Supporting Information

Multifunctional Moth-eye TiO_2/PDMS Pads with High Transmittance and UV Filtering

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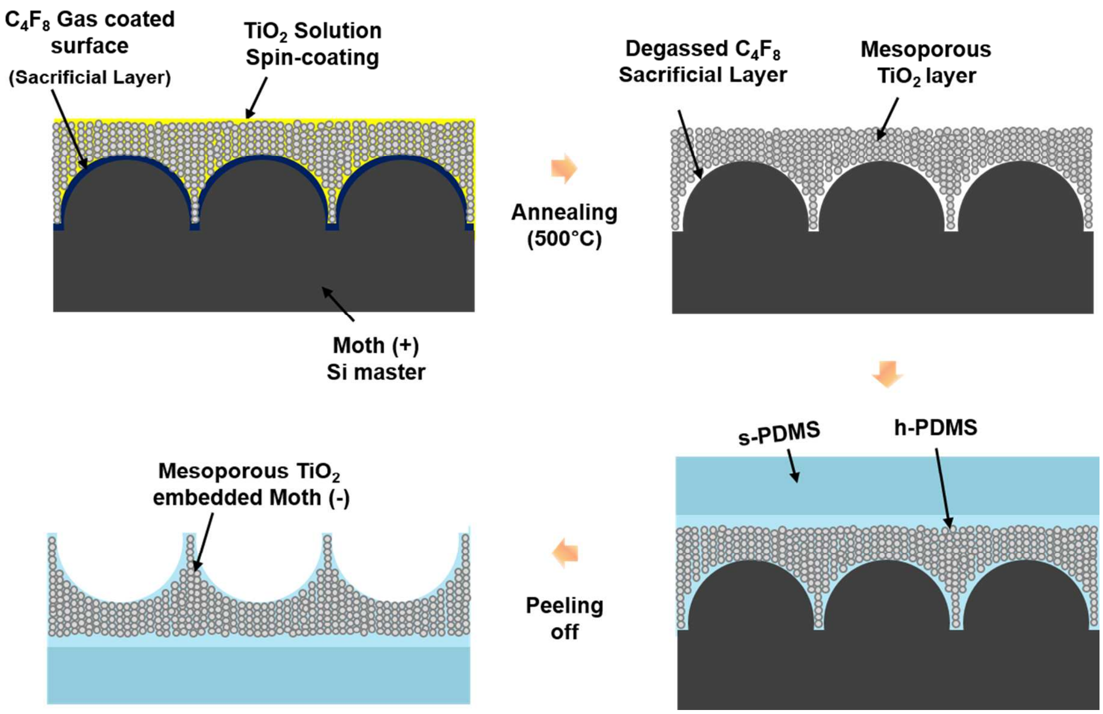

Figure S1. Cross-sectional illustrations of mesoporous moth-eye TiO_2/PDMS pad fabrication process.

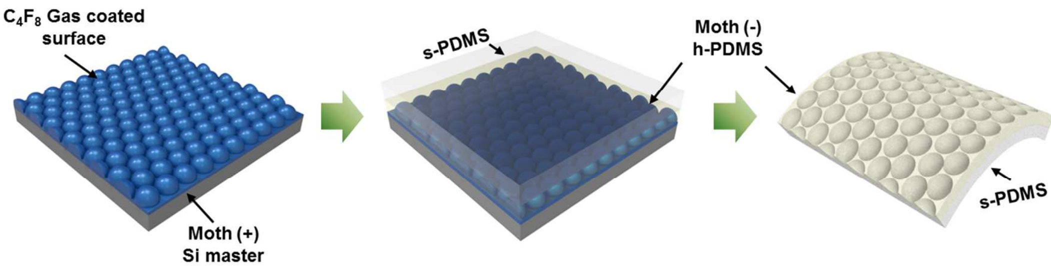

Figure S2. Schematic illustrations of the moth-eye PDMS pad fabrication.

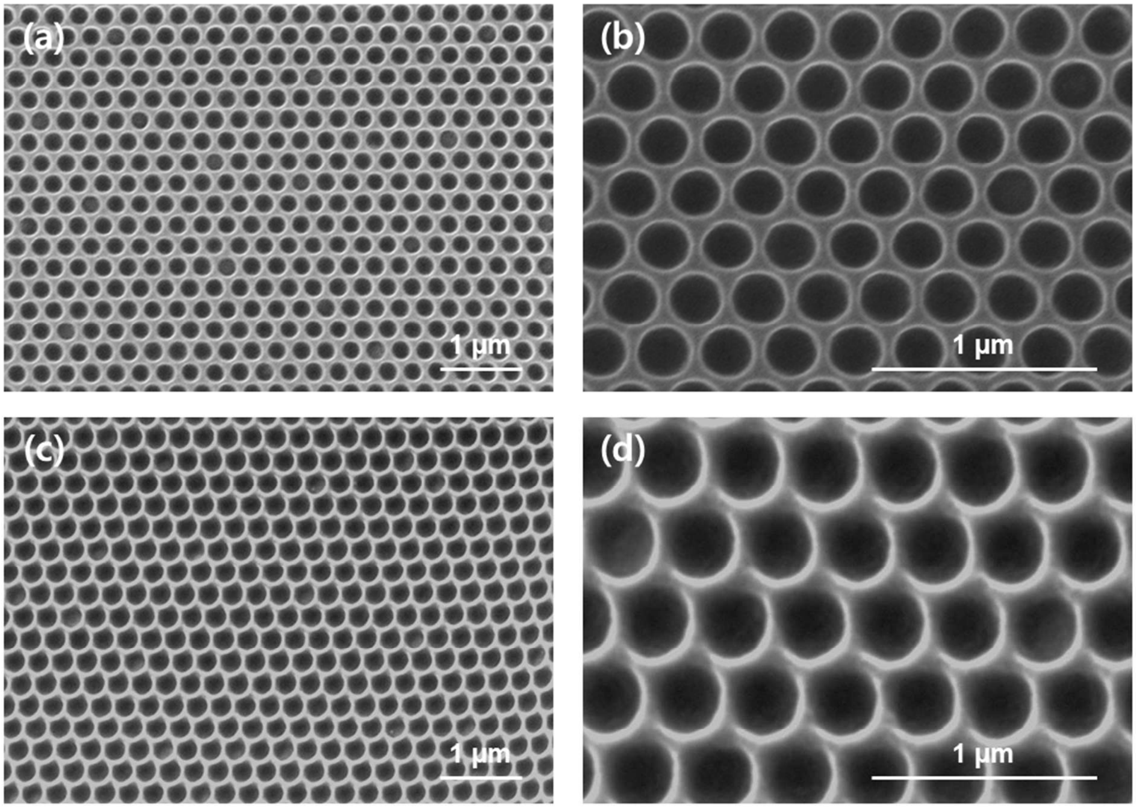

Figure S3. (a–d) Surface SEM images of moth-eye PDMS pad with top-view (a–b) and 40° tilt view (c–d).

- Detailed discussion of the optical characteristics of moth-eye structures

Various PDMS pads were attached to glass surfaces and light was directed incident on the PDMS side, such that it propagated through the PDMS pad to the glass substrate. Recorded images of the experimental configurations are shown in **Figure S3.** To confirm the structural effect of the moth-eyes with respect to optical enhancement, the transmittance and the reflectance spectra of moth-eye PDMS pads without the TiO_2 layer were also measured (**Figure S4**). The measured spectral reflectance of the moth-eye PDMS/glass (average ~4.45%) is lower than that of the glass without moth-eye pads (average ~7.98%). When the moth-eye pads were attached to glass at both the front and back sides, the reflectance (average ~1.37%) was further reduced by ~83% compared to the flat glass substrate. The dual side moth shows a high maximum transmittance (~99.47%) which is maintained in the ~360 nm region. However, below 360 nm, the transmittance was slightly lower than the glass substrate. This can be explained using the well-known grating equation[1] :

$$\sin \theta_d = \frac{m\lambda_0}{n\lambda} + \sin \theta_i \qquad (1)$$

where λ is the period of grating, λ_0 is the incident wavelength, n is the refractive index of incident medium, m is the order of the diffracted light, and θ_d and θ_i are the diffraction and incidence angles respectively. Based on this equation, moth-eye structures with 300 nm periodicity are enough to reduce the external reflection (the incident medium is air (n~1)) at 300–800 nm). However, the optical loss from trapped light in PDMS due to internal reflection (the incident medium is PDMS (n~1.43)) appeared below ~400 nm (**Figure S4**), and therefore transmittance loss with the moth-eye PDMS pad below 360 nm can be explained by optical loss calculations[2]. However, this barely affects the high transmittance in the visible spectrum (390–700 nm).

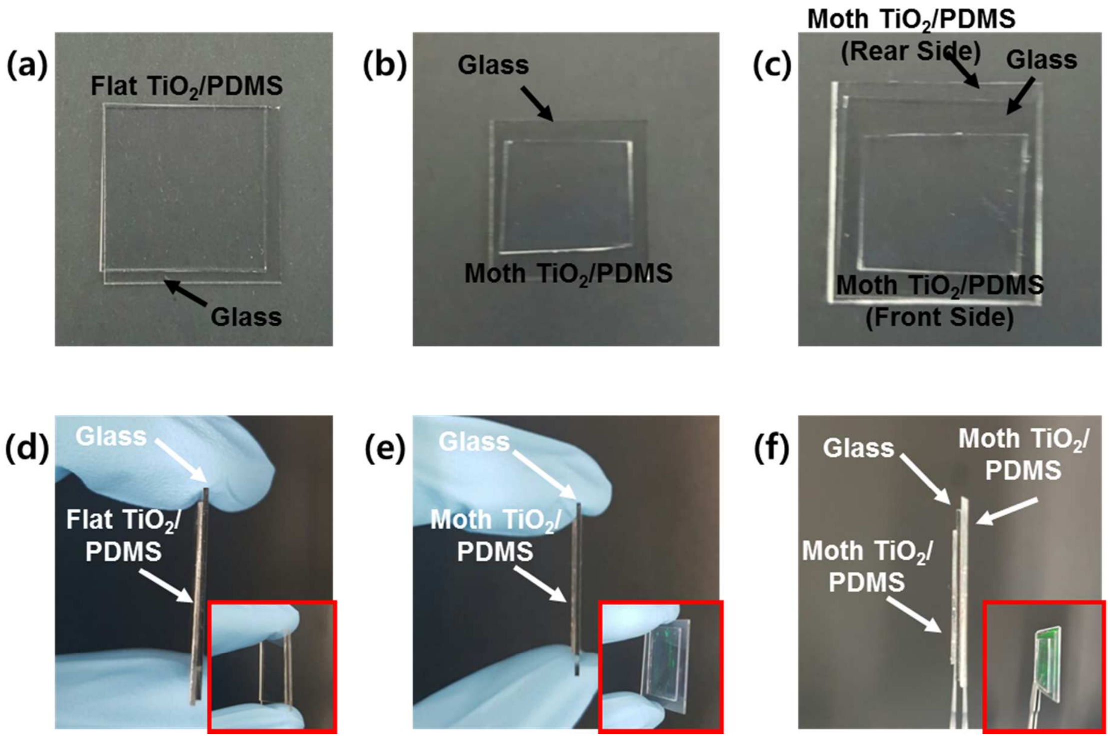

Figure S4. Experimental configurations for measuring the transmittance and reflectance spectra of various PDMS pads for top-view images (a-c) and the side-view images (d-f).

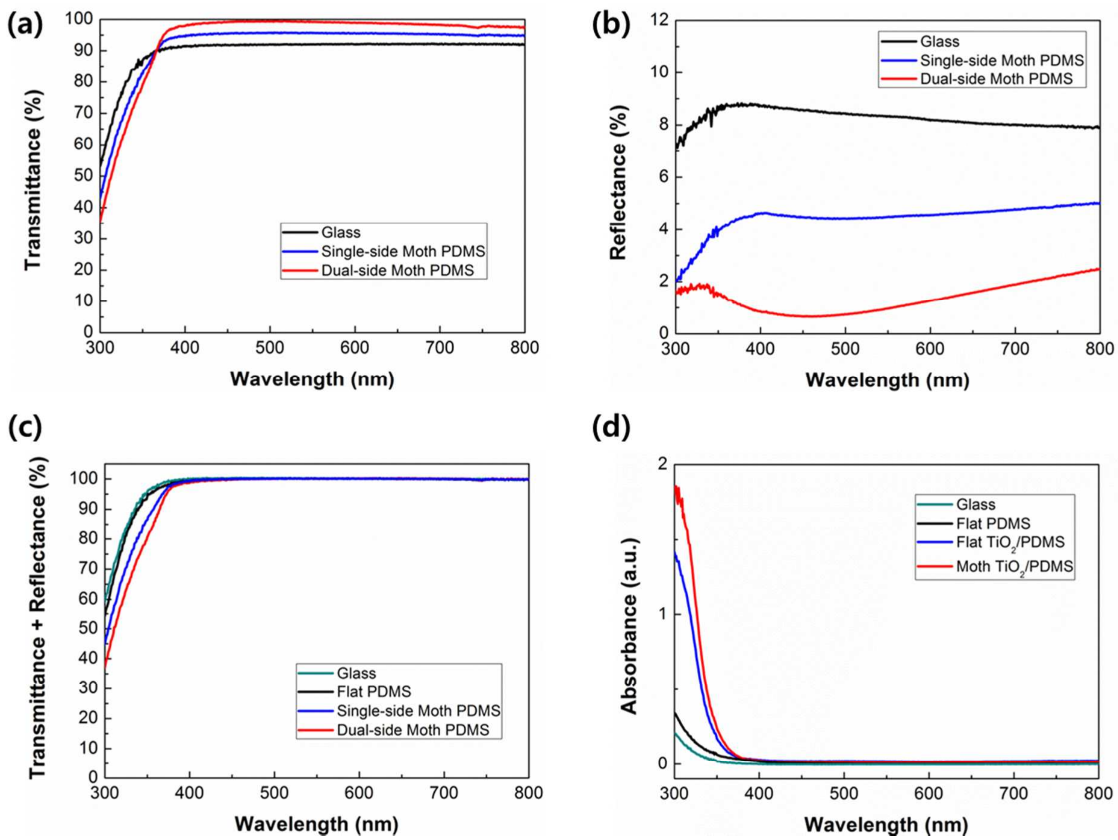

Figure S5. (a) Transmittance and (b) reflectance spectra of the bare glass and the moth-eye PDMS pads onto the glass. (c) Sum of the transmittance and reflectance for evaluating the optical loss from trapped light in PDMS. (d) Absorbance spectra of the bare glass and the (flat/moth) TiO_2/PDMS pads.

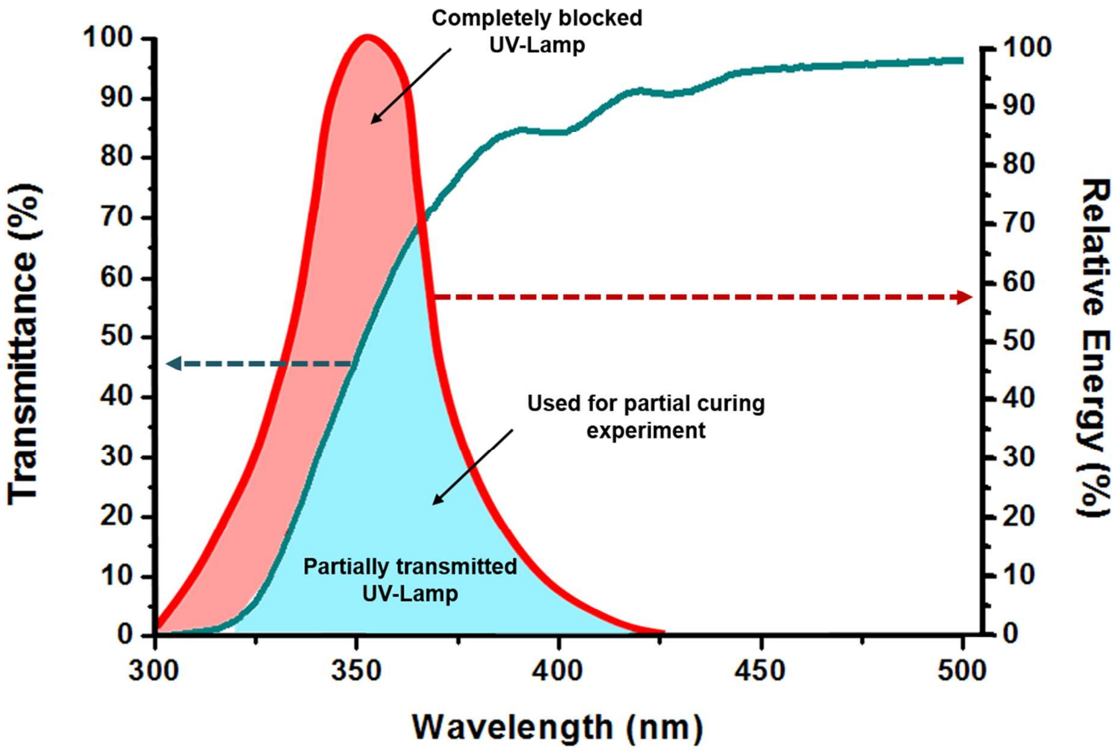

Figure S6. Combined graphs of Transmittance spectra of the moth-eye TiO_2/PDMS pad and the relative irradiation energy of the UV curing lamp.

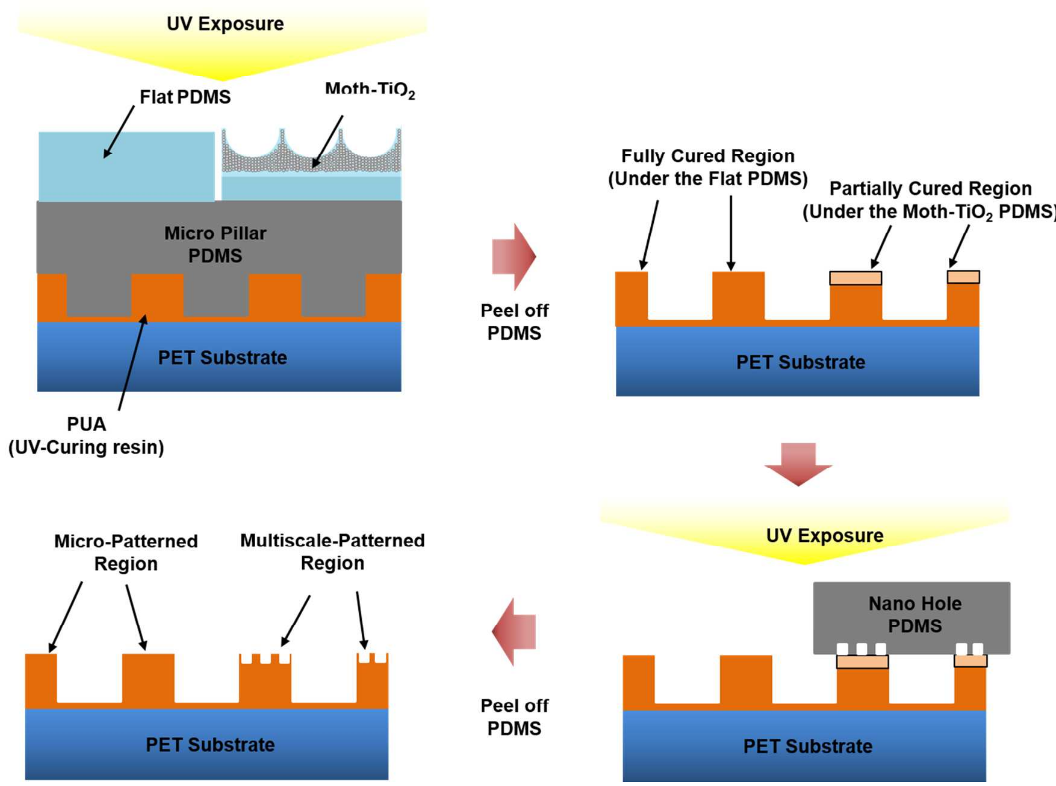

Figure S7. Cross-sectional illustrations of the successive process for fabricating multiscale hierarchical structures using moth-eye TiO_2/PDMS pad.

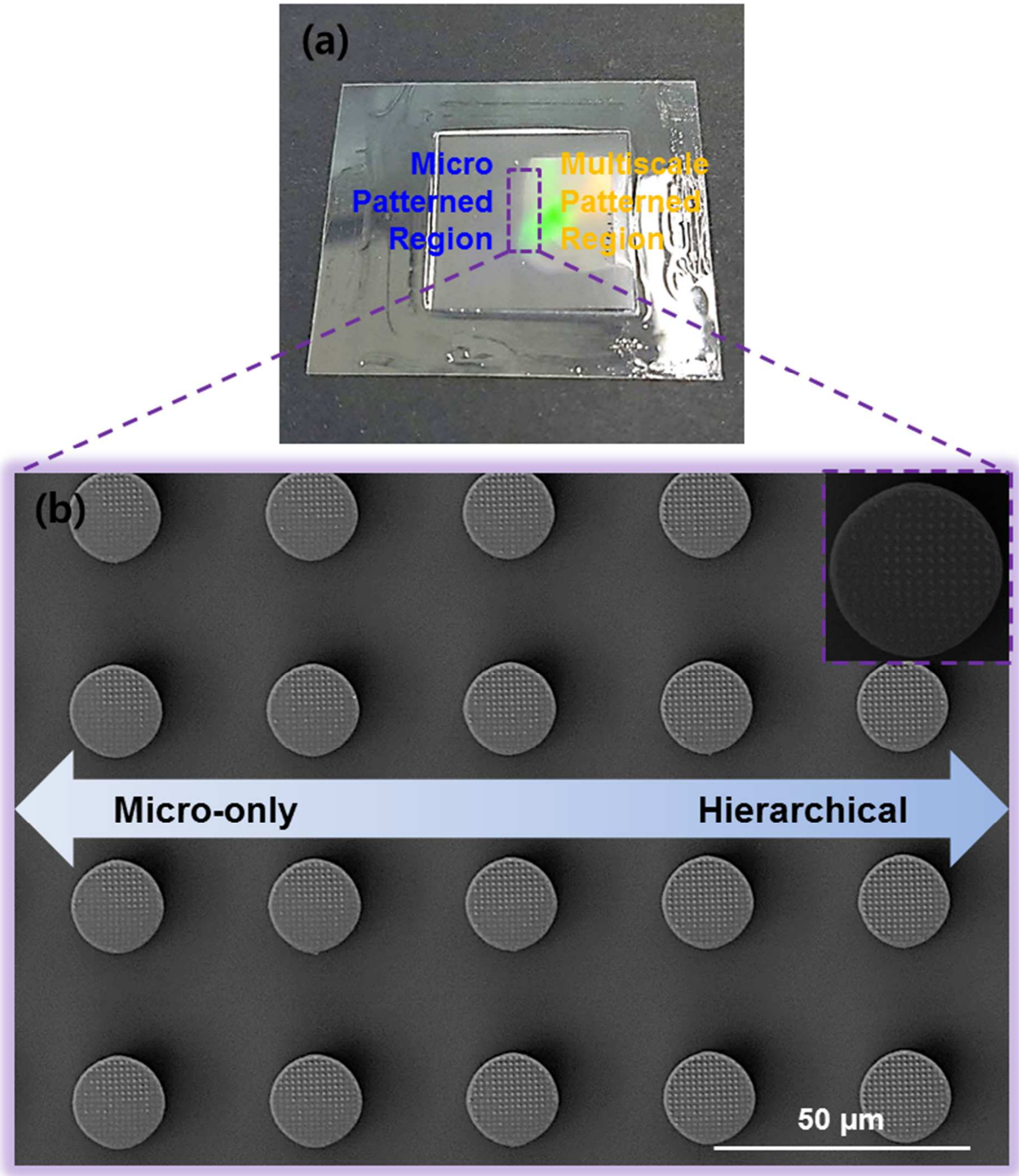

Figure S8. (a) Digital camera images of the transient region of microscale pattern and multiscale hierarchical pattern. (b) SEM images at the interface between flat PDMS pad and moth-eye TiO_2 pad.

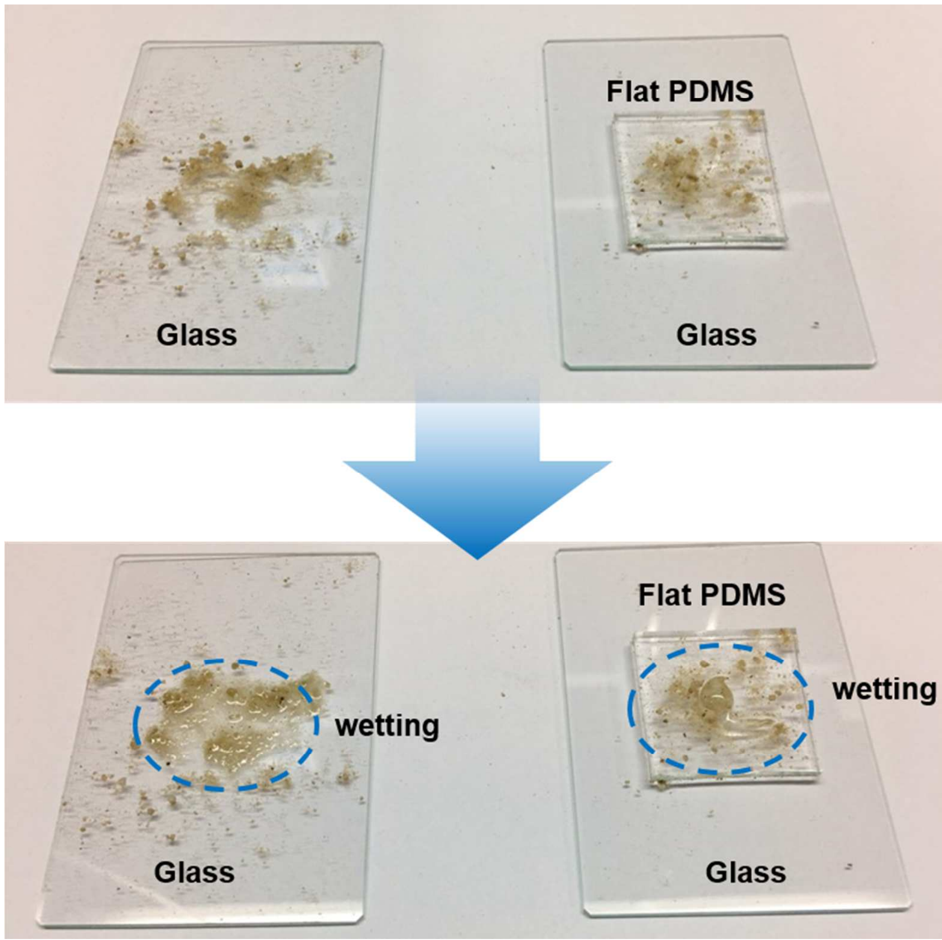

Figure S9. Images of self-cleaning effect using the flat glass and flat PDMS.

Reference

1. Song, Y. M.; Choi, H. J.; Yu, J. S.; Lee, Y. T., Design of highly transparent glasses with broadband antireflective subwavelength structures. *Opt. Express* **2010,** *18* (12), 13063-13071.

2. Bagal, A.; Dandley, E. C.; Zhao, J.; Zhang, X. A.; Oldham, C. J.; Parsons, G. N.; Chang, C.-H., Multifunctional nano-accordion structures for stretchable transparent conductors. *Mater. Horizons.* **2015,** *2* (5), 486-494.