Electronic Supplementary Material (ESI) for Energy & Environmental Science

Supplementary information

An Integrated Oil Separation and Water Purification by Double-Layer TiO_2-based Mesh

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The long-term stability test

The stability of superhydrophobicity of TiO_2-based ODP modified mesh film was tested. After storing the superhydrophobic mesh film in the dark for 30 days, we tested the contact angle of the film again to prove the stability. Figure S1 showed that mesh film still exhibited the superhydrophobicity with contact angle of 158° after 30 days.

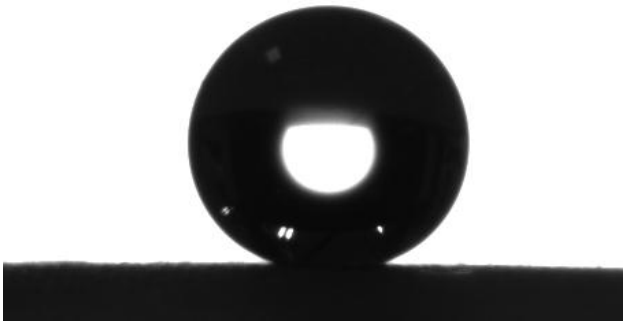

Figure S1. Image of water droplet (3 μL) on the TiO_2-based ODP modified mesh film after 30 days of storage.

The harsh condition test

The superhydrophobic mesh film on treatment with organic solvent was tested. After immersing the ODP-modified TiO_2 coating mesh film into the organic solvent for 10 min, we dried the mesh film and measured the contact angle. We used 5 different organic solvent for the harsh condition test. Figure S2 showed the effects of various organic solvents on the water repellency of the mesh film. Those non-polar or weak-polar organic solvents, like cyclohexane and dichloroethane, could dissolve the ODP and result in the loss of superhydrophoicity.

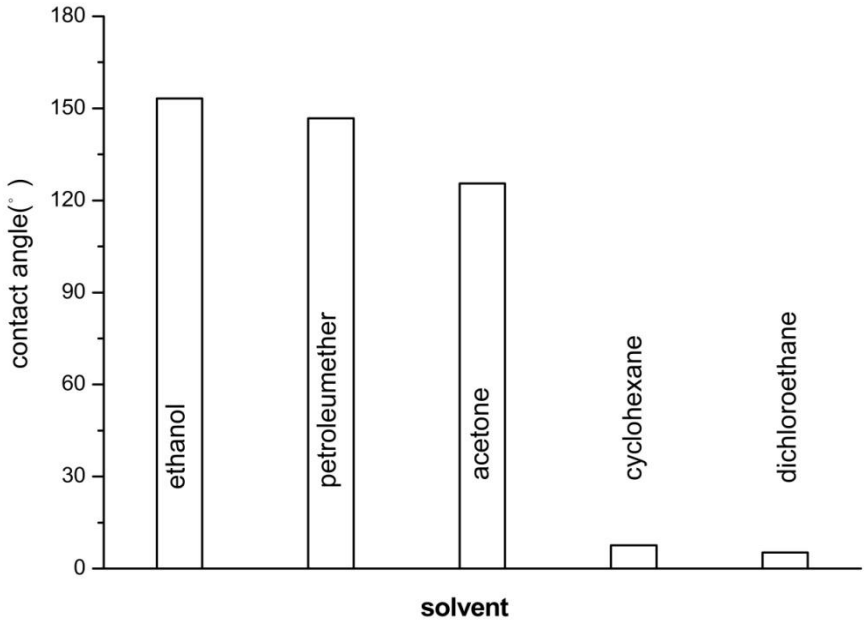

Figure S2. Contact angles of ODP-modified TiO_2 coatings mesh film after immersing into different organic solvents.

The superhydrophobic stability in different harsh conditions was tested for the ODP-modified TiO_2 coatings mesh film. The standard solution with pH ranging from 1 to 14 and 0.9% NaCl solution was used for the CA measurement. Acid solution was made by the dilution of 36.5% HCl solution, alkaline solution was made by the dissolution of NaOH powder. Figure S3 demonstrate the experimental results for CA measurement. There is no difference in contact angle for acid solution and neutral solution, but strong alkaline water could greatly decrease the contact angle, and the superhydrophobic property of the mesh film. The reason is perhaps that the alkaline condition could accelerate the hydrolyzation of the ODP.

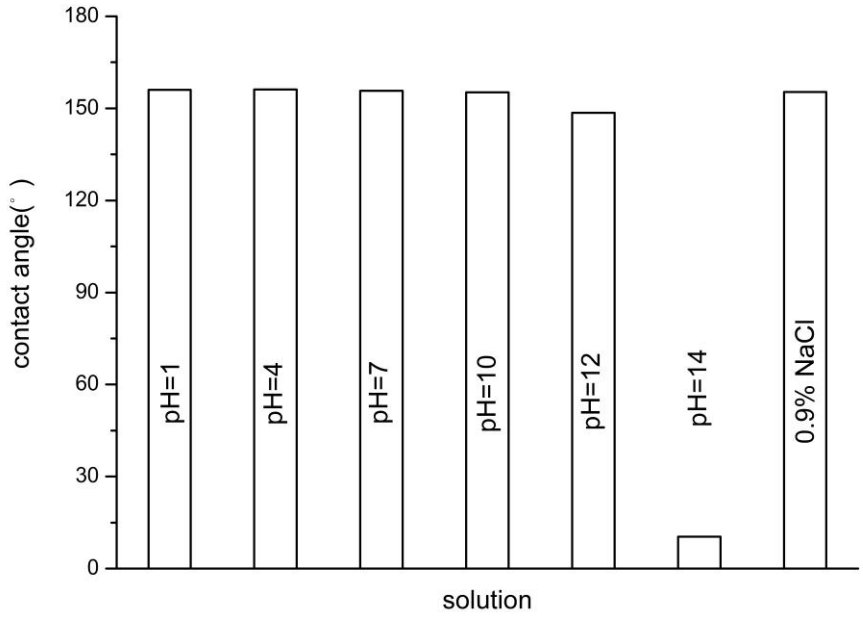

Figure S3. Contact angles variation of ODP-modified TiO_2 coatings mesh film with water at different pH and 0.9% NaCl solution

Test for recyclability

To investigate the recyclability of the double layer TiO_2 coating mesh film. We evaluated both photocatalysis and wetability to test the recyclability. We conducted five cycles of water purification, each cycle lasted 2h of UV illumination. In each cycle, we used 50 mL of 20 μmol/L MB (methlyene blue) aqueous solution as polluted water. We evaluated the photocatalysis from upper layer of mesh film, and the repeatability of superhydrophobicity from lower layer of mesh film.

1. ODP degradation/readsorption:

Figure S4 showed the SEM image of the lower layer of the TiO_2-based mesh film after the first cycle use. We could still see the micro- and nano-structure of TiO_2. Then

we used the same method in the article to re-modify the ODP onto the mesh film, and measure the contact angle. Figure S5 showed the contact angles of lower-layer mesh film after each cycle of ODP readsorption. After five cycle use, the mesh film with ODP modification could still be superhydrophobic.

2. Evaluation of photocatalysis life

After the first cycle use, we kept the upper layer of the TiO_2-based mesh film for the next four cycle use. Then we used the spectrometer to check the decrease of MB concentration. Figure S6 showed the adsorption curve of MB during the fifth cycle of water purification. We could still see the obvious drop of absorbance peak values.

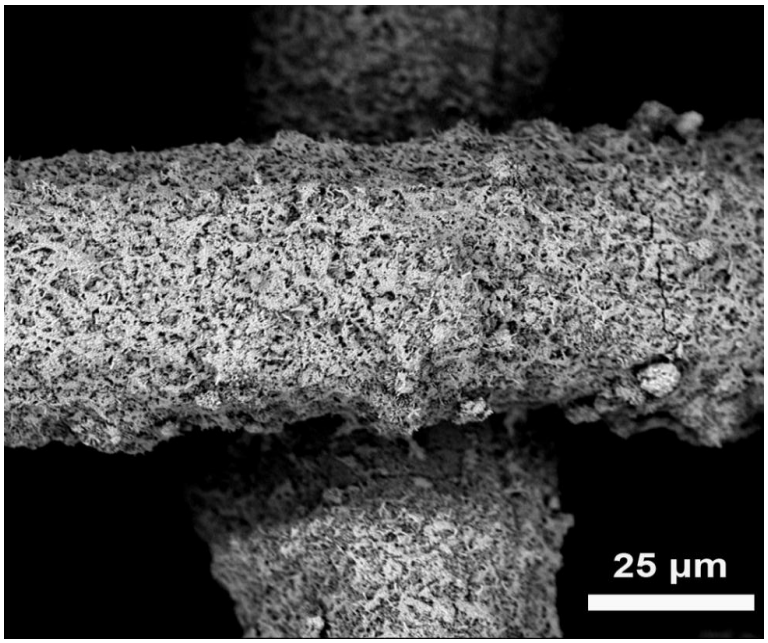

Figure S4. SEM image showing the micro- and nano-struture of TiO_2 coating after the first cycle use.

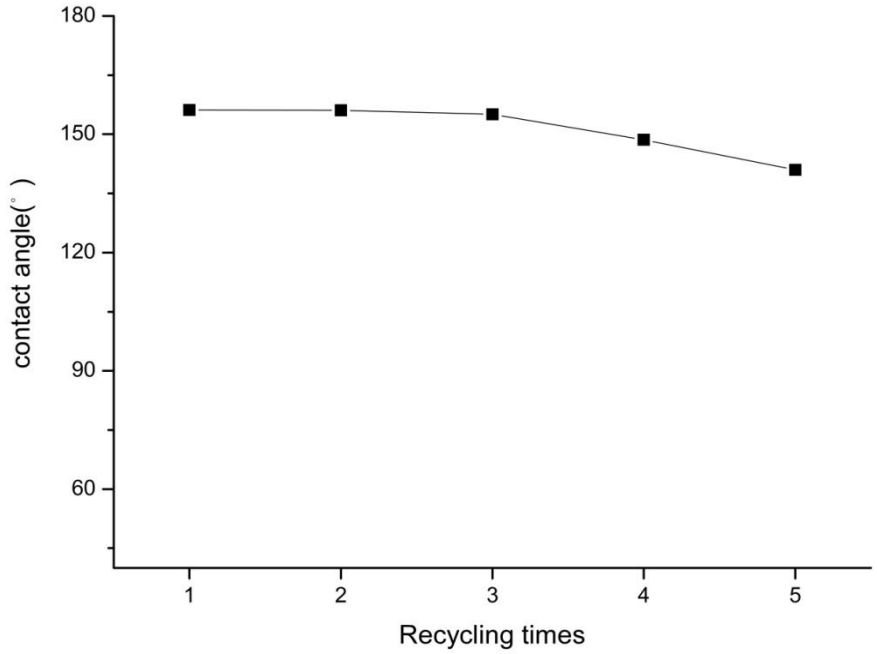

Figure S5. Contact angles of lower layer TiO_2-based mesh film after the readsorption of ODP in each cycle.

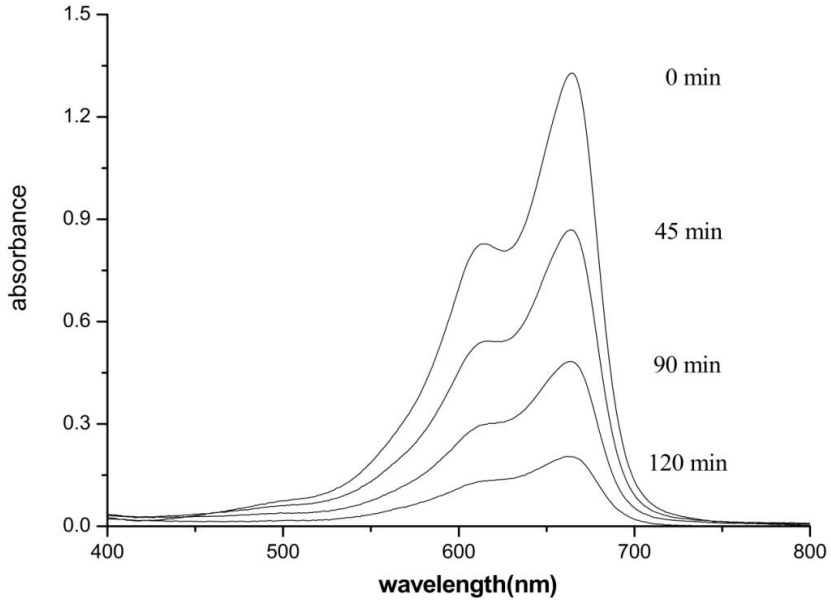

Figure S6. Variation of UV-vis absorbance curves for methylene blue aqueous solutions at the fifth cycle of photodegradation.