Supporting Information

Hyperphilic/hydrophobic hybridized surfaces for efficient fog harvesting

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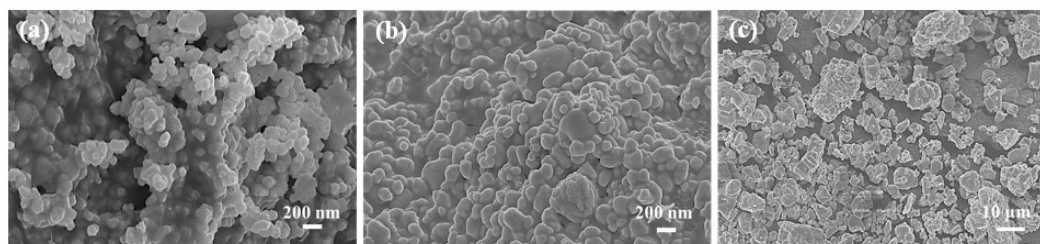Email addresses: zguo@licp.cas.cn (Z. Guo)*

**Additional data and figures:**



**Fig. S1.** (a) The SEM images of $ZrO_2$ nanoparticles at 30000 multiples. (b) The SEM images of $Cu_2O$ nanoparticles at 10000 multiples. (c) The SEM images of CuO microparticles at 5000 multiples.
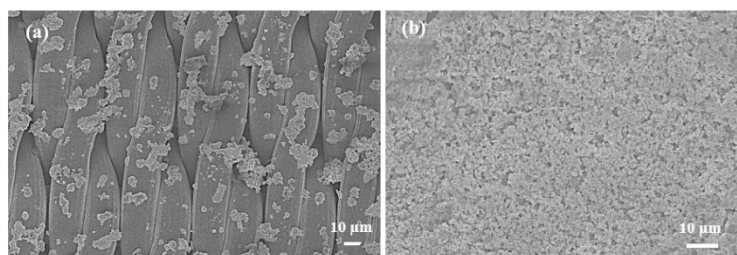


**Fig. S2.** (a) The SEM images of $ZrO_2$ and $CuO/CuO_2$ particles in a 1:0 ratio before modification at 1000 magnification. (b) The SEM images of $ZrO_2$ and $CuO/CuO_2$ particles in a 3:1 ratio before modification at 1000 magnification.
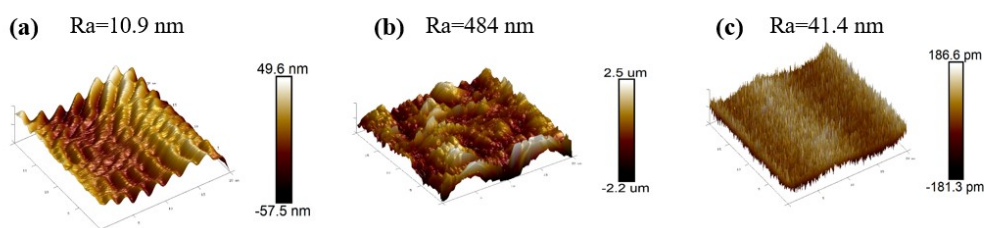
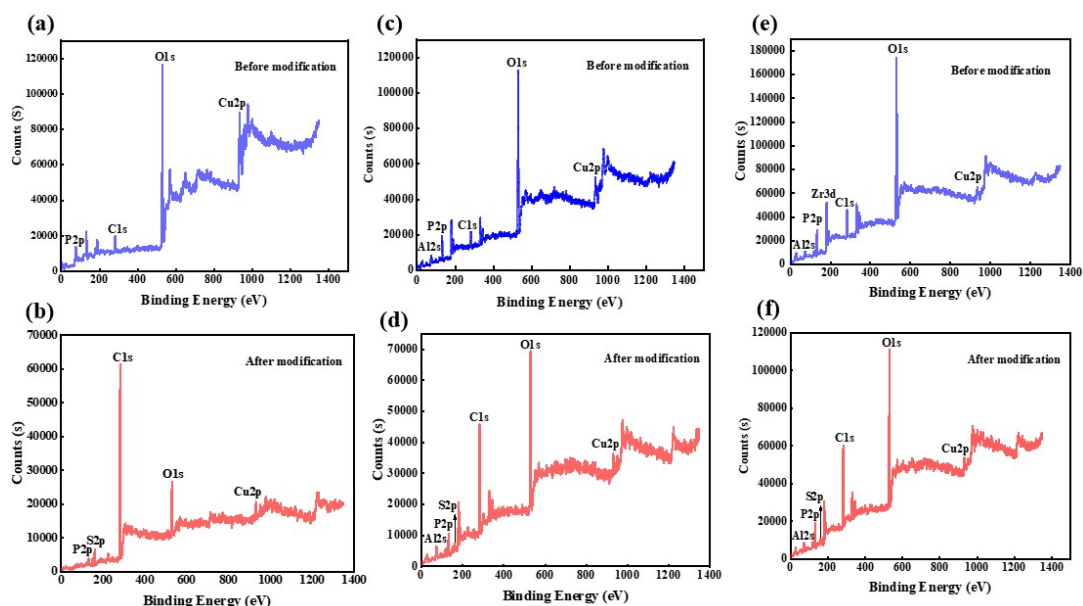**Fig. S3.** AFM images of SOH, ssm-4, and SLH.



**Fig. S4.** (a)-(f) XPS patterns before and after 3:1, 6:1, and 9:1 modified by ODT, respectively.
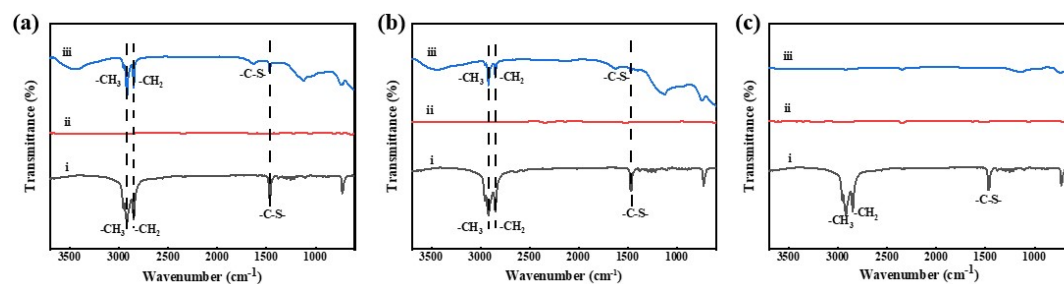


**Fig. S5.** (a) i is the IR spectrum of ODT, ii-iii are the IR spectra of 3:1 before and after modification by ODT, respectively. (b) i is the IR spectrum of ODT, ii-iii are the IR spectra of 6:1 before and after modification by ODT, respectively. (c) i is the IR spectrum of ODT, ii- iii are the IR spectra of 9:1 before and after modification by ODT, respectively
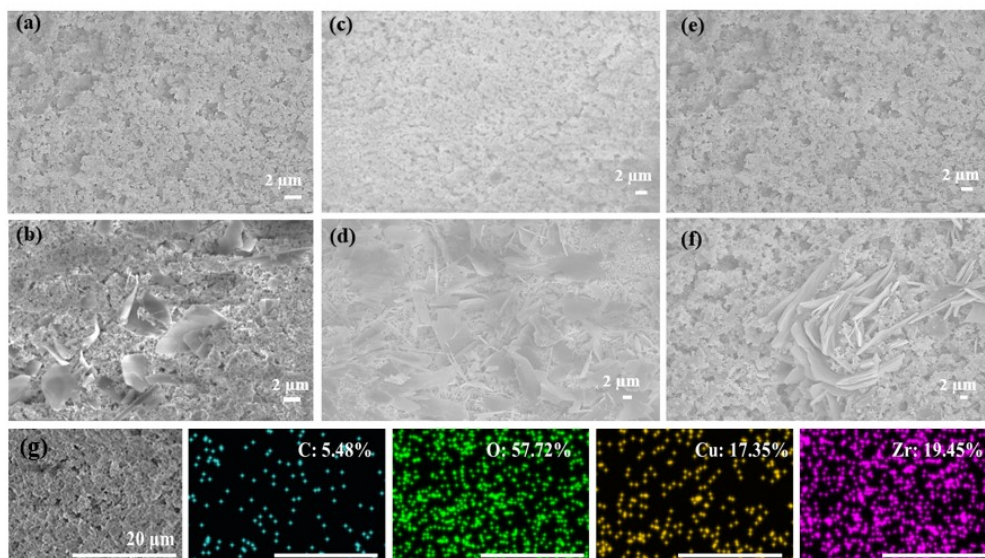
**Fig. S6.** (a)-(b) The SEM images of $ZrO_2$ and $CuO/CuO_2$ particles with 1:1 ratio before and after retouching. (c)-(d) The SEM images of $ZrO_2$ and $CuO/CuO_2$ particles with 3:1 ratio before and after retouching. (e)-(f) The SEM images of $ZrO_2$ and $CuO/CuO_2$ particles with 6:1 ratio before and after retouching. (g) The EDS images of $ZrO_2$ and $CuO/CuO_2$ particles with 4:1 ratio before retouching.

**Table S1.** Water-gas contact angle values and oil-water contact angle values of mixed particles sprayed with different mass ratios of $ZrO_2$ and $CuO/Cu_2O$ (0:1, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, and 1:0) after heat curing ODT modification.

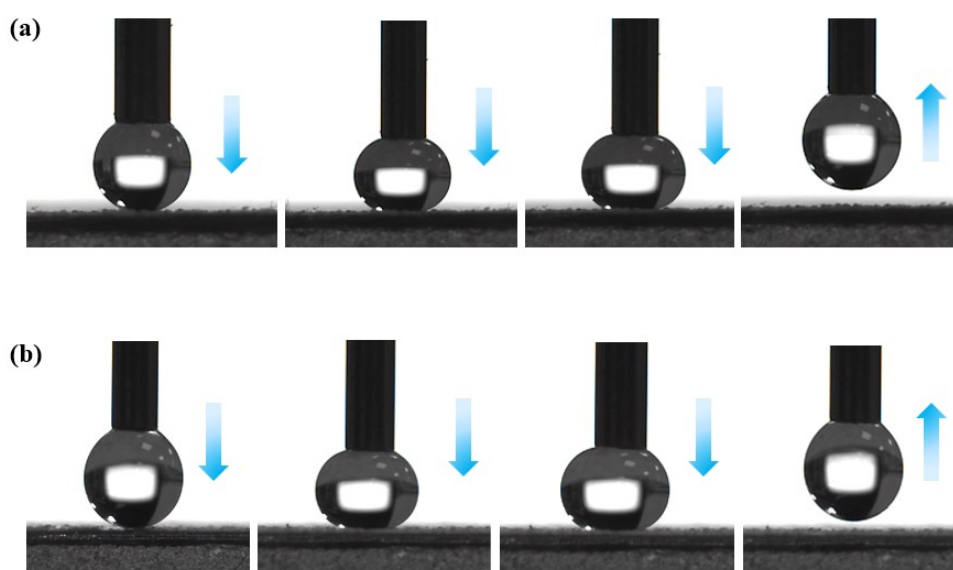| Precursor [ZrO$_2$:CuO/Cu$_2$O] | WCA/° (Before modification) | WCA/° (After modification) | WCA/° (After modification) |
|---|---|---|---|
| 0:1 | 0 | 0 | 160 |
| 1:1 | 0 | 140 | 110 |
| 2:1 | 0 | 139 | 129 |
| 3:1 | 0 | 149 | 157 |
| 4:1 | 0 | 158 | 160 |
| 5:1 | 0 | 150 | 156 |
| 6:1 | 0 | 135 | 152 |
| 7:1 | 0 | 91 | 155 |
| 8:1 | 0 | 21 | 159 |
| 9:1 | 0 | 20 | 159 |
| 1:0 | 0 | 153 | 0 |



**Fig. S7.** (a)-(b) superhydrophobic behavior of ssm-3 and ssm-4.
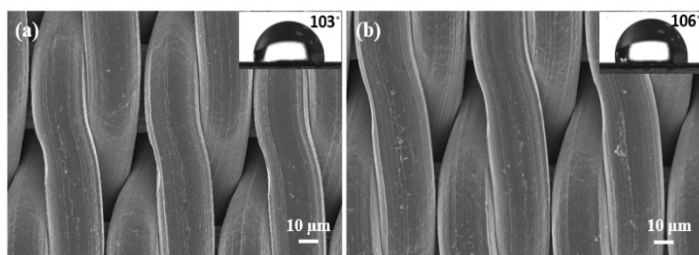
**Fig. S8.** (a)-(b) SEM patterns of surface morphology and wettability changes of ssm before and after modification by ODT.
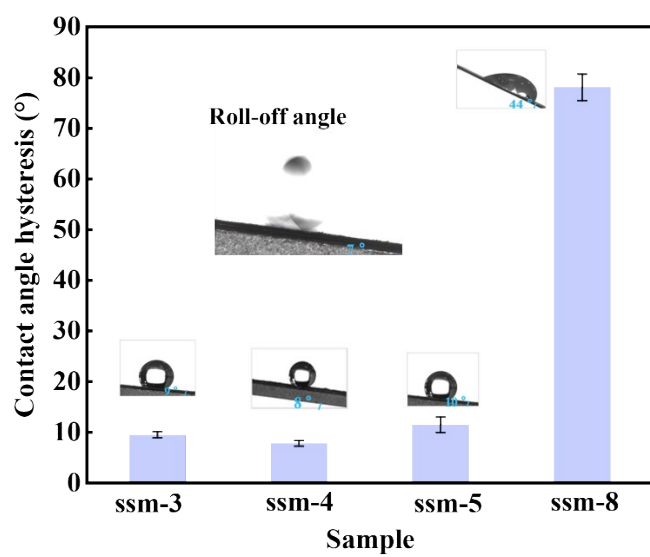


**Fig. S9.** The contact angle hysteresis of the samples.

**Table S2.** Fog harvesting testing in real-world conditions

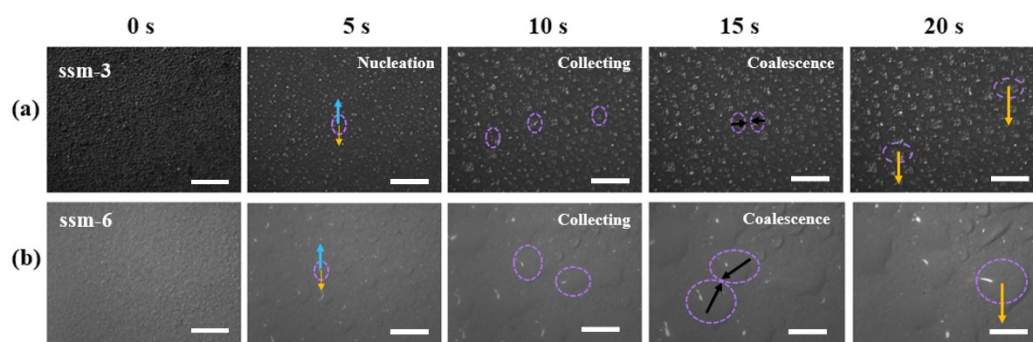| Test Date | Humidity | Fog Flow Velocity | Temperature | Fog Harvesting Efficiency |
|-----------|----------|-------------------|-------------|---------------------------|
| 2025.03.15 | 92% | 3~5 m·s$^{-1}$ | 12 ℃ | 0.467 g·cm$^{-2}$·min$^{-1}$ |
| 2025.03.16 | 57% | 1.5-3.3 m·s$^{-1}$ | 15 ℃ | 0.061 g·cm$^{-2}$·min$^{-1}$ |
| 2025.03.17 | 74% | 1.47~2.33 m·s$^{-1}$ | 16 ℃ | 0.057 g·cm$^{-2}$·min$^{-1}$ |
| 2025.03.18 | 67% | 1.83~2.24 m·s$^{-1}$ | 12 ℃ | 0.072 g·cm$^{-2}$·min$^{-1}$ |
| 2025.03.19 | 79% | 3~3.5 m·s$^{-1}$ | 14 ℃ | 0.092 g·cm$^{-2}$·min$^{-1}$ |
| 2025.03.20 | 82% | 2.11~2.54 m·s$^{-1}$ | 16℃ | 0.085 g·cm$^{-2}$·min$^{-1}$ |



**Fig. S10.** (a)-(b) Optical photographs of the mist trapping process on the superhydrophilic/superhydrophobic hybridized surfaces of ssm-3, ssm-6 at 0, 5, 10, 15, and 20 s. Scale: 0.5 cm.
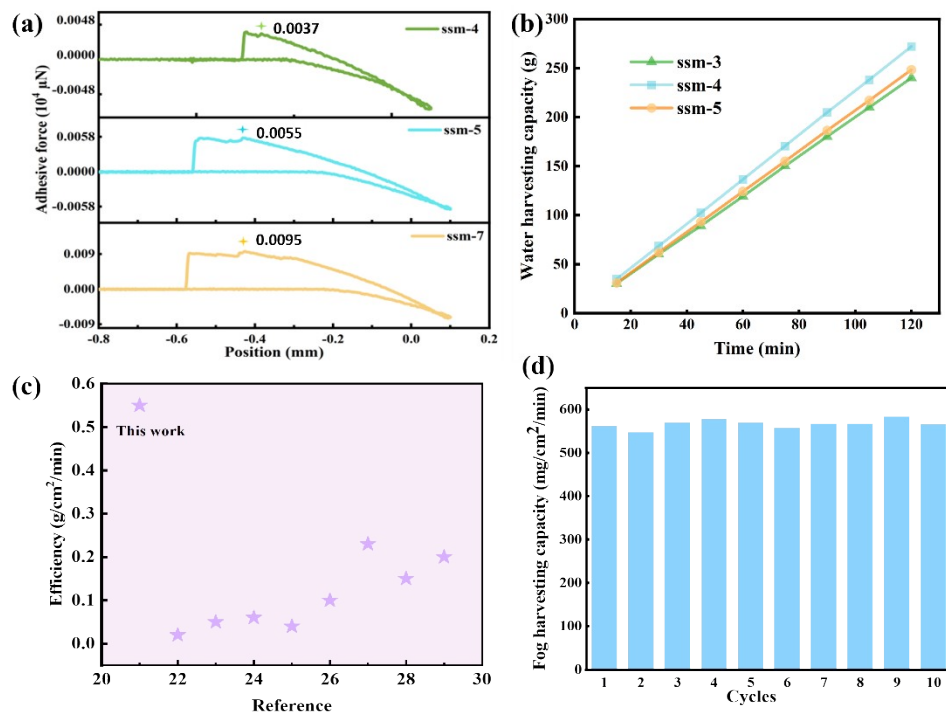
**Fig. S11.** (a) The adhesion test chart of ssm-4, ssm-5, and ssm-7. (b) Stability test of ssm-3, ssm-4, and ssm-5. (c) Comparison of fog harvesting efficiency between our work and similar systems. (d) Durability test of ssm-4 sample.
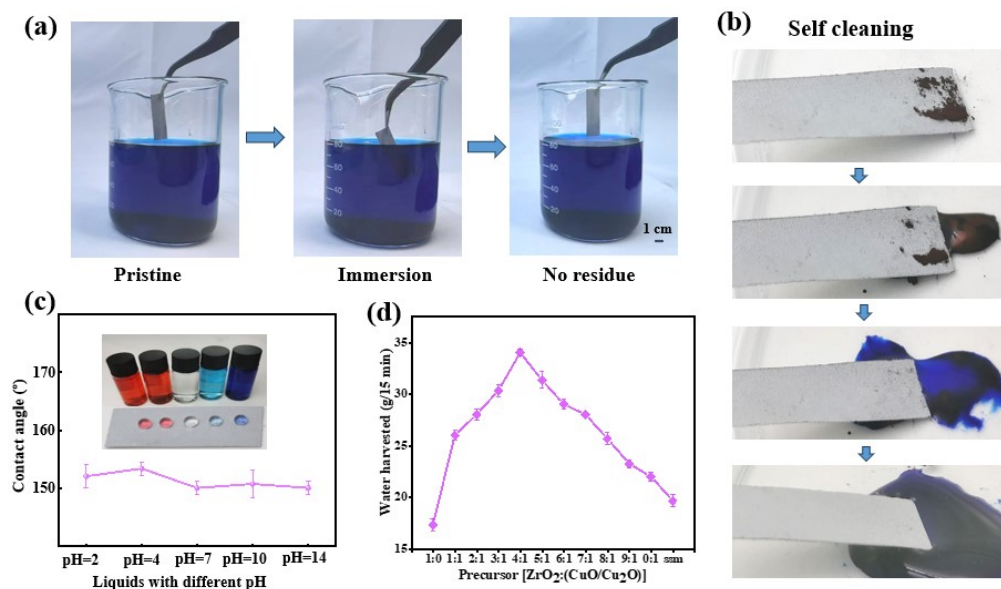


**Fig. S12.** Durability test of ssm-4. (a) The appearance of the ssm-4 surface being immersed and removed from the water. (b) Self-cleaning effect of the ssm-4 surface. (c) The appearance WCA and OCA of the ssm-4 surface in the solution of different pH. (d) Amount of water harvested by various superwetting sample surfaces within 15 min.
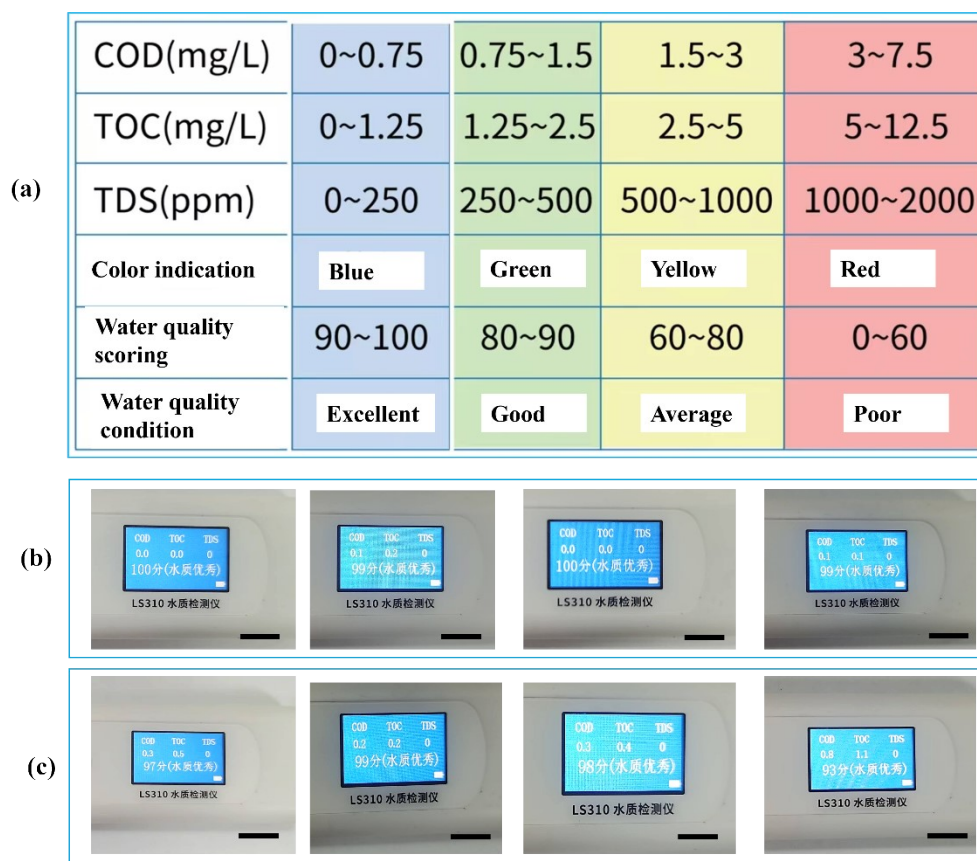
| COD(mg/L) | 0~0.75 | 0.75~1.5 | 1.5~3 | 3~7.5 |
|---|---|---|---|---|
| TOC(mg/L) | 0~1.25 | 1.25~2.5 | 2.5~5 | 5~12.5 |
| TDS(ppm) | 0~250 | 250~500 | 500~1000 | 1000~2000 |
| Color indication | Blue | Green | Yellow | Red |
| Water quality scoring | 90~100 | 80~90 | 60~80 | 0~60 |
| Water quality condition | Excellent | Good | Average | Poor |

**Fig. S13.** Assessment of water quality before and after fog harvesting. (a) Water quality standard table for LS310 water quality analyzer. (b) Water quality in the fog harvesting device. (c) Water quality in the fog harvesting of ssm-4. Scale: 1 cm.