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The breakup dynamics of viscous capillary bridges on hydrophobic surfaces

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The breakup dynamics of highly viscous capillary bridges on grounded hydrophobic surfaces is investigated. The breakup dynamics bears a very close resemblance to that of highly viscous free capillary bridges. However, due to the strong dependency of the dynamics on the surface properties, the wettability of the substrate must be taken into account. In this regard, it is demonstrated that under specific conditions, particularly for hydrophobic surfaces and slow dynamics, inertia and hydrodynamic dissipation in the bulk can be disregarded. In view of this, a simple scaling law based on the balance between surface forces and contact line friction force (according to the Molecular Kinetic Theory) is derived. Furthermore, Surface Evolver is employed to calculate the shape of the capillary bridge under various geometrical constraints before breakup. It is shown that the minimum width of the capillary bridge at the onset of instability is the correct length scale for the problem at hand. Accordingly, the correct time and velocity length scales are computed, leading to scaling variables that let groups of experimental data collapse on the same curve.

Hauptautor: JABBARY FARROKHI, salar (TU Darmstadt)

Co-Autor: Prof. HARDT, Steffen (nstitute for Nano- and Microfluidics, TU Darmstadt, Alarich-Weiss-Straße 10, D-64237 Darmstadt, Germany)

Vortragende(r): JABBARY FARROKHI, salar (TU Darmstadt)

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