Modeling Droplet Dynamics on Liquid Infused Surfaces

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Inspired by pitcher plants, Liquid Infused Surfaces (LIS) are constructed by infusing rough or porous materials with a lubricant, as illustrated in Fig. 1, and they have been shown to exhibit many advantageous surface properties, including self-cleaning, drag reduction, anti-icing and anti-fouling [1]. In this contribution, we demonstrate how our ternary free energy lattice Boltzmann model [2] is suitable for studying droplet dynamics on LIS [3]. First, we find that there is a rich interplay between contact line pinning and viscous dissipation at the wetting oil ridge. The effect of contact line pinning is prominent for relatively large apparent contact angle. For lower apparent contact angle, viscous dissipation at the wetting ridge is more important and hence the shape of the wetting ridge, characterised by aspect ratio, is key for determining the droplet mobility. Second, we observe that the advancing mechanism of the droplet is a combination of sliding and rolling motion, and that the amount of rolling is affected by the droplet shape and the contact area with solid. Due to the nature of the corrugated substrate, the solid contact area of the droplet decreases quickly with increasing apparent contact angle. Therefore, droplet on LIS demonstrates different rolling dynamics compared to smooth surfaces.

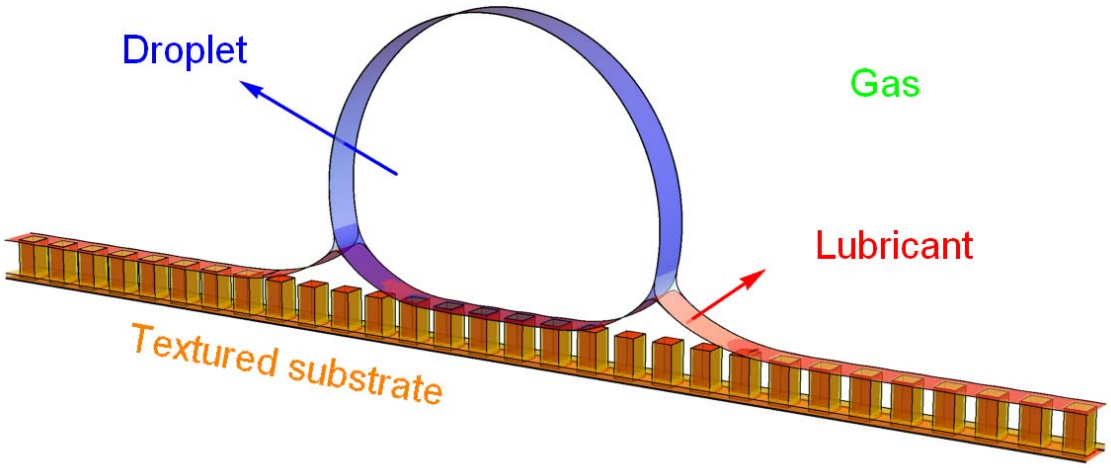

Figure 1. Illustration of LIS where a droplet is sitting on a textured substrate infused with a lubricant.

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