Supplementary Information

Photo-responsive nano/micro-membrane for smart separation and self-cleaning

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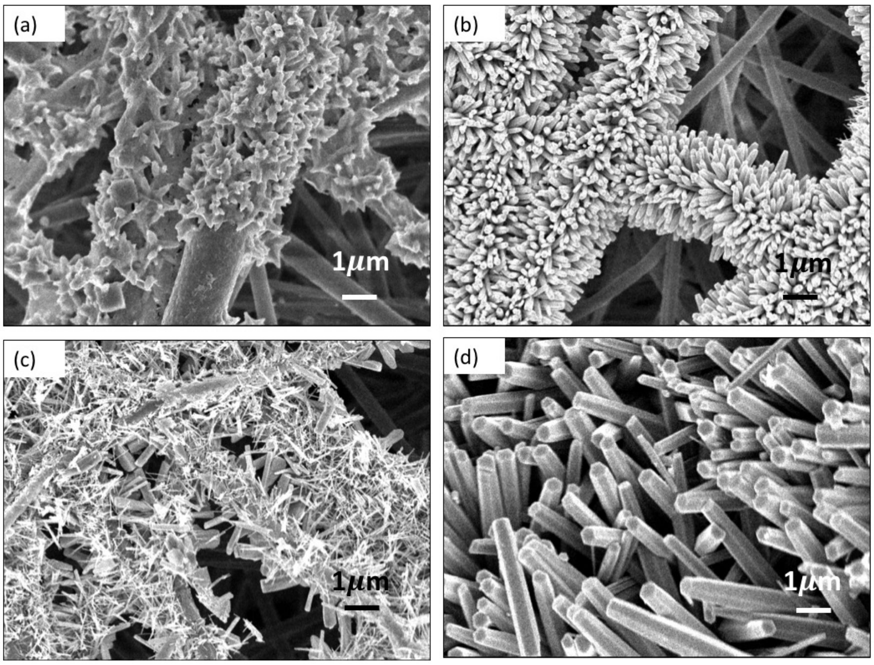

Figure S1 FESEM images of ZnO modified PSF nano-fibrous membrane with different hydrothermal duration. (A) 1hr; (B) 3hr; (C) 5hr; (D) 24hr.

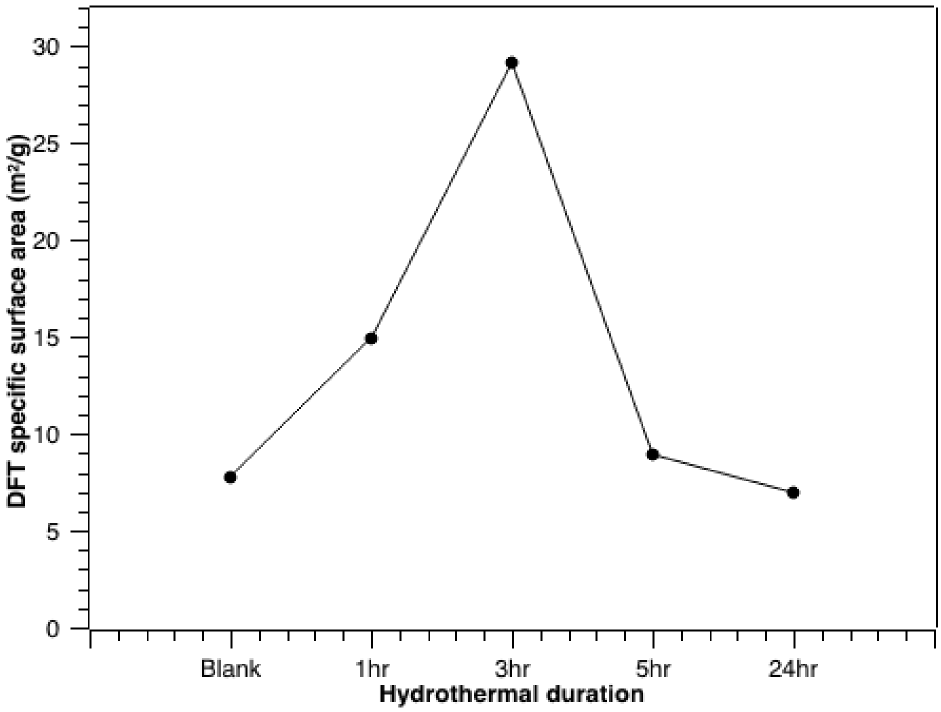

Figure S2 DFT specific surface of ZnO modified PSF nano-fibrous membrane with different hydrothermal duration.

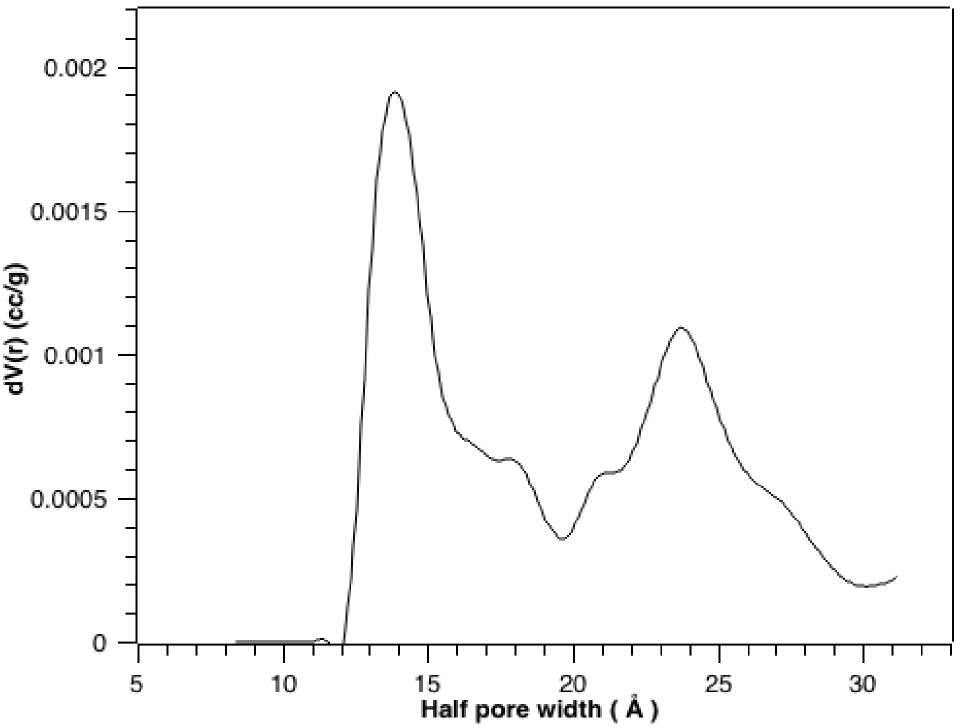

Figure S3 Pore size distribution of ZnO modified PSF nano-fibrous membrane with 3hr hydrothermal duration.

Photocatalytic Oxidation

The photocatalytic ability of the synthesized samples was tested. In addition, PSF nano-fibrous membrane without ZnO was also used as a control. The experiment was carried out in a closed chamber. Acid orange 7 (AO7) was used as a target pollutant. ZnO modified membrane (3 cm × 3 cm) was added into the 10 ppm AO7 solution and placed in the dark for 1hr to ensure adsorption equilibrium. 2 mL samples were collected before the start of experiment, 1 hr later and another 10 mins later to ascertain complete adsorption. Thereafter, UV irradiation was switched on and the samples were collected at every 20 mins interval. The samples were analysed using the UV-vis spectrophotometer by obtaining the absorbance reading scanned over a wavelength range of 300 nm to 600 nm. The absorbance reading can be converted into concentration (mg/L) by using the standard curve for AO7.

Table S1 and Figure S4(a) show the changes of AO7 concentration for different hydrothermal durations (c/c_0 vs. Time). Table S2 and Figure S4(b) compare the photo-degradation rate of AO7 as the first order reaction ($-\ln(c/c_0)$ vs. Time). All of the ZnO modified membrane showed better photo-degradation rate than the blank sample. The sample with 3hr ZnO nanorods growth was able to achieve the highest photo-degradation efficiency 96.70% after 240 min of UV irradiation and the highest rate constant with k = 0.0145 min^{-1}, while efficiency of the blank sample without ZnO was only 81.81%, and the reaction constant k (0.0073 min^{-1}) is the lowest. As for 1hr hydrothermal growth, due to the insufficient ZnO nanorods formation, the reaction rate was slower than 3hr. By increasing the hydrothermal duration to 5hr and 24hr, the reaction rate constant deceases to 0.0097 min^{-1} and 0.0087 min^{-1}. This result also matches the FESEM image of the membrane morphology as shown in Figure S1 and the specific surface area result as shown in Figure S2. Therefore, this PCO test result indicates that the 3hr-growth ZnO modified nano-fibrous membrane had the best potential for application in photo-catalysis and self-cleaning.

Table S1. AO7 degradation efficiency of 240min for different hydrothermal duration

Hydrothermal Duration (hr)	Degradation Efficiency (%)
1	92.85
3	96.70
5	87.40
24	85.52
Blank	81.81

Table S2 Photo-degradation rate constant and R^2 of AO7 for various hydrothermal duration

Hydrothermal Duration (h)	Rate Constant (min^{-1})	R^2
1	0.0119	0.9849
3	0.0145	0.9867
5	0.0097	0.9926
24	0.0087	0.9937
Blank	0.0073	0.9954

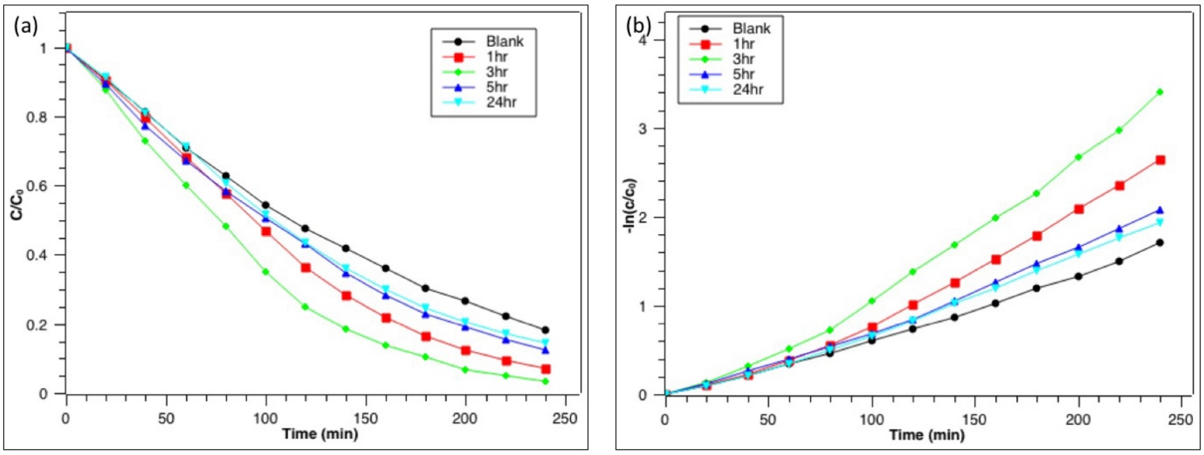

Figure S4 (a) Changes of AO7 concentration and (b) photo-degradation rate for different hydrothermal duration