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Supplementary information

A robust superhydrophobic and superoleophobic surface with inverse-trapezoidal microstructures on a large transparent flexible substrate

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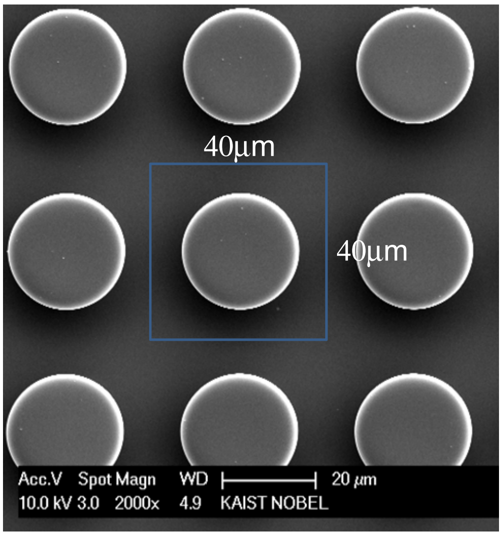

Figure S1. A SEM photograph (*top view*) of the fabricated PDMS trapezoids (the same sample with Figures 2b to d) with dimensions of H = 11.9 µm, θ_{side} = 56°, P = 40 µm, and W_t = 26µm.

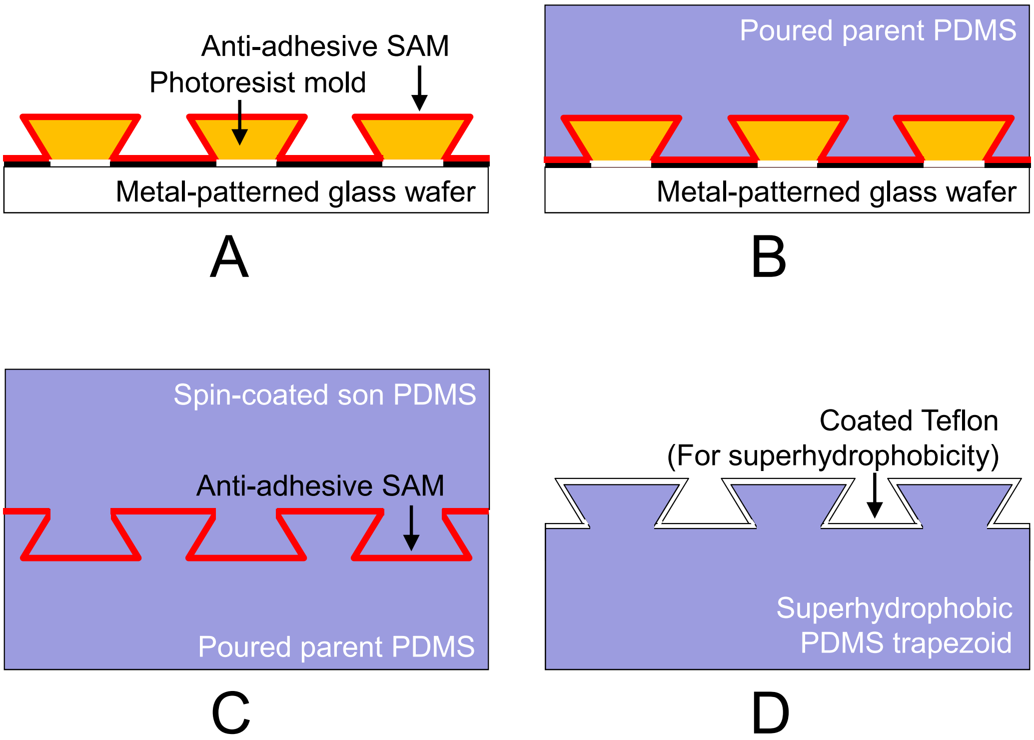

Figure S2. Schematic diagrams of the two consecutive PDMS replication processes. (A) Formation of a self-assembled monolayer (SAM) to help in peeling–off the curved PDMS from the negative photoresist mold; (B) First replication: pouring of PDMS prepolymer onto the photoresist mold to form the parent PDMS replica and curing for 10 min at 110 °C; (C) Second replication: anti-adhesive SAM coating after O_2 plasma treatment (80 W, 60 Pa, 15 sec), spin-coating of PDMS prepolymer on the parent PDMS mold and curing for 10 min at 110 °C; (D) Peeling off the son PDMS from the curved parent PDMS and spin-coating of the Teflon for the enhancement of the hydrophobicity and transparency on the fabricated PDMS trapezoids array.

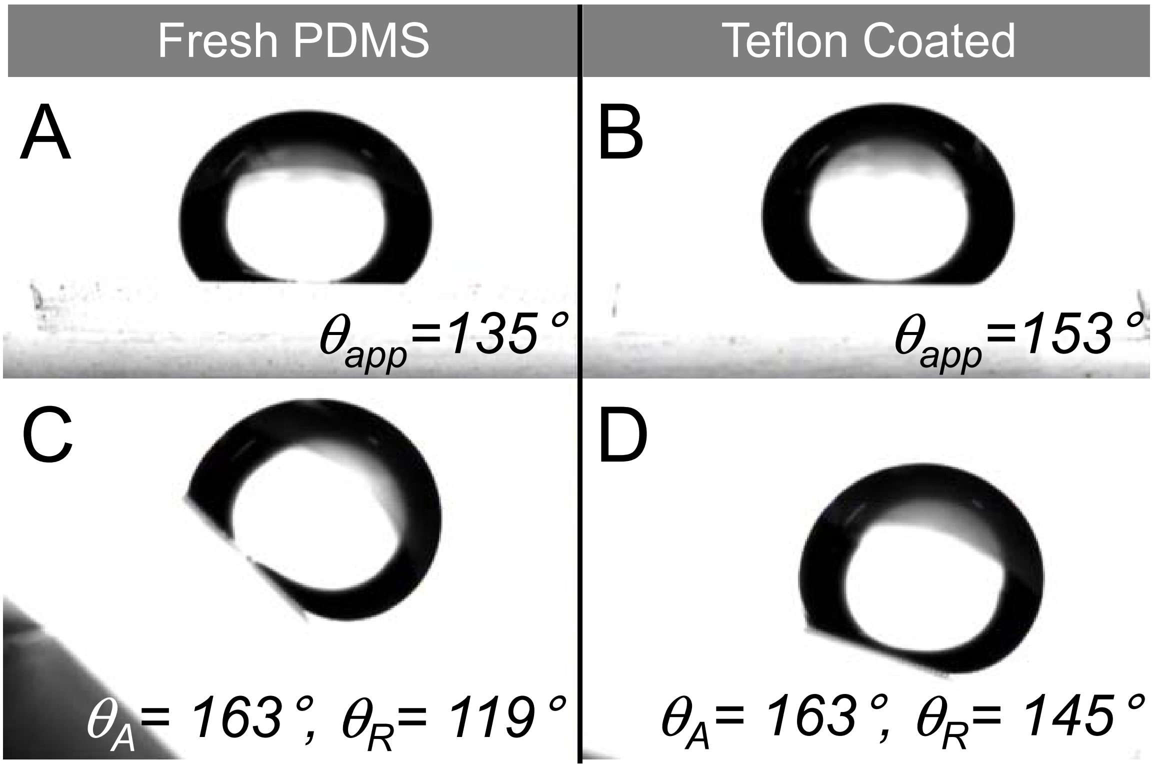

Figure S3. Contact angles of the fabricated PDMS trapezoids (A) before Teflon coating and (B) after the Teflon coating. Contact angle hysteresis of the fabricated PDMS trapezoids on a tilted plate (C) before the Teflon coating (θ_{HYS} = 44°) and (D) after the Teflon coating (θ_{HYS} = 18°). A deionized water droplet of 10 µL was used for each measurement.

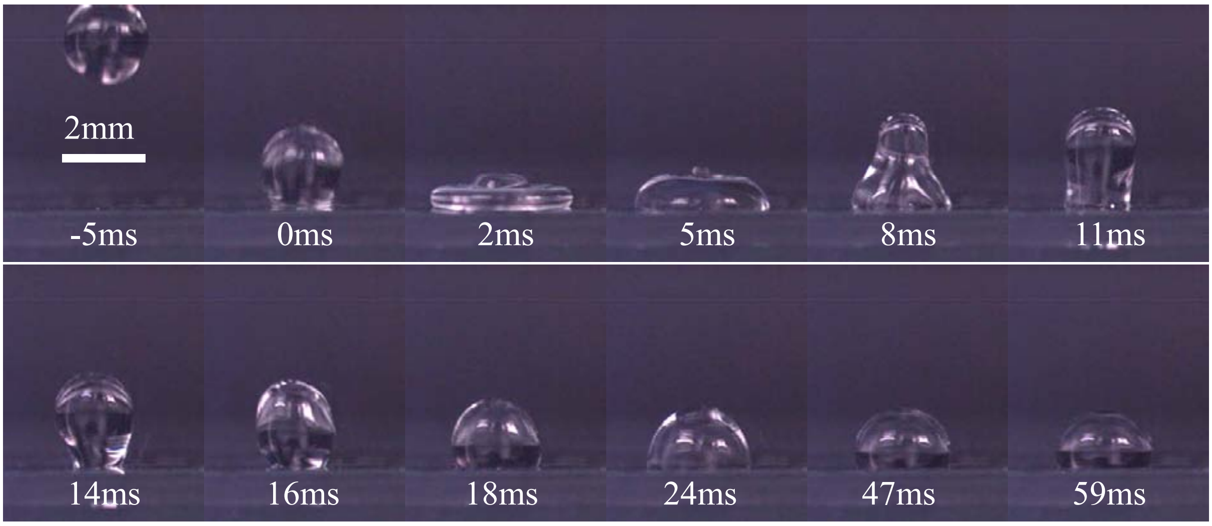

Figure S4. Snapshots of high-speed camera images.

Anchored water droplet on the Teflon-coated flat PDMS surface.

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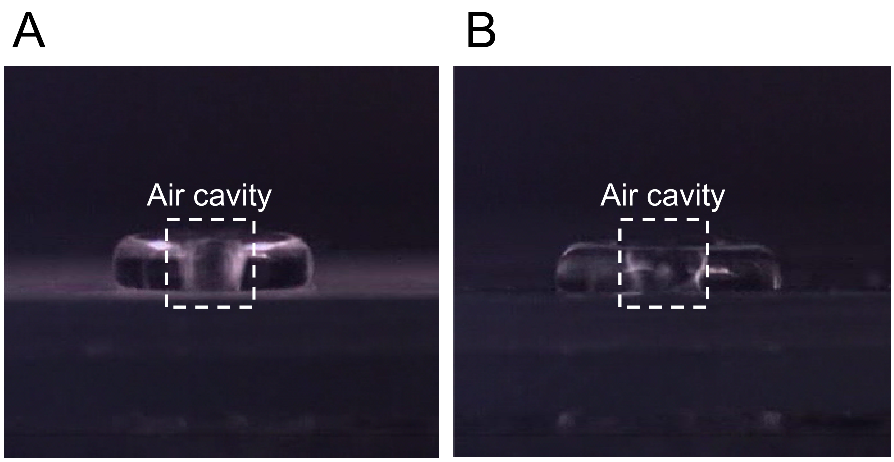


Figure S5. Snapshots after 4 ms from the instant of impact (A) on the Teflon-coated PDMS *trapezoids* surface and (B) on the Teflon-coated *flat* PDMS surface. In both snapshots, air cavities are clearly observed in a similar dimension, which is evidence of a lack of pinning at the surface.[1] However, the water droplet in (B) is stuck on the surface, while the water droplet in (A) bounces again completely.

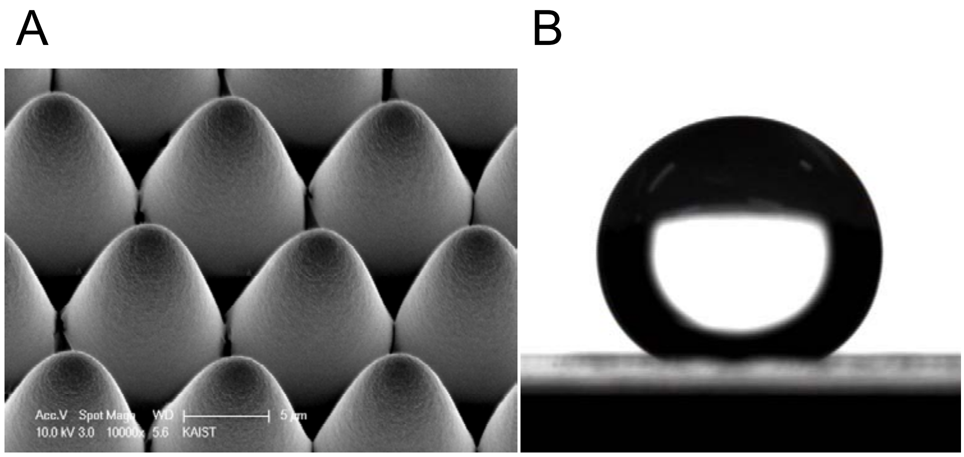


Figure S6. a) A SEM image of the PDMS microlens array used for the transmittance measurement as a control group, which is also shown in Figure 4a. A single microlens has a diameter of 10 μm and a height of 12 μm. b) A water droplet on the superhydrophobic PDMS microlens array used for the transmittance measurement, as shown in Figure 4a. The contact angle is approximately 163°.

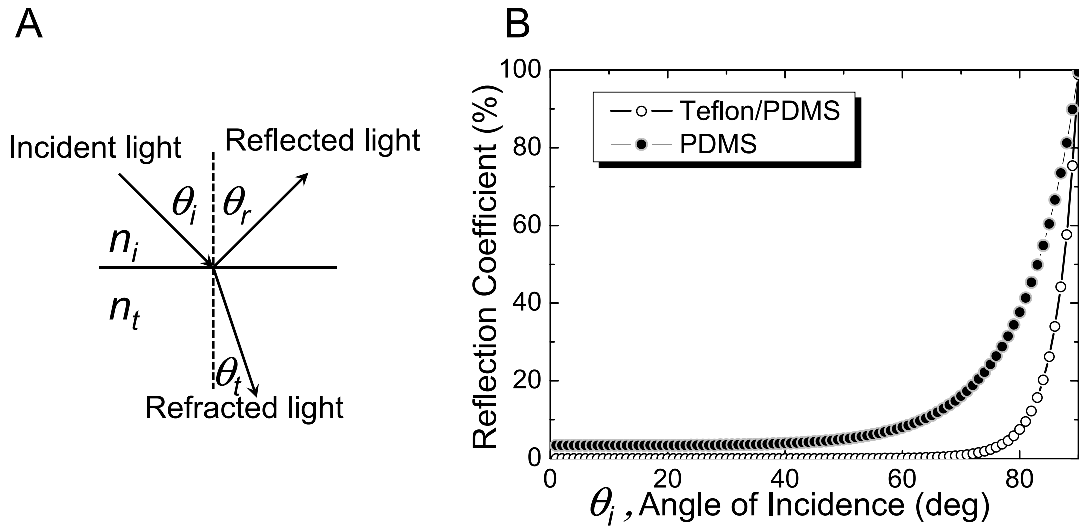


Figure S7. (A) Schematic diagram that explains Snell's law ($\theta_i = \theta_r$). (B) Reflection coefficients calculated from the Fresnel equation with Snell's law as a function of the incident angle of the light. By Teflon coating on the PDMS surface, the reflection coefficient is remarkably reduced at most incident angles. As a result, transmittance can be increased by the Teflon coating process.

Calculation of reflection coefficients: Due to a Teflon coating on the PDMS surface, a gradual change of the refractive indices was achieved, which is beneficial in decreasing the reflections at the interface. Teflon had an intermediate value of the refractive index (n_{Teflon} = 1.30) between the refractive index of air (n_{Air} = 1) and the refractive index of PDMS (n_{PDMS} = 1.45). The reflection coefficients at the interface between two materials can be computed by using the Fresnel equation[2] with Snell's law, as depicted in Figure S7A. The following equations were used for the computing the reflection coefficients of the light without polarization, *i.e.* $R = (R_s + R_p) / 2$:

$$R_s = \left[\frac{\sin(\theta_t - \theta_i)}{\sin(\theta_t + \theta_i)}\right]^2 = \left[\frac{n_i \cos\theta_i - n_t \cos\theta_t}{n_i \cos\theta_i + n_t \cos\theta_t}\right]^{22} \qquad \text{(S1)}$$

$$R_p = \left[\frac{\tan(\theta_t - \theta_i)}{\tan(\theta_t + \theta_i)}\right]^2 = \left[\frac{n_i \cos\theta_t - n_t \cos\theta_i}{n_i \cos\theta_t + n_t \cos\theta_i}\right]^2 \qquad \text{(S2)}$$

$$\sin\theta_t = \frac{n_i \sin\theta_i}{n_t} \qquad \text{(S3)}$$

where R_s is the reflection coefficient for *s*-polarized incident light, R_p is the reflection coefficient for *p*-polarized incident light, θ_i is the angle of light incidence, θ_t is the angle of light refraction, n_i is the refractive index of incident media, and n_t is the refractive index of transmitted media, respectively. In order to calculate the reflection coefficients of the Teflon-coated PDMS surface, the two reflection coefficients that were obtained from the two interfaces (Air to Teflon, and Teflon to PDMS) were multiplied. As plotted in Figure S7B, the Teflon-coated PDMS surface exhibits a lower reflection coefficient rather than the PDMS surface alone. The reduced reflection coefficients resulted in an increment of transmittance as described in Figure 4a.

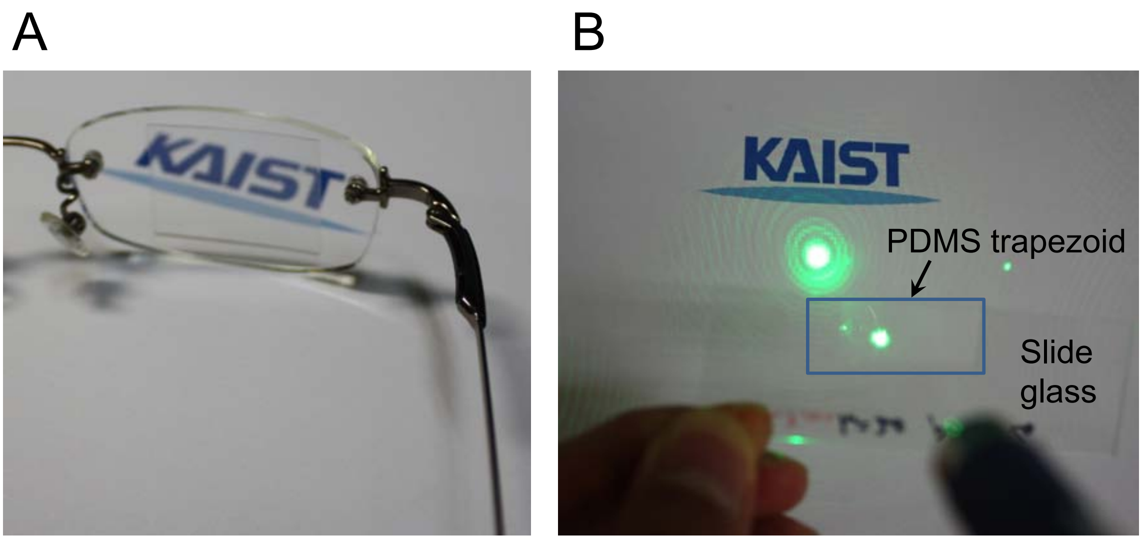
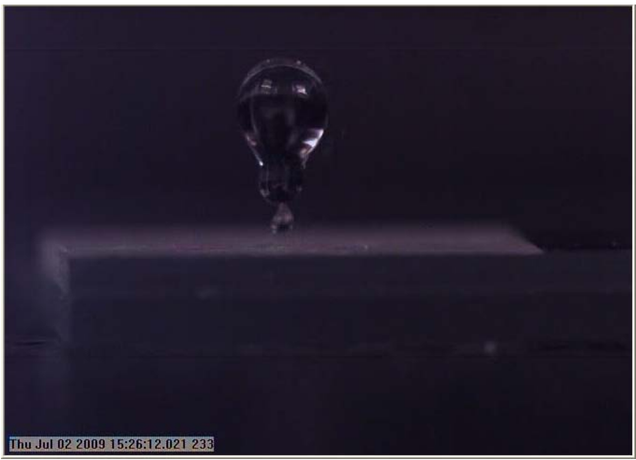


Figure S8. (A) A photograph of the PDMS trapezoids sample on one lens of eyeglasses. (B) A photograph of green laser diffraction patterns made by a PDMS trapezoids sample, verifying the existence of micro-sized patterns on the surface.

[1] P. Brunet, F. Lapierre, V. Thomy, Y. Coffinier, R. Boukherroub, *Langmuir* **2008**, *24*, 11203.

[2] E. Hecht, in *Optics*, Ed: A. Black, Addison Wesley, San Francisco, USA **2002**, pp. 101-121.



Movie S1. A movie showing the bouncing of a water droplet (γ_{la} = 72 mN/m) on a Teflon-coated PDMS trapezoids surface (θ_{app}=153°) with the geometry of H = 11.9 µm, θ_{side} = 56°, and P = 40 µm. The Weber number $W_e = \rho V^2_{impact} R_{drop}/\gamma_{la}$ is approximately 7.2, where R_{drop} =1 mm, and V_{impact} = 79.2 cm/sec.

Movie S2. A movie showing the anchored water droplet (γ_{la} = 72 mN/m) on a Teflon-coated flat PDMS surface (θ_{app}=122°). The Weber number $W_e = \rho V^2_{impact} R_{drop}/\gamma_{la}$ is approximately 7.2, where R_{drop} =1 mm, and V_{impact} = 79.2 cm/sec.

Movie S3. A movie showing the water-repellency of the fabricated Teflon-coated PDMS trapezoids surface. Even after a few seconds of submergence in deionized water, the superhydrophobic PDMS trapezoids surface does not get wet.

Movie S4. A movie that shows the methanol-repellency of the fabricated Teflon-coated PDMS trapezoids surface. After a few seconds of submergence in blue-colored methanol, the superhydrophobic PDMS trapezoids surface on a slide glass does not get wet while the methanol spreads over the slide glass. The methanol droplet at the other side of the slide glass can be observed through the PDMS trapezoids sample.