Electronic Supporting Information

Modular 3D-Printed Fog Collectors Integrated with Dual Wetting-contrast Patterns

Jie Guo[a], Zhiguang Guo[a,b,*] and Weimin Liu [b]

[a] Ministry of Education Key Laboratory for the Green Preparation and Application of Functional Materials, Hubei University, Wuhan 430062, China

[b] State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Lanzhou 730000, China

*E-mail: zguo@licp.cas.cn

Supplementary Information contains:

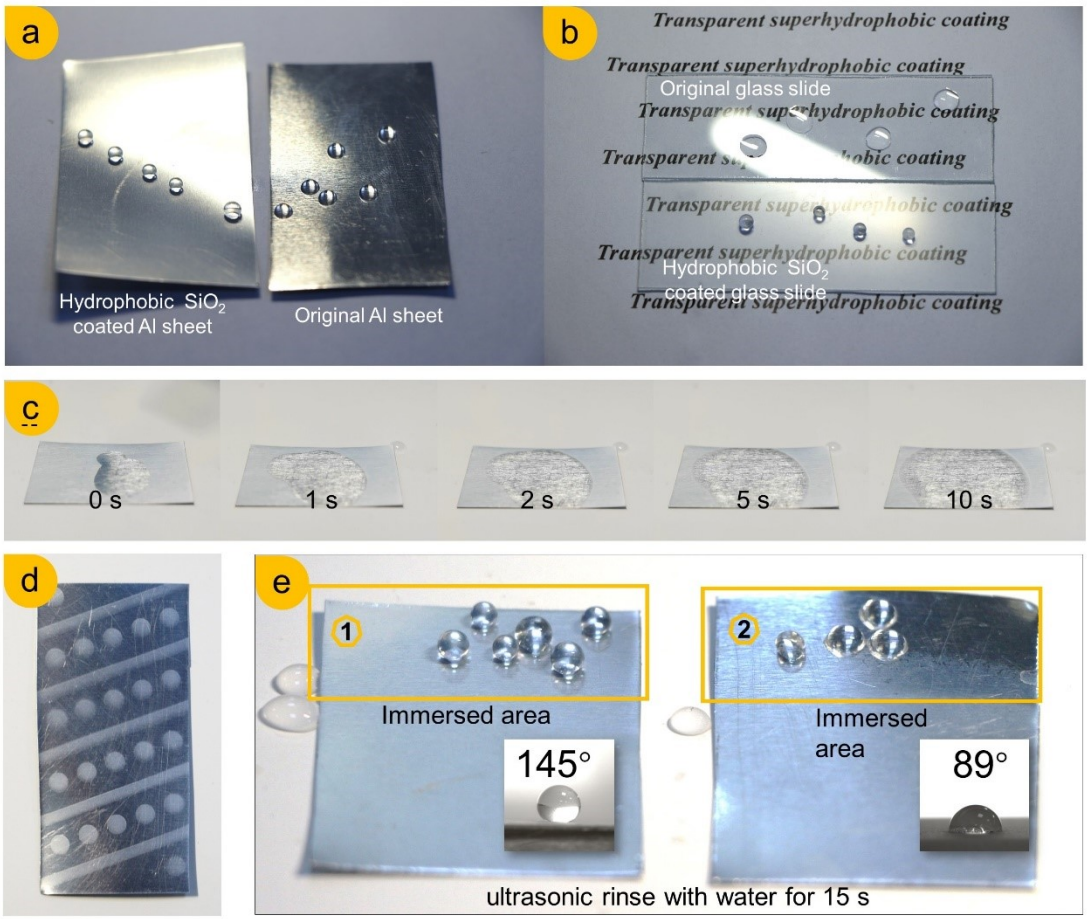

Fig. S1 Optical photographs of (a) waterdrops on the hydrophobic nano-silica coated and original aluminium sheets, (b) waterdrops on the hydrophobic nano-silica coated and original glass slides, (c) fast spreading of a waterdrop on the hydrophobic nano-silica coated surface, (d) a hybrid-patterned surface, and (e) waterdrops on the superhydrophobic surface before and after 15 s ultrasonic rinse, with WCA images insert.

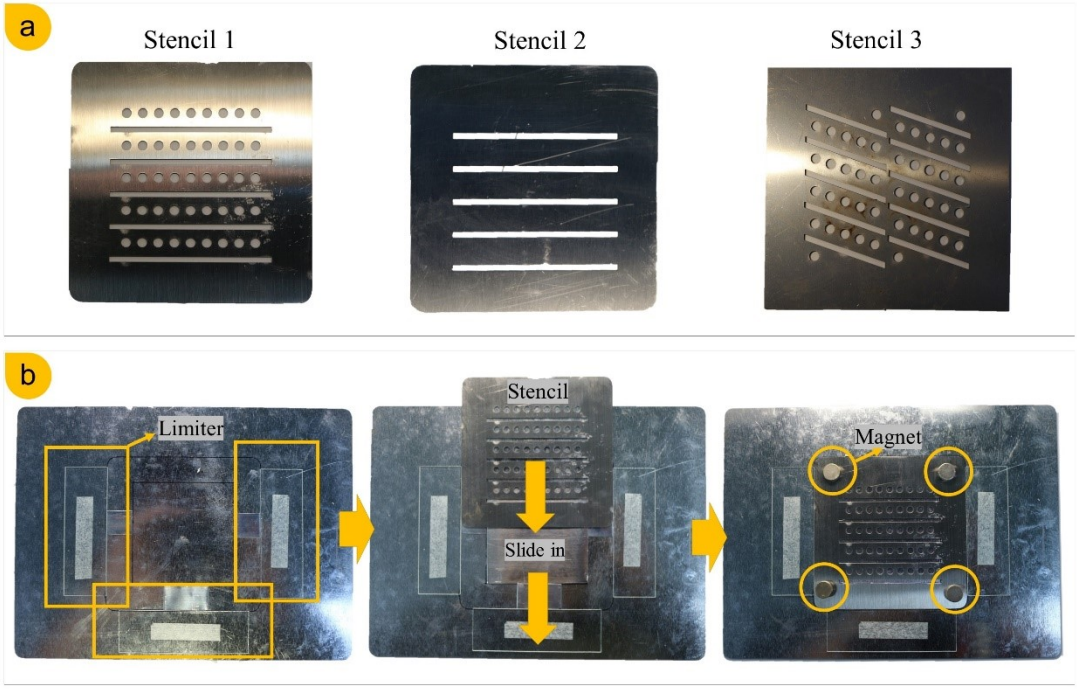

Fig. S2 Optical photographs of (a) three kinds of stencils used for pattern creation, and (b) the process of fast fixing the stencil on the stainless steel base.

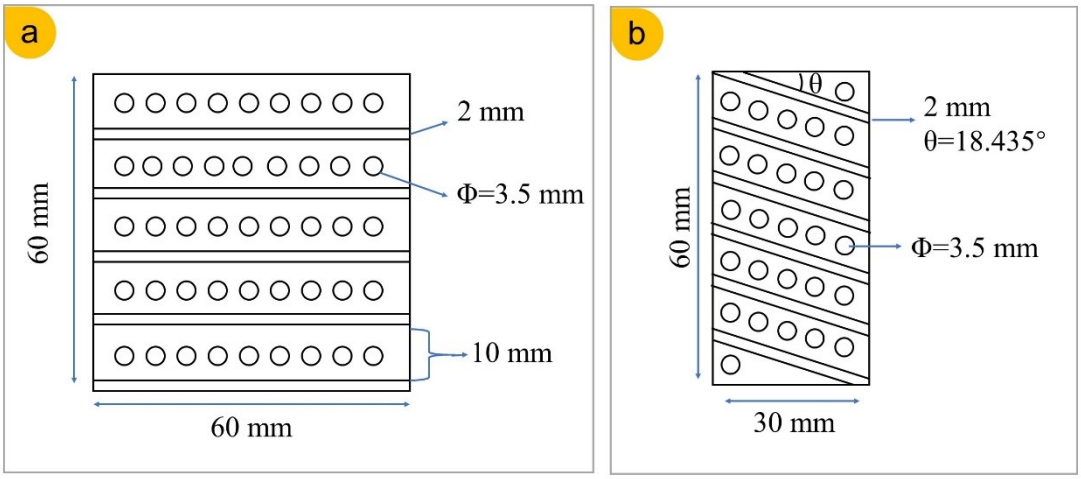

Fig. S3 Schematic diagram of the pattern distribution on (a) sample that directly used in fog harvesting test and (b) sample for assembly on the modules.

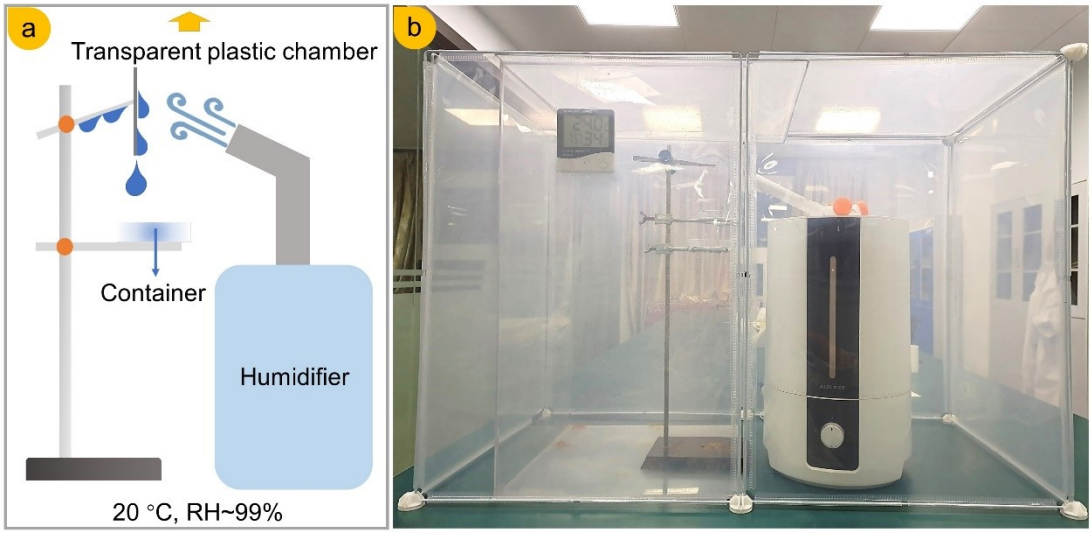

Fig. S4 (a) Schematic diagram and (b) optical photograph of our fog harvesting experimental setups.

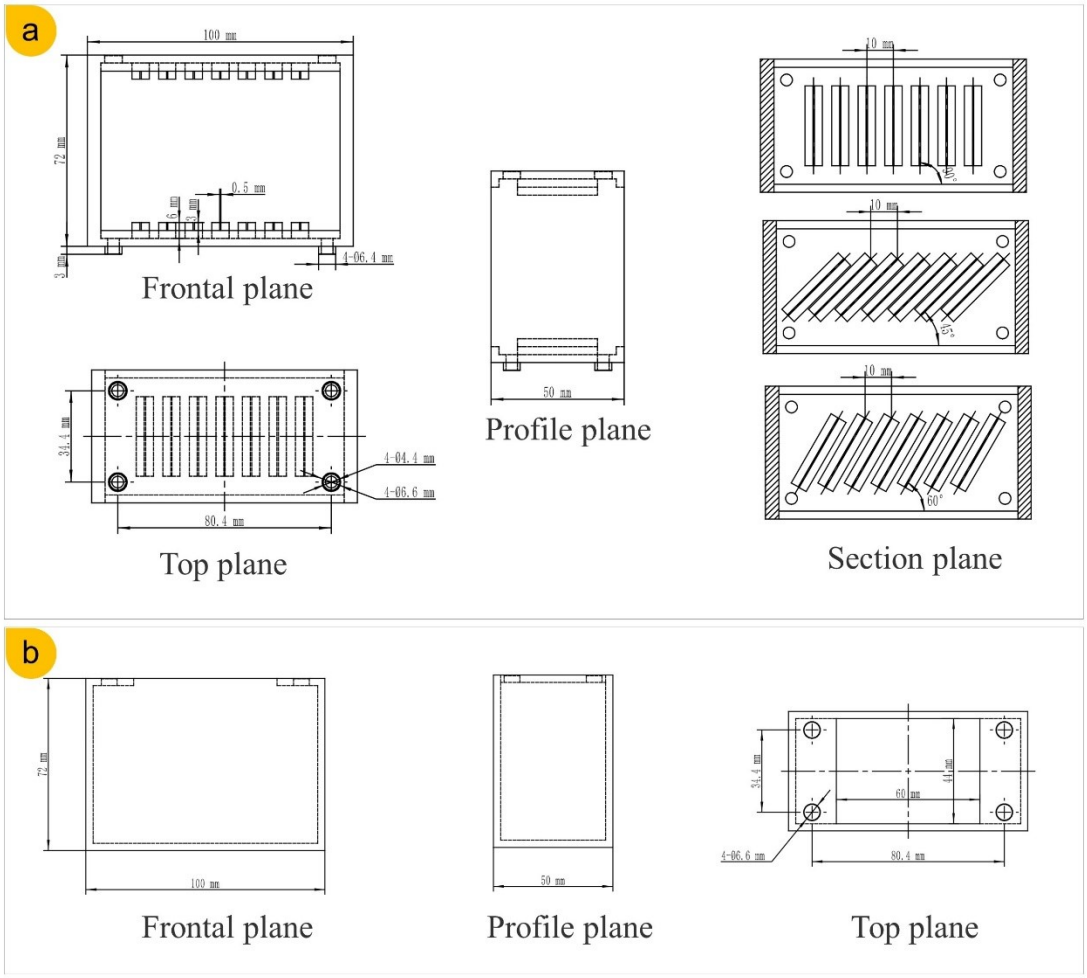

Fig. S5 Three-view drawing of (a) the water collection module and (b) the water tank module.

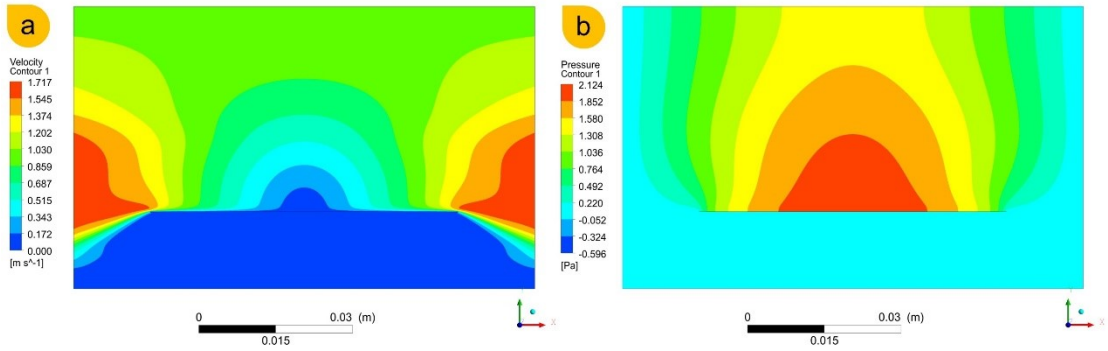

Fig. S6 (a) Velocity contour and (b) transient pressure contour in 2D fluid simulation of a fog flow hitting on a plane sample.

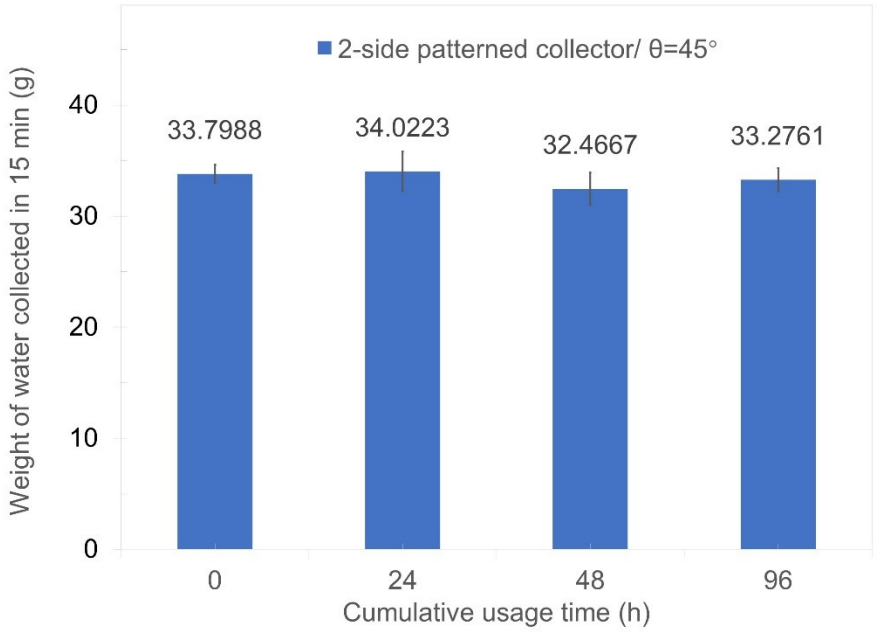

Fig. S7 The weight of water collected in 15 min by the collector (2-side patterned collector/ θ=45°) with different usage time.

Supplementary Video Information

Video 1 Waterdrops dripped on a hydrophobic nano-silica coated aluminium surface.

Video 2 Waterdrops dripped on a hydrophilic nano-silica coated aluminium surface.

Video 3 Motions of waterdrops on the hybrid-patterned surface during the fog harvesting process.

Supplementary methods

2.1 Materials

Ethyl cellulose (Shanghai Macklin Biochemical Co., Ltd.), Anhydrous ethanol (China National Medicines Corporation Ltd), methylbenzene (China National Medicines Corporation Ltd), aluminum sheet, Hydrophobic nano-silica (Aerosil®R202, primary particle size:14 nm, ≥ 99.8%, Evonik Industries AG), Hydrophilic nano-silica (primary particle size: 30±5 nm, ≥ 99.5%, Shanghai Macklin Biochemical Co., Ltd.). Other chemicals were of analytical grade and used as received.

2.2 Sample preparation

Preparation of superhydrophobic nano-silica coating 1 g ethyl cellulose (EC) was dissolved in 50 g mixed solution of toluene and ethanol (in a mass ratio of 4:1). 1g hydrophobic nano-silica was dispersed in 50g ethanol via 5 min magnetic stirring and 5 min ultrasonic dispersion.[1] the EC solution and nano-silica suspensions were spray-coated on the substrate with a spray gun (model: W101, nozzle aperture: 0.8 mm) in sequence.

Preparation of hydrophilic pattern via a stencil 0.8g hydrophilic nano-silica was dispersed in 50g ethanol via 5 min magnetic stirring and 5 min ultrasonic dispersion. 10 g EC solution was added into the hydrophilic nano-silica suspensions. The as-prepared superhydrophobic samples were placed on a base, then covered with a stainless steel stencil (Figure S2). The stencil and the base were firmly fixed with magnets. After that, the hydrophilic nano-silica suspensions were spray-coated on the sample with a spray gun (Figure S1).

Fabrication of modular water-collection devices We drew our design with SolidWorks software and printed our finished product with a commercial 3D printer (Fig S5). There are slots arranged in parallel in the device for fixing the as-prepared patterned aluminum sheets.

2.3 Fog-harvesting measurement

The prepared sample (6×6 cm^2) was fixed on the bracket vertically in a chamber. At 25 °C, a commercial humidifier was place in front of sample surface with a fixed humidity of 99%. The fog stream was blown out from the nozzle at 30° in the horizontal direction, the nozzle was 8 cm away from the center of the sample. The diameters of fog droplets are 1-5 μm. The harvested water droplets were collected with culture dish below the samples. Both the water collected on the dish and remained on the samples was counted.

2.4 Characterization

The water contact angles (WCAs) of the samples were measured by using a JC2000D system. The static WCA was measured from a 5.0 μL deionized water droplet and averaged over three different fresh spots on each sample. The droplet growth was recorded by JC2000D system, too. The microstructure and morphology of the samples were observed via field-emission scanning electron microscopy (FESEM, Zeiss Sigma500).

References

[1] Liu, J.; Wang, C.; Ewulonu, C. M.; Chen, X.; Wu, M.; Huang, Y. Fabrication of superhydrophobic and degradable cellulose paper materials for straw application. *Cellulose* **2022**, 29, 527.