Pendant droplets under a wet substrate pin on surface defects despite having no contact line

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Pendant drops spontaneously appear on the underside of wet substrates through the Rayleigh-Taylor instability. These droplets are unstationnary, they exchange liquid with the surrounding film and any perturbation will set them in motion [1]. Here, using experiments, numerical simulations, and theory I show that pendant drops sliding under a slightly tilted wet substrate can pin on surface defects, even though they do not have a contact line. Instead, this pinning force has a gravito-capillary origin that I rationalize for arbitrary substrate topographies with a semi-analytical convolution based theory. I finally demonstrate how to harness this pinning force to guide pendant drops using the substrate topography.

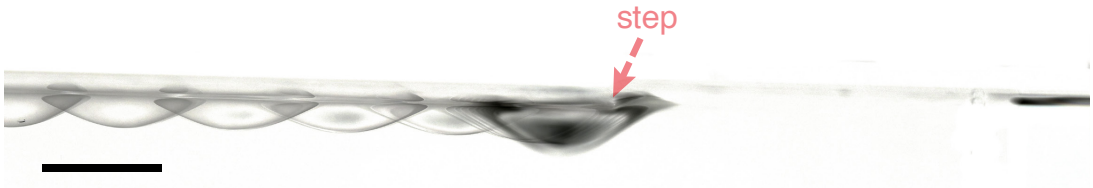

Figure 1. Chronophotography of a silicone oil pendant drop sliding under a wet surface inclined by 2.2 deg. The surface has a sharp step of height 330 μm (highlighted) that pins the drop. The images include reflexions of the drop on the wet substrate, scale bar 5 mm, time interval 2 min.

References

1. E. Jambon-Puillet, P. G. Ledda, F. Gallaire, P-T Brun, Drops on the underside of a slightly inclined wet substrate move too fast to grow, *PRL*, **127**, 044503 (2021).