Electronic Supporting Information

Alternating nanoscale (hydrophilic-hydrophobic)/hydrophilic Janus cooperative copper mesh fabricated by a simple liquidus modification for efficient fog harvesting.

Lieshuang Zhong ‡[a,b], Jing Feng ‡[a,b], and Zhiguang Guo *[a,b]

[a]Hubei Collaborative Innovation Centre for Advanced Organic Chemical Materials and Ministry of Education Key Laboratory for the Green Preparation and Application of Functional Materials, Hubei University, Wuhan, People's Republic of China.
[b]State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Lanzhou, People's Republic of China.
**Corresponding author. Tel: 0086-931-4968105; Fax: 0086-931-8277088. Email address: zguo@licp.cas.cn (Guo)*
‡These authors contributed equally to this work.

Contents:

1. Additional data and figures

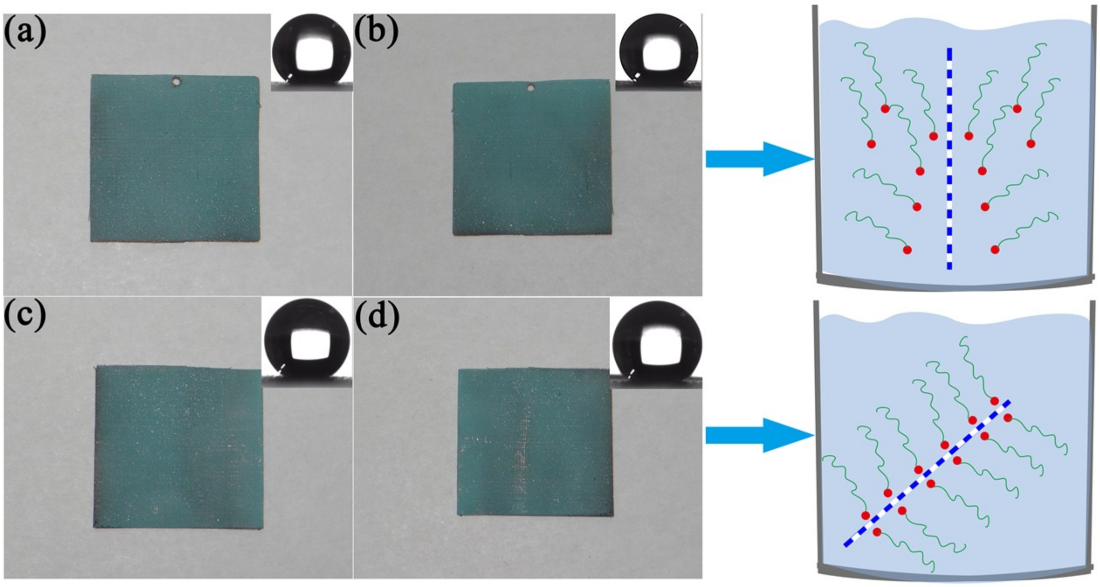

Figure S1. Schematic illustrations and photographs of the two sides of a copper mesh modified with a certain position in 0.5mM 1-Octadecanethiol /ethanol solution. a) and b) represents photos of two sides of copper mesh covered by $Cu(OH)_2$ nanoribbons placed vertically in the middle of the beaker during modification. c) and d) shows photos of two sides of copper mesh covered by $Cu(OH)_2$ nanoribbons placed at 45° to the bottom of the beaker. The small image in the upper right corner represents the water contact angle of two sides of each sample.

As shown in Fig. S1, when the sample was placed vertically in the middle of the beaker or tilted at 45° to the bottom of the beaker, the wettability of two sides of the copper mesh was not significantly different, which could be reflected by the values of water contact angle. When it was placed vertically, the water contact angles of two sides of the copper mesh were 140° and 138.5°, respectively. Similarly, when it was tilted at 45° to the bottom of the beaker, the water contact angles of two sides of the copper mesh were 143.5° and 138°, respectively. Nevertheless, when the sample was placed horizontally at the bottom of the beaker, the wettability of two sides of the copper mesh was obviously different, one side showed hydrophobic/hydrophilic (water contact angle was 137.5°, oil water contact angle was 144.5°, and the other side represented hydrophilic (water contact angle was 37.5°). This phenomenon indicated that special position of substrate and low concentration of modifier together were the keys to achieve cooperative alternating wettability and asymmetric wettability on a copper mesh by virtue of a simple liquidus surface modification.

Table S1. Average water contact angle (WCA) and oil contact angle (OCA) on both sides of the sample modified by 0.1-2mM concentration 1-Octadecanethiol /ethanol solution. O-CM represents the obverse side of the nanoribbons-like structured $Cu(OH)_2$ sample modified by 1-Octadecanethiol /ethanol solution and R-CM represents the reverse side of that.

modifier concentration/mM	WCA(O-CM)/°	OCA(O-CM)/°	WCA(R-CM)/°	OCA(R-CM)/°
0.1	0	153	0	161.5
0.2	0	151	0	158
0.3	0	150	0	154
0.4	134	148	32.5	151.5
0.5	137.5	144.5	37.5	150
0.6	145	141.5	66	139.5
0.7	148	71	79.5	84
0.8	150	56	106.5	50.5
0.9	153	48	120	46.5
1.0	155	33	143	23
2.0	158	0	156	0

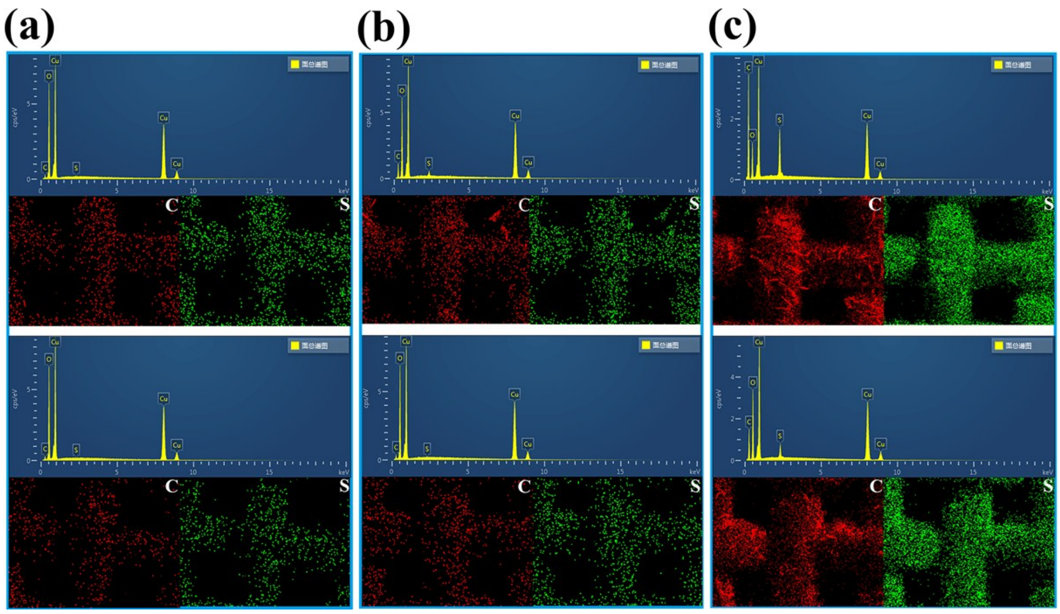

Figure S2. a) EDS spectrum of the unmodified copper mesh two sides grown with $Cu(OH)_2$ nanoribbons. b) EDS spectrum of the two sides of copper mesh grown with $Cu(OH)_2$ nanoribbons modified by 0.5mM 1-Octadecanethiol /ethanol solution. c) EDS spectrum of the two sides of sample modified by 2mM 1-Octadecanethiol /ethanol solution.

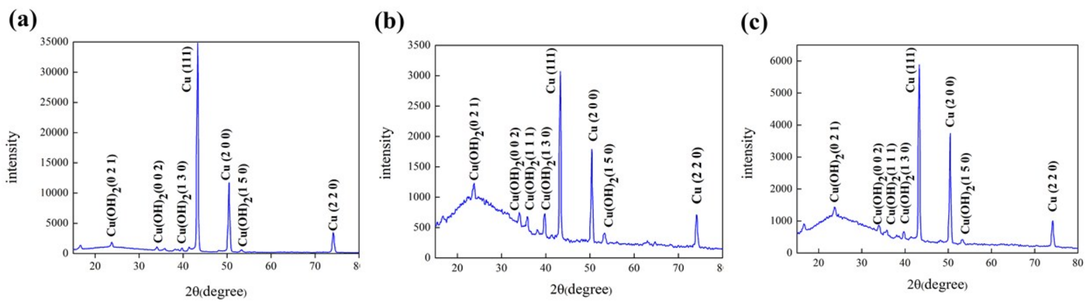

Figure S3. a) XRD pattern of the nanoribbons-like structured $Cu(OH)_2$ sample. b) XRD pattern of the obverse side of the nanoribbons-like structured $Cu(OH)_2$ sample modified by 0.5mM 1-Octadecanethiol /ethanol solution. c) XRD pattern of the reverse side of the nanoribbons-like structured $Cu(OH)_2$ sample modified by 0.5mM 1-Octadecanethiol /ethanol solution.

From the three pictures, it could be seen that when the sample was not modified, the peak value of copper was higher because it was not covered by 1-Octadecanethiol /ethanol solution. This indicated that the XRD spectra of unmodified and modified samples were significantly different. Beyond that, the XRD pattern of the obverse side and reverse side of the nanoribbons-like structured $Cu(OH)_2$ sample was obvious different under the same modifier concentration and the same modification position. Comparing with b and c, the copper peak value of the obverse side of sample was lower than that of the reverse side of sample. The obverse side of the nanoribbons-like structured $Cu(OH)_2$ sample covered with more 1-Octadecanethiol /ethanol solution decreased its peak copper absorption substantially.

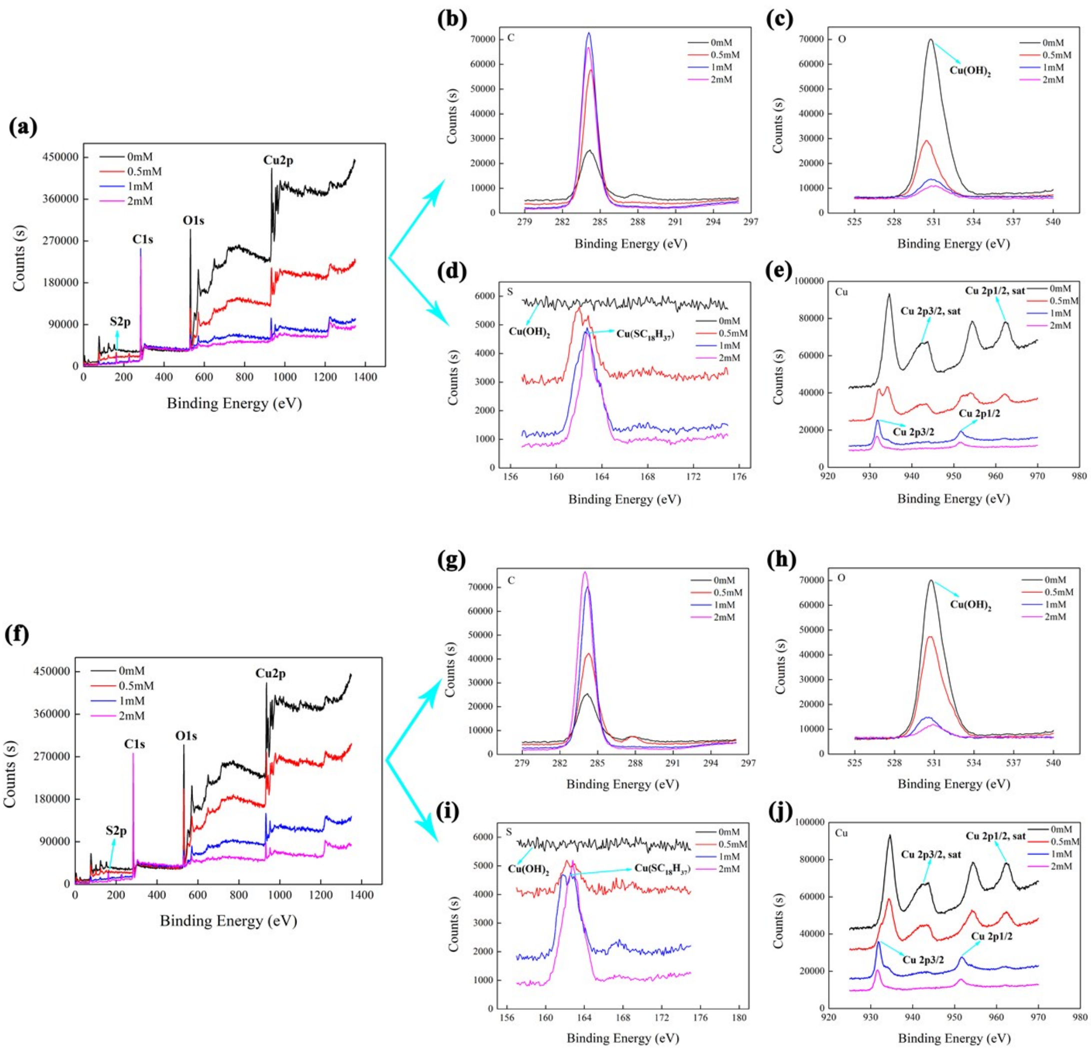

Figure S4. XPS survey spectrum of the obverse side (a-e) and reverse side (f-j) of the nanoribbons-like structured $Cu(OH)_2$ sample modified by 0mM, 0.5mM, 1mM, 2mM concentration 1-Octadecanethiol /ethanol solution.

XPS survey spectrum, especially Cu 2p XPS spectra, was an effective characterization method, which could prove that the obverse of the sample modified by 0.5mM concentration 1-Octadecanethiol /ethanol solution was equipped with alternating hydrophobic/hydrophilic chemistry pattern. As shown in Fig. S4e, the unmodified nanoribbons-like structured $Cu(OH)_2$ sample exhibited Cu 2p 3/2, Cu 2p 3/2,sat , Cu 2p 1/2, and Cu 2p 1/2,sat peaks at 932.5, 943.3, 952.7, and 962.6 eV, respectively.[1, 2] The Cu 2p 3/2,sat and Cu 2p 1/2,sat peaks consistent with the superhydrophilic $Cu(OH)_2$ were gradually weakened on account of being modified with 1-Octadecanethiol /ethanol solution, until disappearing completely with excessive mercaptan. The four peaks all existed in the sample modified by 0.5mM 1-Octadecanethiol /ethanol solution, but Cu 2p 3/2,sat and Cu 2p 1/2,sat peaks intensity were obvious weakened.

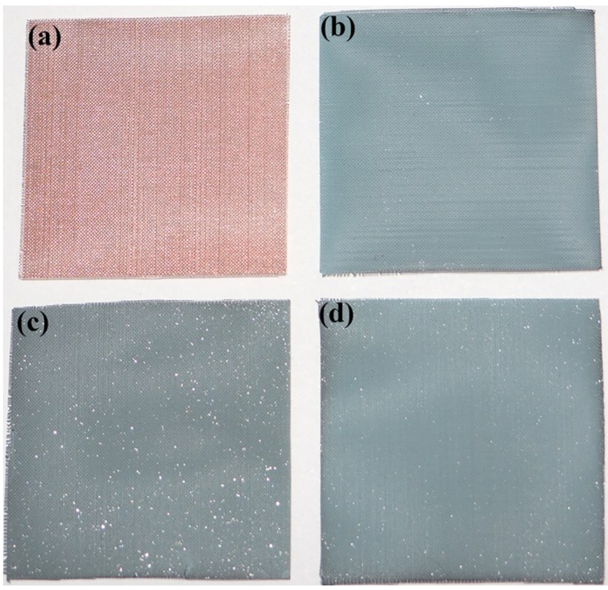

Figure S5. a) Photograph of original copper mesh showing yellow color. b) Picture of nanoribbons-like structured $Cu(OH)_2$ sample representing blue color. c) and d) Photographs of the obverse side and reverse side of the nanoribbons-like structured $Cu(OH)_2$ sample placed horizontally in the bottom of the beaker after 0.5mM 1-Octadecanethiol /ethanol solution modification.

From a and b figures, the original copper mesh was yellow, while the copper mesh grown with $Cu(OH)_2$ nanoribbon was blue. When nanoribbons-like structured $Cu(OH)_2$ sample was modified by 1-Octadecanethiol /ethanol solution, the sample surface showed something shiny, that was mercaptan. As shown in c and d figures, the mercaptan content of the obverse side of sample was higher than that of the reverse side of sample.

References

1. L. Tie, J. Li, M. Liu, Z. Guo, Y. Liang and W. Liu, *J. Mater. Chem. A*, 2018, **6**, 11682-11687.

2. W. Yang, J. Li, P. Zhou, L. Zhu and H. Tang, *Chem. Eng. J.*, 2017, **327**, 849-854.