Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Leaf Vein-Biomimetic Nanofibrous Membranes with Self-assembled Nanonets for Surface Filtration of Water Contaminants

Ning Tang,[a, b] Shichao Zhang,[a, c] Xia Yin,[*a, c] Jianyong Yu,[*a, c] and Bin Ding[a, c]

[a] *State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Textiles, Donghua University, Shanghai 201620, China.*

[b] *College of Textile Science and Engineering (International Institute of Silk), Zhejiang Sci-Tech University, Hangzhou, 310018 China.*

[c] *Innovation Center for Textile Science and Technology, Donghua University, Shanghai 200051, China.*

Supplementary Information

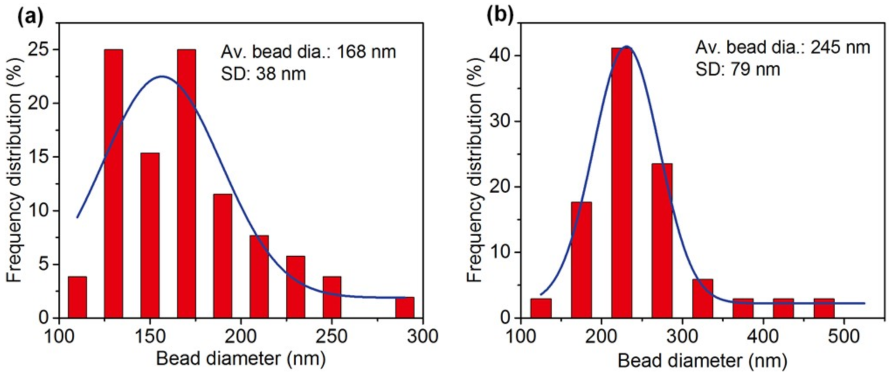

Figure S1 Bead diameter distributions of PVDF membranes prepared from solvent of (a) DMSO, and (b) DMF.

Table S1. Solubility parameters of DMSO, DMF, DMAc, and water according to Hildebrand, Hansen.[1]

Compounds	δ_t/(J cm^{-3})$^{0.5}$	δ_d/(J cm^{-3})$^{0.5}$	δ_p/(J cm^{-3})$^{0.5}$	δ_h/(J cm^{-3})$^{0.5}$
DMSO	26.6	18.4	16.4	10.2
DMF	24.9	17.4	13.7	11.3
DMAc	22.8	16.8	11.5	10.2
Water	28.4	15.1	17.1	16.9

Table S2. Crystallinity of PVDF powder and PVDF membranes obtained from different solvents.

Samples	Solvent	Crystallinity (%)
PVDF powder	/	65.8
	DMSO	31.8
PVDF membrane	DMF	39.0
	DMAc	46.4
PVDF-TW membrane	DMAc	53.3

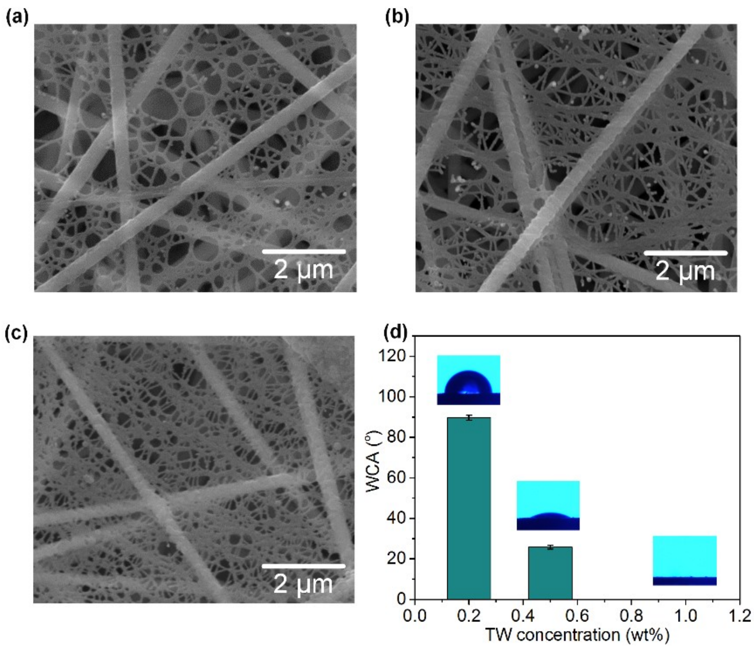

Figure S2 SEM images of BNFMs obtained from 2 wt% PVDF solution with TW concentration of (a) 0.2, (b) 0.5, and (c) 1 wt%. (d) WCA of the BNFMs with different TW concentrations.

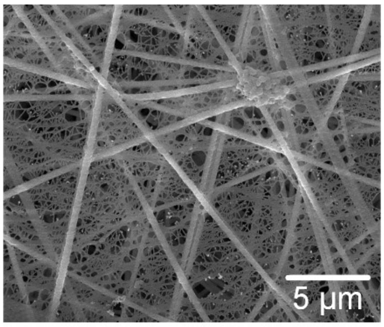

Figure S3 SEM image of BNFM with low magnification (2 wt% PVDF with 0.5 wt% TW).

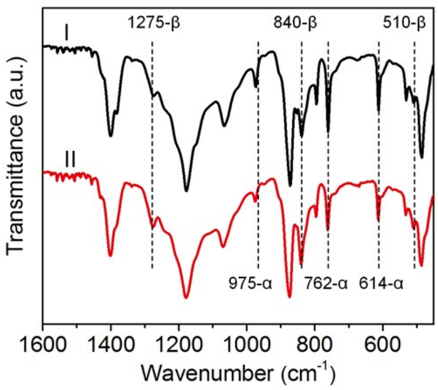

Figure S4 Enlarged graph of FTIR spectra in Figure 3c.

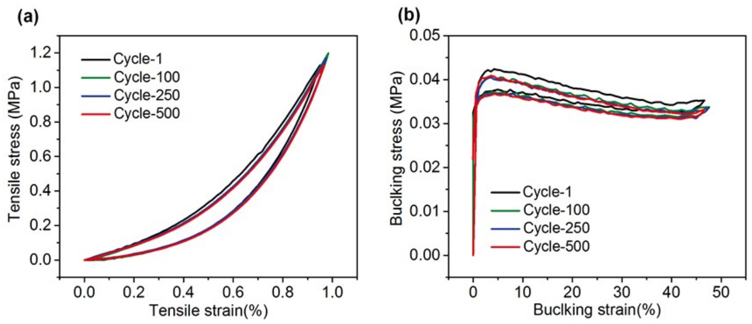

Figure S5 (a) A 500-cycle tensile fatigue test, and (b) a 500-cycle buckling fatigue test of the BNFMs (SPT as a sample).

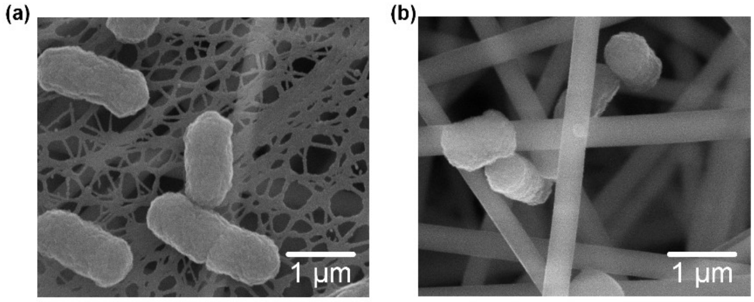

Figure S6 SEM image of (a) SPT, and (b) SiO_2 NFM after filtration of *E. coli* (at low bacterial concentration).

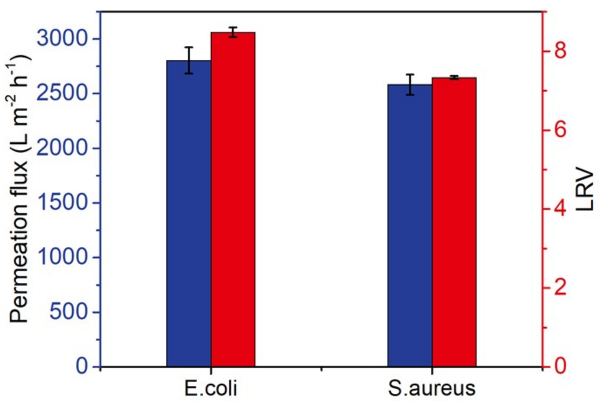

Figure S7 Removal performance of BNFMs for different bacteria.

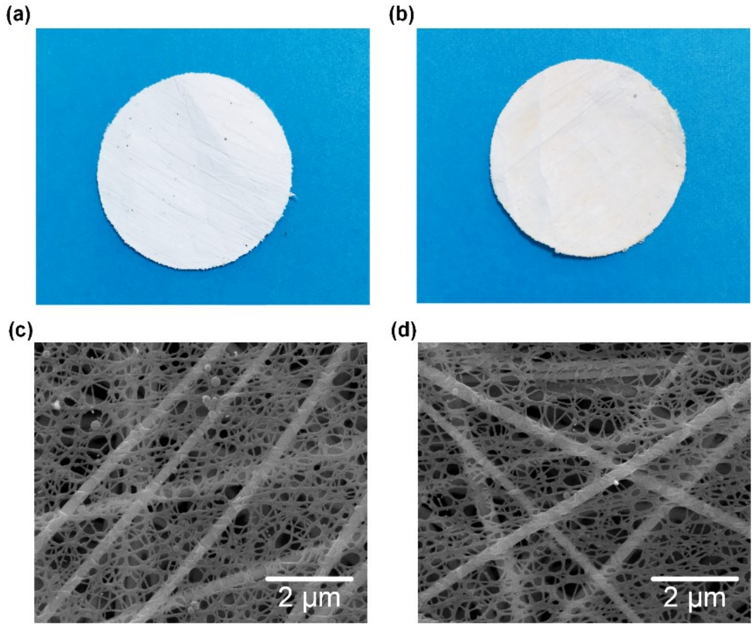

Figure S8 Photographs of BNFMs after enduring 7 days of testing at pH value of (a) 2 and (b) 12. SEM images of BNFMs after enduring 7 days of testing at pH value of (c) 2 and (d) 12.

Movie S1: Filtration of *E. coli*-containing water using the syringe filter.

Movie S2: Filtration of TiO_2 suspension by dead-end fil system (pH 2 at 25 ^{o}C as a sample).

Supplementary Discussions

Effect of TW concentrations on the BNFMs.

As demonstrated in Figure S2, addition of TW can effectively facilitate the evolution of porous films to nanonets and thus improve the structural uniformity of the BNFMs. Meanwhile, from the SEM images showed in Figure S2a-c, we can clearly see that the pore size of the nanonet slightly decreased with the increase of the TW concentration from 0.2 to 1 wt%, which was mainly attributed to the fast nucleation and growth of the polymer poor phase caused by the rapid adsorption of the water molecules by the polar head group of TW.[2] The TW has influence not only on the morphology of the nanonets but also the wettability of the BNFMs. As shown in Figure S2d, the WCA sharply decreased from 89.7^{o} to 26^{o} when the TW increased from 0.2 wt% to 0.5 wt%. Further increasing the TW to 1 wt% resulted in a decrease of the WCA to 0^{o}. Considering the above, 0.5 wt% TW was chosen for the next series of studies.

Removal performance of BNFMs for different bacteria.

Except for E. coli, S. aureus, a typical coccus, was also selected to test the purification performance of BNFMs. The results were showed in Figure S7. The permeation flux (2582 L m^{-2} h^{-1}) and LRV (7.33) of BNFMs for S. aureus were slightly lower than that for E. coli because of the smaller size of S. aureus, which resulted in denser cake layer on the membranes and easier escape form the membrane pores.[3,4] However, the bacterial removal efficiency of BNFMs for S. aureus is still satisfied with the standard of United States Pharmacopoeia (LRV $\geqslant$ 7).[5]

References

1 Hansen, C. M. Hansen solubility parameters: a user's handbook. CRC Press, **2007**.

2. J.-L. Guo, Y. Li, Z.-L. Xu, P.-Y. Zhang and H. Yang, Investigation of Polyvinylidene Fluoride Membranes Prepared by Using Surfactant OP-10 Alone or with a Second Component, as Additives, via the Non-Solvent-Induced Phase Separation (NIPS) Process, *Journal of Macromolecular Science, Part B*, 2014, **53**, 1319-1334.
3. Y. Wang, F. Hammes, M. Düggelin and T. Egli, Influence of size, shape, and flexibility on bacterial passage through micropore membrane filters, *Environ. Sci. Technol.*, 2008, **42**, 6749-6754.
4. F. Wang, M. Liu, R. Ding, M. Liang, L. Huang, J. Yu and Y. Si, Rechargeable Antibacterial Polysulfonamide-Based N-Halamine Nanofibrous Membranes for Bioprotective Applications, *ACS Applied Bio Materials*, 2019, **2**, 3668-3677.
5. M. A. Taylor, E. F. Alambra, J. Anes, J. Behnke, B. Enachescu, C. L. Fitzgerald, M. Fortado and M. L. Sizelove, Remote site production of sterile purified water from available surface water, *Prehospital and Disaster Medicine*, 2004, **19**, 266-277.