Electronic Supplementary Material (ESI) for New Journal of Chemistry.
This journal is © The Royal Society of Chemistry and the Centre National de la Recherche Scientifique 2022

Electronic Supplementary Material (ESI) for New Journal of Chemistry.
This journal is © The Royal Society of Chemistry and the Centre National de la Recherche Scientifique 2022

Electronic supplementary information (ESI)

Improvement of filtration and antifouling performance of nanofibrous sterile membrane by one-step grafting zwitterionic compound

Qin Cheng,[a, 1] Xiaodan Jia,[a, 1] Pan Cheng,[b] Pengcheng Zhou, [a] Wei Hu,[a] Cuicui Cheng ,[c] Hui Hu,[d] Ming Xia, [a] Ke Liu *[a] and Dong Wang *[a, b]

[a] Key Laboratory of Textile Fiber and Products, Ministry of Education, Hubei International Scientific and Technological Cooperation Base of Intelligent Textile Materials & Application, Wuhan Textile University, Wuhan 430200, China

[b] College of Chemistry, Chemical Engineering and Biotechnology, Donghua University, Shanghai 201620, China

[c] Technical Information Center, Shandong Taipeng Group Co., Ltd, TaiAn 271600, China

[d] Humanwell Healthcare Group Co., Ltd, Wuhan 430000, China

* Corresponding author: luecole@foxmail.com (K. Liu), wangdon08@126.com (D. Wang).

[1] The authors contributed equally to this work.

The isocyanate-sulfopropylbetaine (NCO-SB) is synthesized using addition reaction as described in Fig. S1. The FTIR spectrum is consistent with the previous literatures [1,2]. The peaks emerging at 2260 cm^{-1} in the FTIR spectrum (Fig. S2) is assigned to characteristic stretching peak of NCO group. And a new absorption peak appears at 1548 cm^{-1} and 3280 cm^{-1} due to deformation vibration and stretching vibration of N-H group. The adsorption bands at 1040 cm^{-1}, 1200 cm^{-1} and 606 cm^{-1} are attributed to the stretching vibration of SO_3^- group. In addition, the presence of an obvious new absorption peak at 1715 cm^{-1} related to the stretching vibration of the carbonyl in urethane groups.

The chemical structure of the NCO-SB is analyzed by ^{1}H NMR (Fig. S3). The signals at 0.85 ppm, 0.91 ppm and 3.15 ppm are assigned to the –CH_3 group of 2, 4 and 10. The chemical shifts in the 0.93-1.1 ppm correspond to the proton hydrogen –CH_2 groups of 5, 7 and 12. Signals at 2.15 ppm, 2.25 ppm, 2.94 ppm, 3.54 ppm, 3.74 ppm and 4.49 ppm are clearly attributed to –CH_2 groups of 3, 13, 11, 9, 1 and 8, respectively. The peaks observed at 2.86 ppm are assigned to the –CH group of 6. According to FTIR and ^{1}H NMR analysis, it can be concluded that the NCO-SB is successfully synthesized.

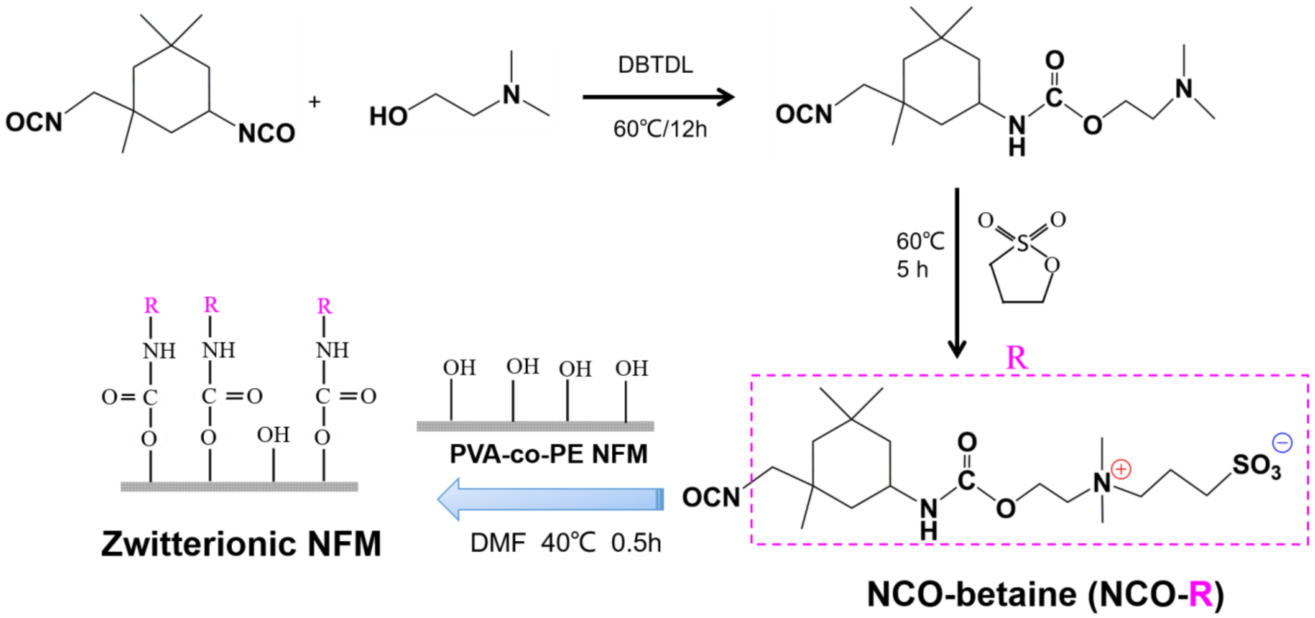

Fig. S1. Reactive principle and preparation process of NCO-R and zwitterionic NFM.

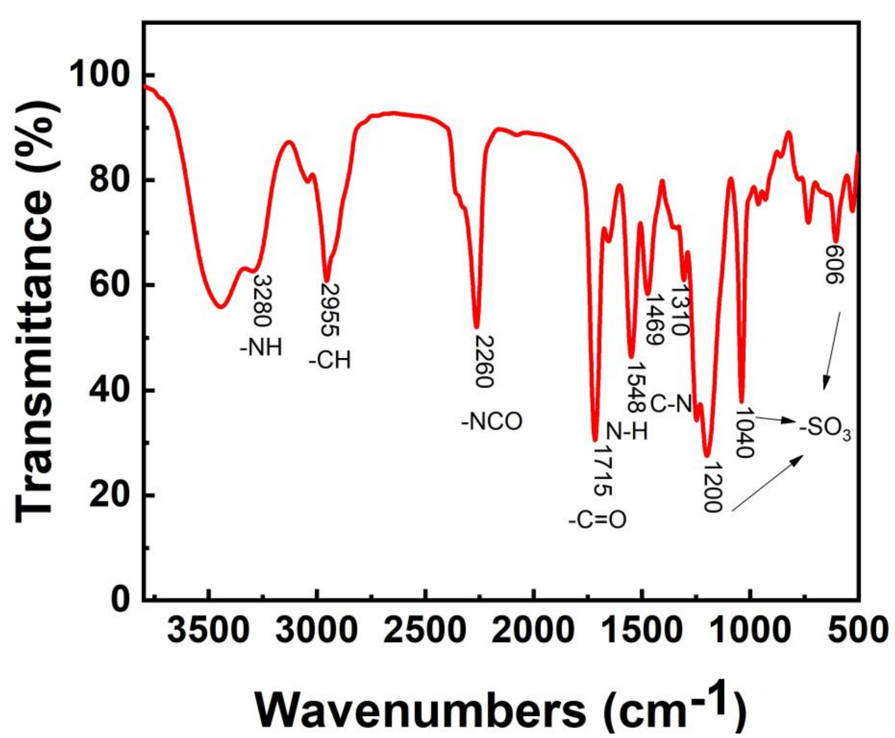

Fig. S2. FT-IR spectrum of isocyanate-sulfopropylbetaine (NCO-SB).

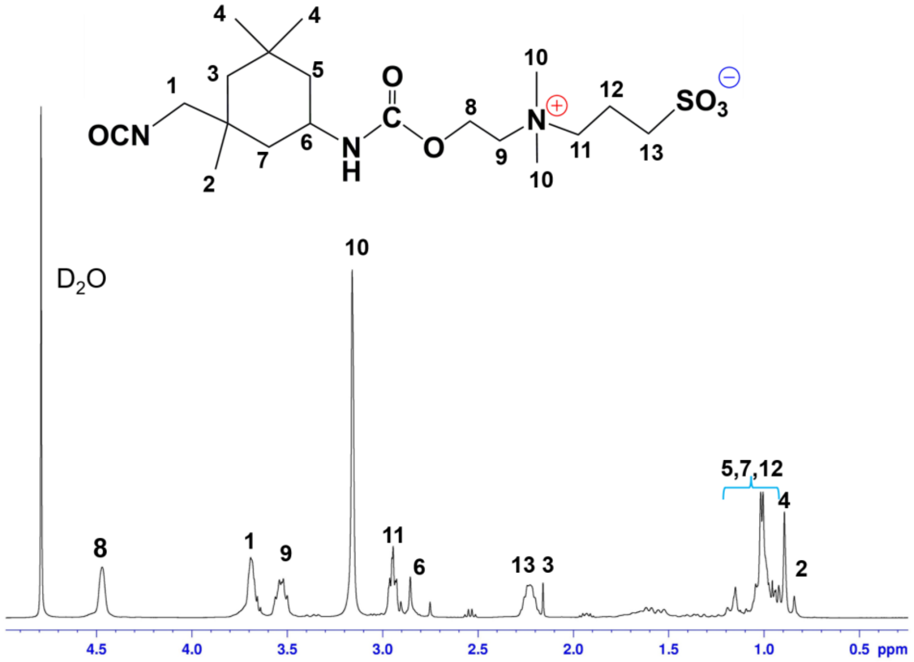

Fig. S3. 1H NMR spectra of NCO-SB.

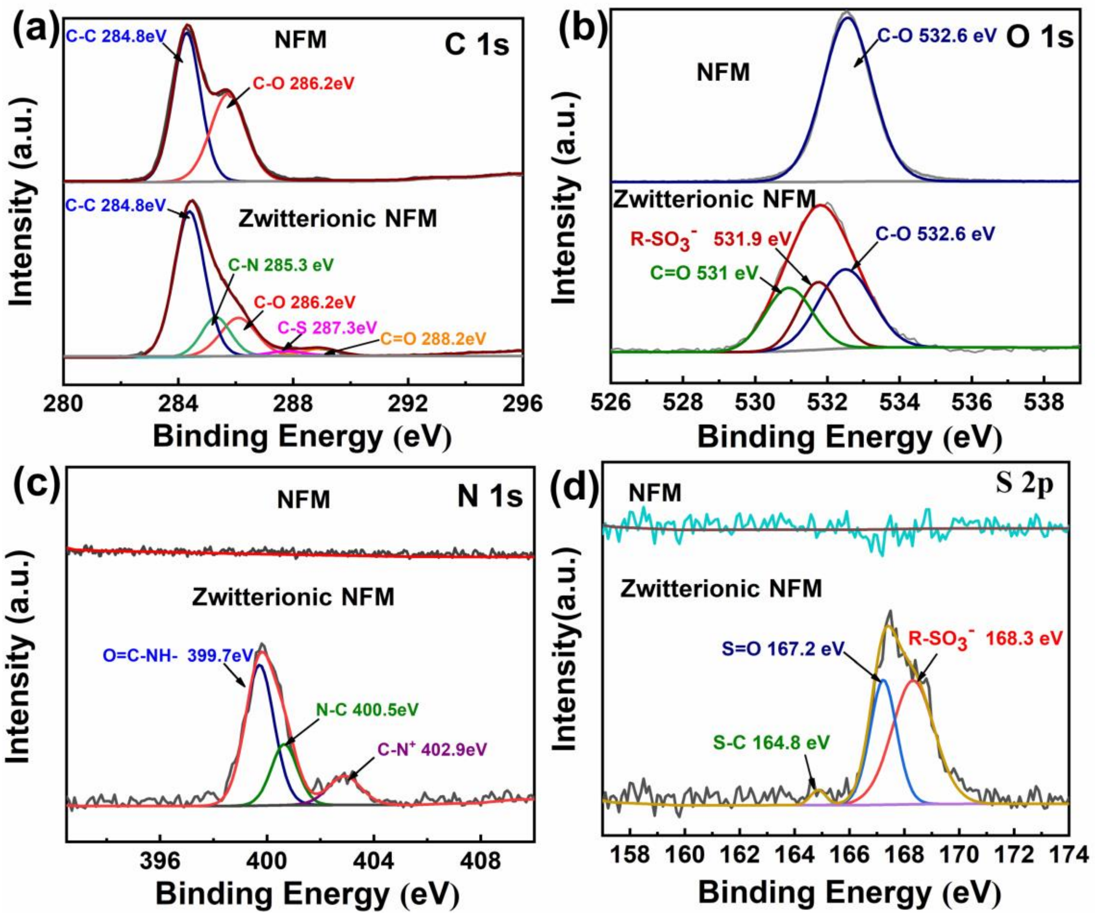

Fig. S4. C1s, O1s, N1s and S2p XPS spectra and curve fitting of NFM and zwitterionic NFM.

The maximal feed pressure the membranes can handle was investigated. The water flux under different feed pressure and the pore size distributions of the membranes after feeding water under different pressure were measured. The membranes were dried at 20℃ before the measurement of the pore size distribution. The results were as shown in Fig. S5. When the feed pressure increased, the water flux of the membranes increased continuously. But when the feed pressure was 0.8 MPa or higher, the water flux of the membranes suddenly increased a lot. As seen in Fig. S5(b), when the feed pressure was in the range of 0.2-0.6 MPa, the pore size distributions of the membranes were close to that of the unused membrane. When the feed pressure was increased to 0.8 MPa, the pore size distribution changes greatly and many large pores appeared. This showed that when the pressure was 0.8 MP or above, the structure of the membrane changed dramatically. In summary, we conclude that the maximal feed pressure that the zwitterionic membrane can handle is 0.6 MPa.

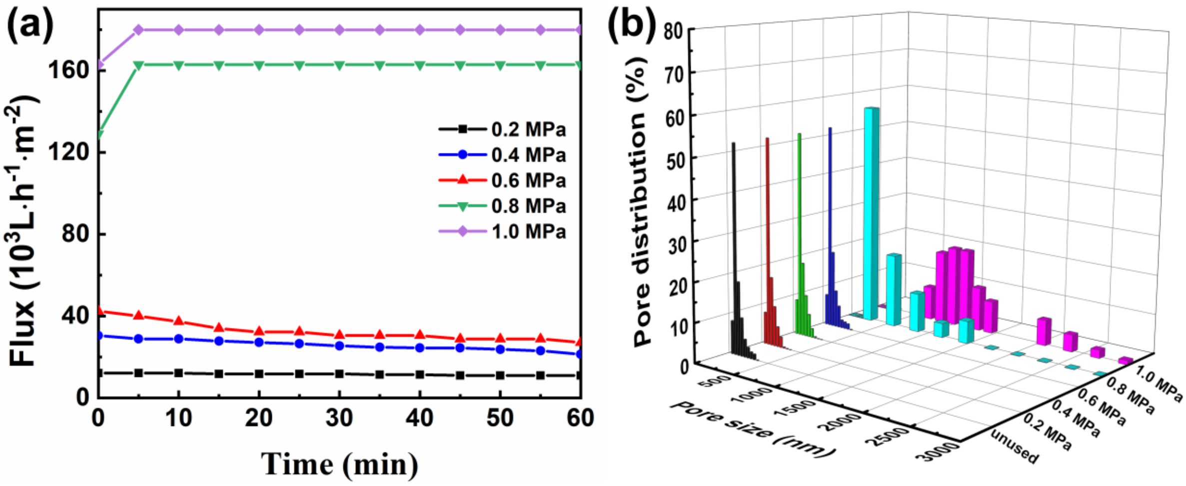

Fig. S5. (a) Pure water flux of membranes varied with test time under different feed pressure. (b) pore size distribution of the membranes before and after feeding water under different pressure.

Table S1 Performance comparison of different membranes

Membrane	Mean pore diameter (nm)	Operating pressure (MPa)	Water flux (L·m-2·h-1)	Ref
CA/PVDF composite nanofiber membrane	0.30	0.1	329	3
Poly (VEVIMIBr) modified PAN nanofibrous membranes	0.21	0.2	2470	4
NFM-APT	0.10	0.2	7400.4	5
Commercial GS0.22 membrane	0.23	0.2	4930	4
Commercial PES membrane	0.22	0.2	6636.6	5
PVDF	0.22	0.2	167	6
Powdered activated carbon dynamic membranes	0.10	0.2	4000	7
Zwitterionic NFM	0.0956	0.2	11032.2	This work

References

1. S. Chen, L. Yuan, Q. Li, J. Li, X. Zhu, Y. Jiang, O. Sha, X. Yang, J.H. Xin, J. Wang, F.J. Stadler and P. Huang, *Small*,2016, **12**, 3516-3521.
2. J. Wang, M. Qiu and C. He, *J. Membr. Sci.*, 2020, **606**, 118119.
3. C. L. Liu, X. F. Li, T. Liu, Z. Liu, N. N.a Li, Y. F. Zhang, C. F. Xiao, X. S. Feng, *J. Membr. Sci.*, 2016, **512**, 1–12.
4. H. Y. Ma, B. S. Hsiao, B. Chu, *J. Membr. Sci.*, 2014, **452**, 446–452.
5. X. Wang, P. Cheng, N. Liu, Y. Wan, Q. Guo, Q. Cheng, K. Liu, Z. Lu, M. Li and D. Wang, *J. Membr. Sci.*, 2020, **601**,117935.
6. Q. M. Xiong, J. Liu, M. Liu, C. H. Shen, X. C. Yu, C. D. Wu, J. Huang, R.Q. Zhou, Y. Jin, *RSC Adv.*, 2020, **10**, 655-665.
7. J. F. Soesanto., K. J. Hwang, C. W. Cheng, H. Y. Tsai, A. Huang, C. H. Chen, T. W. Cheng, K. L. Tung, *J. Membr. Sci.*, 2019, **591**,117298.