## Electronic Supporting Information

# Development of Robust and Superamphiphobic Membranes using Reduced Graphene Oxide (rGO)/PVDF-HFP Nanocomposite Mats for Membrane Distillation

*Environmental Science: Nano*

Tiantian Chen[1], Wen Ma[2], Jongho Lee[3], David Jassby[4], Md. Saifur Rahaman[1,5*]

[1] Department of Building, Civil and Environmental Engineering, Concordia University Montreal, Quebec, Canada, H3G 1M8

[2]Department of Chemical and Environmental Engineering, Yale University, New Haven, CT, 06520, United States

[3] Department of Civil Engineering, The University of British Columbia 6250 Applied Science Lane, Vancouver, BC, V6T 1Z4, Canada

[4]Department of Civil and Environmental Engineering, University of California Los Angeles, Los Angeles, CA 90095-1593, United States

[5]Department of Civil, Geological and Mining Engineering, Polytechnique Montreal, Quebec, H3T 1J4 Canada

*Corresponding author. Tel.: +15148482424, Ext. 5058

E-mail address: saifur.rahaman@concordia.ca (M.S. Rahaman)

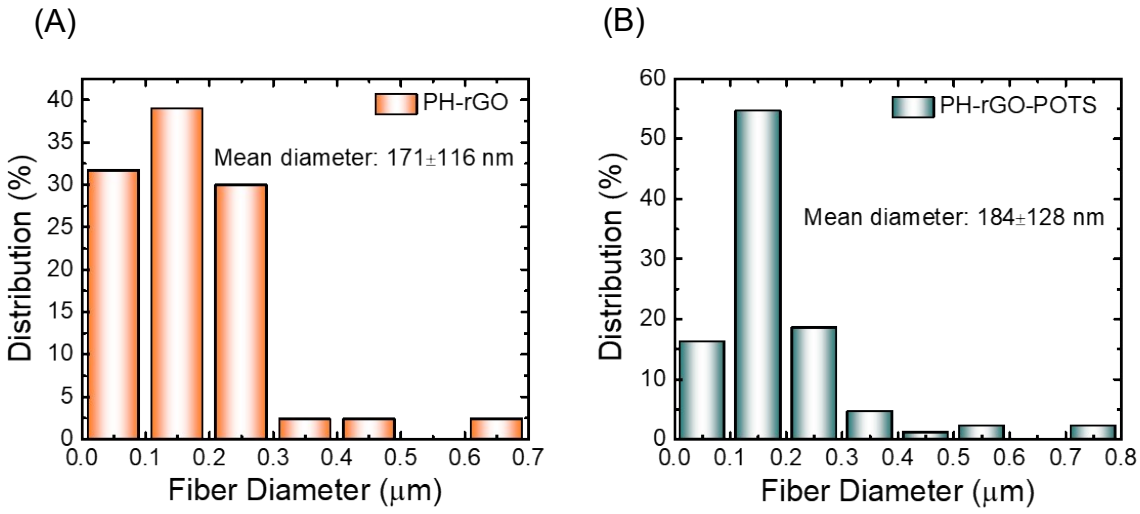


**Fig. S1** Fiber diameter distribution of (A) PH-rGO membrane (B) PH-rGO-POTS membrane.

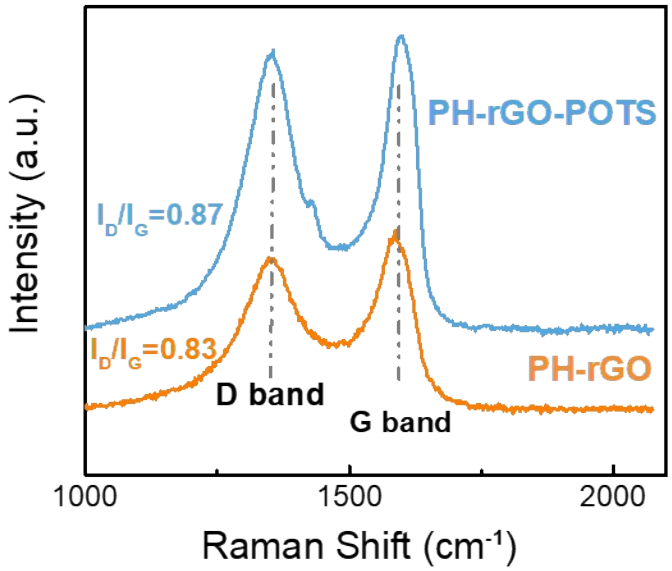


**Fig. S2** Raman spectra of (A) PH-rGO membrane and (B) PH-rGO-POTS membrane.

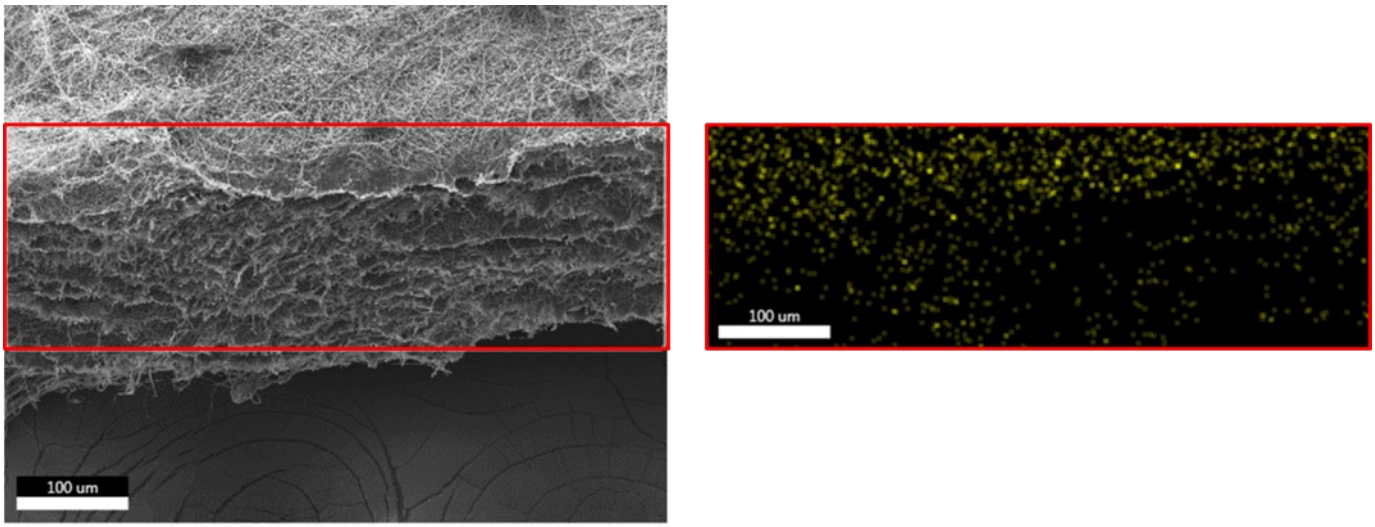


**Fig. S3** The cross-sectional EDS mapping images of Si element on the PH-rGO-POTS membrane.

Video 1.MOV

**Video S1**: Non-sticky test, PH-rGO-POTS membrane was inserted into dye solution and then taken out.

Video 2.MOV

**Video S2**: The roll-off behavior of the water droplets on the PH-rGO-POTS membrane at the horizontal state.

Video 3.MOV

**Video S3**: Self-cleaning behavior of the PH-rGO-POTS membrane

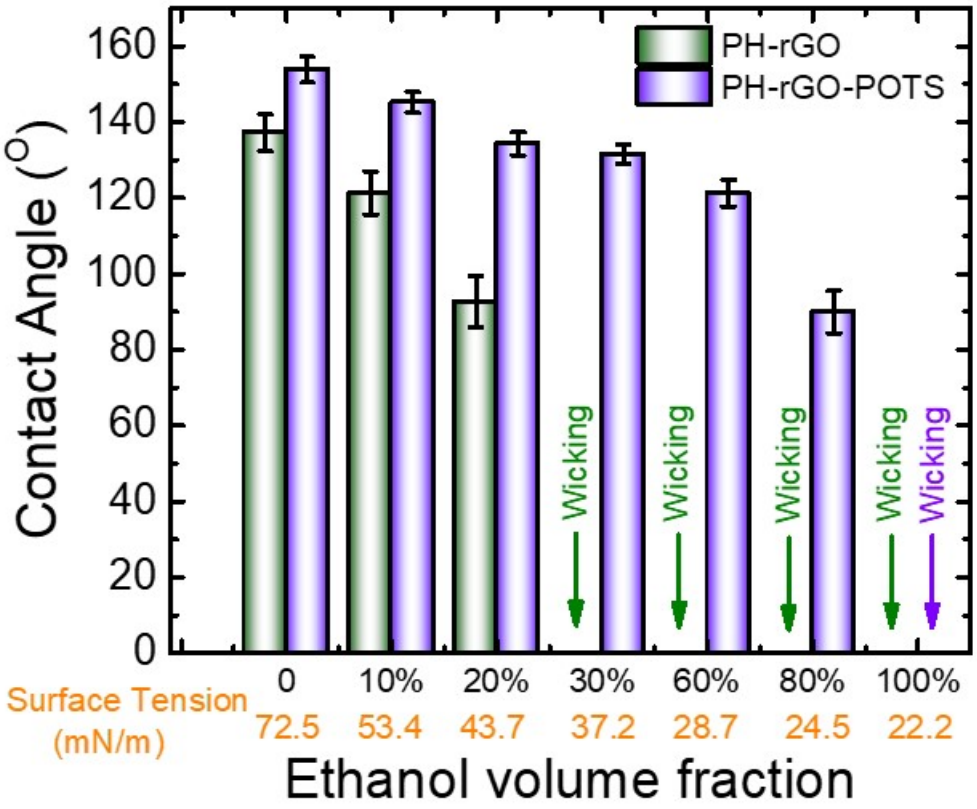


**Fig. S4** Contact angles of the PH-rGO-POTS membrane facing with different water-ethanol mixtures. "Wicking" means that the membrane was wetted by the testing liquids immediately, and no stable contact angles could be measured. The error bars stand for the standard deviations of contact angle measurements. The water-ethanol mixtures with different surface tensions are prepared following a published protocol.[1]

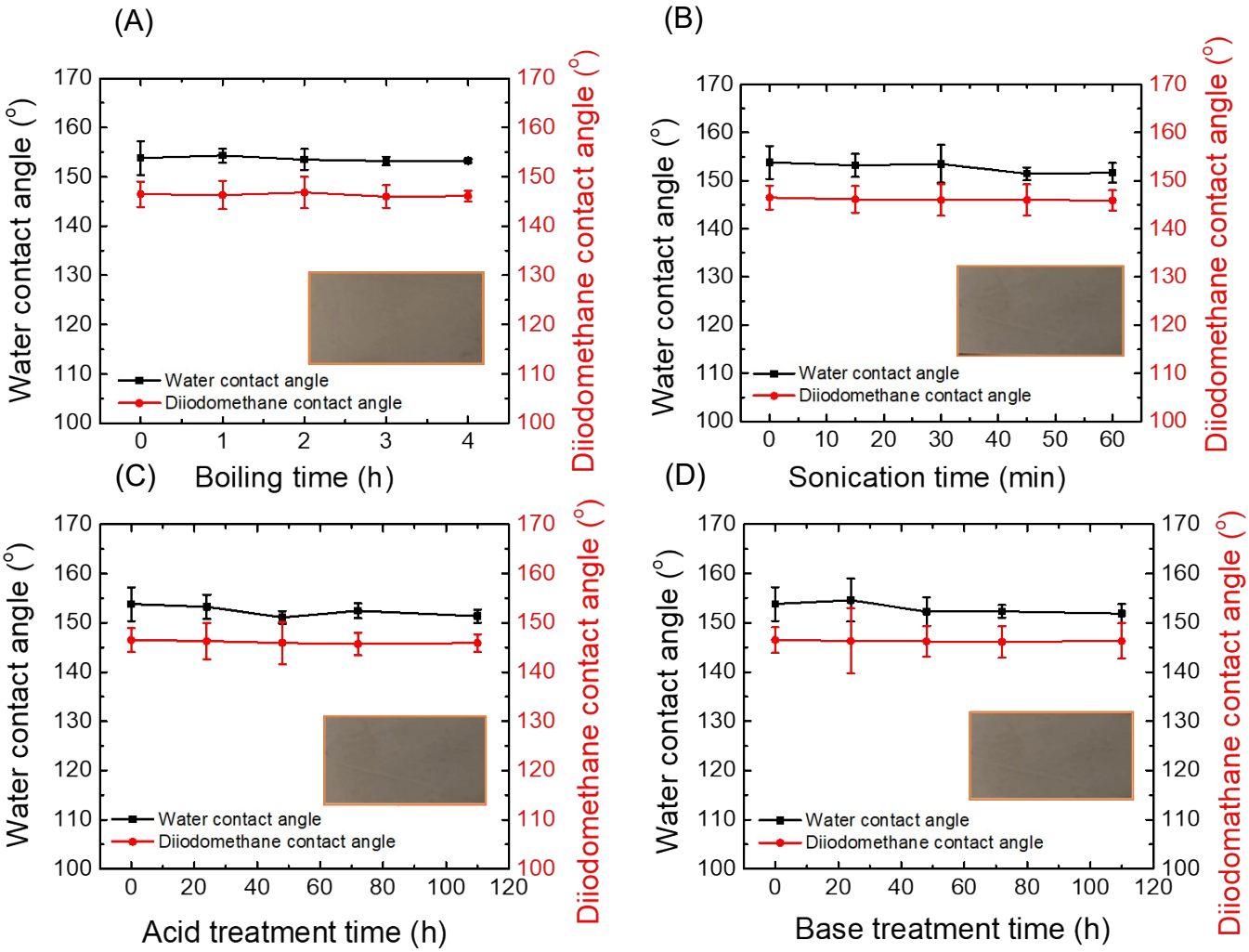


**Fig. S5** Water contact angle (black) and Diiodomethane contact angle (red) of PH-rGO-POTS membranes after challenging with (A) boiling water for 4h, (B) sonication for 60 min, (C) strong acid (HCl, pH=2) for 110 h, and (D) base solution (NaOH, pH=12) for 110 h. The error bars in the figures stand for standard deviation. Insets are optical images of PH-rGO-POTS membranes after various treatments.

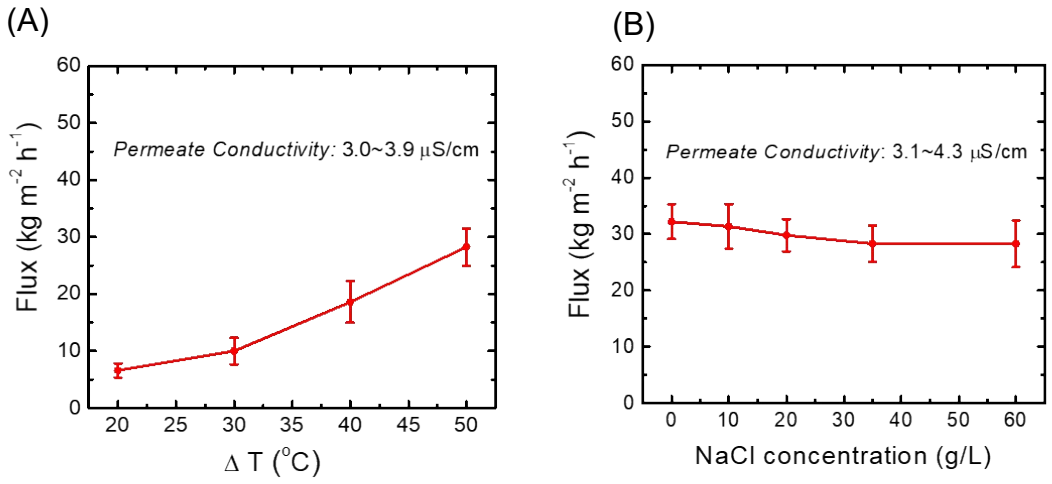


**Fig. S6** (A) Water flux of the PH-rGO-POTS membranes under various temperature differences; the temperature of the feed varied from 35 °C to 65 °C, while the permeate side temeperature was kept constant at 15.0 °C. (B) Water flux of the PH-rGO-POTS membrane under different NaCl concentrations with the temperature difference maintained at 50 °C. The error bars in the figures stand for standard deviation.

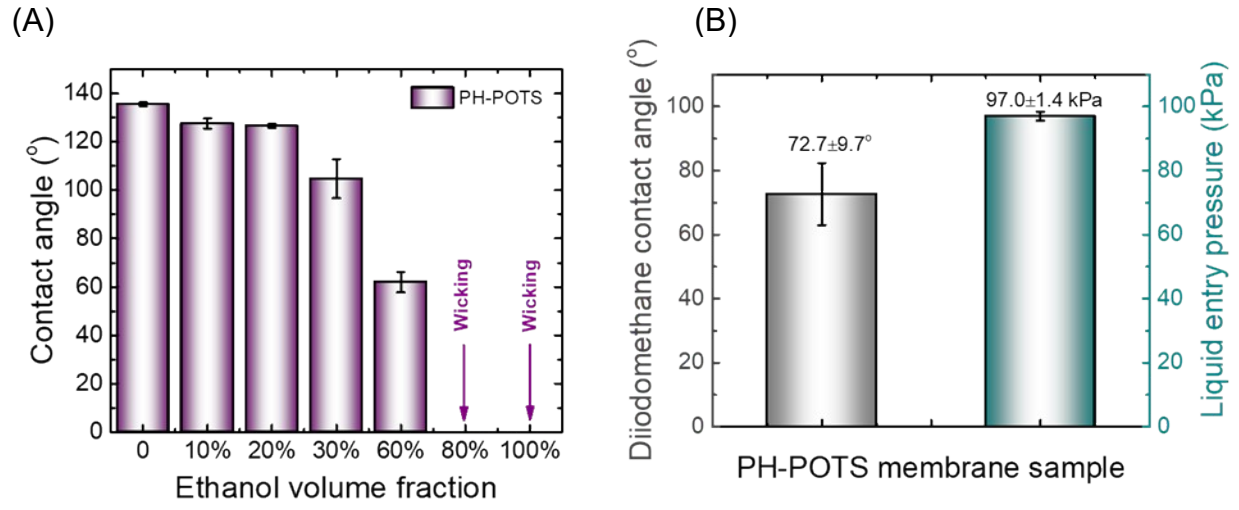


**Fig. S7** (A) Contact angles of the PH-POTS membrane with different ethanol concentrations. (B) Diiodomethane contact angle (grey) and LEP (blue) of the PH-POTS membrane.

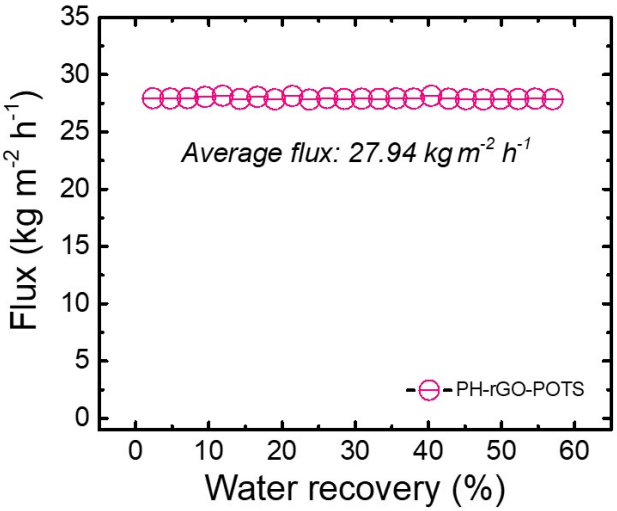


**Fig. S8** Water flux as the function of the water recovery for the PH-rGO-POTS membrane during the long-term stability in presence of mixed foulants (35 g/L NaCl, 20 mM $CaCl_2$, 20 mM $Na_2SO_4$, 100 mg/L humic acid sodium salt, 10 mg/L machine oil, and 0.05 mM SDS). The feed solution temperature was maintained at 65 °C and the permeate side temperature was maintained at 15 °C.

## Supplementary References

1 W. Wang, X. Du, H. Vahabi, S. Zhao, Y. Yin, A. K. Kota, T. Tong, Trade-off in membrane distillation with monolithic omniphobic membranes. *Nat. Commun.*, 2019, 10, 1-9.