Electronic Supplementary Information of Submission:

Hierarchical hydrophilic/hydrophobic cooperative fog collector possessing self-pumped droplet delivering ability

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The Electronic Supplementary Information contains: Fig. S1 to Fig. S10

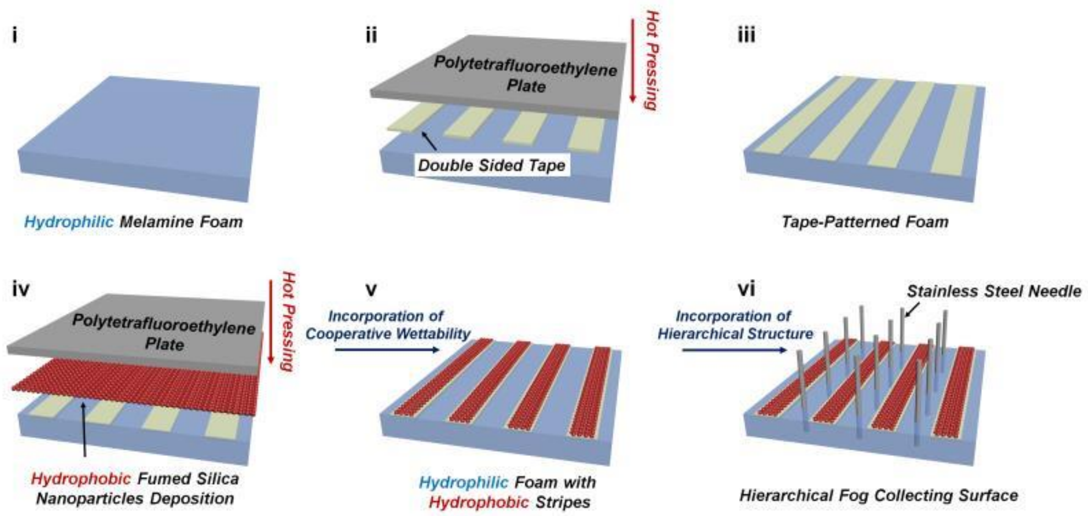

Fig. S1 The schematic diagram showed the fabrication process of hierarchical hydrophilic/hydrophobic fog collecting surface. Taking advantages of the hot pressing with PTFE plate, the hydrophilic melamine foam and the hydrophobic fumed silica nanoparticles was tightly stuck via the double-sided tape stripe. Afterwards, the fog collecting needles were inserted into the binary surface, and the 3H fog collecting surface is obtained accordingly.

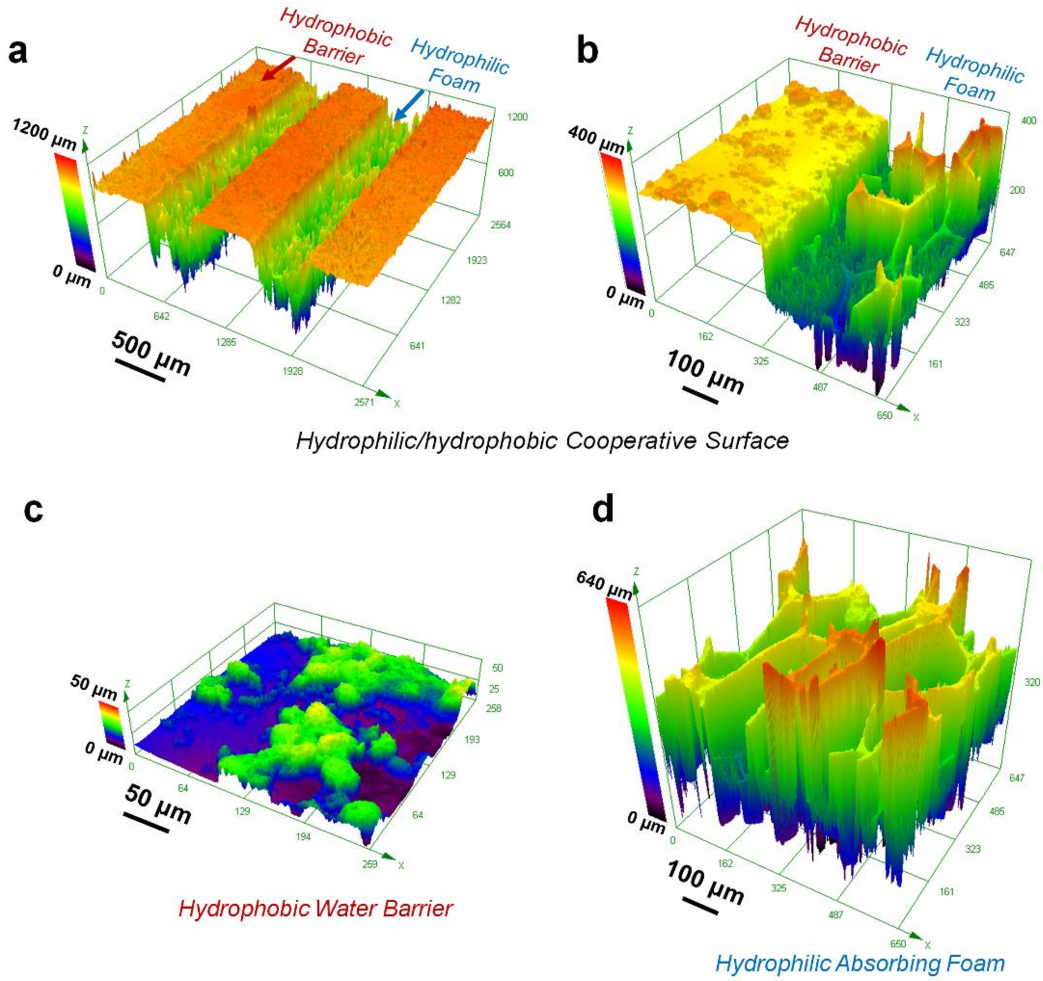

Fig. S2 The three dimensional images of hydrophobic/hydrophilic cooperative surfaces captured by a Laser Scanning Confocal Microscope (LSCM). **(a)** The overview and **(b)** the detailed images of hydrophobic/hydrophilic surfaces. The magnified image of **(c)** hydrophobic water barrier and **(d)** hydrophilic absorbing foam. The scale bars are shown in figures.

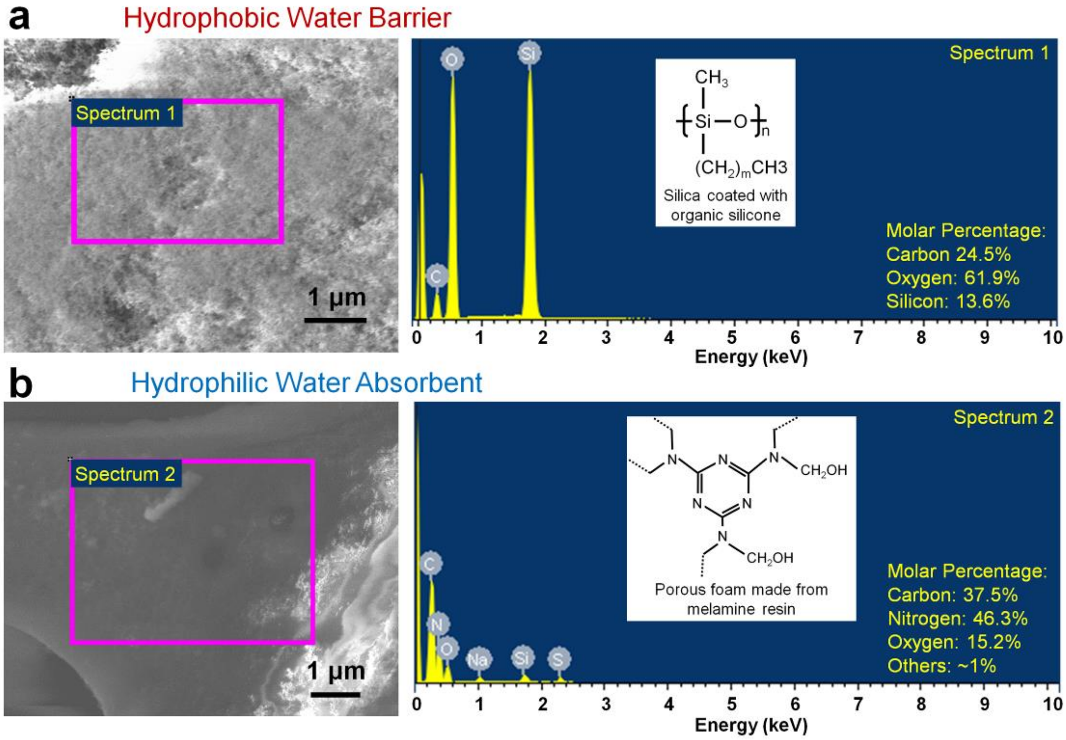

Fig. S3 The EDS analysis of **(a)** hydrophobic barriers made of fumed silica and **(b)** hydrophilic foam of melamine resin. The chemical composition and the molar percentages of various elements are revealed in the figure.

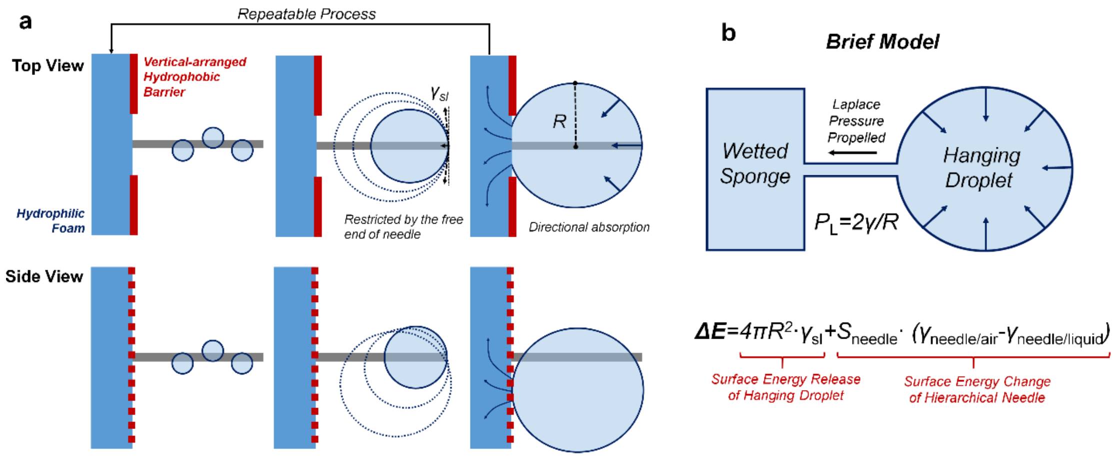

Fig. S4 (a) The details of fog collection on the needle and the directional droplet absorption. The tiny droplets were firstly capture on the needle, and then merged with each other to grow. Once the hanging droplet reaches the free end of the needle, the droplet starts to enlarge toward the sponge due to the restriction from surface tension at the air/liquid interface. In final, the hanging droplet would contact with the hydrophilic site of patterned sponge, and the directional droplet absorption can be fulfilled propelled by surface energy of the spherical droplet. This is a fully repeatable process after the droplet uptake. **(b)** A brief model of the Laplace pressure propulsion are illustrated. The spherical droplets possesses sufficient surface energy. This surface energy can be directionally released while the droplet was connected with a hydrophilic porous structure. With respect to the surface tension, the Laplace pressure resulted from spherical air/water interface is obviously larger than that resulted from a wetted sponge (confined liquid), which facilitates a directional liquid transport. The total energy change of the droplet uptake (***ΔE***) can be attribute to the surface energy release of hanging droplet ($4\pi R^2\cdot\gamma_{sl}$) and the energy change of wetting state of steel needle [$S_{needle}\cdot(\gamma_{needle/air}-\gamma_{needle/liquid})$]. Where R is the radius of droplets, γ_{sl}, $\gamma_{needle/air}$, *and* $\gamma_{needle/liquid}$ is the surface tension of air/water, needle-surface/air, and needle-surface/water interfaces. The S_{needle} represents the surface area of the needle.

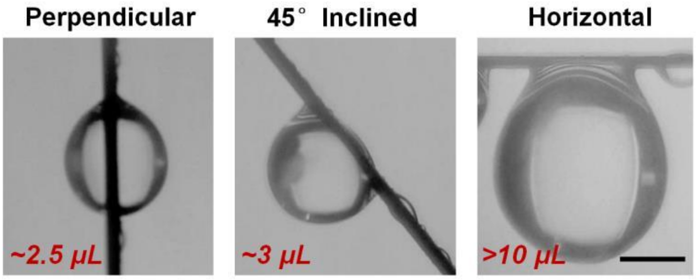

Fig. S5 The in situ optical microscopic observation of the maximum droplet hanging on the stainless needle at various angles. The needle was exposed in the fog with the inclined angles of 0°, 45°, and 90°, and the maximum volume of water hanging was estimated as 2.5, 3 and 10 μL respectively. Scale bar is 1 mm.

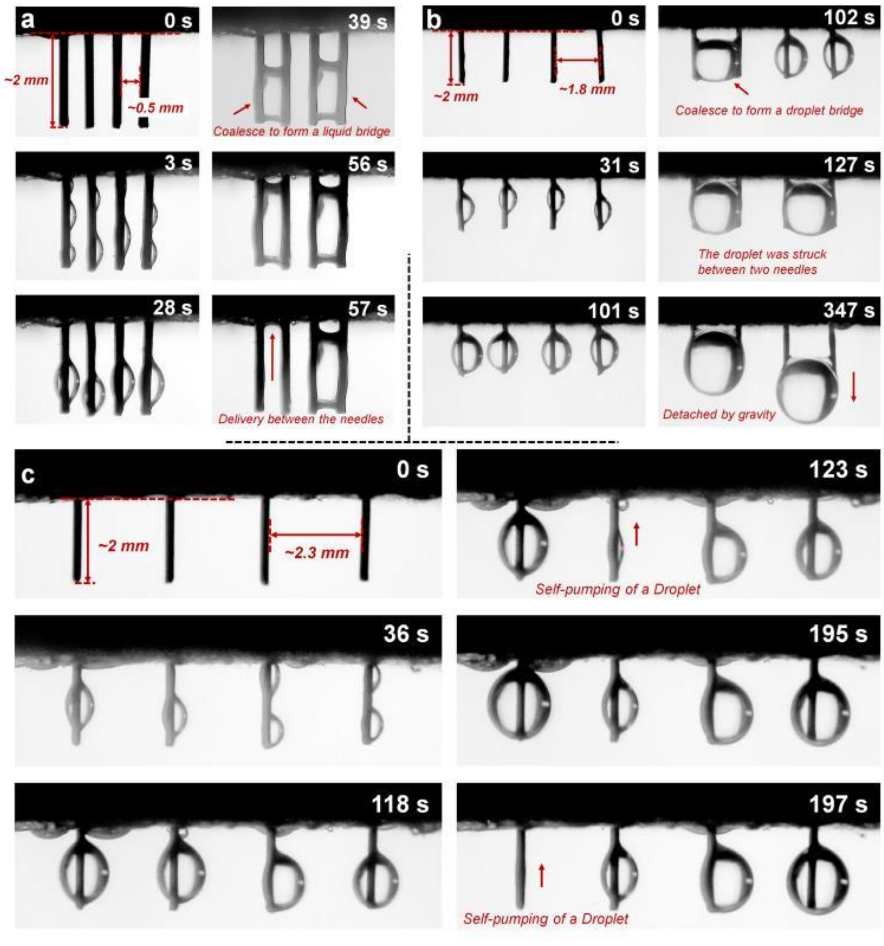

Fig. S6 The appropriate distance between two neighboring needles was investigated. The hierarchical fog collecting surface was placed downwards, and 2 mm needles were assembled with arranged distances. (a) With the distance shorter than 0.5 mm, the collected water coalesces to form a liquid bridge and moves between the needles. (b) The droplet will coalesce with the interval of 1.8mm. Due to the wider distance, the droplet grows so large that it was struck and pulled by gravity at last. (c) As the distance became wider than 2.3mm, droplets hanging on the needles can be uplifted independently, revealing an ideal distance for designing the 3H surface.

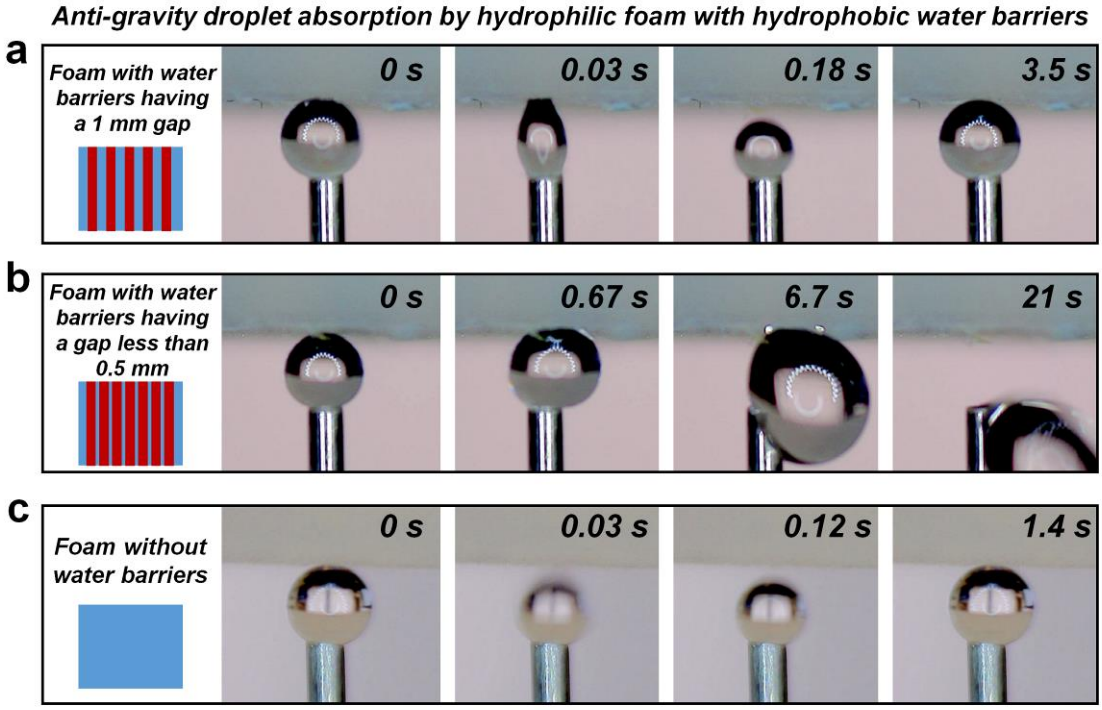

Fig. S7 The penetration behaviors of different surface was recorded by a magnified camera. A droplet supplying needle was settled vertically to the lower side of the surfaces. (a) A droplet was easily absorbed by the foam with hydrophobic stripes having a 1 mm gap in a very short time (0.03s). (b) In comparison, droplet cannot penetrate the foam surface with the barrier gap less than 0.5 mm. Therefore, the appropriate interval between two barriers is about 0.5~1 mm. (c) The foam without water barriers exhibits no penetrating resistance for a single droplet.

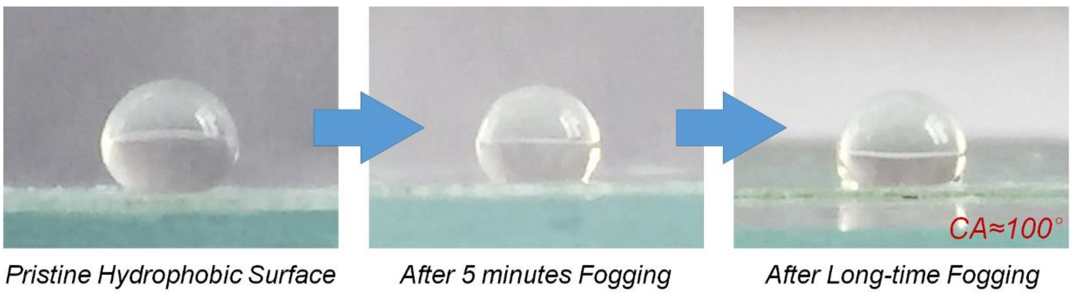

Figure S8. The evolution of hydrophobic stripe during the fogging process. It can been seen that the hydrophobicity of the surface was gradually reduced, arising from the vapor condensation. However, the stripe can keep water repellecy with a contact angle about 100°, which is enough to achieve the directional liquid transport, i.e., the droplet can rapidly transfer from the stripe to the superhydrophilic sponge.

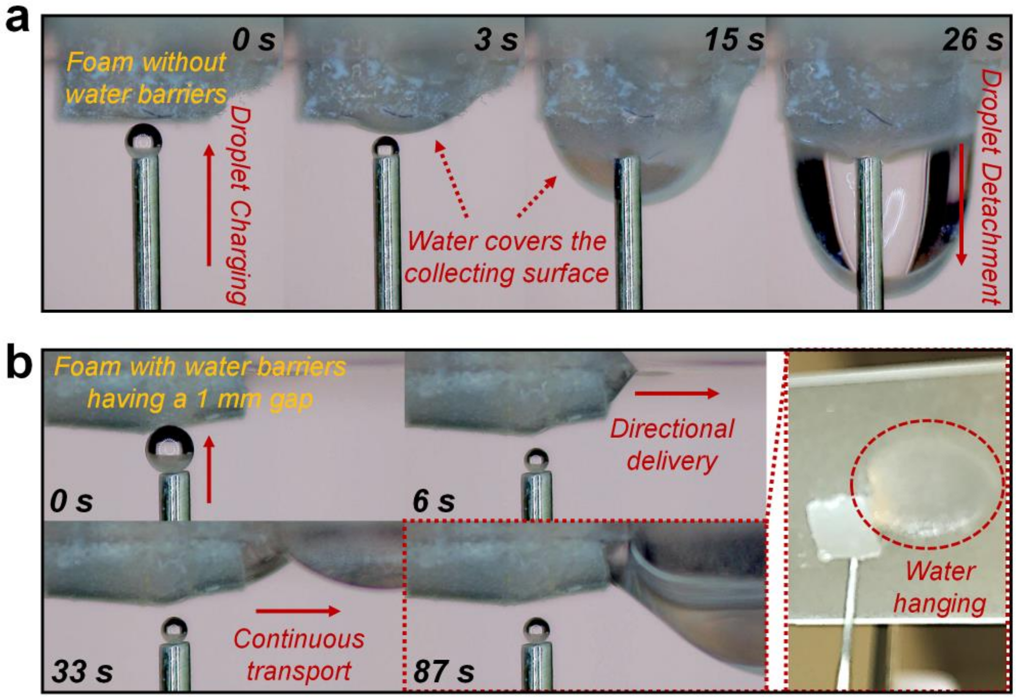

Fig. S9 The continuous droplets delivery on the fog collecting surface. (a) Without the water barriers, the charged water will cover and detach from the surface directly, which shows no self-pumped liquid transporting behavior. (b) After the incorporation of the hydrophobic water barriers, the pathway of water delivery is optimized. More importantly, the droplet can directionally move away from the surface, resulting in the release of fresh fog collecting surface. This design guarantees that the fog collecting surface remains unchanged during the fog collection.

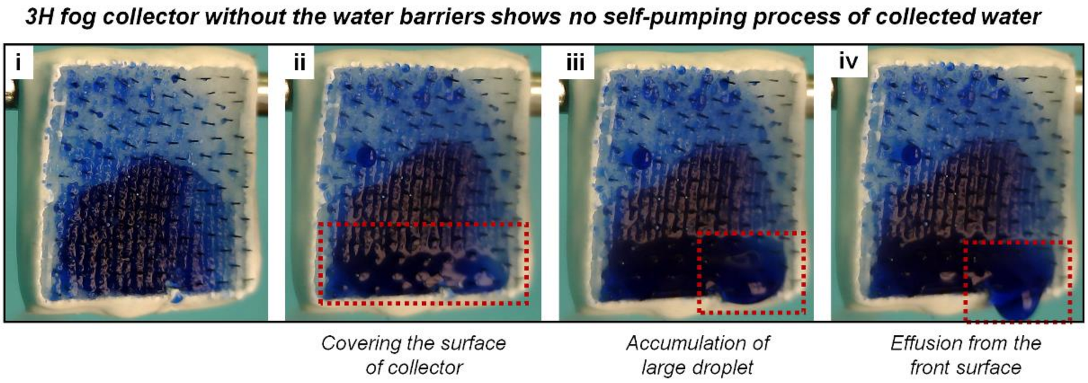

Fig. S10 The plate-shape fog collector without hydrophobic water barriers shows no self-pumped droplet delivery. Therefore, the collected water cannot drain from the water pipe. Alternatively, the collected water gradually covers and then effuses from the front surface of fog collector.