimental data. The combination of experimental and analytical tools offers new insight on a problem that is relevant to open-surface microfluidic devices, especially in the point of care (i.e. low cost) technological domain.

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