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

Supporting Information

Multifunctional silver @ titanium dioxide composite cloth for oil and water separation

Linshan Wu, [a], 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, P. R. China.

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

E-mail: zguo@licp.cas.cn

Contents

1. Sandpaper abrasion test

As shown in Figure S1, the cyclic wear test of sandpaper (800#) is carried out on the surface of MSTCC. 10 cm before and after is recorded as one cycle. After 25 cycles, the WCA of the surface is still above 150°. Even after 65 cycles, the WCA of the surface is still higher than 145°. The results show that MSTCC has a certain resistance to sandpaper abrasion.

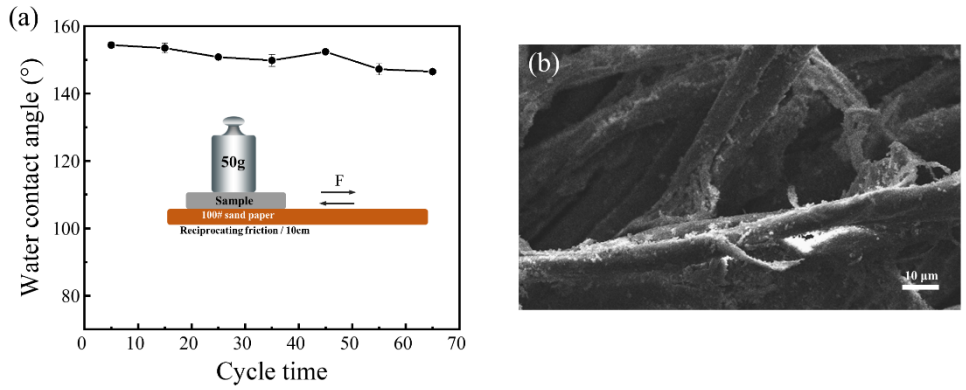

Fig. S1. (a) WCA of MSTCC surfaces as a function of wear cycle. The inset is a schematic representation of the sandpaper abrasion test. (b) SEM image of the sample surface after sandpaper abrasion.

2. Sand impact test

The sand impact test was carried out on the surface of Ag@TiO2 composite cloth. The funnel was placed 20 cm directly above the sample through an iron stand， and 20g of quartz sand were dropped on the sample surface through the funnel. The samples were placed at an inclination angle of 45° from the horizontal plane. As shown in Figure (S2), the coated surface remained superhydrophobic even after 6 sand impacts. (WCA is ~150.3°)

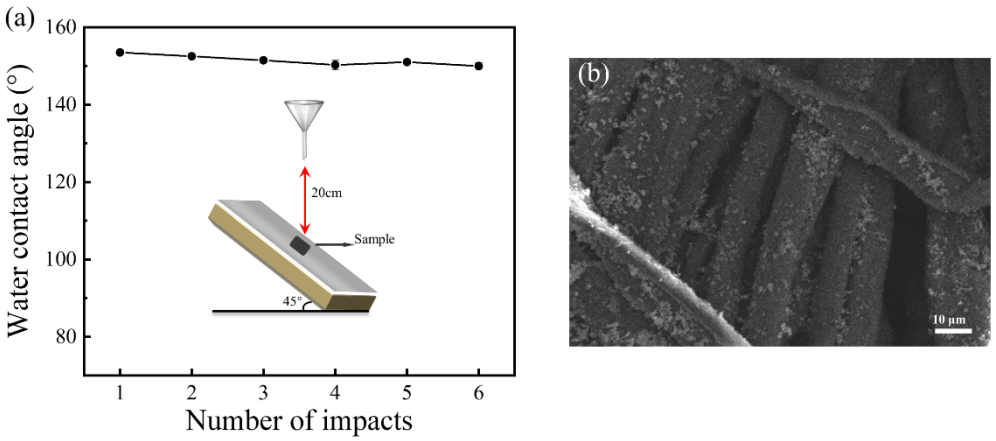

Fig. S2. (a) The diagram of WCA of sample with the increase of sand impact times, the inset is the schematic diagram of the experimental device. (b) SEM image of the sample surface after sand impact.

3. EDS energy spectrum analysis

As shown in Figure S3, C, O, Ti, Ag and Si appeared on the surface. The sources of surface Si are PDMS and HDTMS. Besides, the results of EDS analysis were shown in Fig. S3.

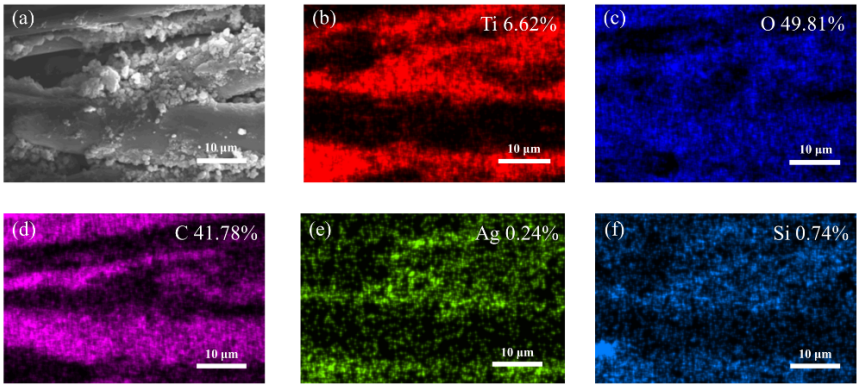

Fig. S3. (a-f) EDS elemental mapping of the prepared samples and their EDS results.

4. X-ray diffraction characterization

XPS was used to analyze the difference between the pristine surface (sprayed MGCC), the surface after 90 min UV irradiation, and the surface after 160 min IR irradiation (Fig. S4a). On the pristine MGCC surface, the different fitted values of 529.9

eV and 531.7 eV correspond to Ti-O and Ti-OH, respectively (Fig. S4b). After UV irradiation, the peak area of Ti-OH increased significantly and that of Ti-O decreased significantly (Fig. S4c). However, after infrared irradiation, the peak area of Ti-OH was almost the same as that of the original surface. (Fig. S4d). It is therefore believed that the change in the hydroxyl group content causes the change in the surface wettability.

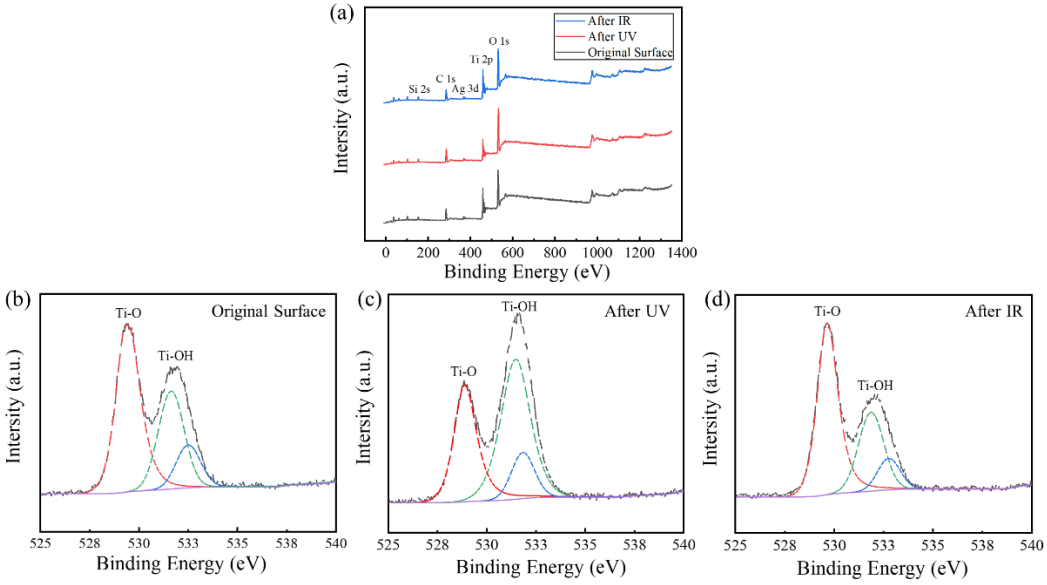

Fig. S4. (a) XPS measurement spectra of pristine MSTCC, after UV irradiation, and after IR irradiation. XPS spectra of the O 1s peak on pristine MGCC surface (b), UV-irradiated surface (c), and IR-irradiated surface (d).

5. Calculation of oil-water separation efficiency

When separating heavy oil and water, use Karl Fischer water titrator to determine the content of water in the collected filtrate. The separation efficiency (R) is calculated as follows:

$$R = \frac{C_1 - C_2}{C_1} \times 100\%$$

Where, C_1 and C_2 represent the concentration of water in the initial solution and filtrate

respectively.

When separating light oil and water, COD is used to determine the content of organic carbon (oil) in the collected filtrate. The separation efficiency calculation formula is as follows:

$$R = \left(1 - \frac{C_p}{C_f}\right) \times 100\%$$

Cp (mg/l) is the oil content in the filtrate after separation, and C_f (mg/l) is the oil content in the mixed solution before separation.

6. SEM image after multiple cycles

As shown in Figure S5, the composite cloth after repeated cycles still maintains a good micro-nano structure.

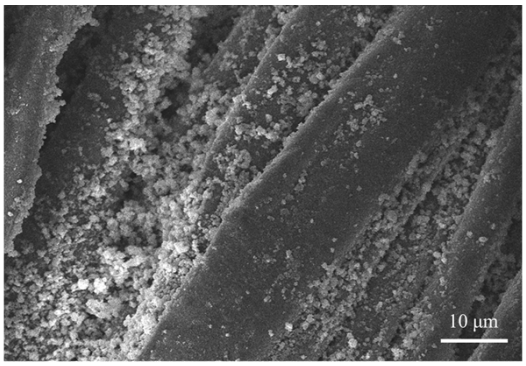

Fig. S5 SEM after multiple separation of MSTCC.

7. Antifouling test

We have carried out anti-oil, anti-dye and self-cleaning experiments to show that the composite cloth has excellent anti-fouling performance.

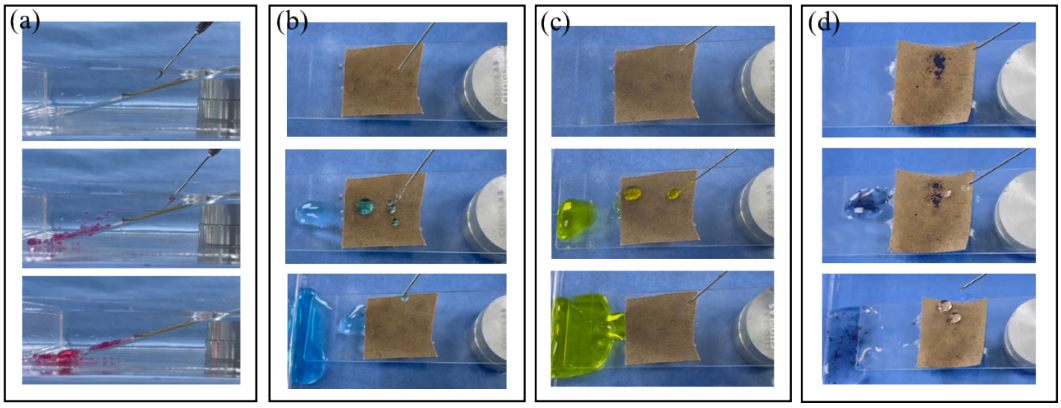

Fig. S6. (a) Dichloromethane (dyed with Sudan red) is injected into the illuminated composite cloth in water, and the oil splashes and falls off on the composite cloth. The water dyed with methyl blue (b) and the water dyed with lemon yellow dye (c) roll off on the unlighted composite cloth. (d) Carbon black is washed away on the composite cloth as the liquid drops fall, and the surface becomes clean.

8. Chemical stability

Using sulfuric acid and sodium hydroxide to control a series of pH solutions, the droplets with pH of 2,4,6,8,10,12 were prepared. Figure S7 shows the state of droplets with different pH on MSTCC, which still shows stable superhydrophobic state. It shows excellent chemical stability of MSTCC.

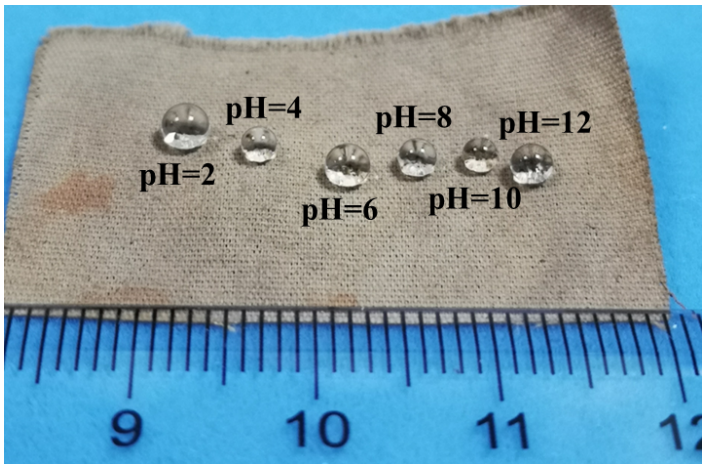

Fig. S7 The state of droplets with different pH on MSTCC.

9. DLS for oil and water separation

The filtrate after oil-water separation was analyzed by DLS. Toluene is selected for light oil and trichloromethane is selected for heavy oil. As shown in Figure S8, the results show that 30.8% of the particles in the filtrate after the separation of light oil and water are about 610nm in size. 24.6% of the particles in the filtrate after the separation of heavy oil and water are about 610nm in size.

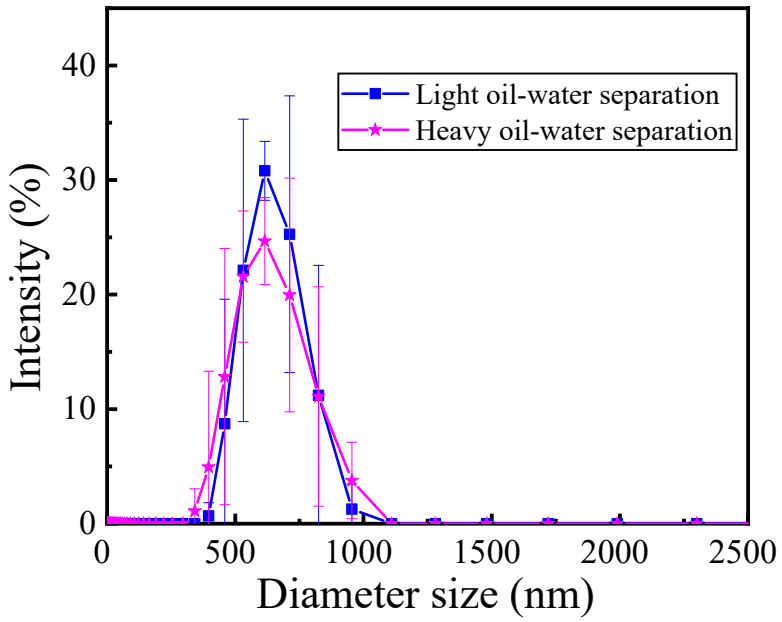

Fig. S8 DLS analysis of filtrate after oil-water separation.