Supplementary Information for

Anisotropic drop spreading on superhydrophobic grates during drop impact

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- **Asymmetric spreading on the HPo grates**

The smaller spreading diameter on grates can be partly attributed to the difference in contact angles between two surfaces. The previous analysis [1] showed that the influence of contact angle on the maximal spreading ratio can be compensated by considering the maximal spreading ratio $\beta_{V\to 0}$ at near-zero impact velocity such as $\sqrt{\beta_{\max}^2 - \beta_{V\to 0}^2} \sim We^{1/2}$, where $\beta_{V\to 0}$ is given by $\beta_{V\to 0} = \left[1/\left(\left(2+\cos\theta_D\right)\sin^4\left(\theta_D/2\right)\right)\right]^{1/3}$ with θ_D being a dynamic contact angle. When the proposed correction was applied to our data using the measured contact angles (Table S1), we verified that the difference at a low *We* number can be indeed accounted for (Fig. S1). However, the maximal spreading ratio on grates is still noticeably smaller at higher *We* numbers. Moreover, the above correction does not fully account for anisotropic drop spreading in parallel and transverse directions. Another possibility is that the initial shape asymmetry of drop becomes amplified during a subsequent spreading stage. However, Fig. 3b shows that asymmetry in the initial spreading diameter is not significant and within measurement uncertainty. Furthermore, a simple scaling argument indicates the opposite. Assuming that the initial diameters are $D_{p,0}$ and $D_{t,0}$ in parallel and transverse directions, respectively, the ratio of the volume distribution V_p/V_t is approximated to be $V_p/V_t \sim \left(D_{p,0}/D_{t,0}\right)^2$. Then, based on the typical scaling relation for the maximal spreading ratio of $D_{\max}/D_0 \sim We^{1/4}$ [2], one reaches $D_{\max,p}/D_{\max,t} = \beta_{grate(p)}/\beta_{grate(t)} \sim \left(D_{p,0}/D_{t,0}\right)^{5/6}$, which shows that the initial asymmetry does not amplify during the spreading stage.

[1] J. B. Lee, N. Laan, K. G. de Bruin, G. Skantzaris, N. Shahidzadeh, D. Derome, J. Carmeliet and D. Bonn, *J. Fluid Mech.*, 2016, **786**, R4.

[2] C. Clanet, C. Béguin, D. Richard and D. Quéré, *J. Fluid Mech*., 2014, **517**, 199-208.

Table S1. Measured contact angle on hydrophobic grates (HPo_grates) along the parallel direction (P) and the transverse direction (T) to grates

	HPo_Grates		
	Adv. CA	**Static CA**	**Rec. CA**
L=50µm(P)	148.8	143.8	139.7
L=50µm(T)	171.2	148.1	130.6
L=100µm(P)	152.8	152.7	147.1
L=100µm(T)	177.9	158.6	141.6
L=150µm(P)	158.1	155.3	151.4
L=150µm(T)	173.0	164.7	152.4

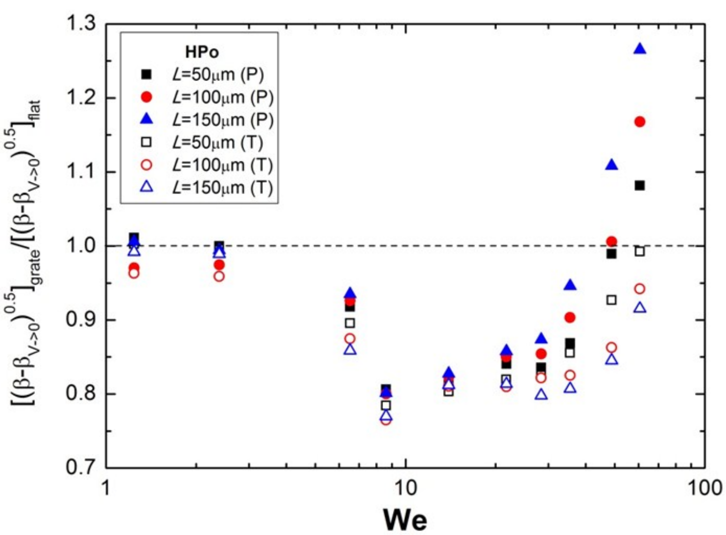

Fig. S1. Normalized maximal spreading diameter on hydrophobic grates relative to flat hydrophobic surface after correcting the influence of contact angle variation between two samples.

- **Cassie-to-Wenzel wetting transition**

  - **HPo grates**

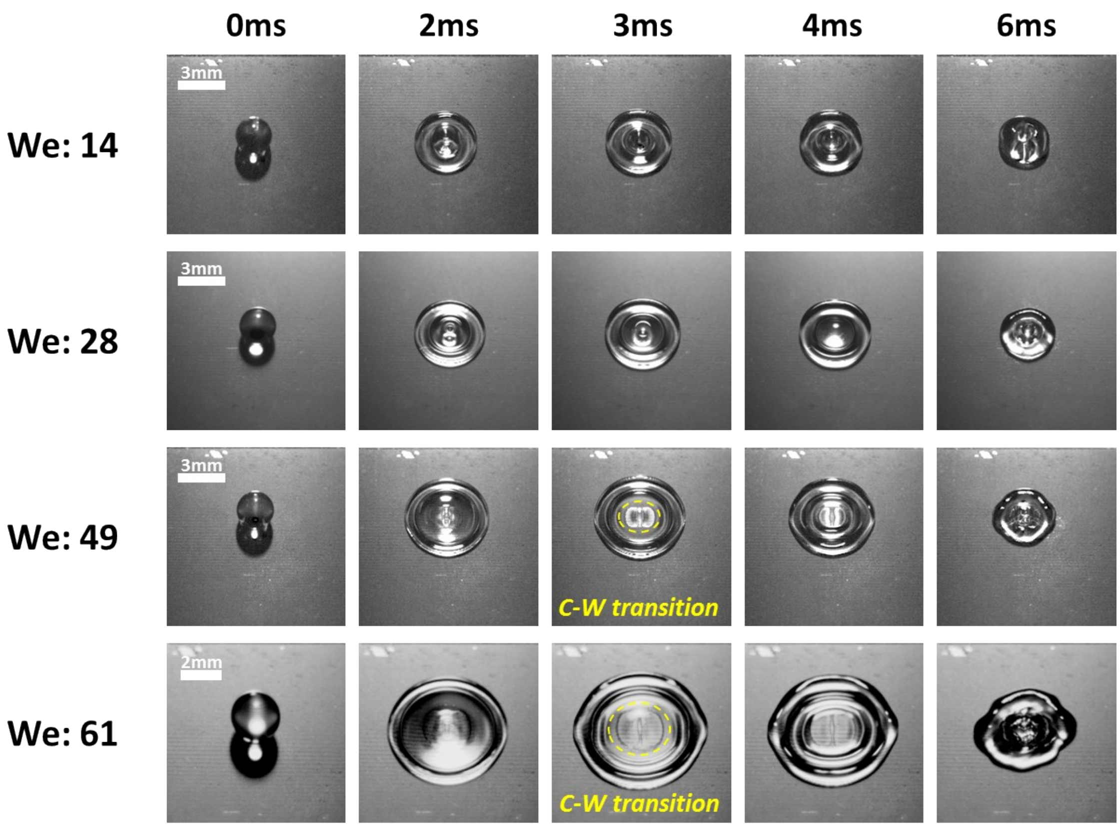

Fig. S2. Top view images of drop impact dynamics on the HPo grates with L=50 μm. The wetted area as a result of the CW transition is visible in captured images.

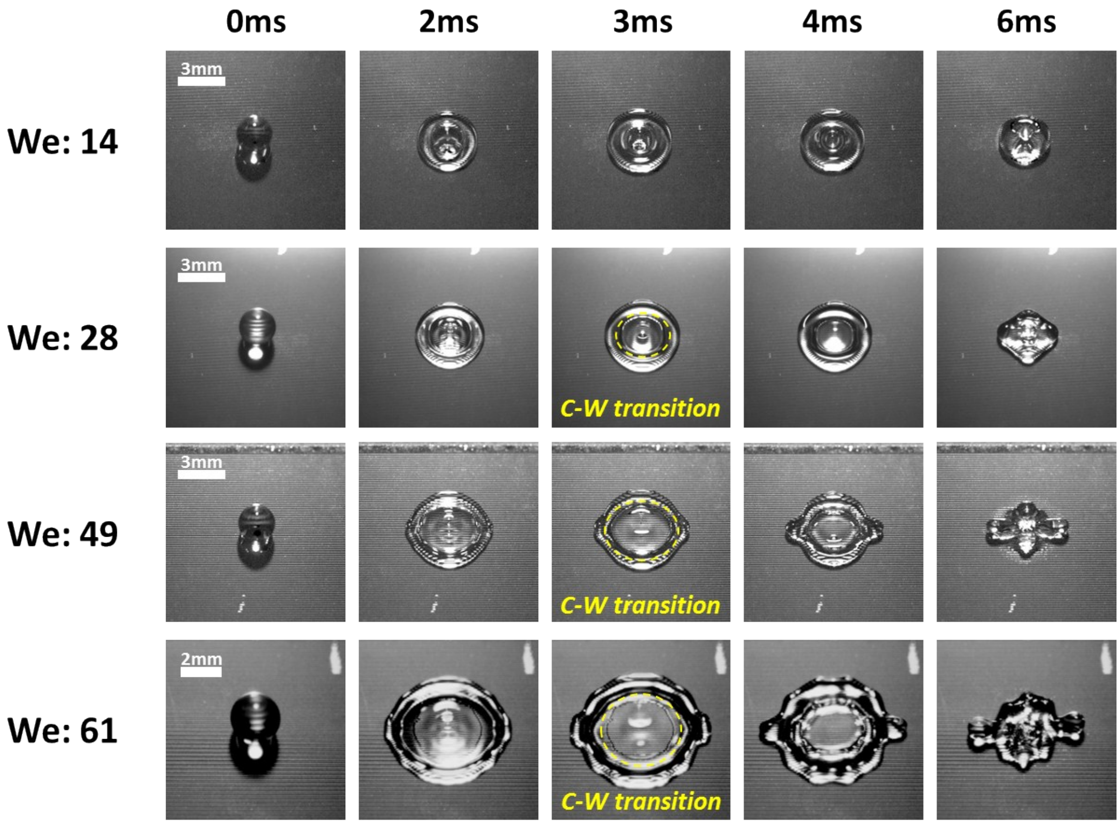

Fig. S3. Top view images of drop impact dynamics on the HPo grates with L=100 μm. The wetted area as a result of the CW transition is visible in captured images.

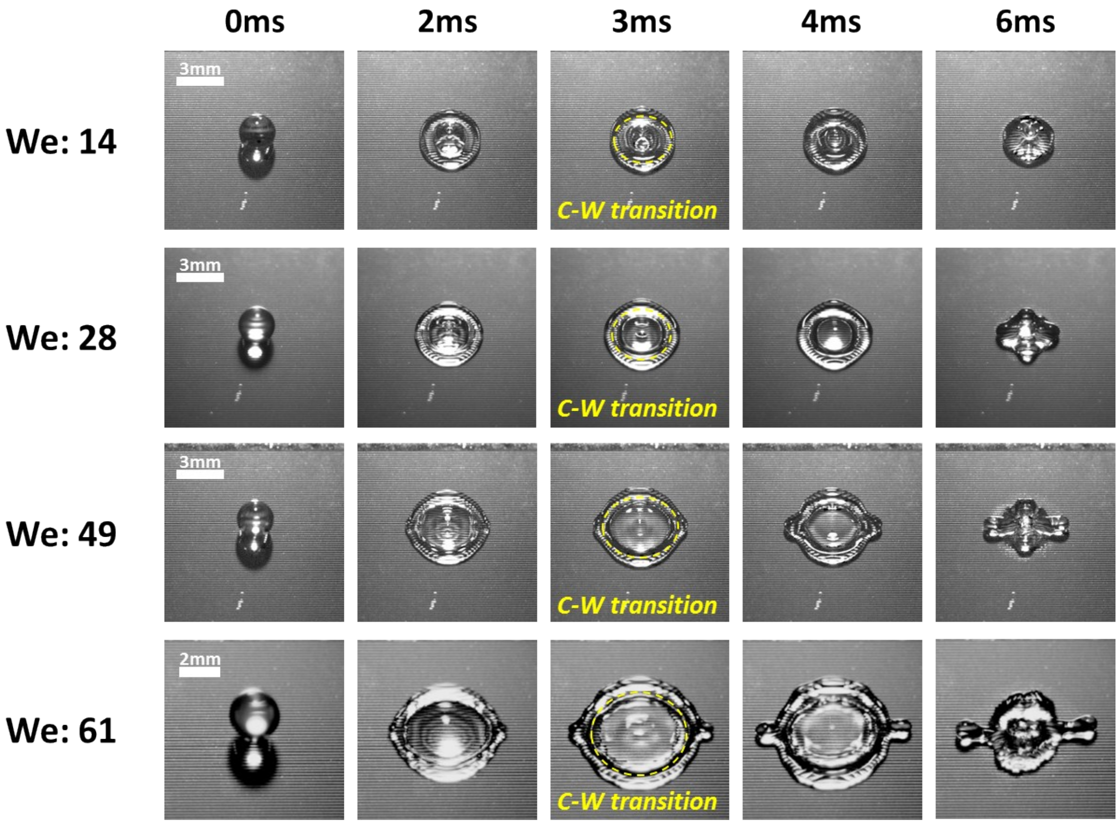

Fig. S4. Top view images of drop impact dynamics on the HPo grates with L=150 μm. The wetted area as a result of the CW transition is visible in captured images.

- SHPo grates

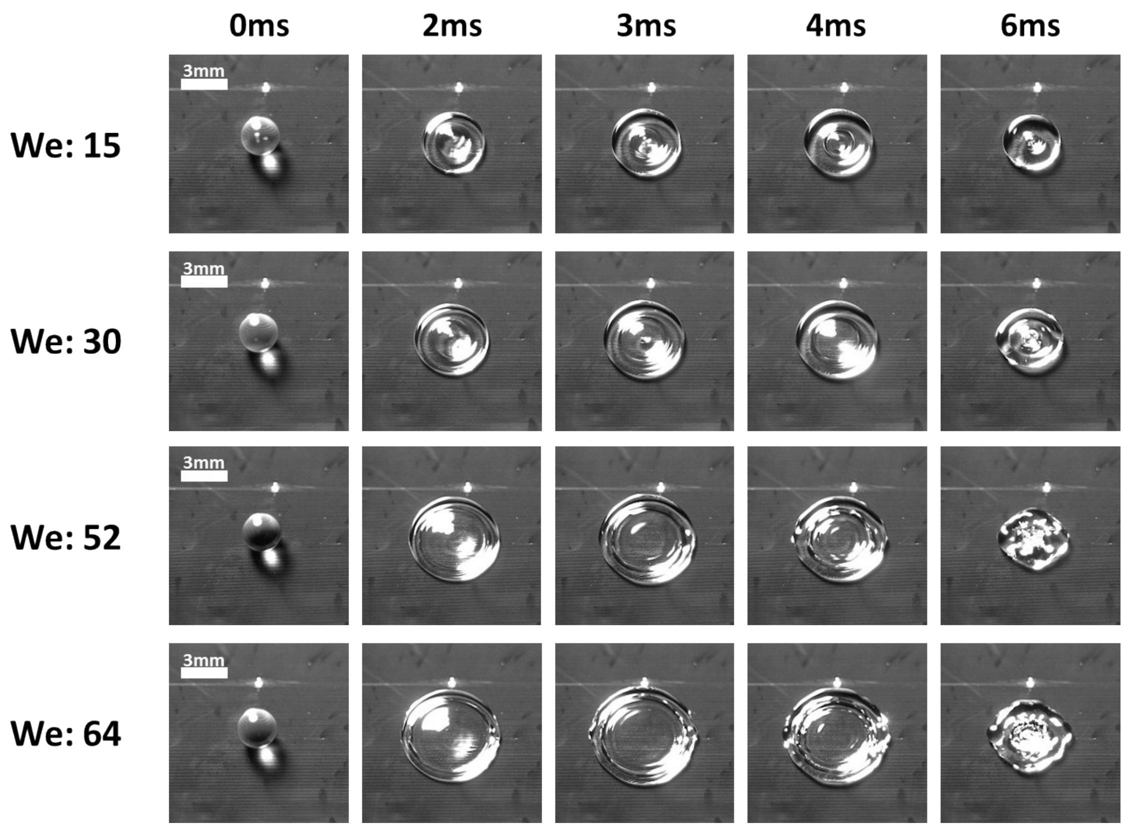

Fig. S5. Top view images of drop impact dynamics on the SHPo grates with L=50 μm. No wetted area is observed on images.

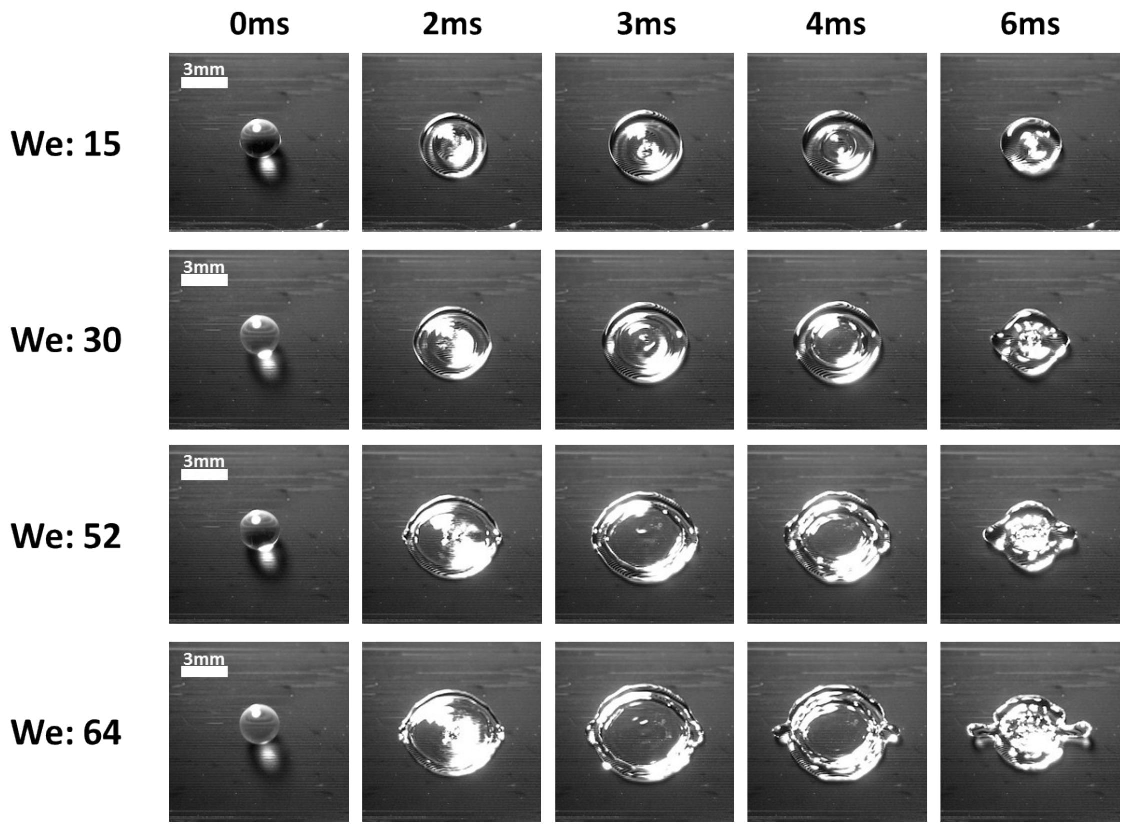

Fig. S6. Top view images of drop impact dynamics on the SHPo grates with L=100 μm. No wetted area is observed on images.

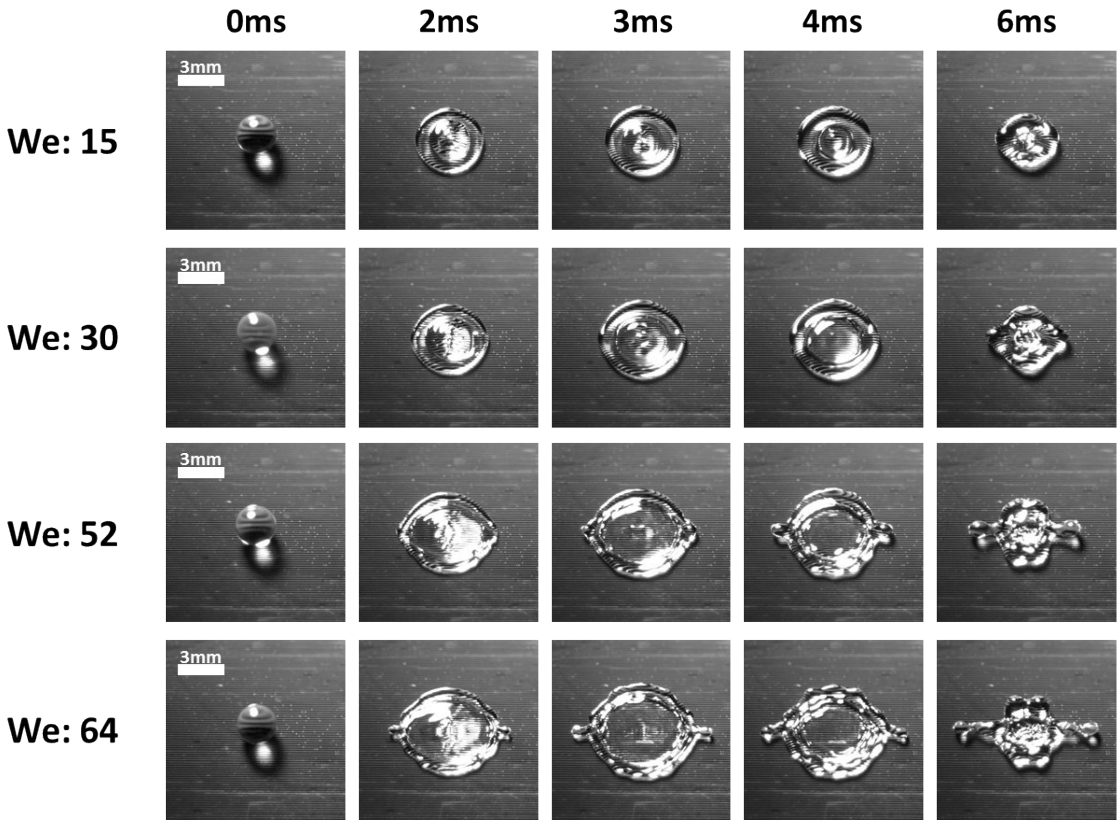

Fig. S7. Top view images of drop impact dynamics on the SHPo grates with L=150 μm. No wetted area is observed on images.