Supporting Information

Janus Membrane Doped with Carbon Nanotubes for Wet-Thermal Management

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S1: TMSPMA solution modification gauze

Table S1 The TMSPMA solution ratio

Solution ratio				
sample	Hb-Gauze-95%	Hb-Gauze-75%	Hb-Gauze-45%	Hb-Gauze-20%
concentration	95%	70%	45%	20%
TMSPMA	4.75 ml	3.5 ml	2.25 ml	1 ml
Acetic acid	0.25 ml	1.5 ml	2.75 ml	4 ml

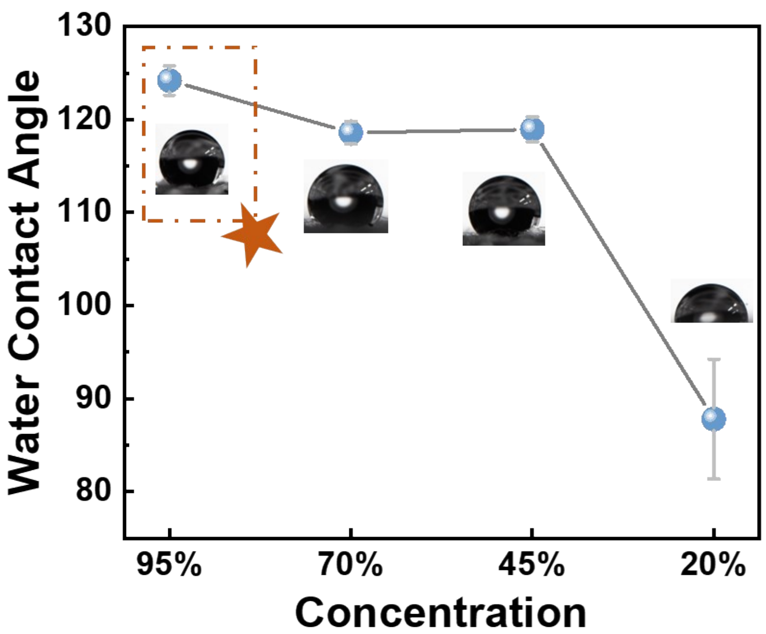

Figure S1 The relationship between TMSPMA concentration and water contact angles of modified gauzes.

In order to explore the influence of TMSPMA solution concentration on gauze modification, the experiment S1 was designed. The concentration selected for the experiment was shown in Table S1. The results of Figure S1 showed that the Hb-Gauze showed the best hydrophobicity when the concentration of the solution was maximum. Therefore, 95% concentration of TMSPMA solution was selected for gauze modification in the follow-up experiments.

S2: Water contact angles of CA fiber membranes with different concentrations and nozzles

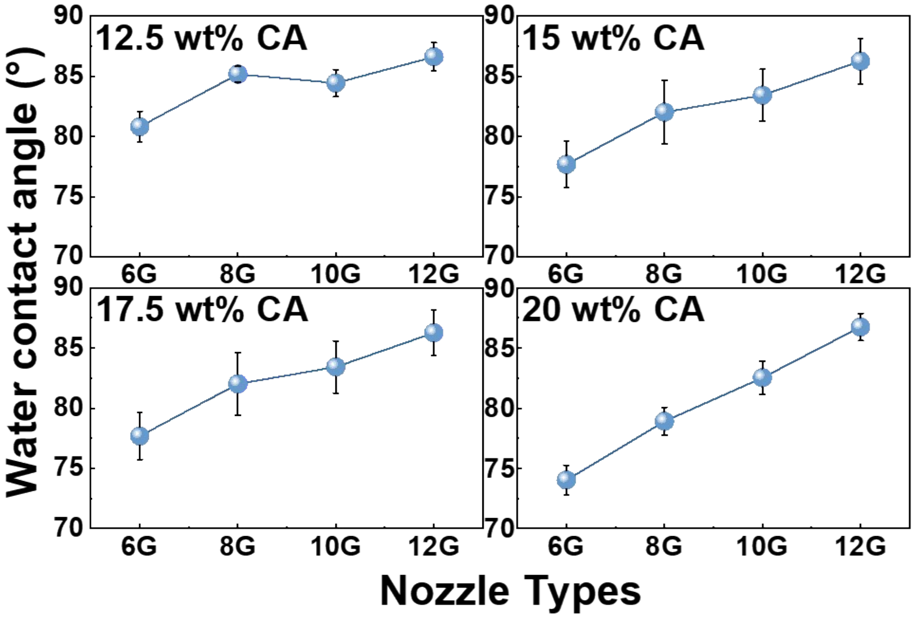

Figure S2 Water contact angles of CA fibrous membranes with concentrations of 12.5wt%, 15wt%, 17.5wt%, and 20wt%, as well as 6G, 8G, 10G, and 12G nozzle types.

A series of experiments were designed to explore the influence of different concentrations of electrospinning solution on the water contact angle of CA, as shown in Figure S2. When the spinning solution concentration increased from 12.5 wt% to 20 wt%, the water contact angle of CA also increased with the increasing of needle diameter. Therefore, the 20 wt% concentration of spinning solution with better performance was selected for electrostatic spinning in subsequent experiments.

S3: Changes of water contact angles before and after doping CNTs

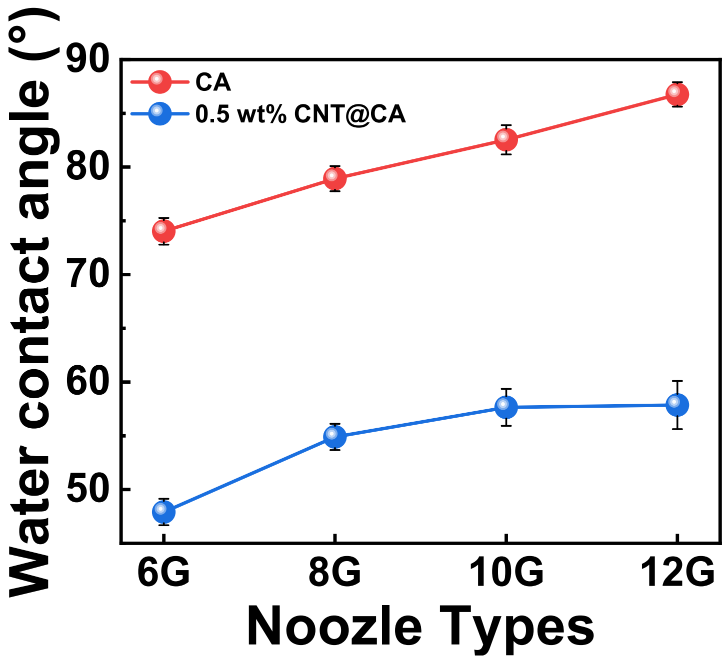

Figure S3 Comparison of water contact angles between CA fibrous membranes and CNTs@CA fibrous membranes.

The CNTs of 0.5 wt% were added to CA electrospinning solution with a concentration of 20 wt%, and the comparison of water contact angles was shown in Figure S3. It can be seen that the water contact angles of CA changed greatly, and the hydrophilicity was greatly improved, which was attributed to the incorporation of hydrophilic CNTs.

S4: TEM images of the CNTs@CA fibrous membrane

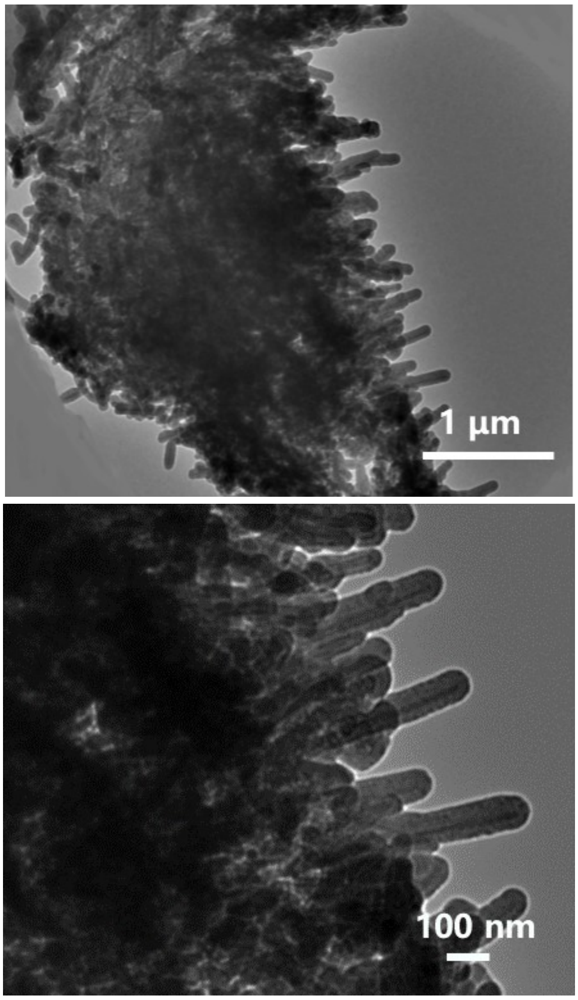

Figure S4 TEM image and local magnification image of the CNTs@CA fibrous membrane.

The TEM images showed the morphology of CNTs wrapped by CA fibers.

S5: Changes of FTIR spectra before and after doping CNTs

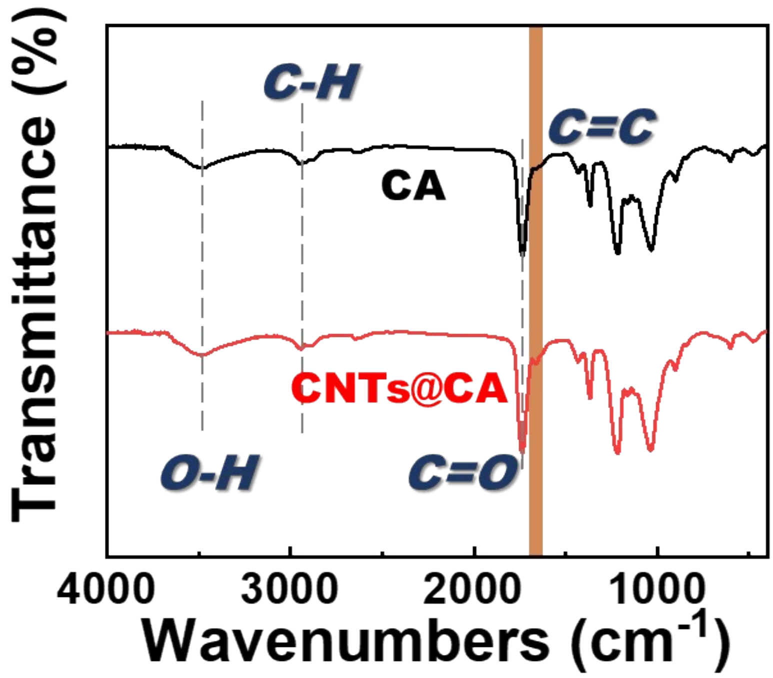

Figure S5 Comparison of FTIR spectra of CA fibrous membrane and CNTs@CA fibrous membrane.

By comparing the infrared spectra of CA fibrous membrane with CNTs@CA fibrous membrane, it can be found that C=C stretching vibration peak appeared at 1650 cm-1 CNTs@CA, which was due to the presence of a large number of sp2 hybridization of C=C in CNTs.

S6: The relationship between the thickness of Janus membrane and the electrospinning time

Table S2: Relationship between electrospinning time and Janus membrane thickness for 12G-Janus and 6G-Janus membranes that can achieve unidirectional liquid transport

Electrospinning time (min)	**Thickness (μm)**	
	12G-Janus membrane	**6G-Janus membrane**
0	295.58 ± 0.73	
25		312.66 ± 2.39
30		319.52 ± 1.70
35	345.72 ± 1.87	324.52 ± 1.31
40	356.58 ± 179	331.8 ± 1.61
45	364.04 ± 2.61	338.38 ± 1.74
50	373.88 ± 2.09	346.56 ± 1.16
55	384.6 ± 1.33	
60	381.72 ± 2.85	
65	395.2 ± 1.96	
70	407.66 ± 1.77	
75	420.46 ± 1.47	

In this work, the thickness and unidirectional liquid transport capacity of Janus membrane were adjusted by adjusting the electrospinning time of CNTs@CA fibrous membrane. Electrospinning time is 0 to 75min. Table S2 exhibited the relationship between membrane thickness and electrospinning time under the premise of unidirectional liquid transport.