

## Supplementary Information

### Using Al<sup>3+</sup> to Tailor Graphene Oxide Nanochannels: Impact on Membrane Stability and Permeability

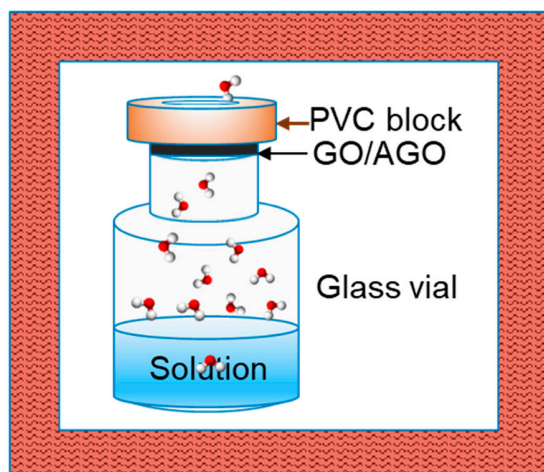
Yijing Y. Stehle<sup>1,\*</sup>, Ellen Jean Robertson<sup>2,\*</sup>, Rebecca Cortez<sup>1</sup>, Ivan V. Vlassiuk<sup>3</sup>, Ronald B. Bucinell<sup>1</sup>,  
Katelyn Olsson<sup>1</sup>, and Luke Kilby<sup>1</sup>

<sup>1</sup> Department of Mechanical Engineering, Union College, Schenectady, NY 12308, USA

<sup>2</sup> Chemistry Department, Union College, Schenectady, NY 12308, USA

<sup>3</sup> [Center for Nanophase Materials Sciences](#), Oak Ridge National Laboratory, Oak Ridge, TN, 37831, USA

\* Correspondence: [stehley@union.edu](mailto:stehley@union.edu); [roberte2@union.edu](mailto:roberte2@union.edu)

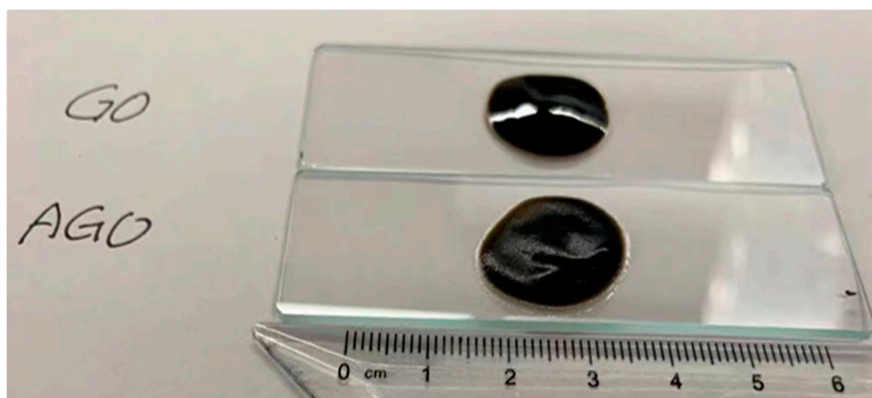


(a)

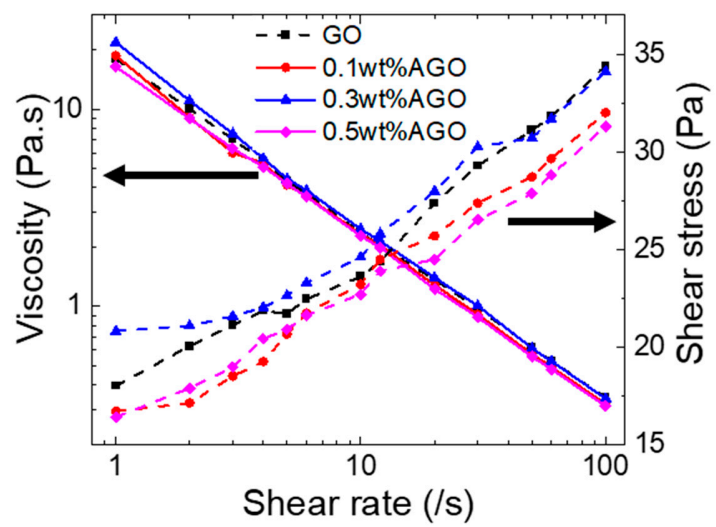


(b)

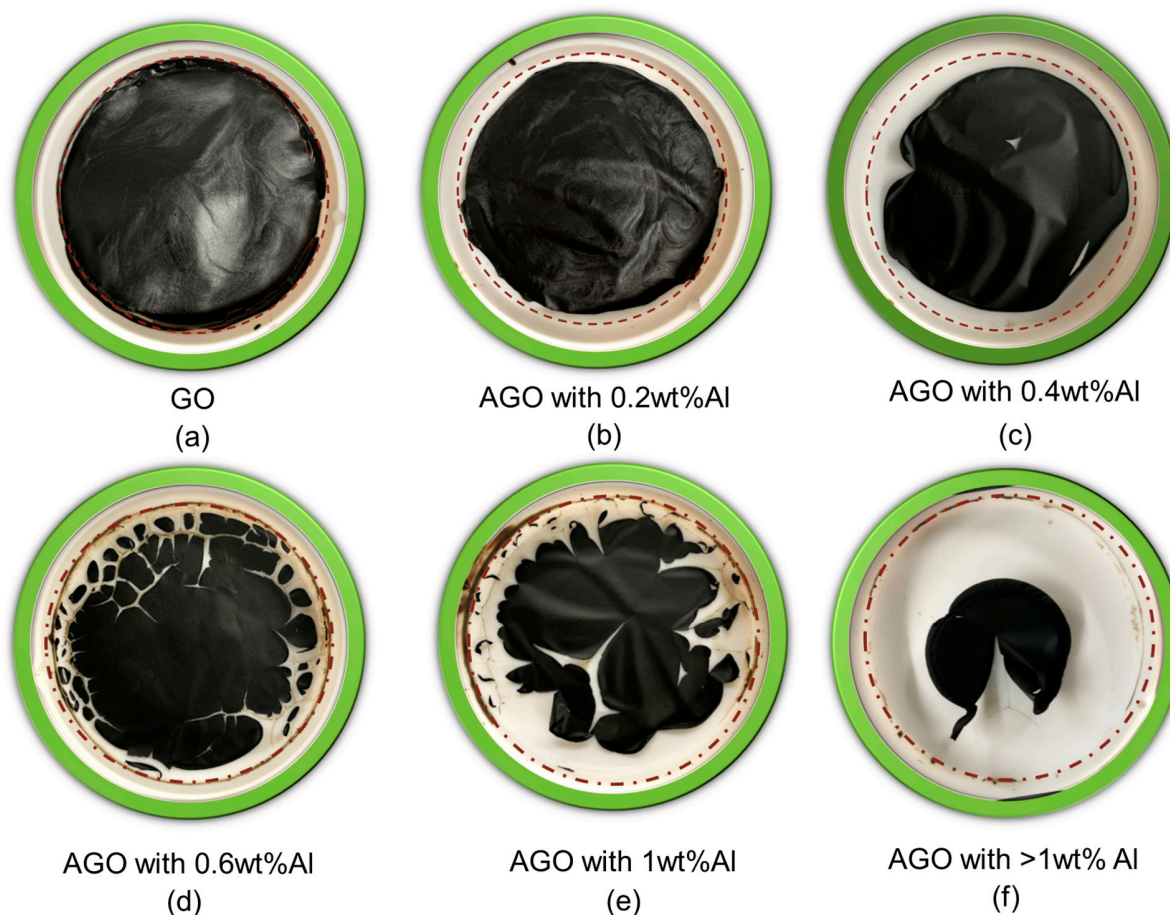
**Figure S1.** Schematic (a) and camera picture (b) of the permeability experiment set up.



**Figure S2.** The AGO solution has a “muddy” look when compared with the GO solution.



**Figure S3.** Viscosity and shear stress at different shear rates of GO solutions with Al concentration from 0~0.5wt%.



**Figure S4.** Digital camera image of as-fabricated GO and AGO membrane in the Teflon evaporation dish. (Dashed red circles indicate the inner circle of the evaporation dish, with a diameter of 12cm) (a) unmodified GO membrane(diameter of 12cm) has the same size as the evaporation dish (b) AGO membrane contains 0.2 wt.% Al(diameter of 11.7cm) is slightly smaller than the evaporation dish; (c) AGO membrane contains 0.4 wt.% Al (diameter of 11.1cm) shows both shrinking and cracking; more shrinking and crack can be observed on the AGO membrane contains (d) 0.6 wt.% Al; (e) 1 wt.% Al; and (f) more than 1wt. % Al.

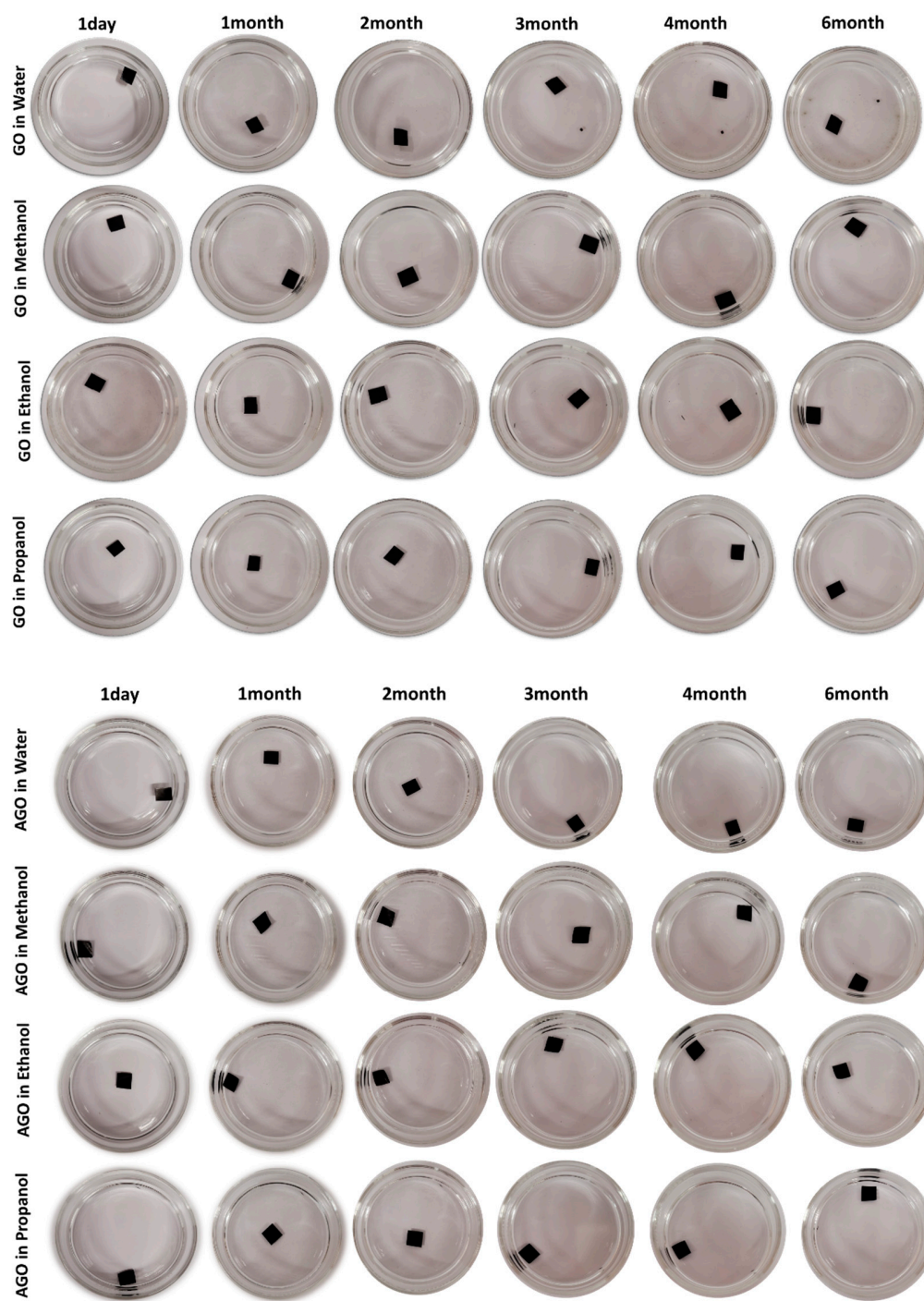
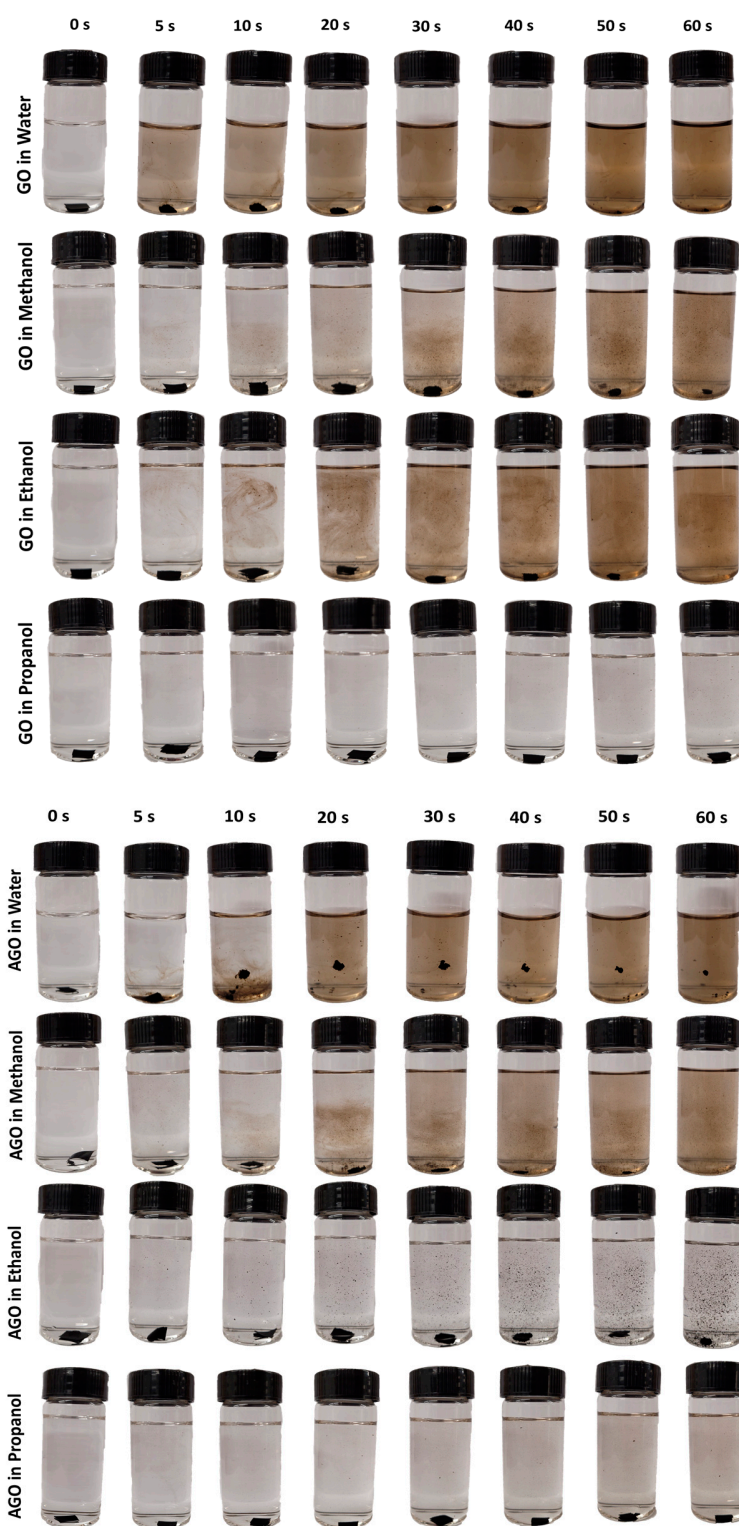
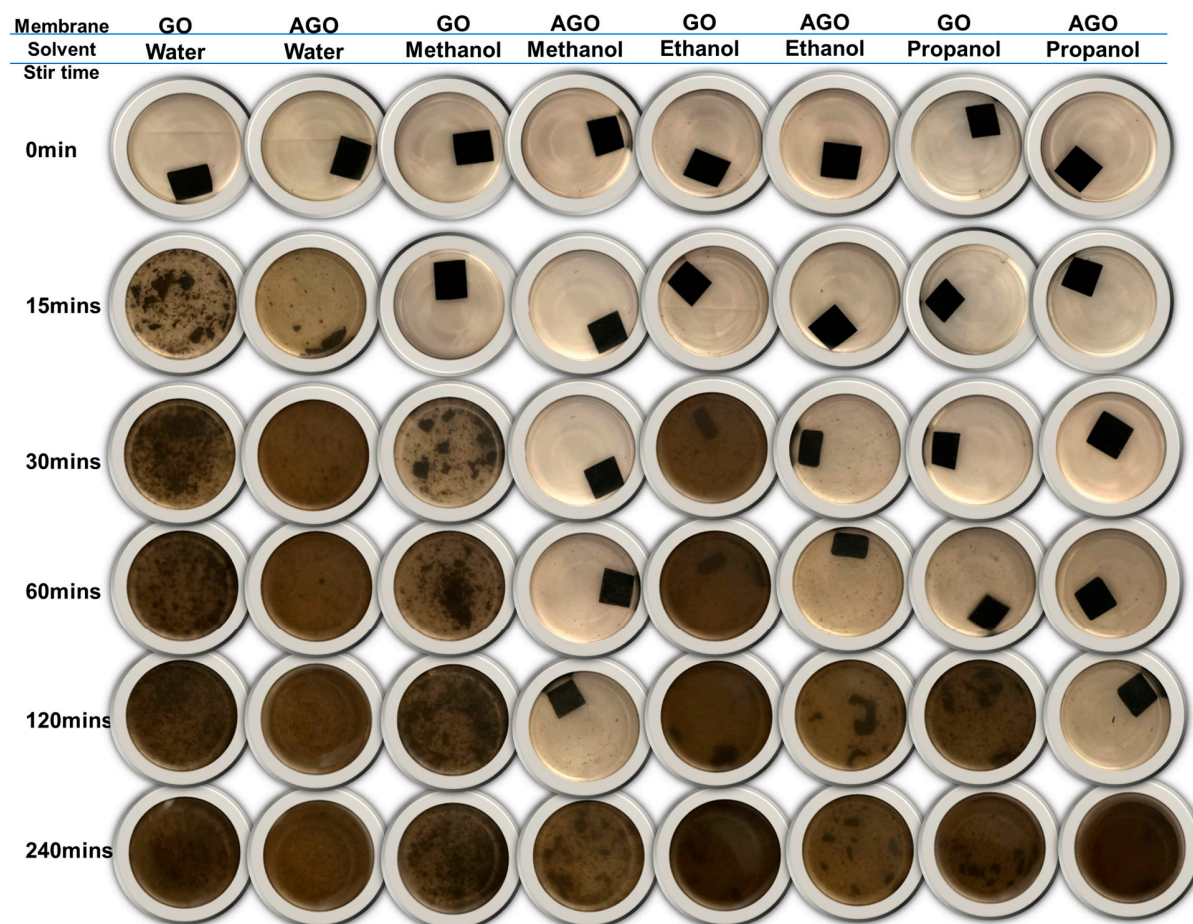


Figure S5. Soaking stability test of GO and AGO membranes in solution with different solvents.



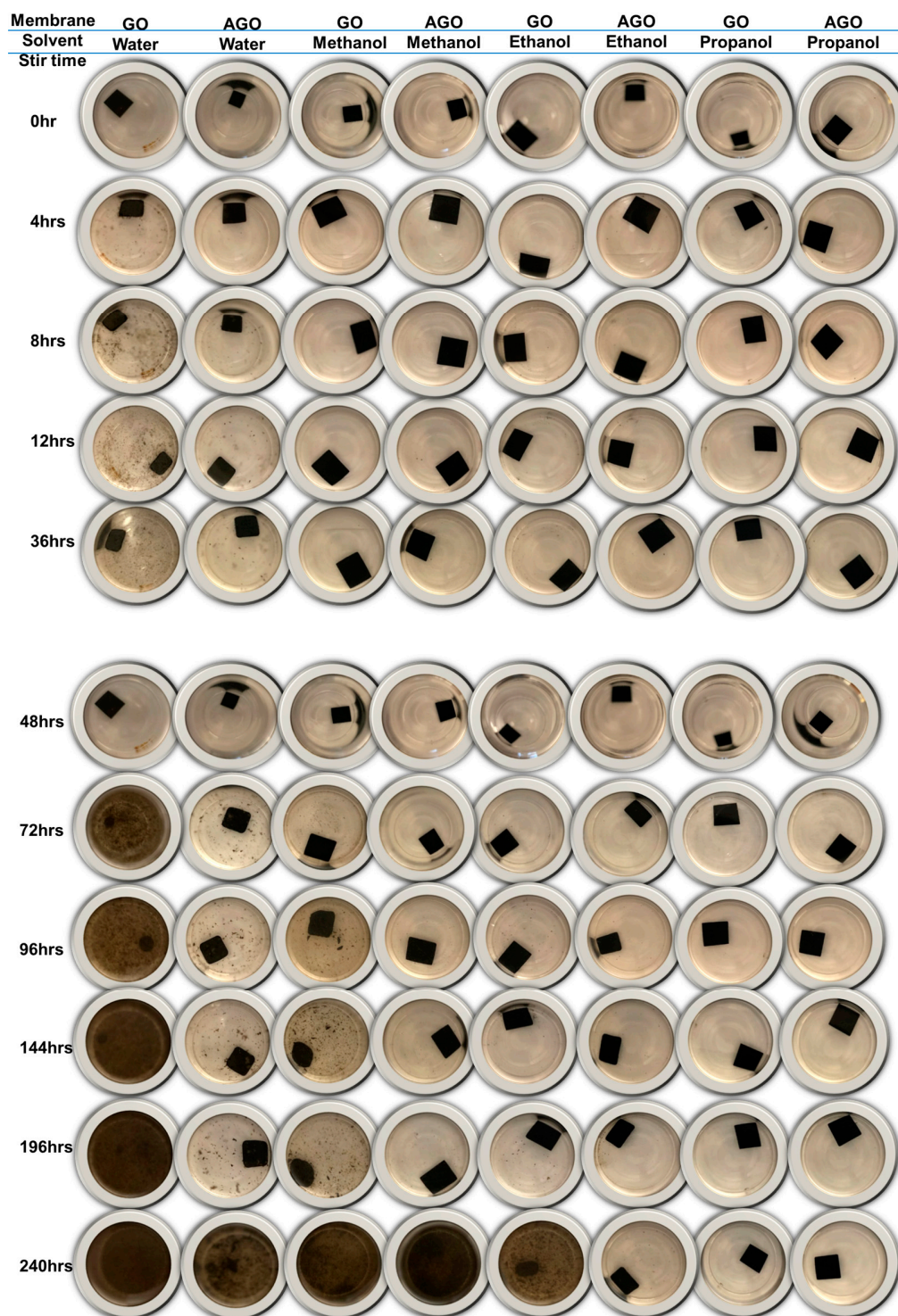


**Figure S6.** Sonication stability test of GO and AGO membranes in solution with different solvents.



**Figure S7.** Stability test of GO and AGO membranes in different solvents with stirring rate of 200 rpm with large stir bar (12mm Length\*5mm Diameter) touches the sample during stirring.

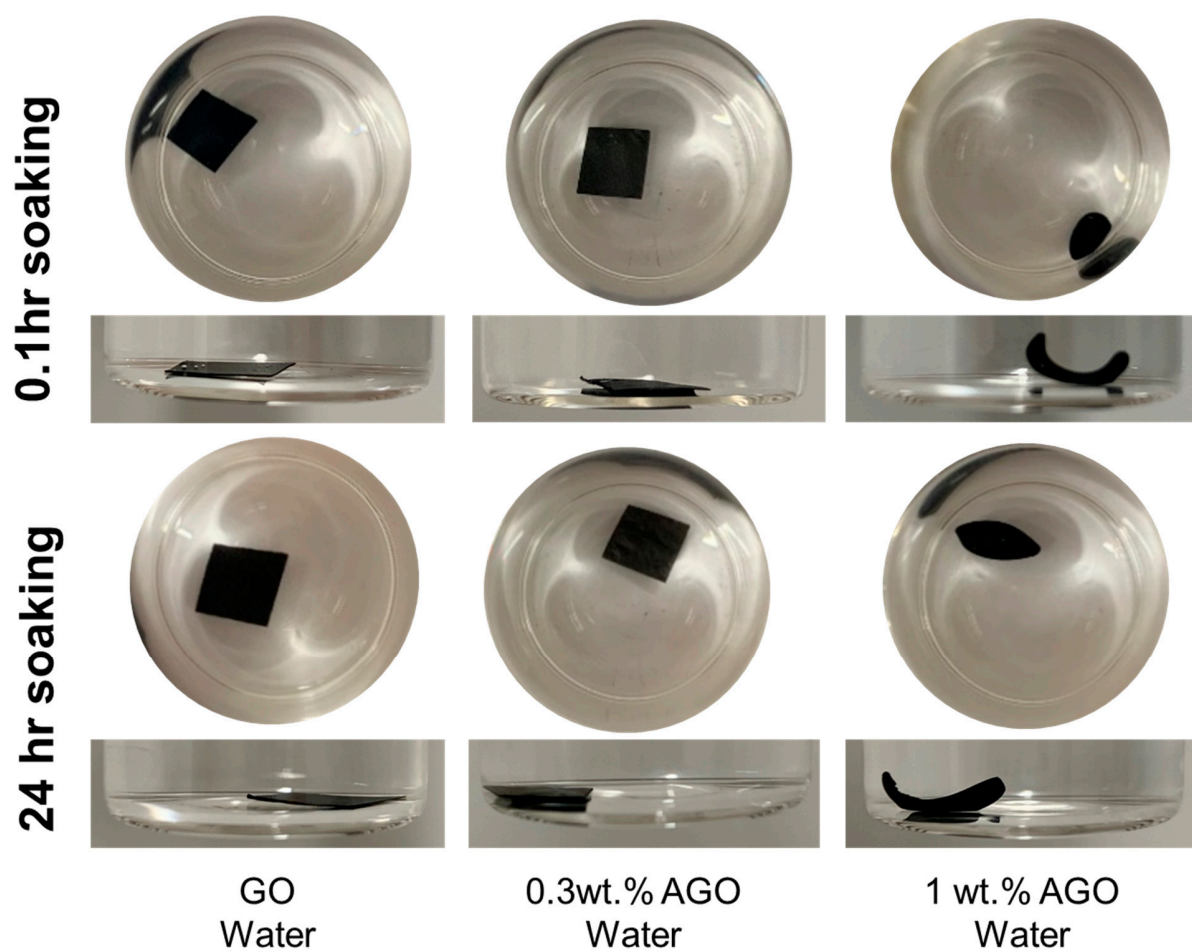




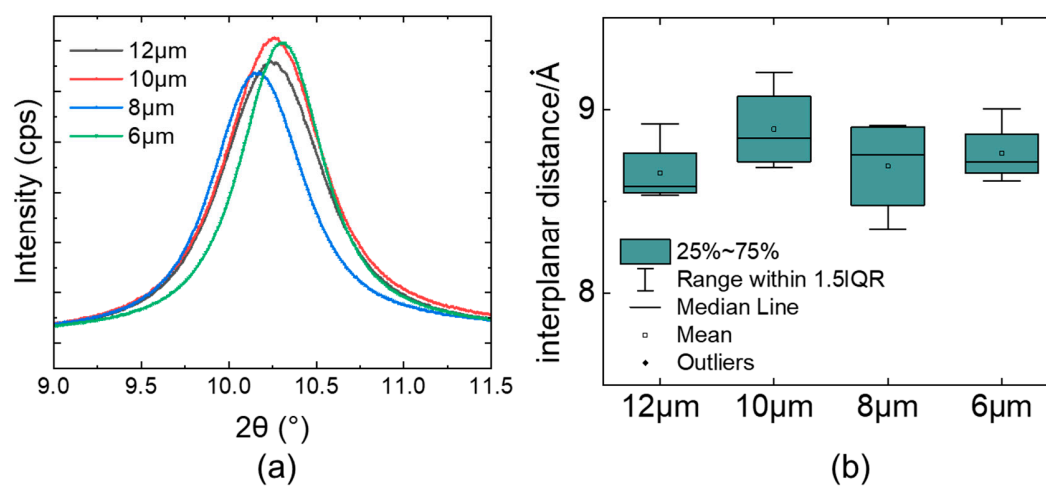
**Figure S8.** Stability test of GO and AGO membranes in different solvents with stirring rate of 200 rpm with small stir bar (10mm Length \*3mm Diameter) bar not touch the sample during stirring.



**Figure S9.** A highly wrinkled and contracted AGO membrane (left) swelled after soaking in water for 48 hours (right). The diameter of the AGO membrane increased 1.5 times, and the thickness increased 5 times.

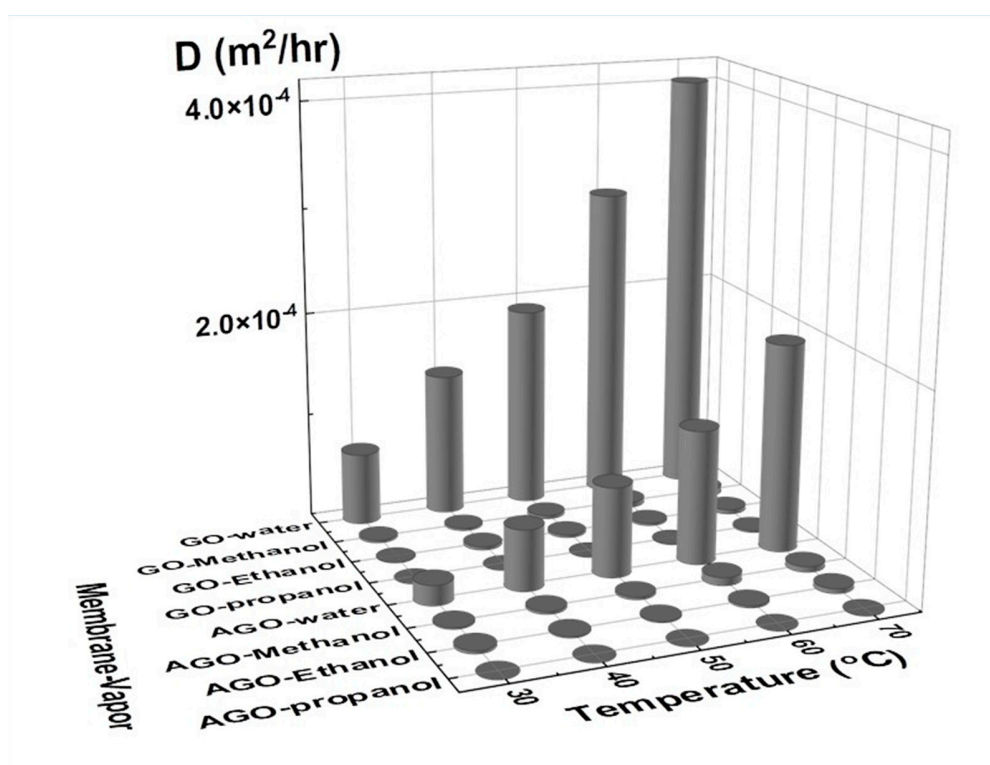


**Figure S10.** GO (left column) and AGO (middle and right columns) membrane soaking. The swelling cannot be visibly observed for the GO membrane and the AGO membrane with AI wt.% < 1 wt.%



**Figure S11.** (a) XRD spectra of GO membrane with different thicknesses, and (b) distribution of interplanar distance derived from XRD spectra.





**Figure S12.** Permeability of GO and AGO membranes to water, methanol, ethanol, and propanol water at different temperatures.