Supplementary Information

Effect of particle size on the stripping dynamics during impacting of liquid marbles onto liquid film

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Supplementary Note

Supplementary Figure S1

Reference

Other supplementary materials for this manuscript include the following:

Supplementary Movie 1 to 3

Supplementary Note: The effective surface tension of LMs by applying puddle height method.

A small liquid marble ($R< l_c$) was almost spherical, but as the volume increased ($R>> l_c$), the shape converted into a puddle due to the effect of gravity over surface tension. The maximum height of the puddle was determined by the gradual increase of the volume of the liquid drop inside LM to a limit value. At this time, the height of the puddle will not increase. The capillary length of a LM is defined as $l_c = \sqrt{\gamma_{LM} / \rho g}$ where γ_{LM} is the effective surface tension, ρ is the density of LM, $\rho = \frac{\rho_w d + \sqrt{3}\pi d^2 d_p \rho_p}{\left(d + 2d_p\right)^2}$.[1, 2] When contact angle between a LM and glass plate (θ_{LM}) is measured, the final height (H_{max}) can be derived from the force balance equation on the contact line: $H_{max} = 2l_c \sin(\theta_{LM} / 2)$.[3, 4] The H_{max} and θ_{LM} of the LMs were measured experimentally. Thus, the effective surface tension of LMs can be obtained by the equation:

$$\gamma_{LM} = \frac{\rho g H_{max}^2}{4\sin^2\left(\theta_{LM} / 2\right)} \quad \text{* MERGEFORMAT (1)}$$

LMs with various droplet volume are formed and transferred to a hydrophobic glass plate. The height of LMs is measured with the increase of volume (**Fig. S1a**). With the gradual increase of the volume of the liquid drop, the height approaches to a limiting value, which is the maximum height (**Fig. S1b**). The contact angle θ_{LM} is obtained with an average value of the θ_{LM} measured under different droplet volumes.

Supplementary Movie

Movie 1 The side view of LM stripping for LM-2. A droplet (R_w=1.34 mm) wrapped by particles of d_p= 2 μm falls and impacts on the soap film from h_0=1.3 cm, and then particles are separated and trapped in the soap film while the internal water dripping out. The Shooting frequency of movie is 2000 Hz.

Movie 2 The side view of LM coalescence for LM-5. A droplet (R_w=1.34 mm) wrapped by particles of d_p= 5 μm falls and impacts on the soap film from h_0=1.3 cm, and then coalesces with the liquid film and oscillates with the soap film. The Shooting frequency of movie is 2000 Hz.

Movie 3 The side view of LM bouncing for LM-15. A droplet (R_w=1.34 mm) wrapped by particles of d_p= 15 μm falls and impacts on the soap film from h_0=1.3 cm, and then bounces and oscillates over the soap film until it coalesces with the liquid film. The Shooting frequency of movie is 2000 Hz.

Reference

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3. P. Singha, C. H. Ooi, N.-K. Nguyen, K. R. Sreejith, J. Jin and N.-T. Nguyen, *Microfluid. Nanofluidics*, 2020, **24**, 81
4. E. Bormashenko, R. Pogreb, G. Whyman and A. Musin, *Colloids Surf. A Physicochem. Eng. Asp.*, 2009, **351**, 78-82.

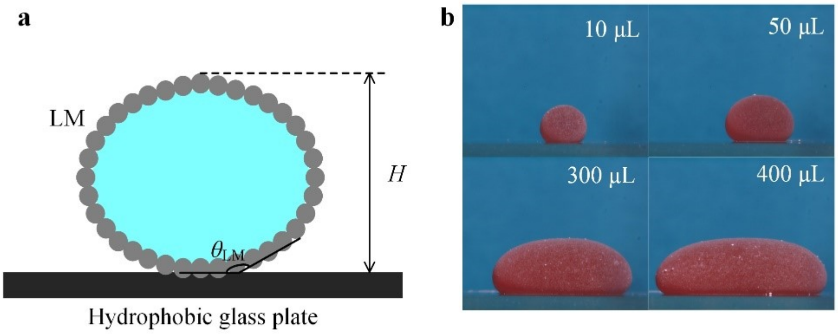

Fig. S1 (a) The measurement of puddle height. (b) LMs coated with PTFE powder having varying volumes.