Deviation of viscous drops at chemical step

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Experimental, theoretical and numerical investigations of Drop motion regained considerable attention in the recent years [1]. Triggered by the development of new micro-fabrication techniques and the advance of computational power, a new range of phenomena have been systematically investigated. Incorporating the effect of contact angle hysteresis in drop dynamics remains a challenging task for numerical simulations [2], and its effect has been little investigated.
In this work we show, with experiments and numerical simulations of gravity driven drops crossing a chemical step oriented at arbitrary angles respect the direction of the body force, that the combination of contact angle hysteresis with macroscopic defects can lead to counter-intuitive results [3]. This because in presence of large contact angle hysteresis the force decomposition that would be intuitively expected is not applicable. Sliding measurements were performed by systematically varying the angles α, the inclination angle with the respect to gravity and ϕ the tilt angle with the respect to the direction of the in-plane body force. The corresponding numerical simulation were obtained through Contact Line Dominated Dynamics solved employing the software Surface Evolver. We observed four distinct scenarios for the drop approaching the chemical step as showed in of Fig.1 panels a), b), c), d). We summarized in a phase diagram all different behaviors diagram as functions of angles α and ϕ (Fig. 1e).

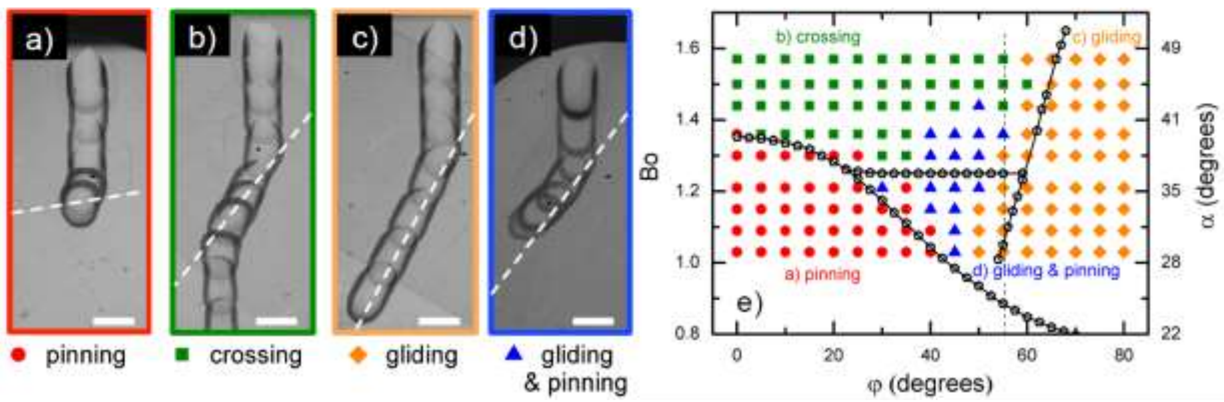

Figure 1: Sequence of the four possible drop trajectories exhibited by a drop approaching the chemical step: a) the drop pins; b) the drop crosses the step; c) the drop slides along the step; d) the drop partially slides along the step and pins in a later stage. The dashed inclined lines mark the chemical step and the horizontal scale bars correspond to 5 mm. e) Dynamical phase diagram showing the four regions in the ϕ-Bo space. Filled symbols refer to experiments, while open symbols are evinced from simulations.

[1] D. Quéré, *Annu. Mater. Res.*, 2008, **38**, 71.
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