# Restoring Superhydrophobicity with Vibration: Supplemental Information

Jonathan B. Boreyko and Chuan-Hua Chen*
*Department of Mechanical Engineering and Materials Science, Duke University, Durham, NC 27708*
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## S1. EVAPORATION PROCESS OF WATER/ETHANOL MIXTURE

The evaporation process of a 2:1 water:ethanol mixture is shown in Fig. S1. Images were recorded for a 2.25 $\mu$L drop of 2:1 water:ethanol mixture on a lotus leaf evaporating in the ambient air. The drop volume was calculated from the images assuming a spherical cap. In Fig. S1, the drop volume quickly diminished from 2.25 $\mu$L to 1.51 $\mu$L in 5 minutes. After the first 5 minutes, the rest of the evaporation process was much slower and approximately followed the $d^2$-law [1] of the evaporation of a single-component drop. The surface tension of water and ethanol are respectively 0.073 N/m and 0.023 N/m at room temperature. The relative evaporation rate of water and ethanol depends on the humidity and the drop shape. Under typical laboratory conditions, the relative evaporation rate (compared to Butyl Acetate) is 0.3 for water and 1.4 for ethanol [2].

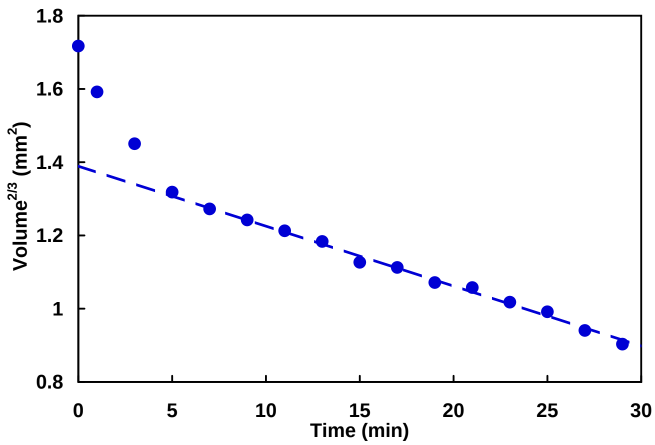
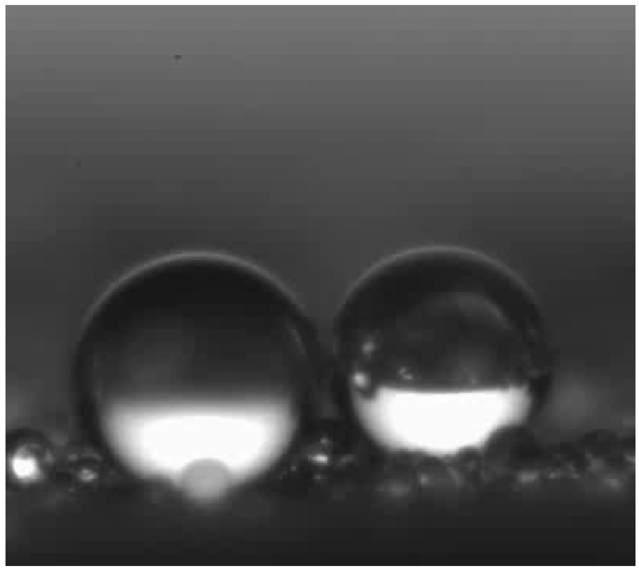



*FIG. S1. The time-lapsed volume of a drop of 2:1 (vol.) water:ethanol mixture evaporating on a lotus leaf. The dashed line is a linear extrapolation of $V^{2/3}$ using data between 5 and 30 minutes.*

The evaporation of a spherical drop of a single-component liquid in air is governed by the so-called $d^2$-law, which states that the square of the drop diameter decreases linearly with time. For a single-component drop with an apparent contact angle around 140°, its evaporation behavior can be approximated to the first order by the $d^2$-law for spherical drops. The drop volume to the 2/3 power ($V^{2/3}$, which is proportional to $d^2$) exhibits a linear relationship with time after the first 5 minutes. This behavior indicates that most of the ethanol has evaporated in the first 5 minutes, and the drop is essentially pure water afterwards. The amount of water evaporated in the first 5 minutes was estimated to be 0.13 $\mu$L by linear extrapolation of the $d^2$-curve, and the remaining 0.61 $\mu$L of evaporation was attributed to that of ethanol. Note that the ratio of the estimated evaporation rates is consistent with the ratio of reported relative evaporation rates. Based on these calculations, the ethanol concentration in the drop is estimated to be below 10% by volume after 5 minutes.

## S2. DEWETTING PROCESS OF WATER CONDENSATE

The dynamic process of Wenzel to Cassie transition of condensate drops is shown in Video S1, from which images were extracted for Fig 4 in the main text. Note the vibration amplitude of the speaker ramped up in the first few milliseconds and there was some slight horizontal vibration. Images from 11 ms to 36 ms represent two cycles of sinusoidal vibration at the steady-state peak-to-peak amplitude of 1 mm and frequency of 80 Hz. Other experimental conditions are described in the caption of Fig. 4 and the main text.



*VIDEO. S1. Dewetting process of water condensate. The video was captured at 4000 fps and played back at 10 fps. The field of view was $4.9\,mm \times 4.4\,mm$.*

## S3. RESONANCE FREQUENCIES OF A PINNED DROP

The resonance modes can be modeled assuming small amplitude oscillations of a drop with pinned contact line shown in Fig. S2 [3]. Briefly, the resonance frequency ($\omega$) of the 1D capillary-gravity wave is given by,

$$\omega_j^2 = \left(g q_j + \frac{\gamma}{\rho} q_j^3\right) \tanh\left(\frac{V}{\pi a^2} q_j\right), \tag{1}$$

where $g$ is gravitational acceleration, $\gamma$ and $\rho$ are the surface tension and density of the liquid drop, $V$ is the drop volume, and $a$ is the contact radius. The wave vector ($q_j$) associated with the 'j' mode is given by,

$$q_j = \frac{\pi(j-0.5)}{p}, \quad j = 1,\, 1.5,\, 2,\, 2.5,\, \ldots \tag{2}$$

where $p = R\theta$ is the half arc length, and the drop radius $R$ is related to the drop volume and the *apparent* contact angle ($\theta$) [4] by,

$$R = \left(\frac{3V}{\pi\left(1-\cos\theta\right)^2\left(2+\cos\theta\right)}\right)^{1/3}. \tag{3}$$

The contact radius is $a = R\sin\theta$.

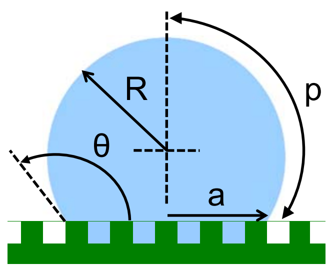



*FIG. S2. Schematic of a pinned Wenzel drop, where $R$ is the radius of the drop, $a$ is the contact radius, $\theta$ is the apparent contact angle, and $p$ is the half arc length.*

For a 1.5 $\mu$L drop used in Fig. 5, the apparent contact angle was measured to be $140 \pm 5°$. The theoretical predictions for the resonance frequencies are 32 Hz for the $j = 1$ mode and 101 Hz for the $j = 1.5$ mode, matching the first two resonance frequencies experimentally measured as $30 \pm 2.5$ Hz and $100 \pm 2.5$ Hz.

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* Electronic address: `chuanhua.chen@duke.edu`

[1] A. Frohn and N. Roth, *Dynamics of Droplets* (Springer, 2000).
[2] http://www.ilpi.com/msds/ref/evaporationrate.html
[3] X. Noblin, A. Buguin, and F. Brochard-Wyart, Euro. Phys. J. E - Soft Matt. **14**, 395 (2004).
[4] D. Quere, Annu. Rev. Mater. Res. **38**, 71 (2008).