Supporting Information For

Noncovalently Functionalized Sulfated Castor Oil – Graphene Oxide-Strengthened Polyetherimide Composite Membranes for Superior Separation of Organic Pollutants and Their Fouling Mitigation

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Table S1. The specification details of the sulfated castor oil

Sulfated castor oil (SCO)	
Reaction time	3 hours
Reaction temperature	25-32°C
pH	7.4
Solubility	Miscible in water
Appearance	Brownish red
Molecular weight	1172 g/mol

Table S2. The casting solution compositions of different polymers and additives

Membranes	Blend compositions (wt%)			Solvent (wt%)	PWF $Lm^{-2}h^{-1}$	Water contact angle (Top surface) (°)
	PEI	SCO	GO	NMP		
PEI_{15}	15	0.0	0	85.0	5.40	110.1
$PEI_{17.5}$	17.5	0.0	0	82.5	6.50	108.3
Bare PEI_{20}	20	0.0	0	80.0	**7.80**	98.5
$PEI/SCO_{0.5}$	20	0.5	0	79.5	15.4	90.5
$PEI/SCO_{1.0}$	20	1.0	0	79.0	20.1	90.0
$PEI/SCO_{1.5}$	20	1.5	0	78.5	24.3	89.2
$PEI/SCO_{2.0}$	20	2.0	0	78.0	32.5	88.1
$PEI/SCO_{2.5}$	20	2.5	0	77.5	**64.5**	83.5
$PEI/SCO_{3.0}$	20	3.0	0	77.0	Film damage due to phase separation	
$PEI/GO_{0.1}$	20	0.0	0.1	79.9	30.3	76.4
$PEI/GO_{0.2}$	20	0.0	0.2	79.8	70.4	60.6
$PEI/GO_{0.3}$	20	0.0	0.3	79.7	45.2 (Flux decline due to aggregation of GO)	58.1
$PEI/SCO@GO_{0.1}$	20	2.5	0.1	77.4	150.6	68.2
$PEI/SCO@GO_{0.2}$	20	2.5	0.2	77.3	**410.6**	40.4

PEI/SCO@$GO_{0.3}$	20	2.0	0.3	77.2	18.6 (Flux decline)	42.1

S1. Membranes characterization

The presence of the sulfonated group in castor oil was analyzed by using Fourier transform infrared (FT-IR) spectrometer (Thermo Nicolet Nexus-410, USA). The presences of the functional moieties in the prepared PEI membranes were analyzed using the attenuated total reflectance FT-IR (ATR-FTIR, IR affinity-1, Shimadzu, Japan). The Raman spectroscopy was recorded using Raman Microscope (Renishaw InVia, UK) with Argon ion (green) laser beam of 514 nm wavelength. The X-ray diffraction (XRD) analysis of the bare PEI, PEI/SCO and PEI/SCO@GO membranes were measured using an X-ray diffractometer (XRD, Smart Lab, Rigaku, Japan) operating at the voltage of 40 mV and current of 40 mA with the reference target of Cu-Ka radiation. The membrane XRD data were collected from $2\theta = 5°$ to 50° with the step of 0.01° in the continuous scan range mode. The sample thickness for the XRD analysis was 200 μm.

The elemental compositions of the whole structural membranes were studied by CHNS elemental analyzer (Vario EL cube Elementar, Germany). The surface elemental compositions of the membranes were tested by X-ray photon spectroscopy (XPS) (ESCALAB 250 XI, Thermo Scientific, USA) with the monochromatic of Al Kα X-ray (1486.6 eV) used as a radiation source. The cross-section membrane structure of the bare PEI, PEI/SCO and PEI/SCO@GO membranes were analyzed using the scanning electron microscope (SEM, Hitachi, S-3400N, Japan). The samples were gold-sputtered prior to the SEM measurement. The roughness of the bare PEI, PEI/SCO and PEI/SCO@GO membranes were measured using the atomic force microscope

(AFM, Model-multimode 8, Bruker, Germany) and the data were recorded from the different locations of the tested sample.

The membrane hydrophilicity was measured using the water contact angle (CA) measuring system (SDC-70, Shengding, China) at the room temperature. The CA was analyzed at different locations of the membrane surfaces and their average values were reported. The surface charge of the bare PEI, PEI/SCO and PEI/SCO@GO membranes were analyzed via the surface zeta potential measurement (Anton Paar SurPASS 3, GmbH, Austria). The zeta potential values were carried out at a neutral pH of 7.0 at 25°C. The pH was adjusted using sodium hydroxide (NaOH) or hydrochloric acid (HCl) and the 10 mM potassium chloride (KCl) was used as a background electrolyte solution. The experiment was repeated for three times for each sample and their average values were reported.

The tensile strength of the bare PEI, PEI/SCO and PEI/SCO@GO membranes were measured using a tensile testing machine (CMT 4204, SANS, China). The sample with a uniform thickness of 0.2 mm, a length of 35 mm and a breadth of 16 mm was positioned between the grips of the tensile machine and the speed of testing was set at a rate of 2 mm min^{-1} according to the ASTM-D882 measurements. The testing was performed for three times for each sample and their average values were reported.

Table S3. The permeate and recovery fluxes of the membranes

Membranes	Permeate fluxes ($Lm^{-2}h^{-1}$)			Recovery water fluxes after washing with deionized water for 30 mins ($Lm^{-2}h^{-1}$)		
	Oil	HA	BSA	Oil	HA	BSA
Bare PEI	1.0 ± 1.5	0.8 ± 0.8	1.0 ± 1.5	2.0 ± 0.4	2.4 ± 0.3	3.0 ± 1.6
PEI/SCO	43.5 ± 0.7	38.6 ± 0.4	40.8 ± 0.8	48.6 ± 0.9	46.6 ± 0.6	53.1 ± 1.7
PEI/SCO@GO	371.0 ± 0.3	396.4 ± 1.9	348.2 ± 0.2	384.3 ± 0.5	405.4 ± 0.4	376.3 ± 2.0