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Fabrication of thin-film composite nanofiltration membrane employing polyelectrolyte and metal–organic framework (MOF) via spin-spray-assisted layer-by-layer assembly

Farid Fadhillah
Chemical Engineering Department
College of Engineering, Imam Mohammad Ibn Saud Islamic University (IMSIU), 11432 Riyadh, Saudi Arabia

INTRODUCTION & AIM

- The problem with the existing membranes:

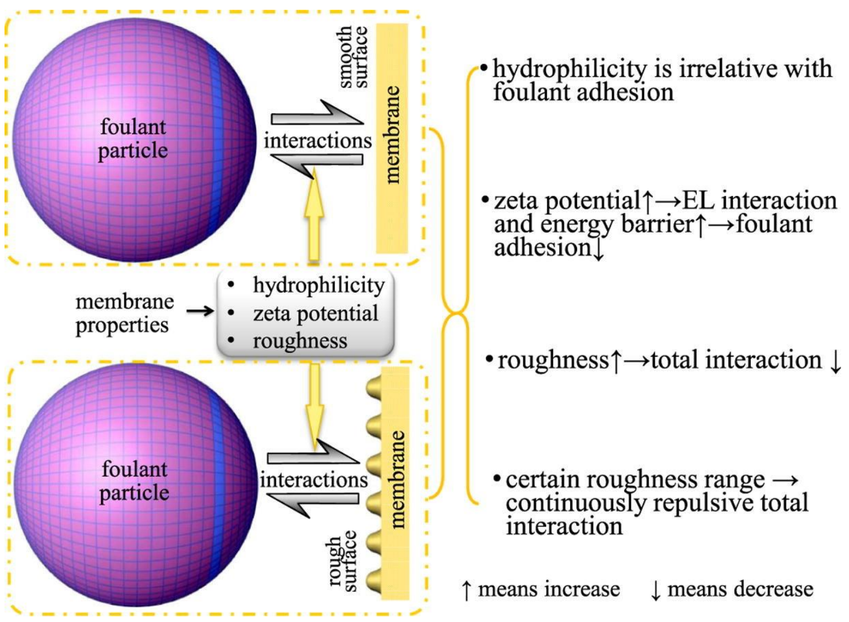

Figure 1. Effect of surface Properties on membrane fouling (adapted from (1))

- The role of using layer-by-layer (LbL) assembly here is to modify the properties of the membrane easily. LbL is generally known for producing smooth and highly hydrophilic surfaces depending on the polyelectrolyte
  - Poly(ethylene imine) and poly(4styrene sulfonate) were used in this work.
- Why use spin spray LbL?
  - Spin lbl is the fastest LbL assembly but has main challenge in scalability
  - Spray Lbl is still faster than dip LbL and does not have problems with scalability and film uniformity of various types of surfaces.
  - Combining the two techniques can overcome the problems of the individual techniques
- Why use MOF303?
  - Successful application in nanofiltration. (2)
  - antiadhesive and antimicrobial properties (3)

METHOD

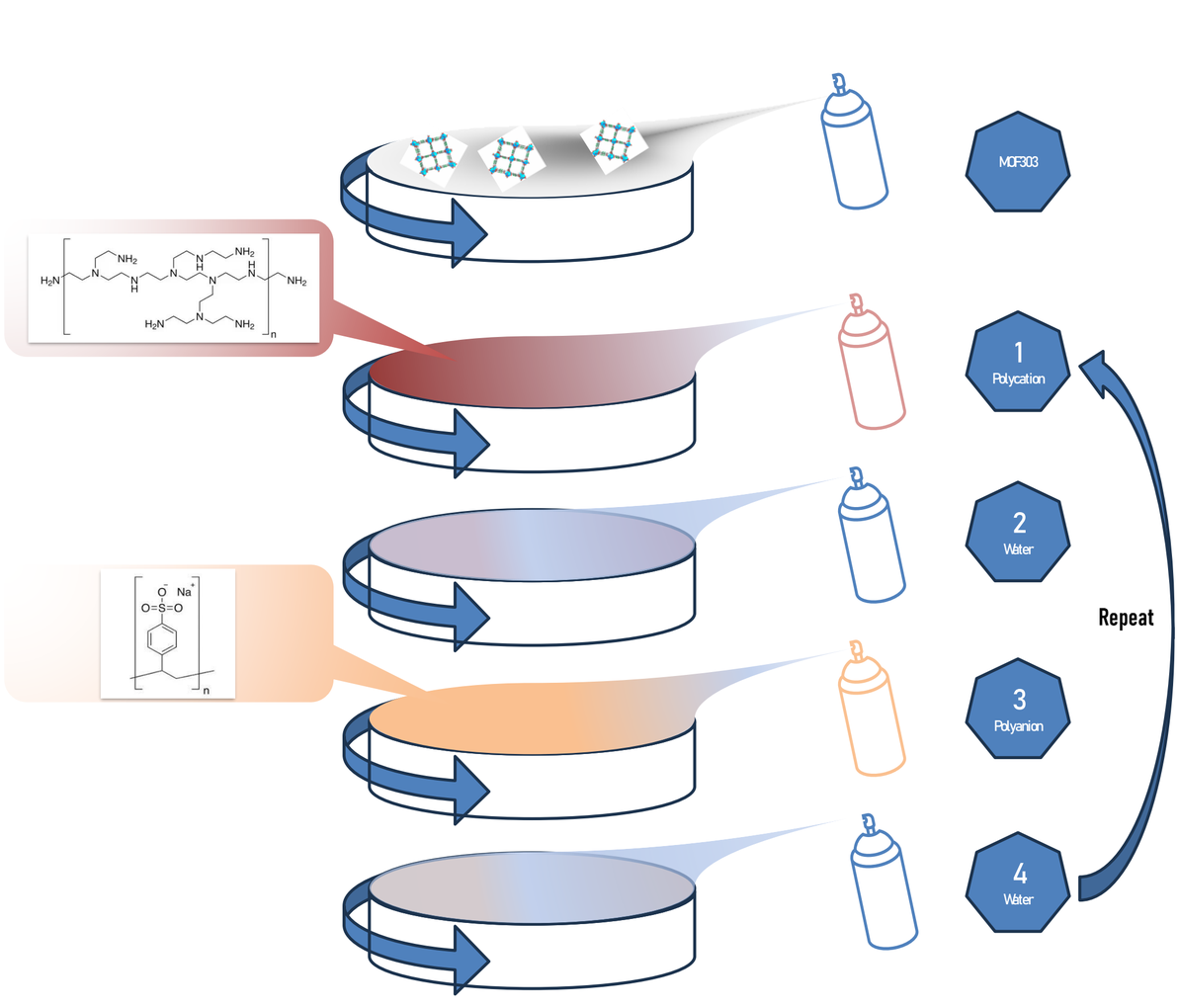

Figure 2. Method of preparing MOF-303 Polyelectrolyte multilayer NF Membrane

RESULTS & DISCUSSION

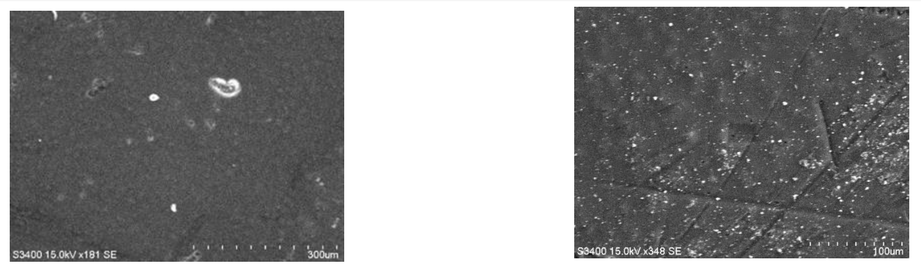

Figure 3. SEM image of NF membrane (left pristine $(PEI/PSS)_5$, right: after MOF303 deposition

Table 1. Surface properties of NF Membrane

Properties	$(PEI/PSS)_5$	$(PEI/PSS)_5$-MOF303
Surface Charge, mV	2.43	18.7
Contact angle, ^{o}	17.88 ± 0.61	25.60 ± 2.61

Table 2. Performance of NF Membrane

Performance*	$(PEI/PSS)_5$	$(PEI/PSS)_5$-MOF303	
MOF-303 size, nm		1251.2 (dispersed by bath sonicator)	826.0 (dispersed by probe sonicator)
Rejection Rate, %	42.61 ± 2.58	18.94 ± 1.58	47.01 ± 0.63
Permeability, $l/m^2.h.bar$	9.46±0.46	0.91 ± 0.13	8.33 ± 0.11
*Testing condition: 2000 ppm NaCl, T = 25^{0}C, P = 10 bar			

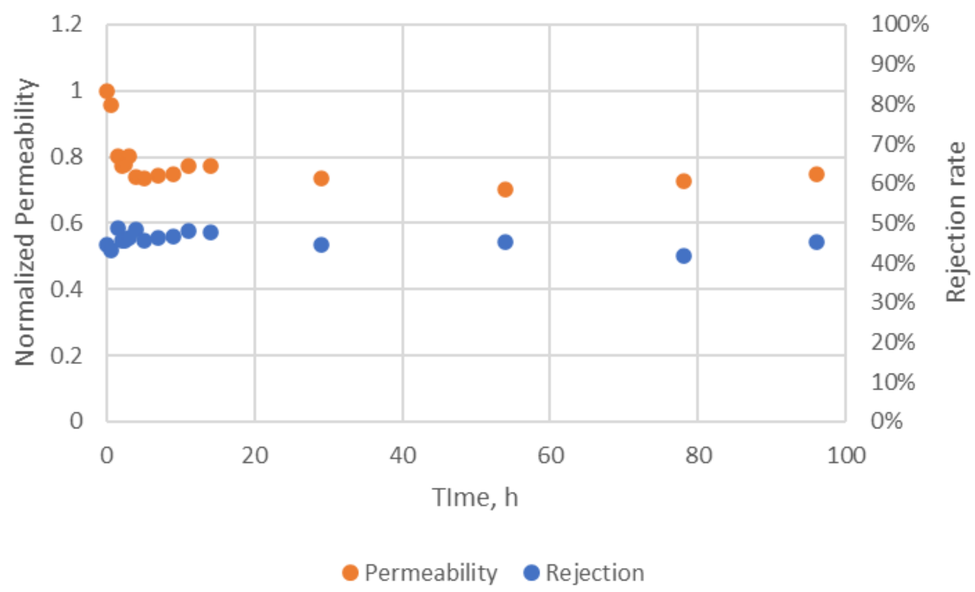

Figure 4. Fouling test of MOF-303 Polyelectrolyte multilayer NF Membrane (foulant : bovine serum albumin)

CONCLUSION

- Successful deposition of MOF303 via spin spray LbL
- The size of the particle plays critical role in the membrane performance
- Maintain Membrane performance and improve the rejection due to increase of surface charge
- Showing improved fouling resistance compared to pristine $(PEI/PSS)_5$ (pristine membrane shows reduction of flux to 67% while MOF303 shows 74%)

FUTURE WORK / REFERENCES

- Optimizing the parameters such as spin speed, particle size
- Characterize the stability of MOF303 incorporation before and after the permeation test.
- Applying the same method for various combinations of polyelectrolytes and biocidal MOF

(1) *Bioresource Technology*, 175, 59-67 (2015)
(2) *Nat Commun* **15**, 10264 (2024)
(3) *Environ. Sci. Technol*. 51, 10, 5511–5522 (2017)