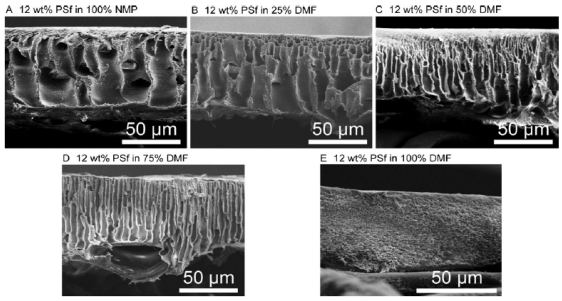
층 형성과 구조 지원 박막 합성 전방 삼투막 성능 관련

삼투압으로 구동되는 막 공정은 손상된 수원을 치료하고, 바다/돌기 물을 담수화하며, 지속 가능한 에너지를 생산할 수 있는 잠재력을 가지고 있습니다.
이러한 공정에 맞춘 막의 개발은 기술을 상업적으로 사용할 수 있는 수준까지 발전시키기 위해 필수적입니다.
본 연구에서는, 위상분리에 의해 제작된 폴리설폰 지지층 위에 계면 중합에 의해 형성된 선별된 폴리아미드 활성층으로 구성되어 있는 멤브레인을 폴리설폰 층의 주조과정에서 사용된 조건을 체계적으로 변화시킴으로써, 구조가 다른 지지층의 배열을 만들었습니다.
또한, 지지층 구조 형성에 용매품질, 폴리머의 농도, 직물 레이어 습윤, 주조블레이드 게이트 높이 등의 역할을 조사했습니다.

키워드

Forward osmosis, Thin-film composite, Porous support, Polysulfone support layer, Support structure, Support formation, Membrane structure, Internal concentration polarization.



[용매, 농도에 따른 멤브레인 단층 SEM]

Support Layer Pore Size (nm)
[Support Layer Finger Width (μm)]

PSf Concentration (wt %) ⟶ \ DMF Concentration (wt %) ⟶	0	25	50	75	100
9	38.8 ± 18.4 nm [27.3 ± 6.3 μm]				39.6 ± 15.6 nm [9.9 ± 1.6 μm]
12	38.5 ± 14.1 nm [20.0 ± 6.2 μm]	22.1 ± 9.1 nm [17.2 ± 4.6 μm]	25.6 ± 13.2 nm [5.5 ± 1.9 μm]	28.4 ± 12.3 nm [2.6 ± 0.7 μm]	35.7 ± 16.8 nm [NA]
15	22.7 ± 10.7 nm [16.4 ± 3.8 μm]				24.3 ± 8.4 nm [NA]
18	20.3 ± 7.0 nm [11.3 ± 3.2 μm]				NA [NA]

[PSf, DMF농도변화에 따른 지지층 공극 크기변화]

Table 3
Summary of measured FO water flux J_w, NaCl observed rejection R, and calculated structural parameter S, porosity parameter ε/τ, intrinsic permeability A, and NaCl permeability coefficient B for the membranes tested[a,b].

Membrane		FO water flux, J_w (L m^{-2} h^{-1})	Structural parameter, S (μm)	Porosity parameter, ε/τ (L m^{-2} h^{-1})	Intrinsic permeability, A (L m^{-2} h^{-1} bar^{-1})	NaCl permeability coefficient, B (L m^{-2} h^{-1})	NaCl rejection, R (%)
PSf concentration (wt%)	DMF concentration (wt%)						
9	0	20.5 ± 3.8	389 ± 150	0.222 ± 0.088	1.63 ± 0.18	0.84 ± 0.19	95.8 ± 1.3
12	0	13.9 ± 1.0	530 ± 48	0.201 ± 0.022	1.04 ± 0.17	0.63 ± 0.20	96.7 ± 1.4
15	0	9.2 ± 0.2	964 ± 301	0.140 ± 0.046	0.97 ± 0.44	0.25 ± 0.12	96.8 ± 3.1
18	0	6.2 ± 2.8	2677 ± 2189	0.064 ± 0.033	1.09 ± 0.06	0.47 ± 0.29	97.2 ± 1.0
12	25	10.8 ± 2.4	676 ± 111	0.163 ± 0.032	0.93 ± 0.37	0.52 ± 0.29	97.3 ± 1.0
12	50	12.5 ± 1.0	577 ± 108	0.166 ± 0.014	0.93 ± 0.24	0.27 ± 0.03	97.7 ± 0.4
12	75	14.3 ± 2.5	545 ± 77	0.155 ± 0.020	1.17 ± 0.23	0.42 ± 0.16	97.9 ± 0.6
9	100	25.0 ± 4.1	312 ± 72	0.264 ± 0.087	1.90 ± 0.30	0.33 ± 0.19	98.6 ± 0.8
12	100	17.6 ± 0.4	502 ± 59	0.140 ± 0.029	1.75 ± 0.35	0.33 ± 0.14	98.5 ± 0.3
15	100	5.6 ± 1.6	2511 ± 1168	0.036 ± 0.013	1.05 ± 0.05	0.84 ± 0.19	99.3 ± 0.3
18	100	0.5 ± 0.1	7934 ± 1051	0.012 ± 0.002	0.66 ± 0.39	0.84 ± 0.19	96.2 ± 2.5
PET not wetted							
12	0	5.4 ± 0.6	2232 ± 447	0.040 ± 0.008	0.92 ± 0.06	0.13 ± 0.06	99.2 ± 0.4
15	0	Below detection limit	NA	NA	0.13	0.10	94.6
Higher casting thickness (height)							
12	0 (20 mils)	5.6	2563	0.057	1.41	0.20	99.0

[a] The experimental conditions are stated in the manuscript.
[b] For the recipes illustrated in Fig. 1 an average of 3 separately cast membranes is reported with standard deviation, except for the membranes cast at 18% PSf in 100% DMF, whose values represent the average and standard deviation of 2 separately cast membranes.

[멤브레인 투과도 측정 요약]

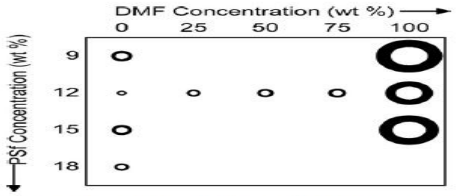


Fig. 11. Bubble graph of A^2/B for the different TFC FO membranes cast in this study, as measured from RO experiments, with A being the pure water intrinsic permeability and B the salt permeability coefficient. Data points are the average of 3 separately cast membranes. RO experimental conditions were as follows: 50 mM NaCl feed solution, 400 psi (27.6 bar) applied pressure, cross-flow of 21.4 cm/s, and temperature of 25 °C. A value for membranes cast at 18 wt% PSf in 100% DMF is not included because the results were not reproducible enough to be considered statistically significant.

[물, 염 투과도에 대한 버블그래프]

원 제 목	Relating performance of thin-film composite forward osmosis membranes to support layer formation and structure
출 처	Journal of Memberane Science
원 저 자	Alberto Tiraferri, Ngai Yin Yip, William A.Phillip, Jessica D. Schiffman, Menachem Elimelech