

Electronic Supplementary Information for

A Novel Profiled Core-Shell Nanofibrous Membrane for Wastewater Treatment by Direct Contact Membrane Distillation

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1. Membrane Porosity

The porosity (i.e. void volume fraction) of the membrane is defined as the volume of the inter-fiber spaces divided by the total volume of the membrane, which was determined by the gravimetric method.¹ Isopropyl alcohol (IPA) was used as the wetting liquid which penetrated into the inter-fiber spaces of the electrospun nanofibrous membrane, the membrane weight was measured before and after saturated by IPA. The membrane void volume fraction, ε , can be calculated by the following equation:

$$\varepsilon = \frac{(w_w - w_d) / \rho_i}{(w_w - w_d) / \rho_i + w_d / \rho_p}$$

Where w_d is the weight of the dry membrane, w_w is the weight of the wet membrane, ρ_i is the isopropyl alcohol density, ρ_p is the polymer density or the calculated average density of electrospun core-shell nanofibrous membrane.

2. Liquid Entry Pressure of Water (LEP_w) Measurement

LEP_w (sometimes faulty called “wetting pressure”) is the pressure that must be applied onto distilled water before it penetrates into a non-wetted (dry) membrane,¹ i.e., water droplet cannot pass through the membrane below this breakthrough pressure. The dry electrospun nanofibrous membrane with an effective area of 0.95 cm^2 was placed into the measuring cell and the reservoir was filled with distilled water. By means of a gas cylinder that was filled with nitrogen, a slight pressure was raised stepwise with 0.005 bar and each pressure was maintained for 10 min in the process of the degasification of the feed side and the LEP_w test. The minimum applied pressure that resulted in a continuous flux was regarded as the LEP_w value. The measurements were carried out thrice using three different membrane samples made under the same condition. The results were averaged to obtain the final LEP_w value.

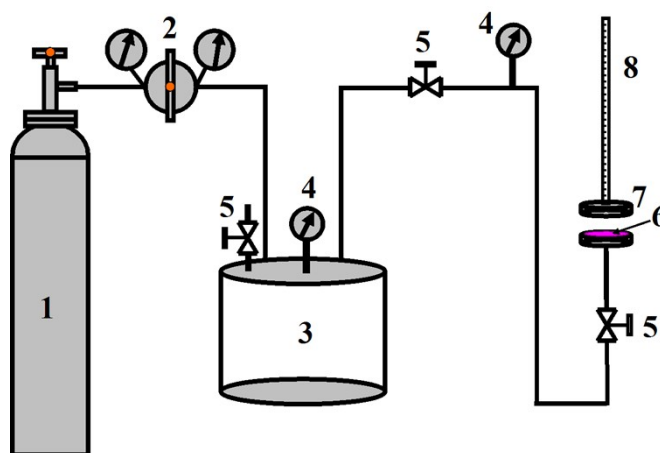


Figure S1. Apparatus for the determination of the LEP_w : (1) gas cylinder with nitrogen, (2) reducing valve, (3) reservoir, (4) manometer, (5) pressure regulator, (6) membrane, (7) measuring cell, and (8) measuring pipette.²

3. Direct Contact Membrane Distillation (DCMD) Test

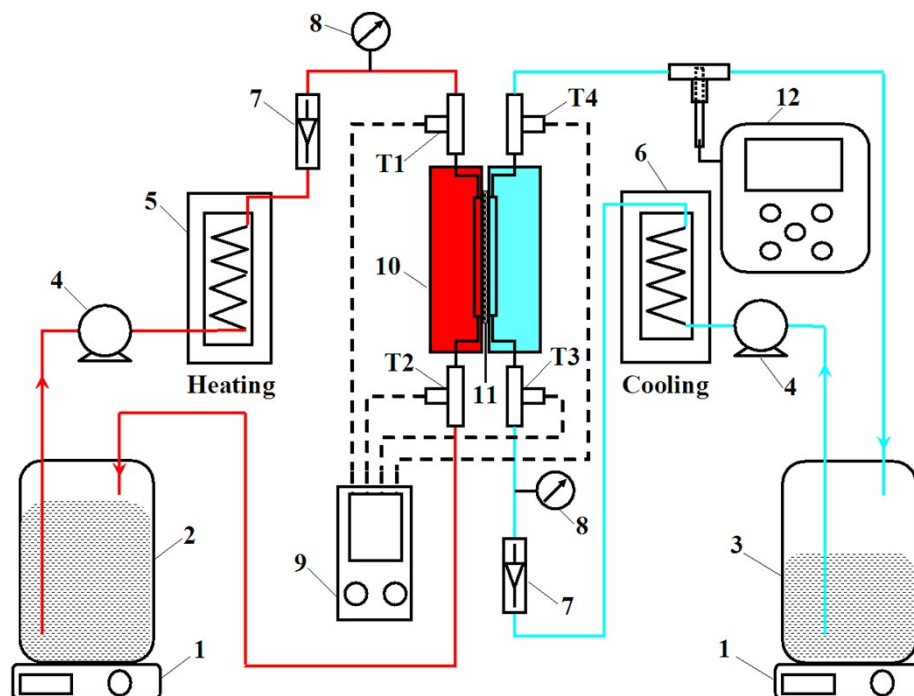


Figure S2. Schematic diagram of the direct contact MD setup: (1) digital balance; (2) feed solution; (3) permeate tank; (4) diaphragm laboratory pump; (5) heating system; (6) chiller; (7) flowmeter; (8) manometer; (9) thermometer; (T1~T4) temperature probe; (10) membrane cell; (11) membrane; (12) conductivity meters.²

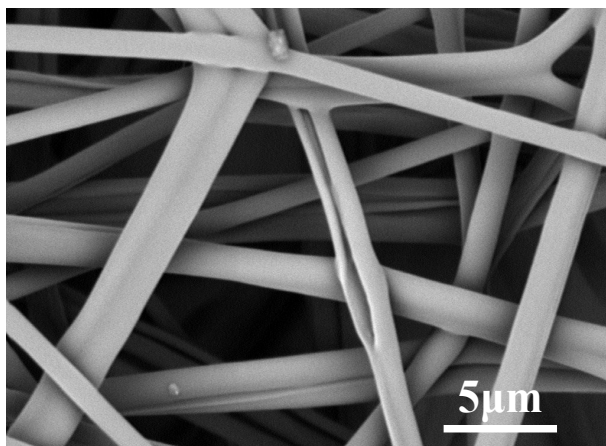


Figure S3. Representative FE-SEM image of electropun profiled PAN-PS-3 nanofiber prepared applying an electric voltage of 18 kV.

Notes and references

- (1) Smolders, K.; Franken, A. C. M. Terminology for Membrane Distillation. *Desalination* **1989**, 72, 249-262.
- (2) Li, X.; Wang, C.; Yang, Y.; Wang, X.; Zhu, M.; Hsiao, B. S. Dual-Biomimetic Superhydrophobic Electrospun Polystyrene Nanofibrous Membranes for Membrane Distillation. *ACS Appl. Mater. Interfaces* **2014**, 6, 2423-30.