Article

ZnO/PDA/Mesoporous Cellular Foam Functionalized Thin-Film Nanocomposite Membrane towards Enhanced Nanofiltration Performance

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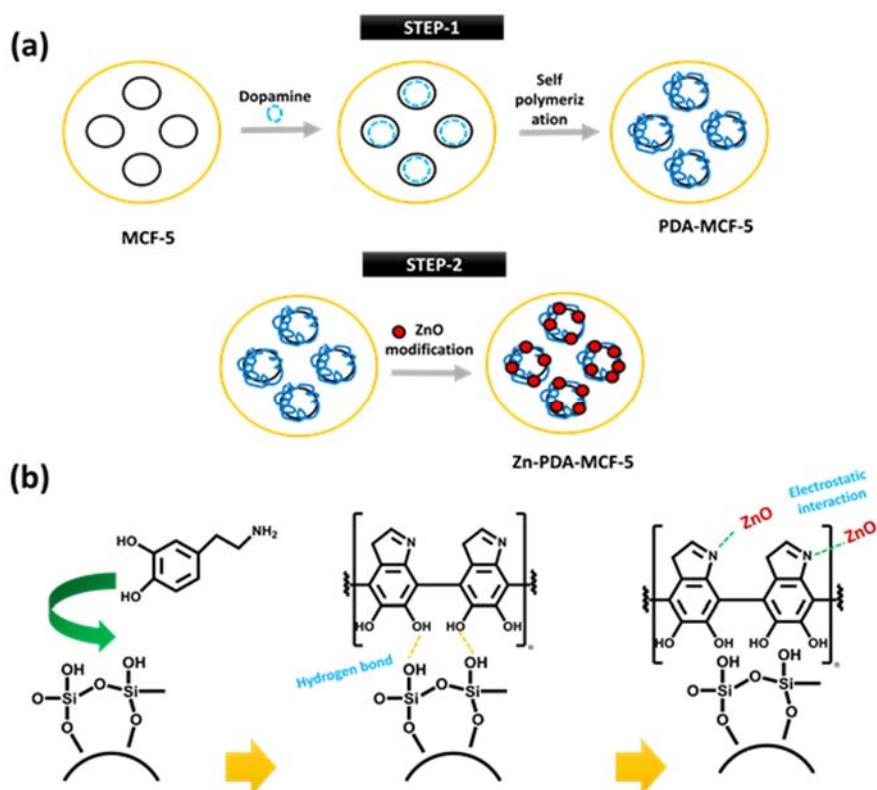
Supplementary Information

Figures

Figure S1. Schematic illustration of synthesis of Zn-PDA-MCF-5 nanoparticle.
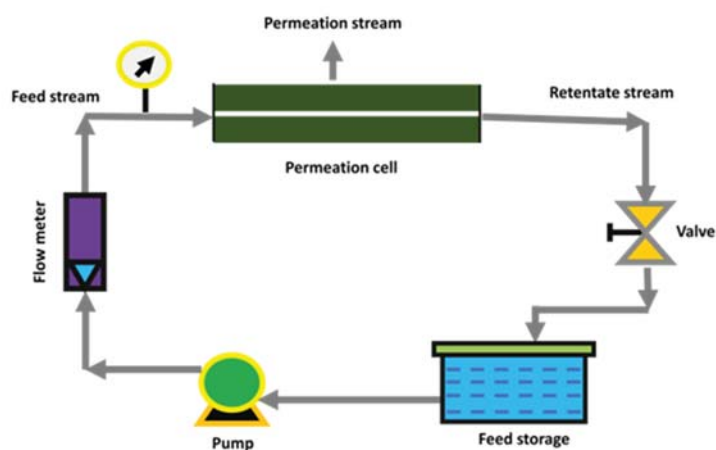
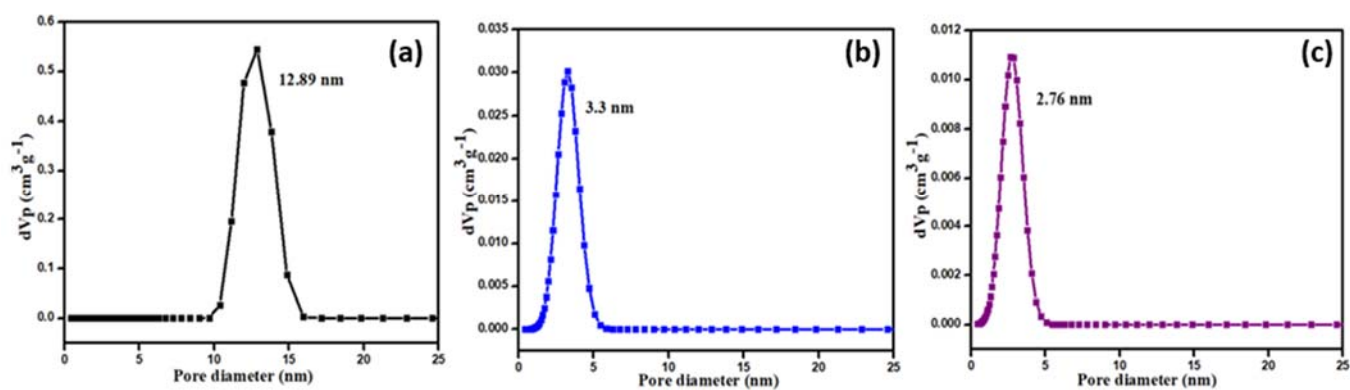**Figure S2.** Schematic illustration of crossflow NF system.

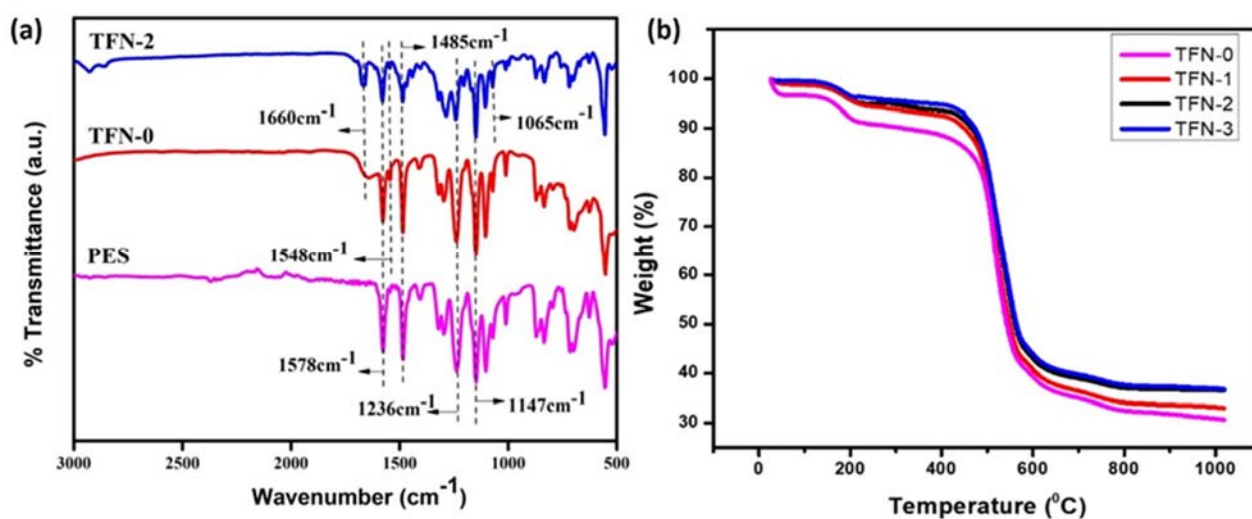**Figure S3.** Pore size distribution of (a) MCF-5 silica (b) PDA-MCF-5 (c) Zn-PDA.

Figure S4. (a) FT-IR spectra and (b) TGA Curves of fabricated membranes.
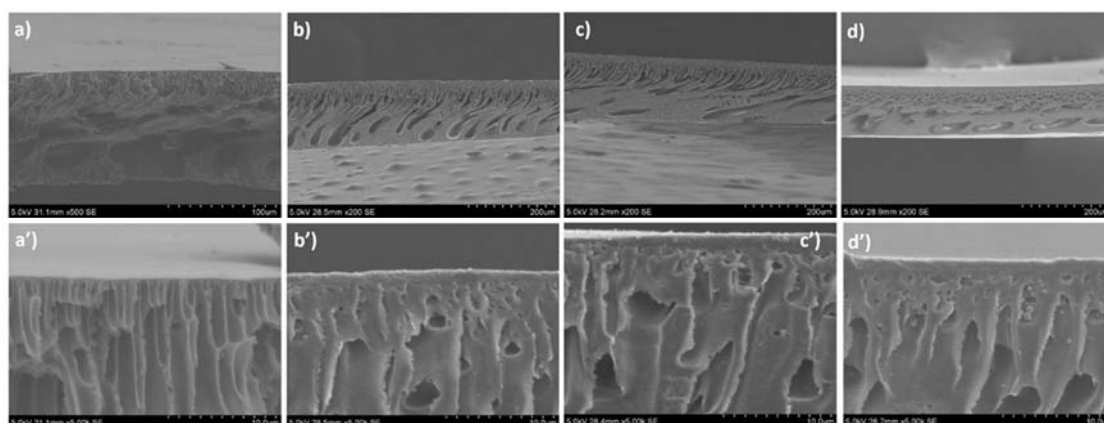
Figure S5. Cross-sectional morphologies of (a, a') PES; (b, b') TFN-0; (c, c') TFN-2; and (d, d') TFN-4 membranes.
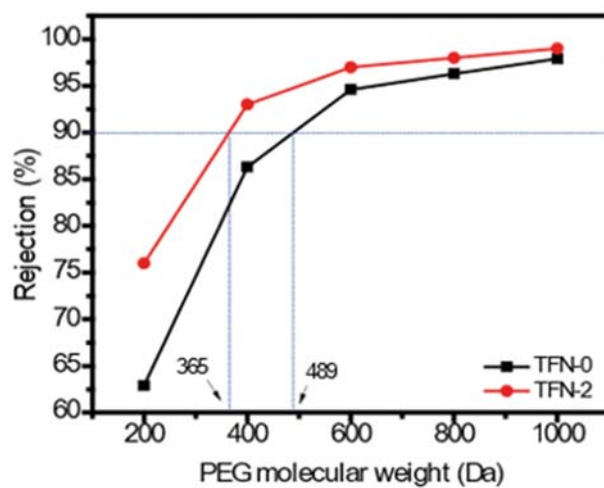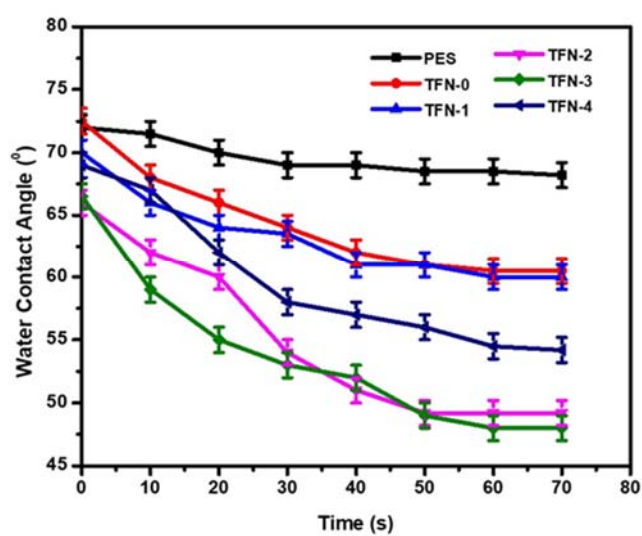

Figure S6. Molecular weight cut-off of membranes.

Figure S7. Dynamic water contact angles of the membranes.

Tables

Table S1. Elemental composition from nanoparticles.

Element	Atomic wt.%	
	MCF silica	**Zn-PDA-MCF-5**
O	72.25	52.50
Si	27.75	10.55
C	0	18.52
N	0	4.67
Zn	0	13.76

Table S2. Brief summary of surface areas and pore sizes of mesoporous fillers.

Samples	Specific Surface Area[a] (m²/g)	Pore Volume[a] (cm³/g)	Pore Size[b] (nm)
MCF-5	389.71	2.13	12.89
PDA-MCF-5	278.12	0.30	03.29
Zn-PDA-MCF-5	138.92	0.12	02.76

[a] Calculation based on BET method. [b] Calculation based on NLDFT method.

Table S3. Roughness parameters of the membranes from AFM.

Membrane ID	Ra (nm)	Rz (nm)	Rrms (nm)
PES	12.80 ± 1.70	40.20 ± 6.30	15.60 ±1.90
TFN-0	47.80 ± 12.60	133.30 ± 26.90	59.50 ± 19.30
TFN-1	45.20 ± 7.70	164.80 ± 23.60	56.70 ± 9.00
TFN-2	37.83±7.00	143.70±21.60	48.13±9.90
TFN-3	70.60 ± 13.50	227.50 ± 39.50	88.20 ± 16
TFN-4	80.60 ± 15.50	292.50 ± 45.30	99.60 ± 18.80

Ra (average roughness), Rz (mean height roughness) and Rrms (root mean square roughness).

Table S4. Parameters of inorganic ions in the feed solution [1,2].

Ions	Z	Hydrated radius (Å)	D (10^{-3} mm²s⁻¹)
Na^+	1	3.58	1.33
SO_4^{2}	-2	3.79	1.07
Mg^2	2	4.28	0.71
Cl^-	-1	3.32	2.03

References

1. H. Sun and P. Wu, "Tuning the functional groups of carbon quantum dots in thin film nanocomposite membranes for nanofiltration," *J. Membr. Sci.*, vol. 564, pp. 394–403, Oct. 2018, doi: 10.1016/j.memsci.2018.07.044.
2. D.-X. Wang, M. Su, Z.-Y. Yu, X.-L. Wang, M. Ando, and T. Shintani, "Separation performance of a nanofiltration membrane influenced by species and concentration of ions," *Desalination*, vol. 175, no. 2, pp. 219–225, May 2005, doi: 10.1016/j.desal.2004.10.009.