Supporting information

1. Experimental section

1.1. Materials

The copper sheet (99.9%) was obtained from Bi Ling Hardware Products Co., LTD, China and the thickness was 0.1mm. PDMS and the curing agent were purchased from Sigma-Aldrich. All other chemical reagents (99.7% anhydrous ethanol; 36.0-38.0% concentrated hydrochloric acid; 99.5% acetone) were AR and were used without further purification. Deionized water was produced using the ModuPure system and used in all experiments.

1.2. Preparation of superhydrophobic PDMS copper sheet

Firstly, the commercial copper sheet (2.5 x 2.5 cm) was cleaned with acetone, absolute ethanol, and deionized water ultrasonic successively. Then the copper sheet was immersed in 0.1 M hydrochloric acid solution for 10 s to remove the oxide layer. After that, Sylgard 184 base was mixed with a curing agent in a mass ratio of 10 :1 to prepare PDMS. The copper sheet (2.5 x 2.5 cm) was coated with a PDMS mixture at 1000 rpm for 10 s and then at speed of 1500 rpm for 15 s. After the spin-coating, the samples were vacuum-dried for 1h at 80℃. Then, the obtained samples were calcined at 550 °C for 1 min 35 s in a muffle furnace to transform into superhydrophobic copper sheets.

1.3 Preparation of hybrid hydrophilic - superhydrophobic PDMS copper sheets

Copper sheets (2.5 x 2.5 cm) were settled into the model under the pressure of about 1 M Pa to obtain a bulgy surface. There were two kinds of copper sheets covered with bulgy surfaces made to imitate two types of desert beetles. Copper sheets with 5 x 5 hemispherical protruding surfaces of 1mm diameter modeled on Physasterna Cribripes back and copper sheets with 5 linear bulgy of 1mm diameter modeled on Onymacris Unguicularis back are presented.

Similarly, a PDMS film was prepared on the two kinds of copper sheets with different surface morphologies by the spin-coating method. Then, the samples were vacuum-cured at 80 ℃ for 1h and calcined at 550 ℃ for 1 min 35 s in a muffle furnace to obtain hydrophilic-superhydrophobic copper sheets. The bulgy part of its surface was hydrophilic, while the plane part was superhydrophobic.

1.4 Water Harvesting Measurements

A homemade testing system was prepared to evaluate the fog-harvesting behavior of the samples. The sample holder can keep the sample (25 mm × 25 mm) perpendicular to the horizontal direction, and the collected water droplets fall off under the action of gravity. In order to simulate the fog in the natural environment, a humidifier is used to generate fog flow. The distance between the humidifier and the sample clip is about 12 cm, and the flow rate is about 50-60 cm/s. The relative humidity in the experiment box is above 90%, and the temperature is around 19±1℃.

1.5 Characterization

Field emission scanning electron microscope (FESEM) images were obtained by JSM-6701F. Static water contact angle (WCA) and roll angle (RA) measurements were tested by a JC2000D goniometer (Zhong Chen Digital Equipment Co. Ltd Shanghai, China). The quantitative elemental composition was characterized by X-ray photoelectron spectroscopy (XPS, Thermo Scientific ESCALAB 250Xi, Physical Electronics, USA). The behaviors of the growth and shedding of droplets on the copper sheets were recorded by a professional digital camera (SONY DSC-HX200) and an industrial camera (DH-HV1351UM).

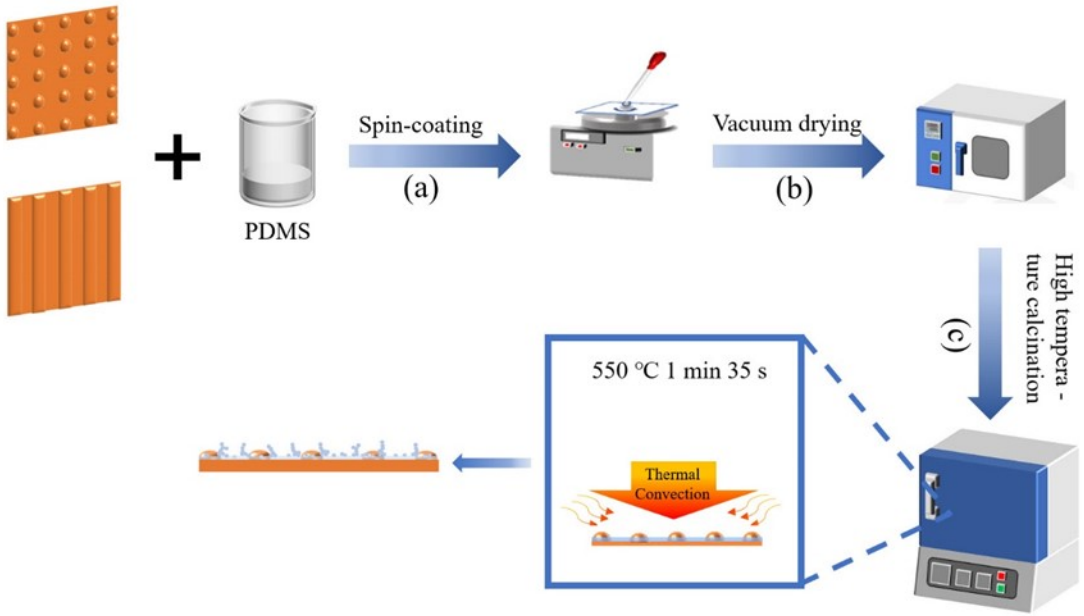

Figure S1. Schematic illustration of the preparation process of alternating hydrophilic−superhydrophobic 3D copper sheets. (a, b) The PDMS film was prepared on a copper sheet by spin-coating. (c) The incomplete combustion of PDMS on the copper sheet results in surface wettability differences. The bulges and their surroundings are hydrophilic, and the plane part is superhydrophobic.

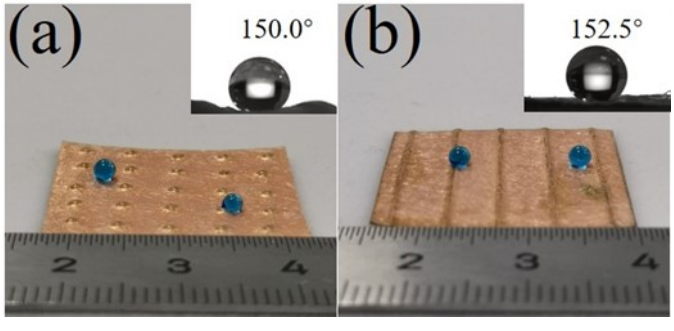

Figure S2. Optical photograph and WCA of Hybrid-HB, Hybrid-LB.

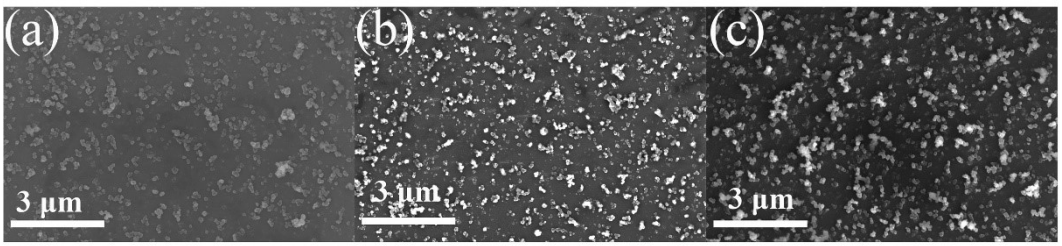

Figure S3 SEM of PDMS copper sheets after calcination with 1min (a), 1 min 30 s (b), 1 min 50 s (c).

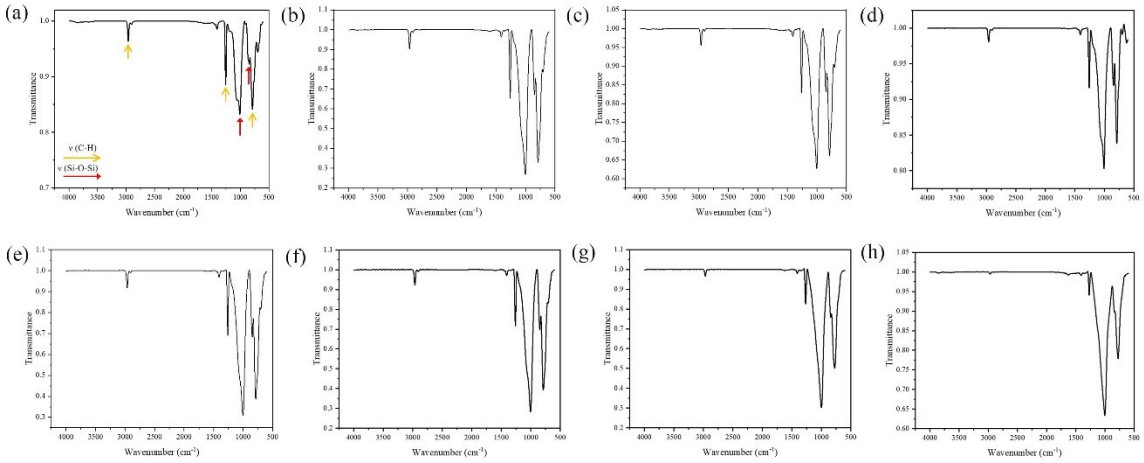

Figure S4 Infrared spectrum of PDMS@ copper sheet with different calcination time. (a) 0 s, (b) 1min, (c) 1 min 10 s, (d) 1 min 20 s, (e) 1 min 30 s, (f) 1 min 40 s, (g) 1 min 50 s, (h) 2 min.

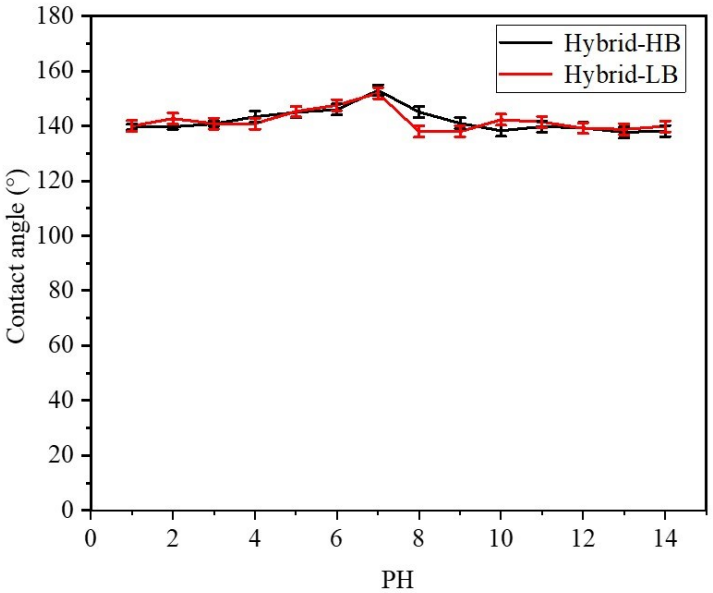

Figure S5 Contact angles of different PH solutions on Hybrid-HB and Hybrid-LB.

Video S6. The shedding process of water on sample SHB.
Video S7. The shedding process of water on sample Hybrid-HB.
Video S8. The shedding process of water on sample Hybrid-LB.