Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Electronic Supplementary Information

Electroconductive nanofibrous membranes with nanosheet-based microsphere-threaded heterostructures enable oily wastewater remediation

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Supplementary Materials

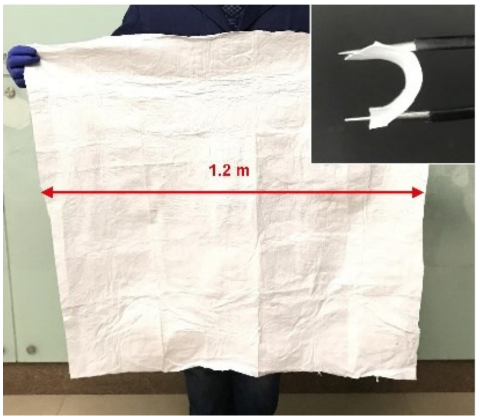

Fig. S1. Electrospun SiO_2 nanofibrous membrane with a width of 1.2 m. Inset showing the flexibility of SiO_2 nanofibrous membrane.

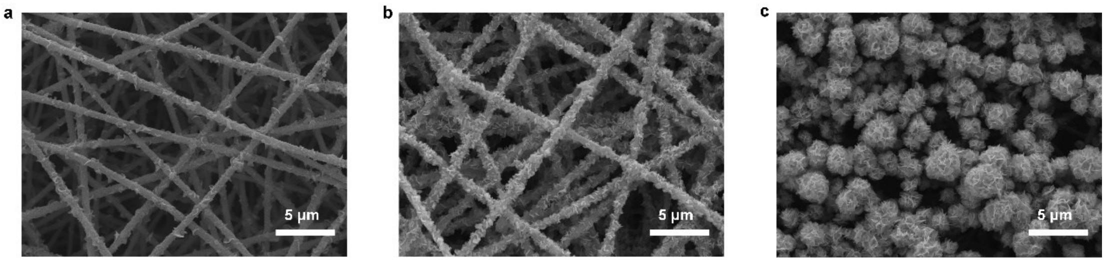

Fig. S2. SEM images of the SiO_2/PANI/BiOBr nanofibrous membranes with (a) 1, (b) 3, and (c) 9 SILAR cycles.

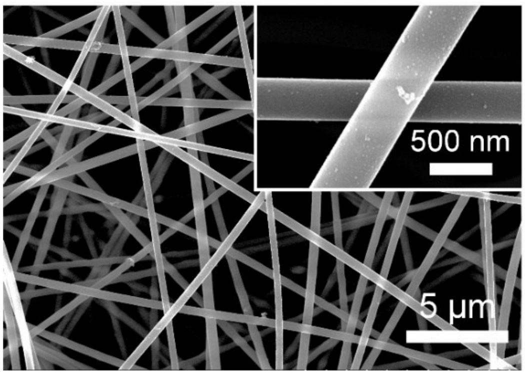

Fig. S3. SEM images of the SiO_2/BiOBr nanofibrous membranes with 6 SILAR cycles, and inset is the high magnification SEM image of nanofibers.

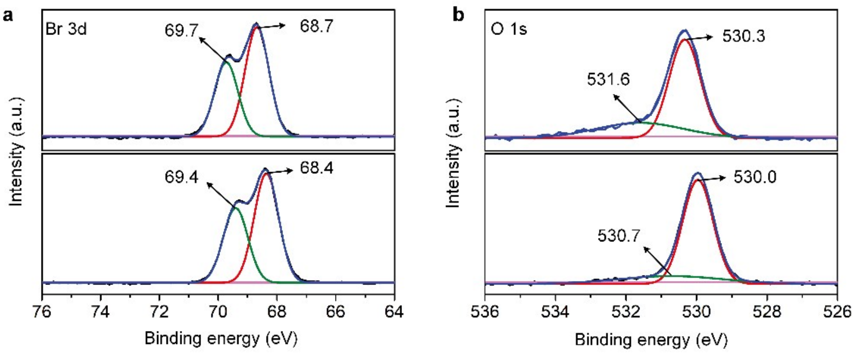

Fig. S4. High-resolution (a) Br 3d and (b) O 1s XPS spectra of SiO_2/PANI/BiOBr nanofibrous membrane (top) and BiOBr powder (bottom).

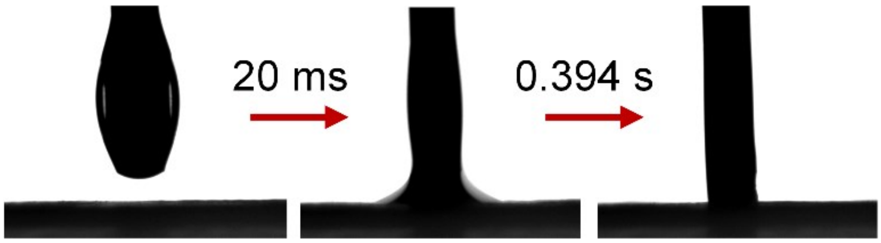

Fig. S5. An oil droplet displaying a very quick spreading on the SiO_2/PANI/BiOBr nanofibrous membrane in the air.

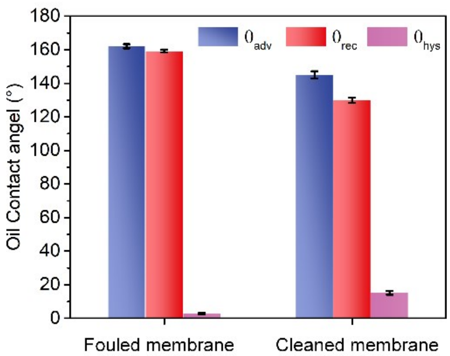

Fig. S6 The advancing contact angle (θ_{adv}), receding contact angle (θ_{rec}), and contact angle hysteresis (θ_{hys}) of the fouled and cleaned SiO_2/PANI/BiOBr membranes.

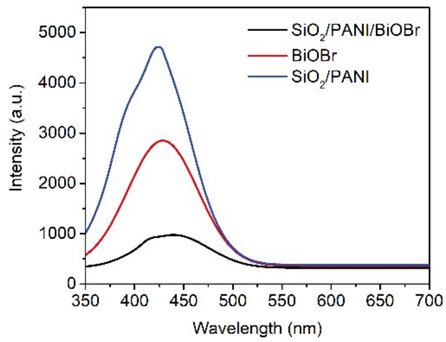

Fig. S7. PL spectra of different samples.

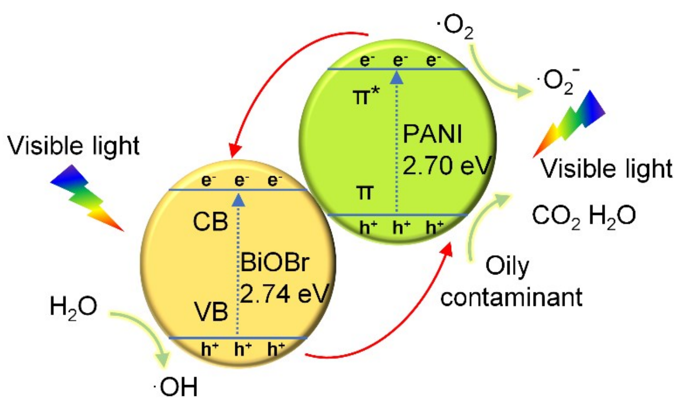

Fig. S8. Schematic of the separation and transfer of photo-generated charge carriers in the SiO_2/PANI/BiOBr membrane under visible light irradiation.

Because π*-orbital energy of PANI is more negative than the conduction band (CB) energy of BiOBr and valence band (VB) energy of BiOBr is more positive than the π-orbital energy of PANI, the interface between the PANI and BiOBr resulted in an oriented electron flow from π*-orbital of PANI to the CB of BiOBr and a hole flow from VB of BiOBr to the π-orbital of PANI.

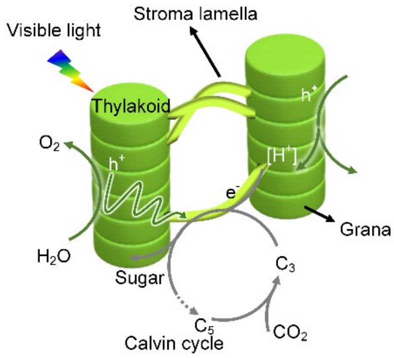

Fig. S9. The photosynthesis mechanism of chloroplast.

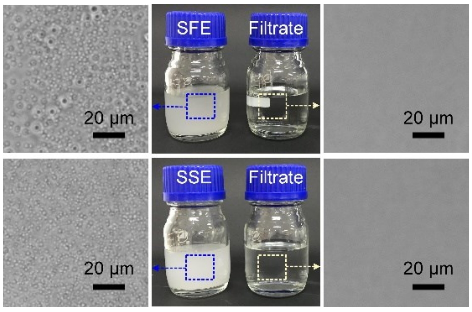

Fig. S10. Optical microscopy images and photographs of the surfactant-free/stabilized emulsions before and after separation.

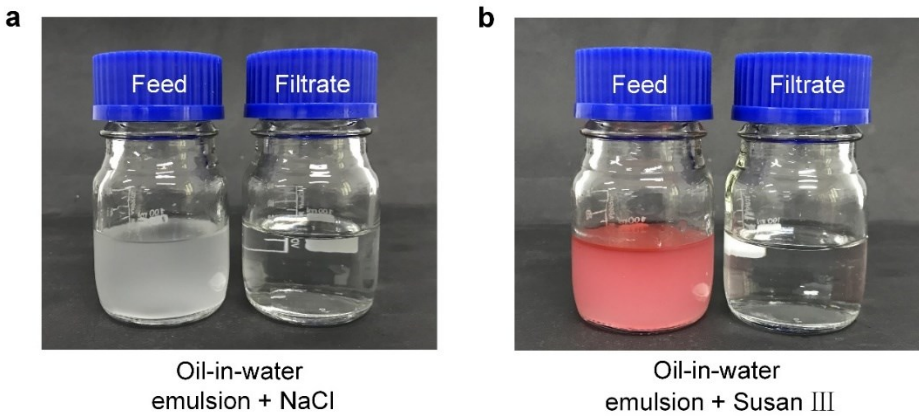

Fig. S11. The photographs of feed solution with (a) oil droplets plus NaCl and (b) oil droplets plus Sudan Ⅲ in aqueous solution and the corresponding filtrates. n-Hexane was taken as model oil.

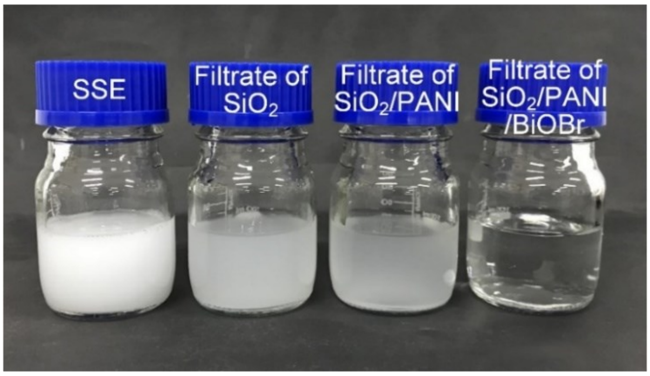

Fig. S12. Surfactant-stabilized soybean oil-in-water emulsion (SSE) before and after separation by different membranes.

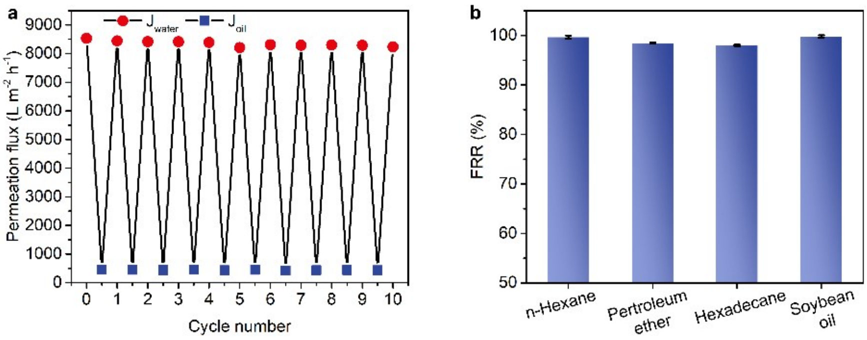

Fig. S13. (a) Cycle separation performance test of the SiO_2/PANI/BiOBr nanofibrous membrane. (b) The FRRs of SiO_2/PANI/BiOBr nanofibrous membrane for various surfactant-stabilized oil-in-water emulsions.

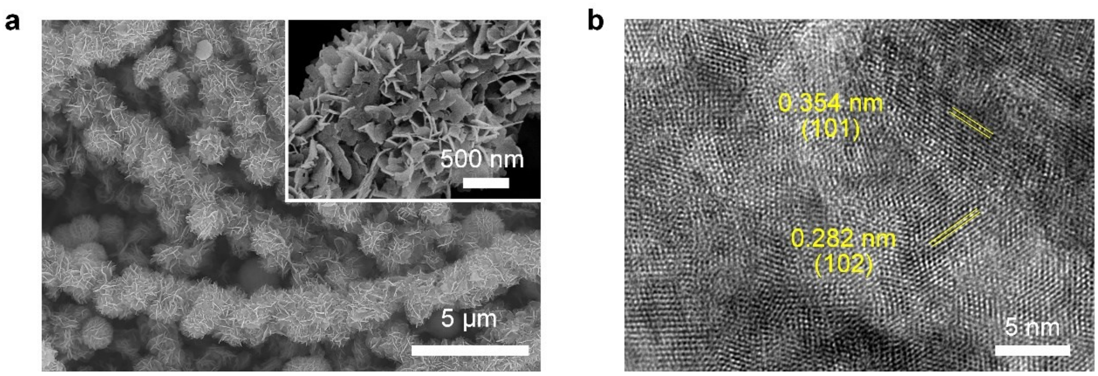

Fig. S14 (a) SEM and (b) HRTEM images of SiO_2/PANI/BiOBr membrane after photocatalytic process.

Table S1. Permeation fluxes of SiO_2/PANI/BiOBr membrane for separating surfactant stabilized oil-in-water emulsions in comparison with the separation membranes in literature.

Membrane	Pressure applied (kPa)	Permeation flux	Normalized flux ($L\ m^{-2}\ h^{-1}\ bar^{-1}$)	Ref.
SiO_2@PEI-PAN-SEP	10	~1500-2000 $L\ m^{-2}\ h^{-1}$	~15000~20000	[1]
Modified PAA-g-PVDF	100	1230-1360 $L\ m^{-2}\ h^{-1}$	1230-1360	[2]
SiO_2/PAN	1	267-647 $L\ m^{-2}\ h^{-1}$	26700-64700	[3]
SWCNT/PD/PEI	50	3030-6060 $L\ m^{-2}\ h^{-1}\ bar^{-1}$	3030-6060	[4]
SWCNT-TiO_2	5	15690-17560 $L\ m^{-2}\ h^{-1}\ bar^{-1}$	15690-17560	[5]
SiO_2/PANI/BiOBr	1	455-1004 $L\ m^{-2}\ h^{-1}$	45500-100400	This work

Supplementary Methods

Calculation method of the adhesion work

The adhesion works of the oil and water on the surface of the relevant membrane were calculated by the Young Dupré's Equation: $W_{ad} = \gamma_{lg}(1 + \cos\theta_{lv})$, where the W_{ad} is the adhesion work, the γ_{lg} is the surface tension of liquid/air interface, and the θ_{lv} is the relevant liquid contact angle in air. For the SiO_2/PANI and SiO_2/PANI/BiOBr nanofibrous membrane, both the WCA and OCA are 0° in air. And the surface tension in air for water and dichloroethane are 72.8 $mN\ m^{-1}$ and 23.2 $mN\ m^{-1}$, respectively. Consequently, for water, the W_{ad} = 72.8 × (1 + cos0°) = 145.6 $mN\ m^{-1}$. For dichloromethane, the W_{ad} = 23.2 × (1 + cos 0°) = 46.4 $mN\ m^{-1}$.

References

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