SELF-PROPELLED DROPLET TRANSPORT ON SHAPED- LIQUID SURFACES

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The ability to direct droplets on flat surfaces has many practical applications in microfluidics, bio-assay and analytical chemistry. Structured gradient surfaces do offer droplet driving and direction control, but it is necessary to overcome the hysteresis force inherent when any liquid contacts a solid surface. Here, we show that efficient droplet propulsion can be achieved on a shaped-liquid surface where a solid topographic gradient at one length scale provides the base for a smaller length-scale liquid conformal surface. This provides a directional force on a propelling the droplet via an imbalance in the contact angle [1] and high droplet mobility *via* the shaped-liquid surface created using nanoscale roughness imbibed with oil [2]. The liquid surface prevents contact between the droplet and the solid and creates liquid on liquid wetting. The resulting surfaces can propel droplets by several times their diameter, as well as against gravity (Figure 1). Furthermore, the strong vertical adhesion of these surfaces, allows impacting droplets to be captured prior to motion (Figure 1b), even when the substrate in completely inverted and the impacting droplets become hanging droplet.

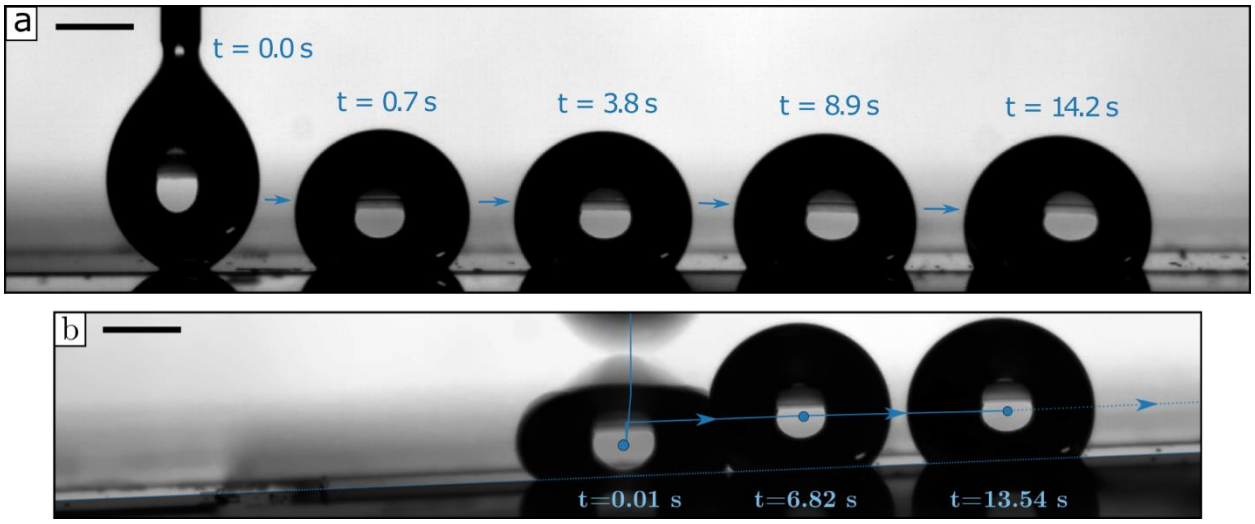

Fig. 1. Droplet self-propulsion on shaped liquid surfaces. (a) Droplet moving by several times its size on a flat surface. (b) Droplet self-propulsion on a tilted surface. Because of the strong vertical adhesion, the droplet is successfully captured (no rebound).

Acknowledgements: This work was supported by the Engineering and Physical Sciences Research Council [grant number EP/P026613/1].

References:

1. Shastry A., M. J. Case, and K. F. Böhringer. 'Directing Droplets Using Microstructured Surfaces' *Langmuir*, **2006**, *volume 22, no. 14*: 6161–67.
2. Wong T.S., S.H. Kang, S.K.Y. Tang, E.J. Smythe, B.D. Hatton, A. Grinthal and J. Aizenberg. 'Bioinspired Self-Repairing Slippery Surfaces with Pressure-Stable Omniphobicity' *Nature*, **2011**, *volume 477, no. 7365*: 443–47.