A Viscous Tweezer

Saurabh Nath[1, 2], Armelle Keiser[1, 2], Christophe Clanet[1, 2], and David Quéré[1, 2]

[1] *Physique et Mécanique des Milieux Hétérogènes, UMR 7636 du CNRS, ESPCI, 75005 Paris, France*
[2] *LadHyX, UMR 7646 du CNRS, École polytechnique, 91128 Palaiseau, France.*

Liquid-infused surfaces (LIS) are a new class of materials, characterized primarily by their extremely low adhesion [1, 2]. Even a very viscous droplet can easily roll off a liquid-infused surface, if the surface if tilted by a few degrees. However, in this talk, we show that alongside being `slippery', liquid infused surfaces are also `sticky'. To investigate this, we take an elementary system comprising a water droplet placed between two horizontal LIS, infused with oils of different viscosities (Figure 1a). We find that if the upper plate is pulled with a sufficiently high velocity, the droplet completely detaches itself form the bottom plate and remains on the top (Figure 1b). Such a capture is possible only if the upper plate viscosity is greater than that of the lower plate. The captured droplet can be subsequently deposited on the lower plate by bringing it in contact and pulling the plates apart slowly. This simple system, thus demonstrates how the dynamical adhesion or `stickiness' of liquid infused surfaces can be harnessed to create a `viscous tweezer'. This has immense potential in terms of applications in micromanipulation and droplet transport. In this talk, we will discuss the physics of such *viscous captures* and the parameters that govern it.

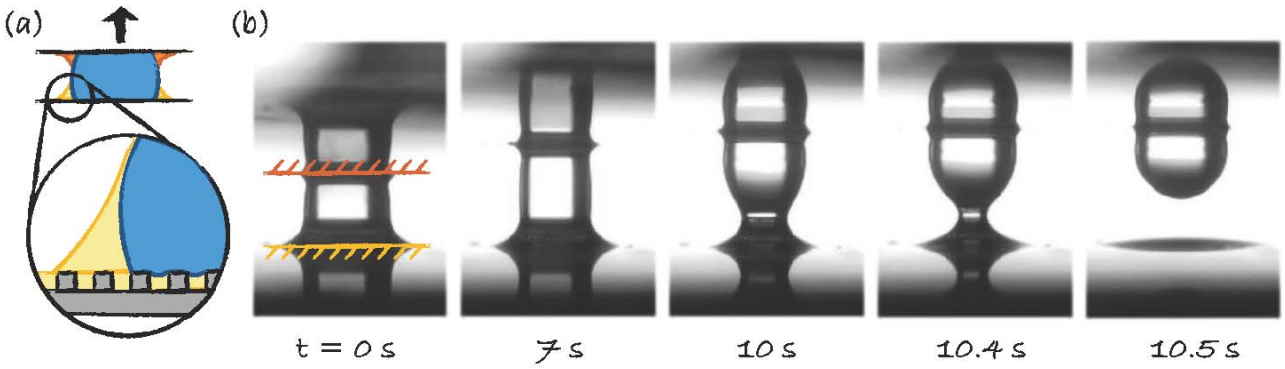

Figure 1. (a) Schematic of the experimental system: a droplet placed between two liquid-infused surfaces. The orange and yellow colours signify different oil viscosities. Zoomed in section shows oil locked in the textures rising to form a meniscus and cloaking the droplet. (b) Experimental image sequence of a 1 μL droplet being pulled up at a velocity of 30 μm/s, leading to a *viscous capture.* The oil viscosities on the upper and lower plates are 10,000 cSt and 10 cSt respectively. The red and the orange lines in the first frame mark the positions of the two plates, the droplet being in between. Outside these lines what we see are reflections of the droplet on the upper and lower plates.

[1] A Lafuma et al. Europhys. Lett. **96** (2011) 56001.
[2] T S Wong et al., Nature, **477** (2011) 443.

Acknowledgement: ITN LubISS network.