Supporting Information

Highly durable hydrophobicity in simulated space environment

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Experimental

Materials and fabrication of PFPE-filled AAO: The micro- and nano- structure anodic alumina oxide (AAO) was prepared by unconventional two-step anodization as the procedure reported in the literature.[1] Once ready, they were immersed into a 2.5% (v/v) PFPE (Sinopec Lubricant Company) solution in 1,1,2-trichlorotrifluoroethane (Sigma-Aldrich) for 24 h to load PFPE, followed by rinsing with acetone. Finally, PFPE-filled AAO were prepared by heating at 100 ^{o}C for 60 min. Two samples were fabricated as controlled experiments. One is prepared by sping-coating a droplet of pure PFPE liquid on silicon surface at 1000 rpm for 2 min; another is prepared by spin-coating PFPE solution on AAO surface at 3000 rpm for 60 s. Both controlled samples were treated by heating at 100 ^{o}C for 60 min in an oven.

Low earth orbit (LEO) space irradiation: The PFPE-filled AAO were then put into chamber of a space environment simulation facility at Lanzhou Institute of Chemical Physics to conduct the AO irradiation at 4.0×10^{-3} Pa. The flux of AO is 6.73×10^{15} atoms$\cdot$cm$^{-2}\cdot$s^{-1}. Exposure time of 0.5 h, 1.5 h, 2.5 h, 3.5 h and 5 h were carried out respectively to investigate the time independence of wettability of PFPE-filled AAO. Meantime, we also carried out other irradiation such as UV exposure, proton irradiation, and electron irradiation. UV exposure experiment was carried out under excimer light with wavelength of 200-450 nm under the pressure of 4.0×10^{-3} Pa using a mercury Xenon lamp, the intensity of which was determined by an UV monitor to be 15.8 mW$\cdot$cm^{-2}; Proton irradiation experiment was conducted under the

pressure of 3.0×10^{-3} Pa; for electron irradiation, the energy of the electron beams was 28 KeV and its power flux was 50 $\mu A \cdot cm^{-2}$. Their irradiation time is shown in table S1.

Characterization: Contact angles (CA) were acquired using a DSA-100 optical contact-angle meter (Kruss Company, Ltd, Germany) at ambient temperature (25 ^{o}C) by injecting 5 μL of testing liquids onto the samples, and the CA values were determined automatically using the Laplace–Young fitting algorithm. Average CA values were obtained by measuring the sample at five different positions, and images were captured with a digital camera (Sony, Ltd, Japan).The surface morphologies were observed using a field-emission scanning electron microscope (SEM, JSM-6701F, Japan) at 5-10 kV. The changes in the chemical structure of the PFPE filled AAO were recorded by Fourier transform infrared spectra (FTIR) on a TENSOR 27 instrument (BRUKER, KBr disks forcompounds and polymers, while ATR was used for modified surfaces). Chemical composition information were obtained by X-ray photoelectron spectroscopy (XPS), which was carried out on a PHI-5702 multi-functional spectrometer using Al Kα radiation and the binding energy were referenced to the C1s line at 284.6 eV from adventitious carbon.

Table S1. Irradiation time under various radiation sources

Irradiation source	Irradiation time				
Atomic oxygen	0.5 h	1.5 h	2.5 h	3.5 h	5 h
Ultraviolet	4 h	6 h	8 h	10 h	12 h
Proton	3 min	6 min	9 min	12 min	-
Electron	10 min	15 min	20 min	25 min	-

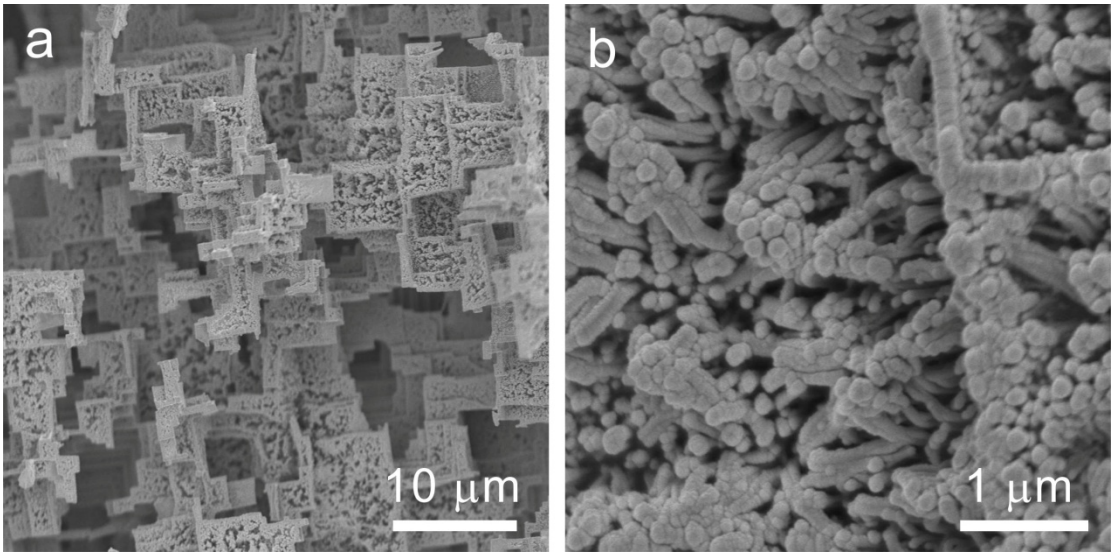

Figure S1. SEM images of hierarchical anodic anodized alumina (a) and magnified view (b).

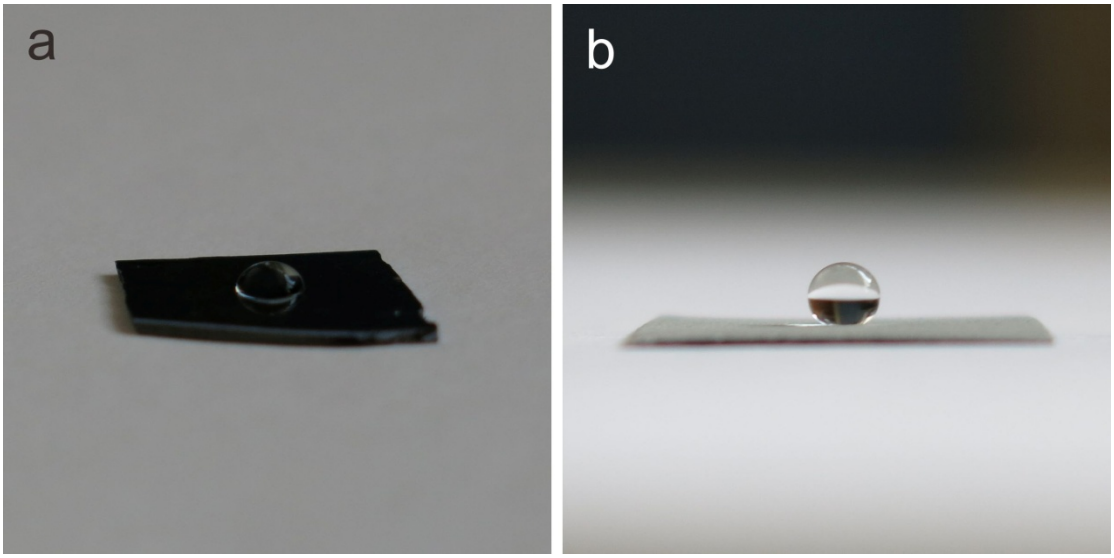

Figure S2. Digital images of water droplet on PFPE film spin-coated silicon surface (a) and AAO surface (b).

References

1. W. C. Wu, X. L. Wang, D. Wang, M. Chen, F, Zhou, W. M. Liu and Q. J. Xue, *Chem. Commun.*, 2009, **45,**1043.