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Selective Superwettability Coating Surface with Proactive Anti-Crude Oil-Fouling Property

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Experimental Section.

Materials.

The glass slide, copper and PTFE sheets, stainless-steel mesh (SSM, mesh number: 300) and nylon cotton fabric were commercially available. Crude oil was provided by SINOPEC Jilin Petrochemical Co., Ltd. China. The fluorosurfactant Capstone FS-50 was obtained from Chemours Co., Ltd. America. The titanium dioxide (TiO_2, P25 type, $m_{anatase}$:m_{rutile}= 4:1, AR) was purchased from Zhejiang Shaoxing Lijie Chemical Co. Ltd., China. The polytetrafluoroethylene suspension (PTFE, AR, 60 wt%) were purchased by Aladdin Biochem, Ltd.

Fabrication of superhydrophilic-superoleophobic coatings with proactive resistance to crude oil.

First, the aluminium phosphate (AP) binder was formulated by gradually adding $Al(OH)_3$ to diluted orthophosphoric acid (H_3PO_4, wt% = 60%) according to a molar ratio of 3:1 with magnetically stirring for 3 h at 100℃, and weighed 2 g in deionised water to dilute it. Then, 1.2 g TiO_2 nanoparticles and 2 g FS-50 (Capstone^{TM} FS-50) were weighed and dissolved in 20 mL of anhydrous ethanol, and the prepared diluted AP binder was added, and the above solutions were stirred for 30 min and then treated with ultrasonication for 10 min. Finally, 1 g PTFE suspension into the well-mixed solution and continuing magnetic stirring for 10 min followed by ultrasonication for 10 min, the designed spray solution was prepared. The well-dispersed solution was then sprayed evenly onto the surface of different substrates under 0.2 MPa of N_2 gas. After heat treatment at 120 ℃ for 2 h, the coating was further cross-linked to form a composite coating named AP-FS50-TiO_2-PTFE.

Instrumentation and characterization.

The microstructure morphology of coating was observed by the scanning electron microscopy

(Zeiss Gemini, Germany). The XPS spectra were obtained using an X-ray photoelectron spectrometer (Thermo scientific escalab 250Xi, USA). The water contact angle and bubble contact angle were measured using a contact angle testing system (Powereach JC2000DM, China). Water content was determined using a volumetric titrator (Lead Sezies KLS-411) and oil content was determined using a total organic analyser (TOC/TNb, Analytikjena Multi N/C series). The droplet size distribution of oil/water emulsions was tested using a polarised light microscopy (BX 53 M, Olympus, Japan).

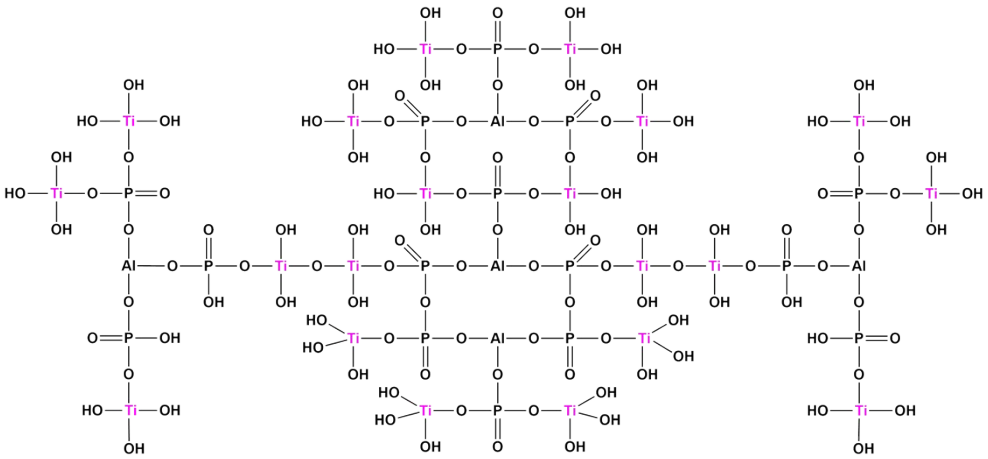

Figure S1. Schematic diagram of interaction mechanism of AP-TiO_2.

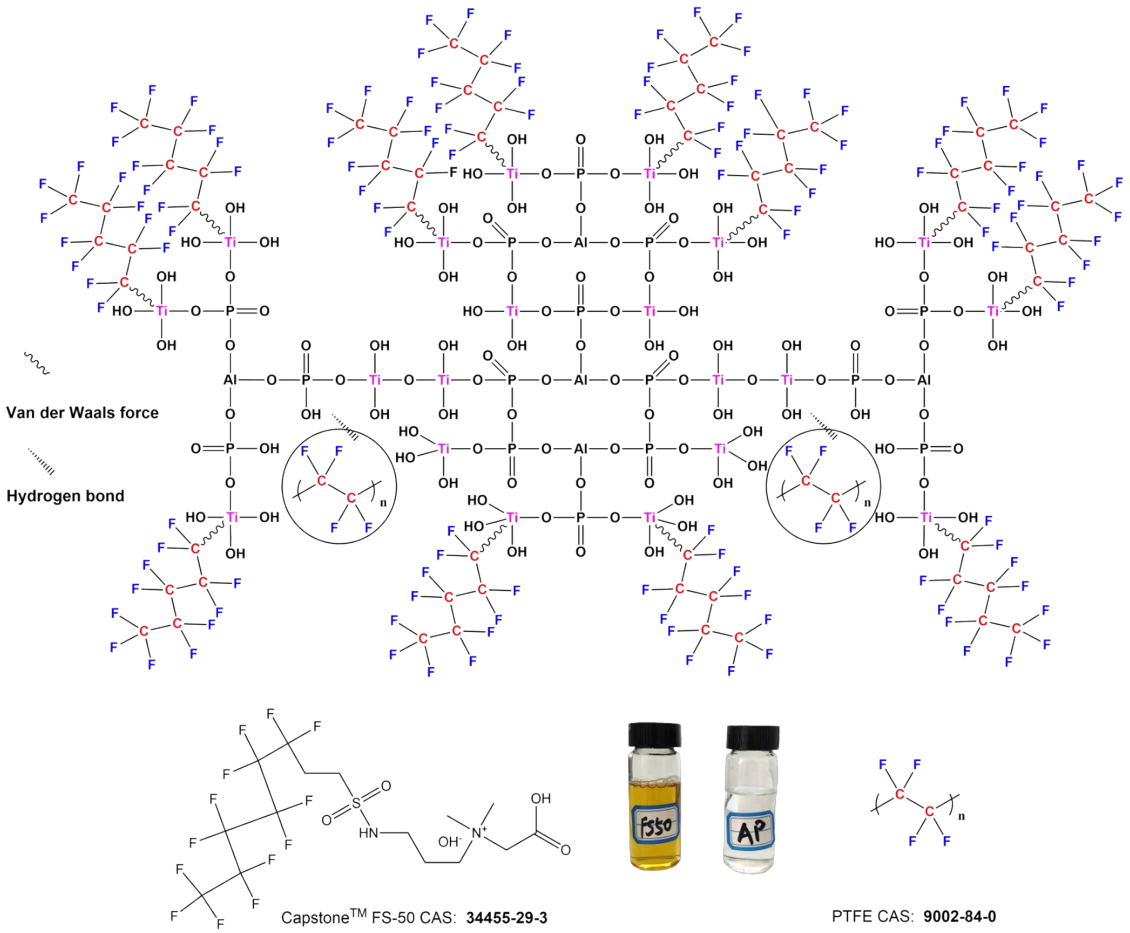

Figure S2. Schematic diagram of interaction mechanism of AP-FS50-TiO_2@PTFE (Insets are photographs of the actual object of the FS-50 and AP binder).

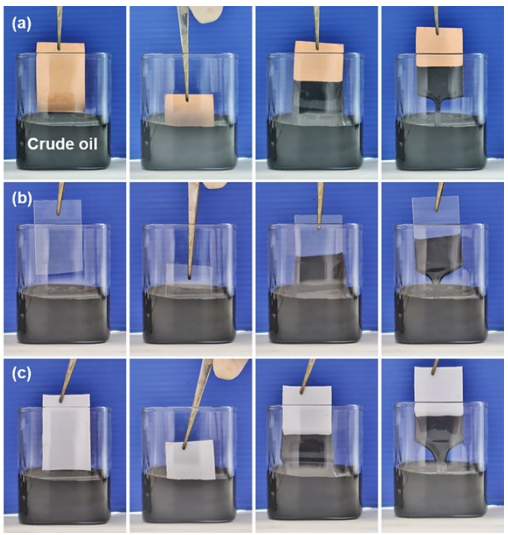

Figure S3. Photographs of original (a) glass, (b) copper sheet and (c) PTFE sheet after being dripped into crude oil.

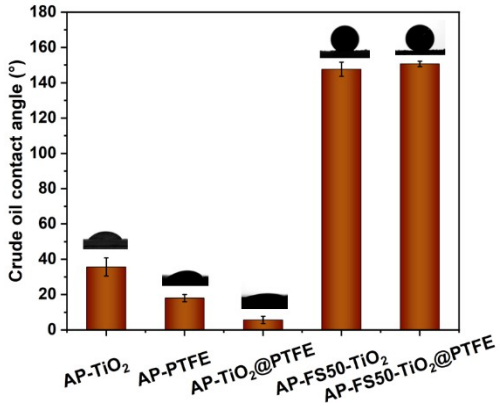

Figure S4. The oil contact angle of crude oil at 25 °C on different post-coated copper sheets in air.

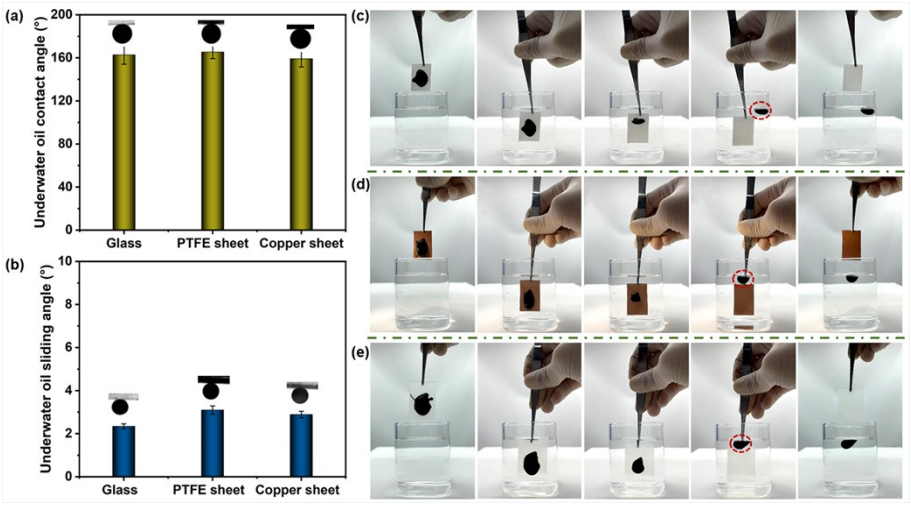

Figure S5. The oil contact angle (a) and oil sliding angle (b) of post-coated different substrates in water. The self-cleaning test of pre-wetted post-coated (c) glass, (d) copper sheet and (e) PTFE sheet after adherence to crude oil underwater.

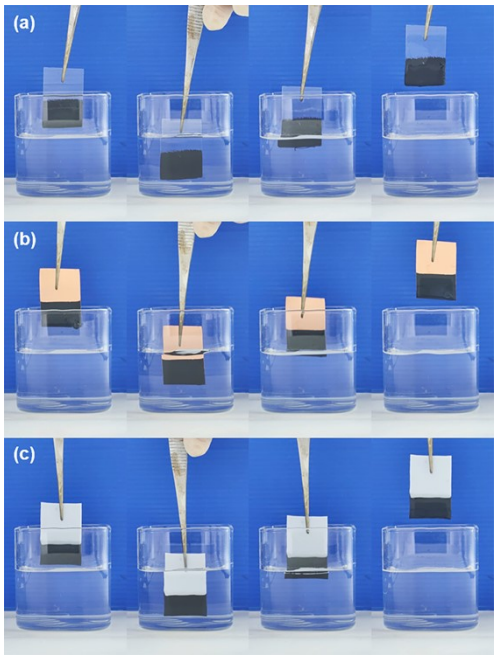

Figure S6. The self-cleaning test of original (a) glass, (b) copper sheet and (c) PTFE sheet after adherence to crude oil under water.