

Supplementary information

Improved antireflection properties of moth eye mimicking nanopillars on transparent glass: Flat antireflection and color tuning

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Fabrication of a moth eye surface: A quartz substrate is dipped into a Alconox solution; it is rinsed with deionized water several times and then dried with N₂ gas blowing. For the preparation of a PS NP solution, the purchased PS NP solution is diluted to a ratio of 4:1 with a methanol solution containing. The quartz is treated with ultraviolet ozone (UVO) for 5 min. The diluted PS NP solution is then deposited on the substrate, which is placed in a spin-coater. The PS NPs are self-assembled into a monolayer with spin rates and steps that are optimized for the 200 nm diameter of the PS particles. The size of PS NPs on the substrate is reduced with 90 W RF plasma in O₂ ambient. Successive quartz etching is performed with 150 W RF plasma in a mixture of ambient gases, where the CF₄:H₂ ratio is 2:3. The chamber pressure of the plasma process is fixed at 60 mTorr. A post-etching process involving 150 W O₂ plasma or 20 min of boiling at 160°C in a piranha solution removes the residual reactant and remained PS NPs.

Superhydrophobic coating: The nanostructured surface is activated with 15 min of UVO treatment and transferred to a plastic box filled with N₂ gas. Tridecafluoro-1,1,2,2-tetrahydrooctyl-trichlorosilane (FOTS, Aldrich) is injected into the box, which is then deposited for 15 min in a thermal oven at 100°C. The vapor deposited substrate is taken out of the box and annealed in the thermal oven at 100°C for 1 hour to solidify the binding and arrangement of the SAM molecules.

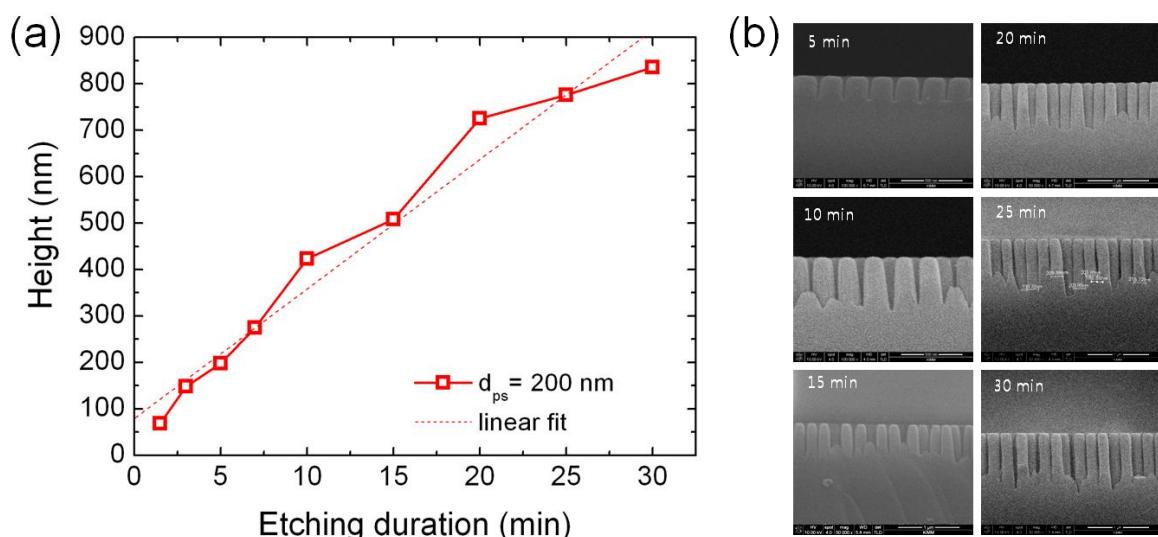


Figure S1. Etching rates and SEM images of the fabricated samples. (a) Graph of the etching depth (pillar height) versus the etching duration for the masking of 200 nm diameter PS particles on a quartz glass; and (b) SEM images of the fabricated moth eye surfaces having the round cone shape nanopillars for different etching times of 5 min, 10 min, 15 min, 20 min, 25 min, and 30 min. The average etching rate is about 30 nm/min by linear fitting.

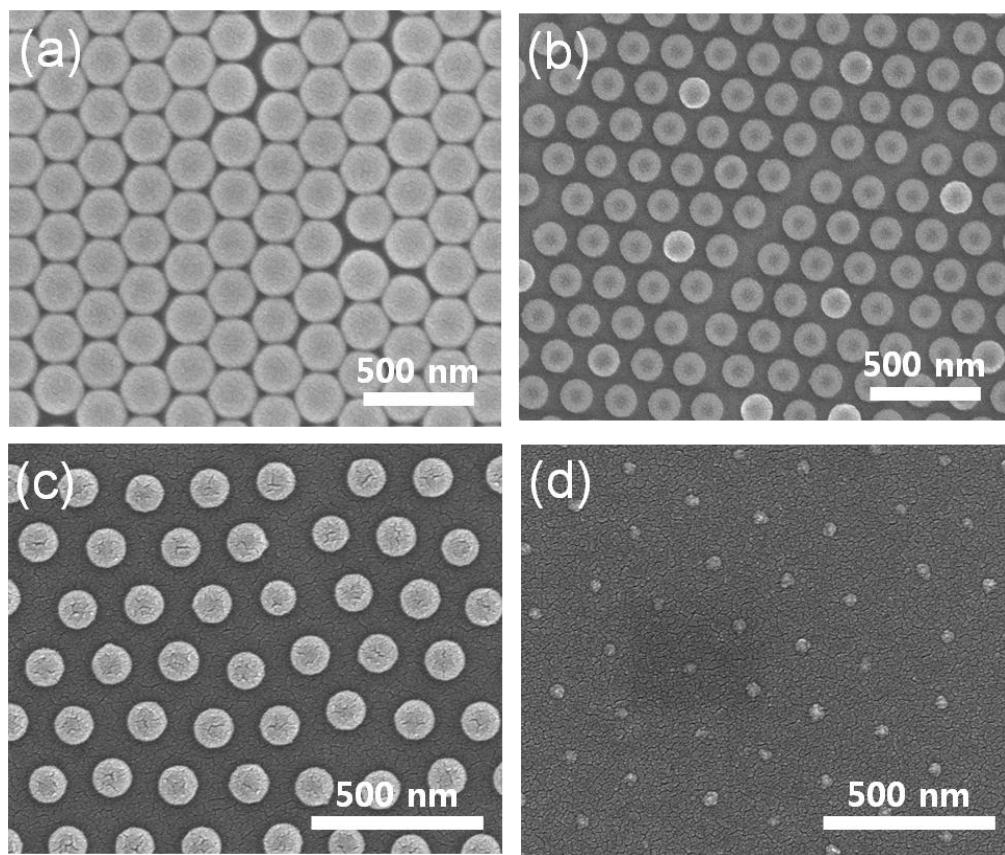


Figure S2. SEM images of a 200 nm diameter PS NP monolayer on a glass surface according to the size reduction process (a) An as-coated PS NP array made with a spin-coating method. (b), (c), and (d) Size-reduced PS NP arrays treated with oxygen plasma for 15 s, 30 s, and 45 s, respectively.

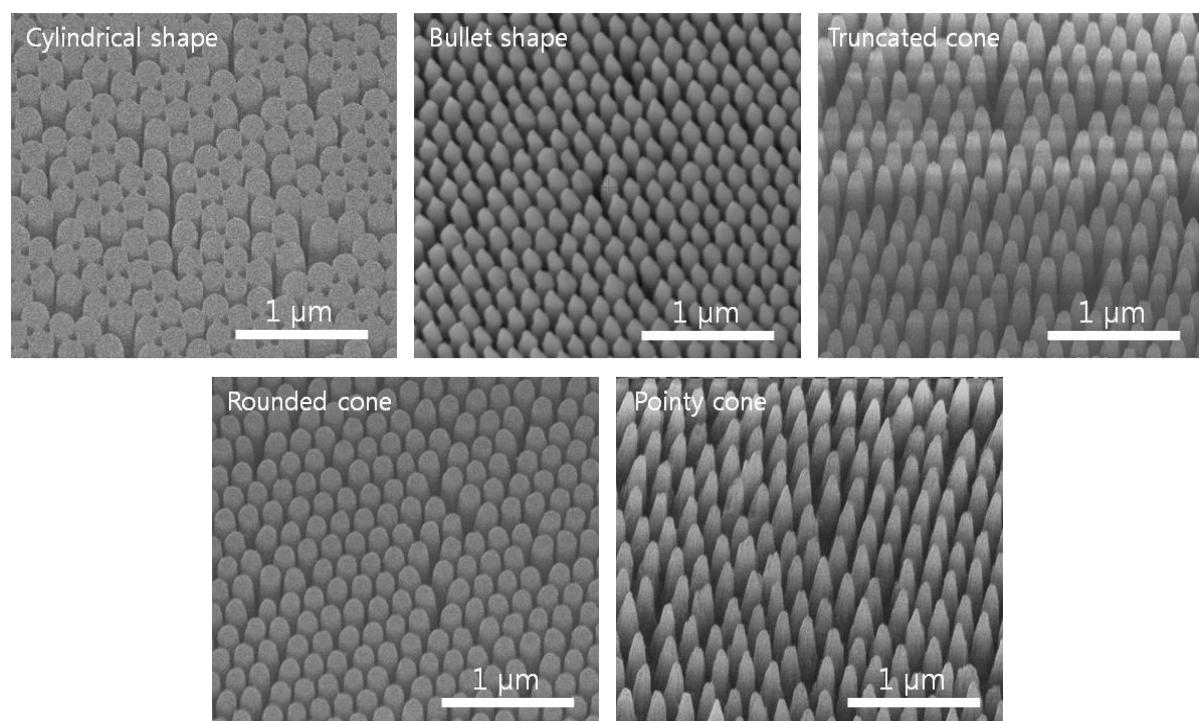


Figure S3. Tilted SEM images of moth eye surfaces having the different shapes of nanopillars. The tilting angle is 30°. The scale bars are 1 μm .

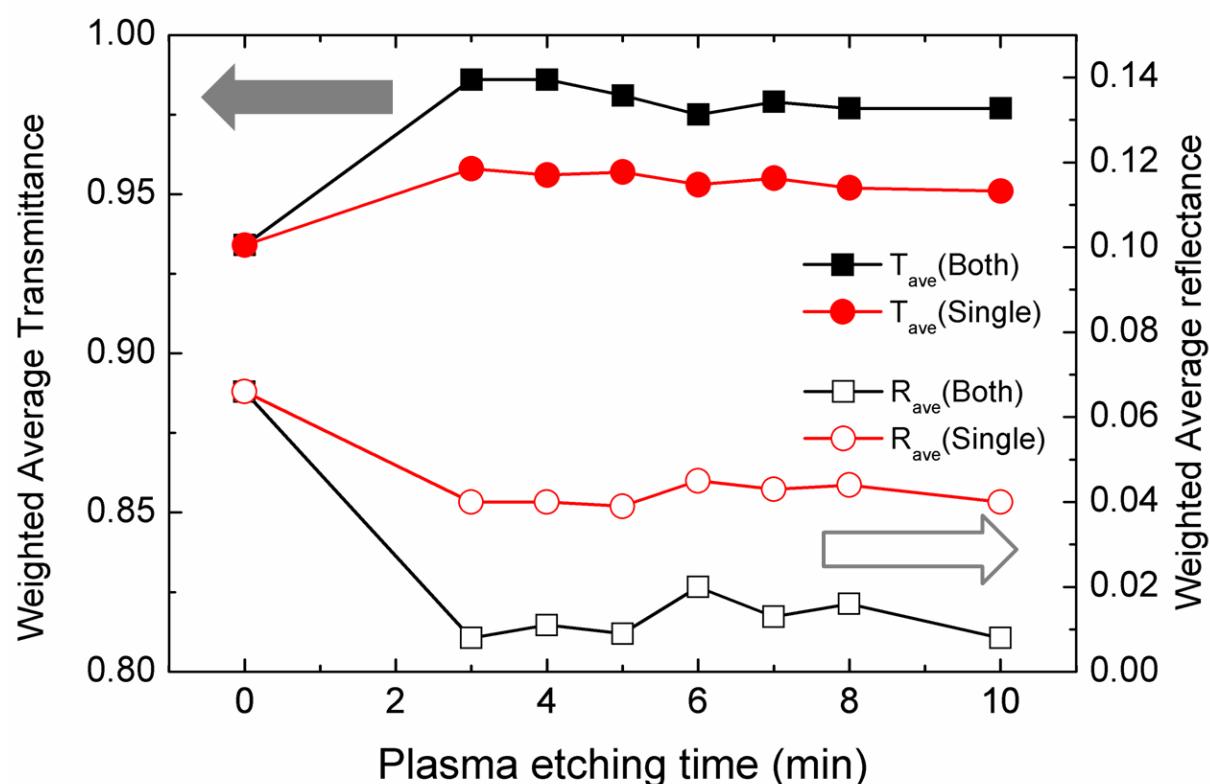


Figure S4. The weighted average transmittance and reflectance of moth eye surfaces according to the plasma etching time. The measured transmittance and reflectance spectra are averaged under AM 1.5G solar spectrum for the range of 380~800 nm wavelength. The values of both and single side moth eye structured surfaces are indicated by black and red lines and symbols, respectively.

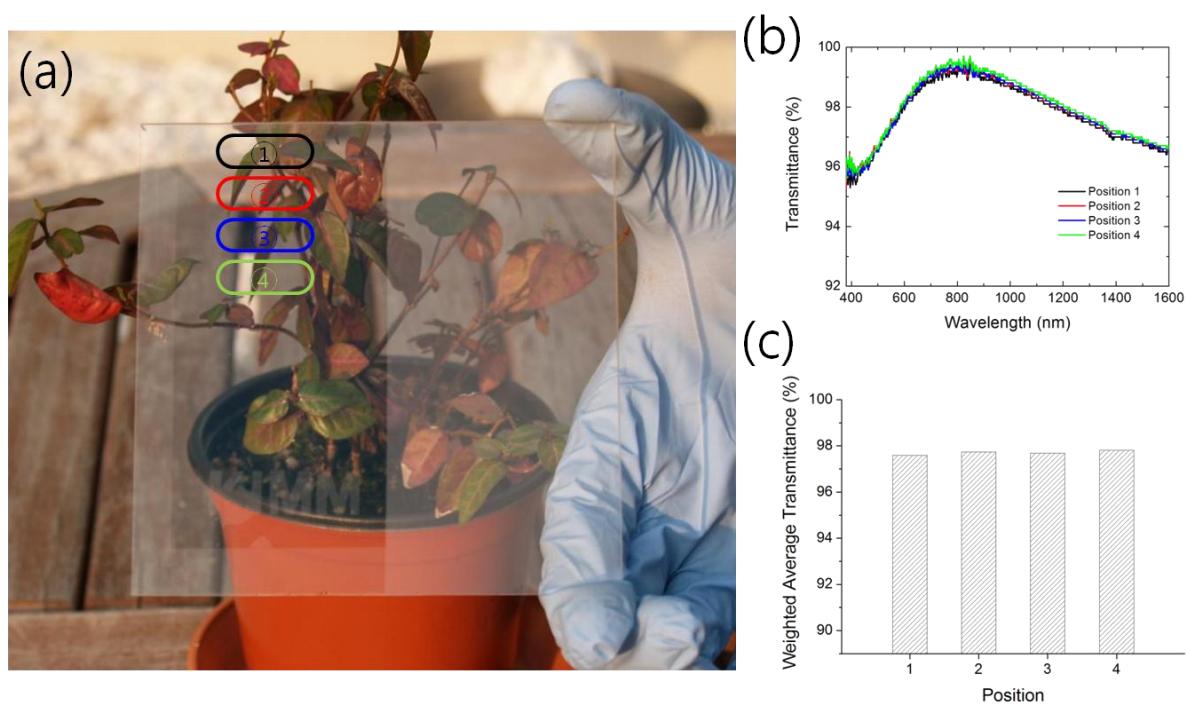


Figure S5. Optical uniformity of $100 \times 100 \text{ mm}^2$ sized moth eye glass. (a) The positions that transmittance was measured for the range of 380~1600 nm wavelength. The area of elongated circle is almost same with the light exposure area for the transmittance measurement. (b) The transmittance spectra of 4 measuring positions. The variation of 4 spectrums is within 0.5 %. (c) The weighted average transmittance of 4 measuring positions. The measured transmittance values are averaged under AM1.5 solar spectrum.