Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supplementary Materials

A novel route to fabricate superhydrophobic surface on copper substrate without additional low surface energy materials

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1. Appearance of electrolyte system

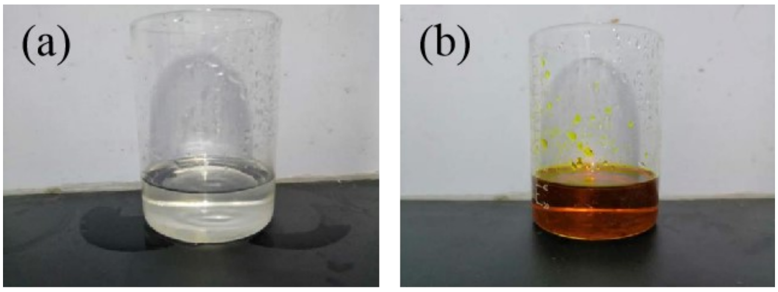

Fig. S1. Appearance of the deep eutectic solvent:

(a) without $CuCl_2 \cdot 2H_2O$; (b) with $CuCl_2 \cdot 2H_2O$

After the addition of 0.2 M $CuCl_2 \cdot 2H_2O$, the color of the liquid changed from colorless to brown.

2. Wettability performance

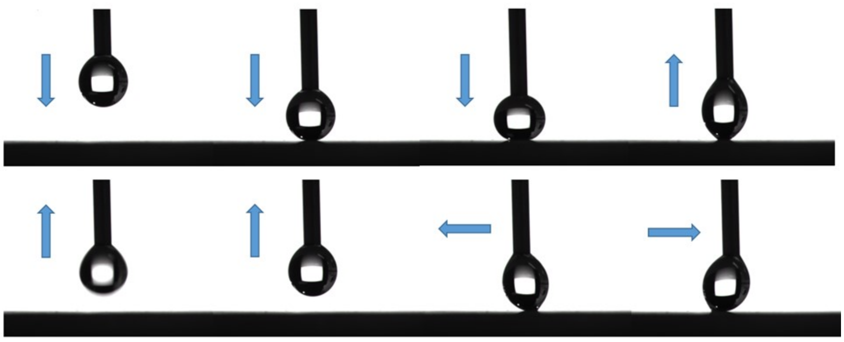

Fig. S2. The wettability test of copper coating after heat treatment

From the Fig. S2, it could be seen that the superhydrophobic sample had a low adhesion to the water droplet.

3. **Chemical composition**

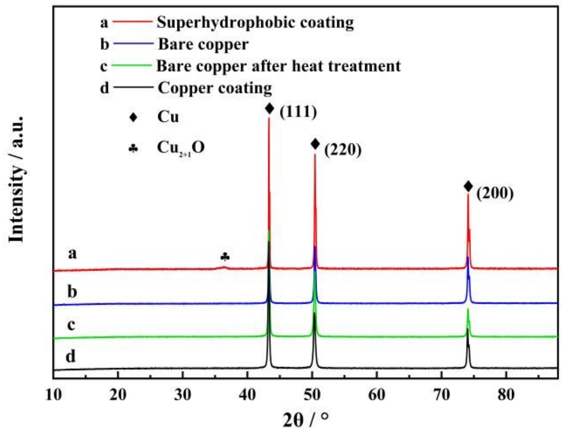

Fig. S3. XRD patterns of different samples

As can be seen from Fig. S3, the superhydrophobic sample was composed of copper and copper oxide. From the EDS analysis in Fig. S4, an increase in oxygen content and C/Cu value indicated the oxidation and adsorption of organic carbon were formed on copper surface after heat treatment. The peaks located at 284.6 eV, 285.5 eV and 288.3 eV in Fig.S4d were related to the binding energy of C-C, C-O and C=O, respectively. The peaks located at 944.1 eV and 946.4 eV in Fig.S4f were related to the binding energy of CuO and Cu_2O, respectively.

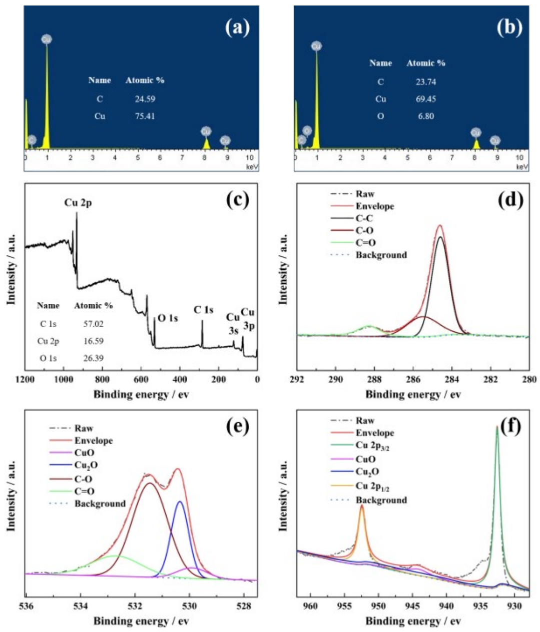

Fig. S4. EDS spectrum: region 1 (a), region 2 (b); XPS spectrum of the superhydrophobic coating: survey spectrum (c), C1s region (d), O1s region(e) and Cu2p region(f) .

4. **Anti-corrosion analysis**

Table S1 shows the corrosion potential (E_{corr}) and current density (j_{corr})

calculated from the potentiodynamic polarization curves in Fig.3a.

Table S1. E_{corr} and j_{corr} and corrosion rate (CR) of different samples

Sample	E_{corr}/V	j_{corr}/A·cm^{-2}	CR/mm·a^{-1}
Superhydrophobic coating	-0.18	4.11×10^{-7}	0.005
Bare copper	-0.27	1.74×10^{-6}	0.020
Bare copper after heat treatment	-0.31	3.04×10^{-6}	0.036
Copper coating	-0.34	5.59×10^{-6}	0.065
Superhydrophobic coating in reference [15]	-0.23	4.28×10^{-7}	0.005
Superhydrophobic coating in reference [16]	-0.23	4.08×10^{-7}	0.005

Table S2. Parameters extracted from Nyquist plots using equivalent circuit modelling.

		CPEf				CPEdl				
Sample	Rs/Ω·cm^2	Y1/Ω^{-1}·s$_n$·cm^{-2}	n_1	Cf/F·cm^{-2}	Rf/Ω·cm^2	Y2/Ω^{-1}·s$_n$·cm^{-2}	n_2	C_{dl}/F·cm^{-2}	Rct/Ω·cm^2	W, Y_0 / Ω^{-1}·s^n·cm^{-2}
Superhydrophobic coating	7.90	4.03×10^{-6}	8.45×10^{-1}	1.29×10^{-6}	4.96×10^2			4.63×10^{-7}	9.60×10^4	1.08×10^{-4}
Bare copper	8.35					1.72×10^{-5}	8.73×10-^{1}	4.72×10^{-6}	1.11×10^4	7.52×10$^-$4
Bare copper after heat treatment	7.16					2.03×10^{-5}	8.66×10^{-1}	5.16×10^{-6}	9.23×10^3	1.04×10$^-$3
Copper coating	9.99					2.57×10^{-5}	8.58×10^{-1}	6.56×10^{-6}	4.99×10^3	1.54×10^{-3}

where R_s is the the solution resistance, CPE refers to a constant phase element,

C_f is the the capacitance value of the protection layer, Y_1 is the constant of the CPE_f element, C_{dl} refers to the the capacitance value of the electric double layer, Y_2 is the constant of the CPE_{dl} element, $R_{f,}$ R_{ct} and W correspond to the protection layer resistance, charge transfer resistance and Warburg impedance, respectively.

5. Mechanical stability

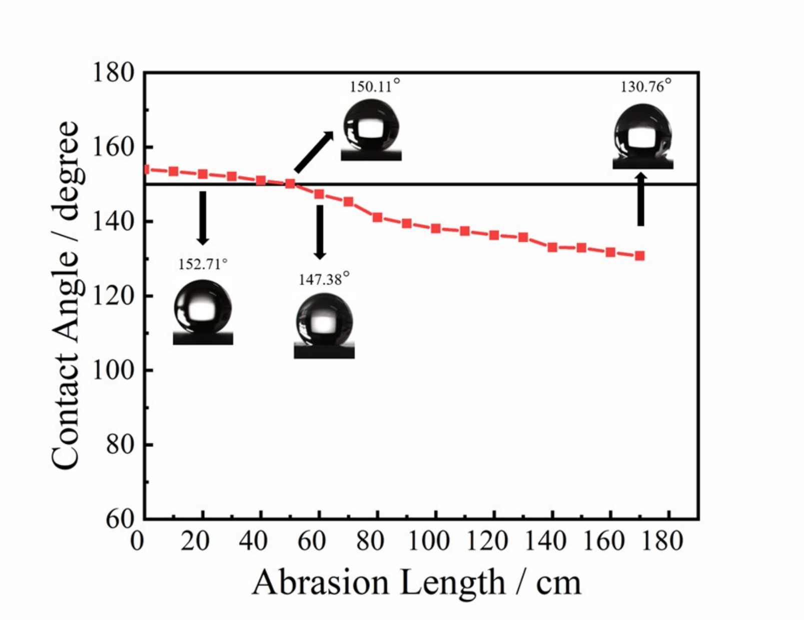

Fig. S5. The relationship between the abrasion length and the WCAs of the sample modified in 1 wt.% palmitic acid ethanol solution for 24 h.

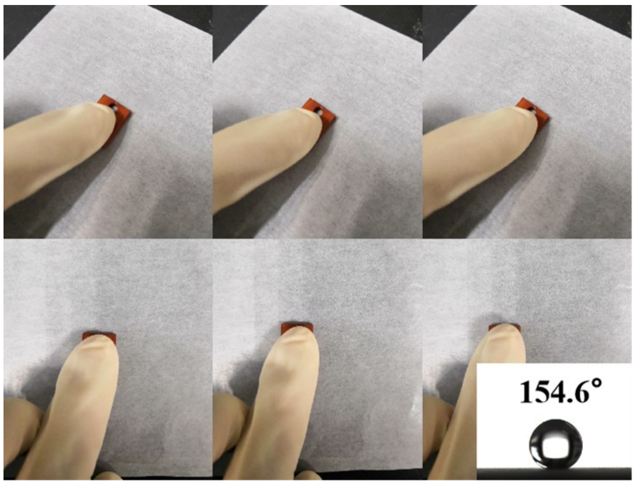

Fig. S6. Finger press test of superhydrophobic coating.

After sixth finger press, the superhydrophobic sample maintain a large WCA of

154.6°.

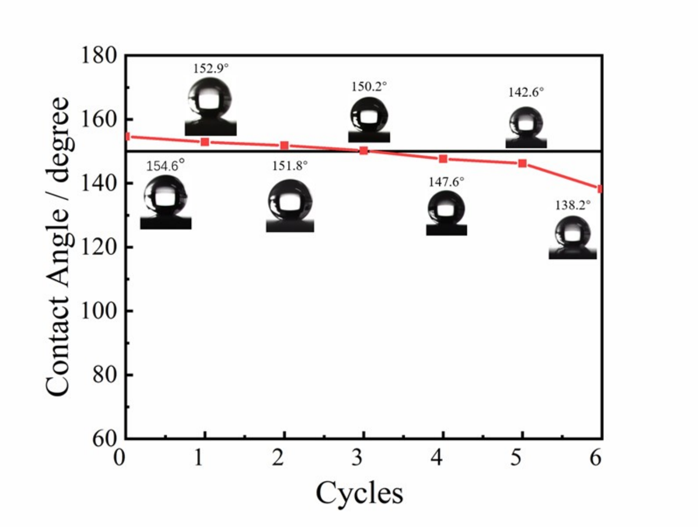

Fig. S7. The relationship between the tape pull cycles and the WCAs.