

Functional Superhydrophobic Engineering Materials via an Extremely Rapid and Simple Route: Supporting Information

Jie Guo,^{a,b} Shen Yu,^{a,b} Jing Li^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 430062, China.*

^b*State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Lanzhou 730000, China.*

*Corresponding author. Tel: 0086-931-4968105; Fax: 0086-931-8277088. Email address: zguo@licp.cas.cn (Guo)

Section 1 Experimental details:

Zinc substrate: After ultrasonic cleaned with water and ethanol, 1.5 cm x 2 cm zinc plate was immersed into 20 ml aqueous solution of 0.1 M CuCl_2 and 0.1 M HCl at room temperature for 1 second. Then the zinc plate was taken out and washed with deionized water and ethanol in turns. The as-obtained zinc plate was subsequently immersed in 1 mM octadecanethiol ethanol solution. The as-prepared zinc plate was washed with ethanol and blown dry.

Copper substrate: Copper plate (0.7 cm x 3.5 cm) and copper mesh (3 cm x 3 cm) was first ultrasonic cleaned with water and ethanol. Then both of them were immersed into 20 ml aqueous solution of 0.1 M AgNO_3 and 0.1 M HNO_3 at room temperature for 1 second. The following steps are the same as that of zinc.

Characterization: The surface microstructures of as-prepared samples were observed by FE-SEM (Field Emission Scanning Electron Microscopy, JSM-6701F, JEOL, Japan). XRD was performed using a PANalytical X'Pert PRO diffractometer (Netherlands). The surface composition of the samples was investigated by XPS (X-ray photoelectron spectroscopy, VG ESCALAB 250, Physical Electronics, USA). WCA (water contact angle) measurements were conducted using a POWEREACH JC2000D goniometer (China). The contact angles were measured by advancing or receding a small volume of liquid ($\sim 5 \mu\text{L}$) onto the surface using a micrometer syringe. At least six measurements were performed to obtain each value. The error in contact angle measurements was $\pm 2^\circ$.

Section 2. Supplementary figures

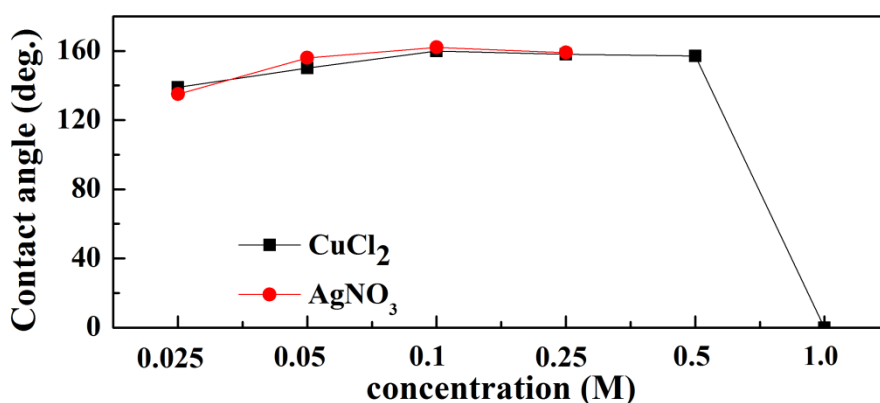


Figure S1. Contact angle scattergram of zinc plates and copper plates obtained in different concentration solutions of CuCl_2 and AgNO_3 , respectively.

For zinc plate, we only gradually changed the concentration of CuCl_2 from 0.025 M to 1 M and maintained HCL at the concentration of 0.1 M with the same immersion time of 1 second. As for copper plate, the concentrations of AgNO_3 were ranging from 0.025 M to 1 M with constant HNO_3 concentration of 0.1 M. Some data is absent because the Ag films start to desquamate when the concentration of the AgNO_3 is larger than 0.5M.

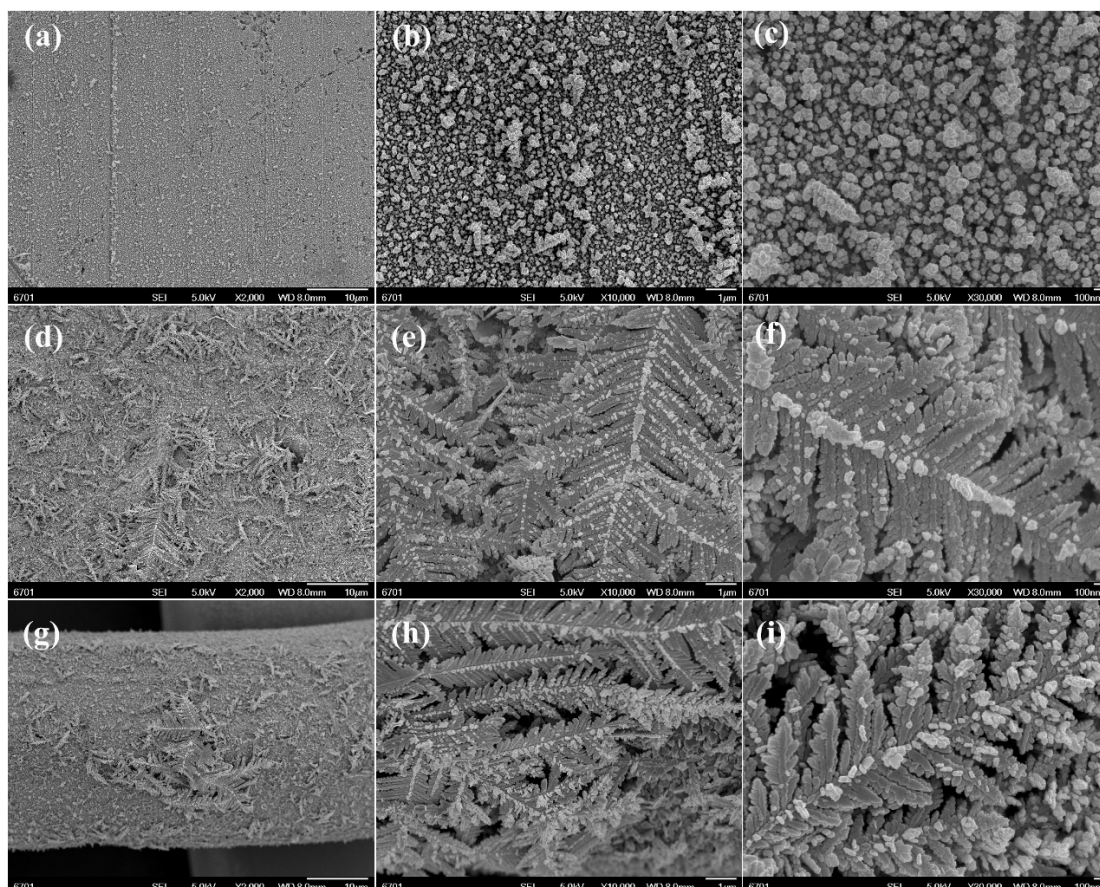


Figure S2. FE-SEM images of as-prepared zinc plate, copper plate and copper mesh in magnification of 2000x, 10000x and 30000x, respectively.

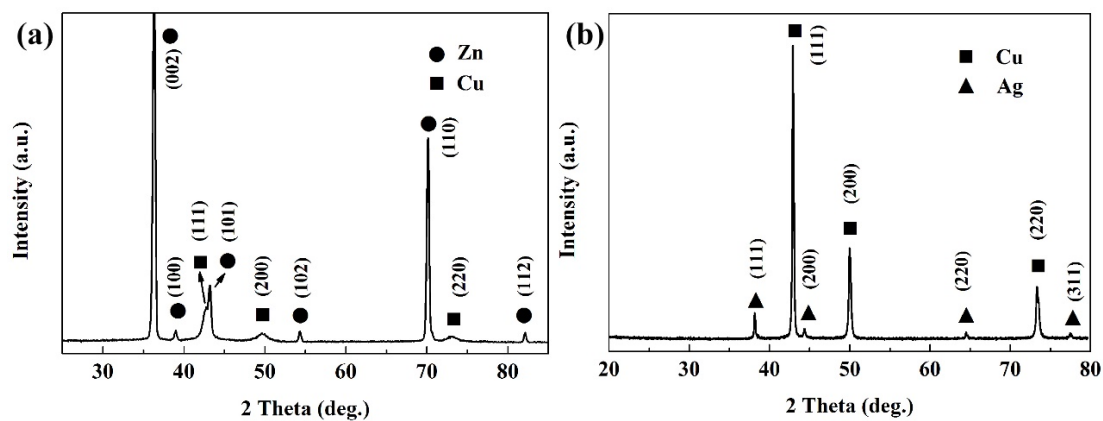


Figure S3. XRD patterns of (a) zinc plate sample surface and (b) copper mesh sample surface.

XRD patterns of as-obtained zinc sample are shown in Fig. S3 A. According to the JCPDS card(No. 00-001-12381; No. 01-070-3038), the diffraction peaks at about 36.5° , 39.1° , 43.5° , 54.6° , 70.8° , 82.4° can be indexed to the (002), (100), (101), (102), (110), (112) planes of the Zn, the peaks at about 43.2° , 50.3° , 73.9° are ascribed to the (111), (200), (220) planes of Cu. As for copper plate (Fig. S3b), the diffraction peaks at about

43.2°, 50.3°, 73.9° can be indexed to the (111), (200), (220) planes of the Cu, the peaks at about 38.1°, 44.3°, 64.4°, 77.5° are ascribed to the (111), (200), (220), (311), (222) planes of Ag (JCPDS card No. 01-070-3038; No. 00-004-07833).

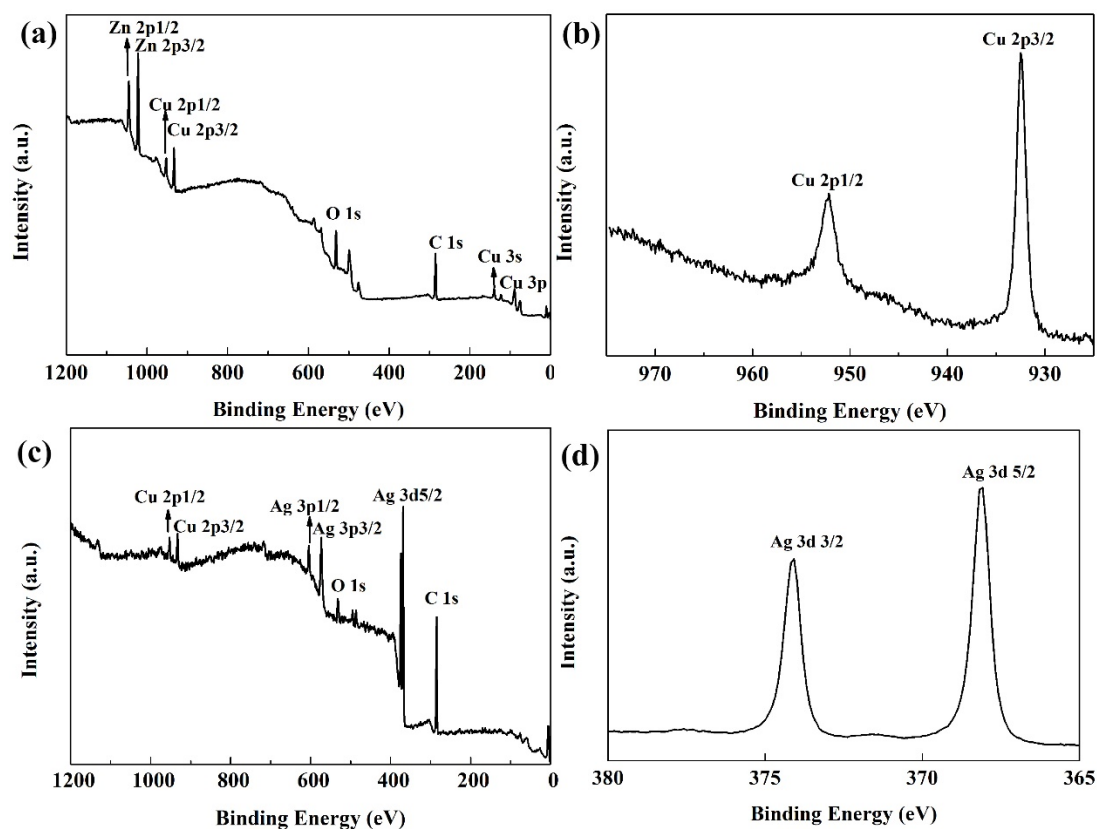


Figure S4. XPS spectra of as-prepared zinc plate surface including (b) the survey spectrum and (c) the Cu region. (d) Infrared spectra of the zinc plate samples before and after modification, respectively. XPS spectra of as-prepared copper mesh surface (c and d).

To further confirm the surface composition of the obtained micro-nanostructures, we conducted XPS experiment. As shown in Fig. S5 a and b, the main peaks at 952.18 eV and 932.48 eV could be assigned to the Cu 2p_{1/2} and Cu 2p_{3/2} double peaks of Cu, which demonstrates that the main component of the outer-most surface of the zinc plate sample is Cu. As for copper plate, the main peaks at 373.40 eV and 368.26 eV could be assigned to the Ag 3d_{3/2} and Ag 3d_{5/2} double peaks of Ag, which also indicates the film on copper plate is made of Ag.

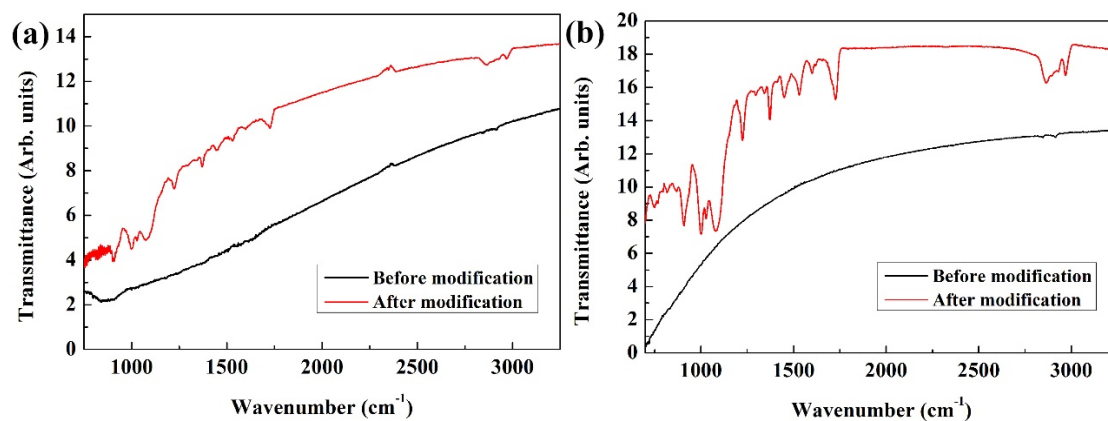


Figure S5. Infrared spectra of (a) as-prepared Cu film on zinc plate before and after modification, (b) as-prepared Ag film on copper mesh before and after modification

The FTIR spectra of zinc plate and copper plate are quite similar. The signals at 1000–1300 cm⁻¹ could be due to C-S. The S-H stretching band at 2550-2600 cm⁻¹ is absent in the spectra since the S-H bond is broken upon chemisorption onto the Cu or Ag film. On the other hand, the symmetrical (d+) and asymmetrical (d-) CH₂ stretching vibrations are commonly used as an indicator for the degree of ordering (crystallinity) of the alkyl chains, which appear at 2850 and 2920 cm⁻¹ respectively. The result indicates that the octadecanethiol has self-assembled onto both Cu and Ag films.