Supplementary Information for

PH-responsive bidirectional oil/water separation material

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This Supplementary Information section contains:

Experimental Section

Materials

Copper mesh films were purchased from a local wire mesh store. *n*-Octadecyl thiol (96%) was purchased from Across organics. $CuSO_4 \cdot 5H_2O$, H_2SO_4, NaOH and HNO_3 were analytical-grade reagents and used as received. H_2SO_4 and NaOH were used to regulate the acid-base property of the aqueous media.

Fabrication of Superhydrophobic Copper Mesh Film

The pristine copper mesh films were immersed in diluted HNO_3 (10% v/v) to remove any surface oxide layer and sequentially cleaned with deionized water and acetone for at least three times. Then, the copper mesh films were dried in a stream of nitrogen gas for 5 min prior to use. The Cu nanoparticles were coated on the copper mesh film via a typically electrochemical deposition process.[25] The copper mesh films were applied as the working electrode whereas a platinum sheet (2.0 cm × 2.0 cm) was used as the auxiliary electrode. The reference electrode was a saturated calomel electrode. All of the electrodes were immersed in a solution containing 0.04 M $CuSO_4$ in 0.5 M H_2SO_4. The distance between the working electrode and the counter electrode, put vertically, was kept at 2.0 cm in the electrolyte. Electroplating process was performed at a current density of 0.017 A/cm^3 for 240 s at room temperature.

After Cu nanoparticles were electrochemically deposited on the mesh films, the copper mesh substrates were coated with a layer of Au via using a sputter coater.[18] Then the copper meshes were immersed in a mixed thiol ethanol solution of $HS(CH_2)_9CH_3$ and $HS(CH_2)_{10}COOH$ for about 10 h. The total concentration of the thiols in the ethanol solution is 1 mM and the concentration fraction of $HS(CH_2)_9CH_3$ and $HS(CH_2)_{10}COOH$ was set as 3:2. After the thiol modification, the copper mesh films were removed and washed with anhydrous ethanol and dried in a drying oven.

Characterizations. The water CA and SA were measured with a 5 μL deionized water droplet at ambient temperature with a DSA100 contact angle meter (Kruss Company, Germany). The average CA and SA values were obtained by measuring the sample at five different positions, and the images were captured with a traditional digital camera. Scanning electron microscopy (SEM) images were obtained on JEOL JSM-5600LV scanning electron microscopes with Au-sputtered specimens. X-ray energy dispersive spectrometer (EDS) attached to the SEM was used for the examination of the chemical composition of the as-prepared fabric.

25 S. T. Wang, Y. L. Song and L. Jiang, *Nanotechnology*, 2007, **18**, 015103.

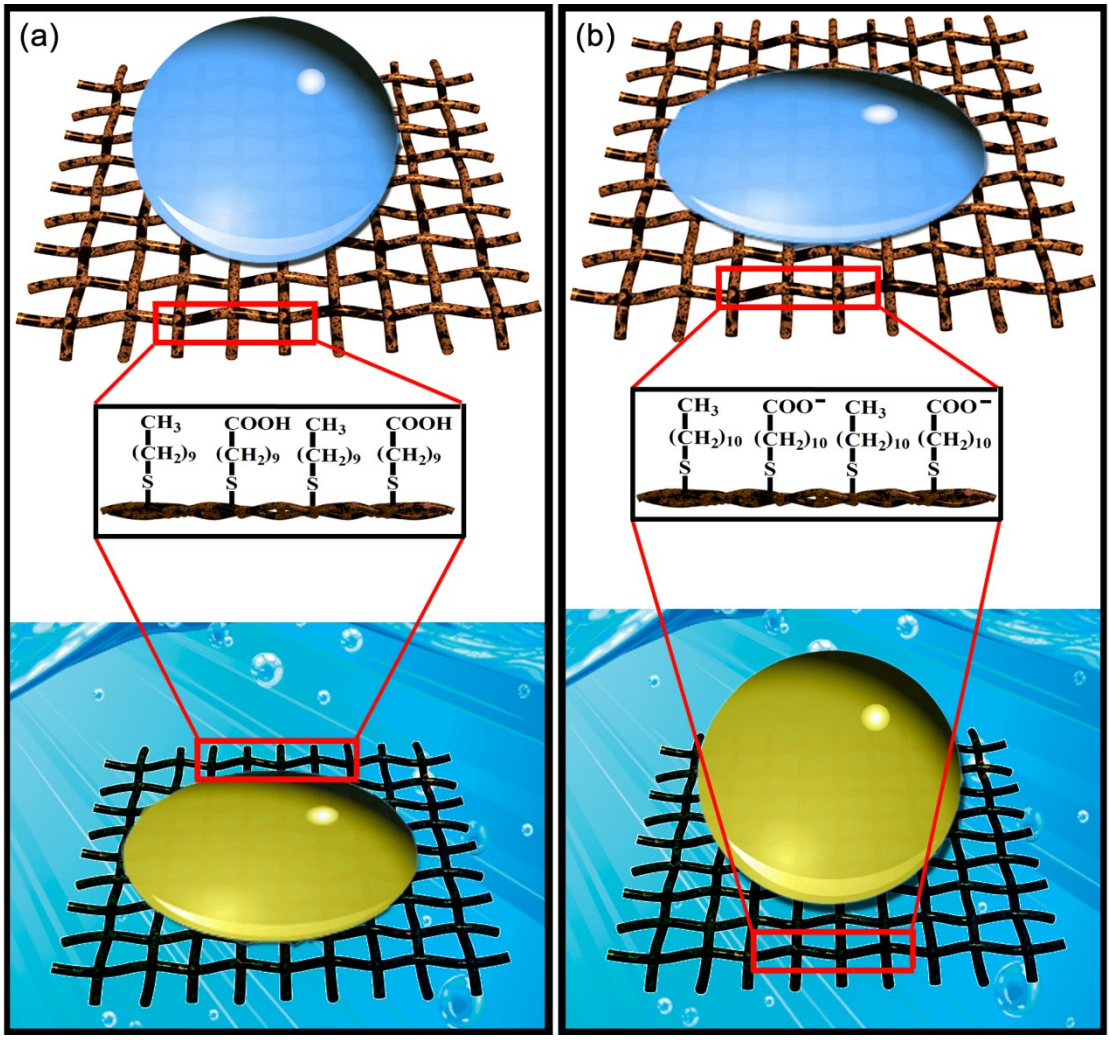

Fig. S1 Schematic illustration of the shapes of the water droplets on the as-prepared copper mesh both in the air and underwater environment. (a) As-prepared copper mesh shows superhydrophobic property in the air to acidic and neutral water droplets however shows superoleophilic property underwater. (b) As-prepared copper mesh shows superhydrophilic property in the air to basic water droplets however shows superoleophobic property under base solution.

Table S1. Summary of philic/phobic natural at various interface[23]

Solid-air-water interface	**Solid-air-oil interface**	**Solid-water-oil interface**
Hydrophilic ($\gamma_{SA} > \gamma_{SW}$)		Oleophobic if $\gamma_{OA}\cos\theta_0 < \gamma_{WA}\cos\theta_W$
		Oleophilic if $\gamma_{OA}\cos\theta_0 > \gamma_{WA}\cos\theta_W$
Hydrophobic ($\gamma_{SA} < \gamma_{SW}$)	Oleophobic if $\gamma_{SA} < \gamma_{SO}$	Oleophobic if $\gamma_{OA}\cos\theta_0 > \gamma_{WA}\cos\theta_W$
		Oleophilic if $\gamma_{OA}\cos\theta_0 < \gamma_{WA}\cos\theta_W$
	Oleophilic if $\gamma_{SA} > \gamma_{SO}$	Oleophilic