Supporting Information

Droplet Motion on a Shape Gradient Surface

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1. The determination of *k* and ***μ***

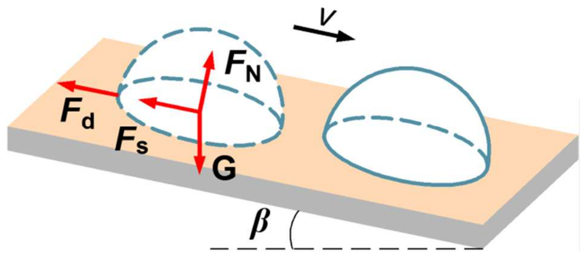

Figure S1. Schematic diagram of forces analysis for droplet on rectangular-shaped copper substrate.

The coefficients k and μ can be measured experimentally as shown in Figure S1. A droplet is deposited onto a rectangular-shaped copper substrate at various tilt angles which is treated by the previous processing procedure but without unbalanced interfacial tension. The droplet accelerates initially by the gravitational force and gradually keeps moving at a constant speed when (F_d+F_s) and component of gravity are in the equilibrium, which can be described as

$$kR\eta\frac{\mathrm{d}x}{\mathrm{d}t}+\mu\rho V\mathrm{g}\cos\beta_n=\rho V\mathrm{g}\sin\beta_n \tag{S.1}$$

thus k and μ can be confirmed via controlling various tilt angles β and solving the above equation. The parallel experiments are repeated by six times and the values of k and μ are obtained approximately 42.487 and 0.108, respectively.

2. The viscous force

The viscous force generated within the liquid, is**Error! Reference source not found.**

$$f_\mathrm{v}=-\eta_2 S\frac{\mathrm{d}v}{\mathrm{d}z} \tag{S. 2}$$

where η_2, S, and $\frac{\mathrm{d}v}{\mathrm{d}z}$ are the dynamic viscosity of the water (0.8937mPa·s at 25□),, the base contact area of droplet on oil layer, and the velocity gradient, respectively. If the back-end of the droplet pinning occurred on the surface, the viscous force can be expressed**Error! Reference source not found.**

$$f_\mathrm{v}=-\eta_2 S\frac{\mathrm{d}v}{\mathrm{d}z}=-\frac{\eta_2 R}{d}\left[\sin\varphi_1(x+R)-\sin\varphi_2(x-R)\right]\frac{\mathrm{d}x}{\mathrm{d}t} \tag{S. 3}$$

$$\varphi_1 = \frac{1}{2}\cos^{-1}\left[\frac{\frac{R^2}{2}\left(1-\tan^2\frac{\alpha}{2}\right)-x^2\tan^2\frac{\alpha}{2}}{\frac{R^2}{2}\left(1+\tan^2\frac{\alpha}{2}\right)}\right] \tag{S. 4}$$

where d is the height of droplet (~1.7mm), R the base radius of droplet (~2.7mm) , φ_1 represents the azimuthal angle to the first boundary at the front of droplet and φ_2 represents the azimuthal angle to the second boundary at the back of the droplet. The volume of probe droplet is 5μL. The values of f_v and F_{ix} are showed in Figure S2 for gradient angle α = 6°.

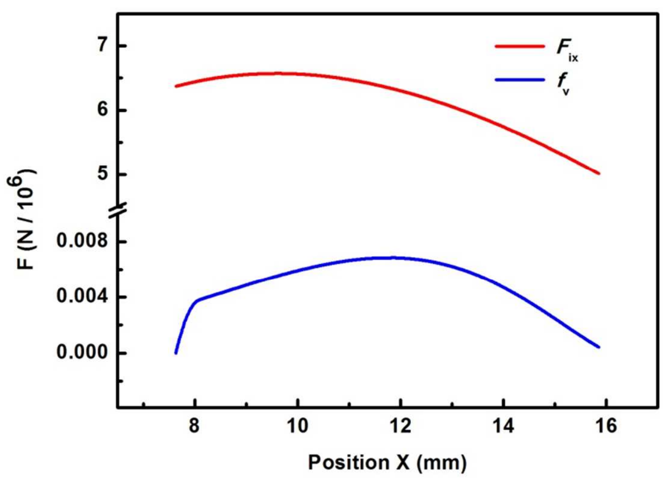

Figure S2. The unbalanced interfacial tension F_{ix} and viscous force f_v as functions of position x.

As shown in Figure S2, f_v is much lower than F_{ix} (approximately 1% of F_{ix}). Moreover, for the droplet moving without back-end pinning, the viscous force is more negligible due to the lower value of $\frac{\mathrm{d}v}{\mathrm{d}z}$ in Equation S2.

1 Wang, Y.; Zhang, H. F.; Liu, X. W.; Zhou, Z. P. Slippery Liquid-Infused Substrates: A Versatile Preparation, Unique Anti-Wetting and Drag-Reduction Effect on Water. *J. Mater. Chem. A*. **2016**, *4*, 2524-2529.

2 Khoo, H. S.; Tseng, F. G. Spontaneous High-Speed Transport of Subnanoliter Water Droplet on Gradient Nanotextured Surfaces. *Appl. Phys. Lett.* **2009**, *95*, 063108.