Supporting Information

Novel Janus Membrane with Unprecedented Osmosis Transport Performance

Shenghua Zhou, Zhu Xiong, Fu Liu*, Haibo Lin, Jianqiang Wang, Tiantian Li, Qiu Han and Qile Fang

Figure S1. Schematic diagram of FO system

Figure S2. (a) FI-IR characterization of the pristine PVFD membrane, superhydrophilic PVDF membrane, Janus membrane M1, M2 with excess F-SiO$_2$ coating and F-SiO$_2$, respectively. (b) XPS characterization for pristine SiO$_2$ and F-SiO$_2$.

Figure S2 (a) gives the FT-IR spectrum of the membrane. The absorbance of characteristic peaks at 462
cm\(^{-1}\) and 806 cm\(^{-1}\) are attributed to Si-O stretching vibrations while distinct characteristic peak appeared at 1065 cm\(^{-1}\) belongs to stretching vibrations of Si-O-Si. The characteristic peaks at 1663 cm\(^{-1}\) are attributed to C=O existed in NVP. Figure S2b shows XPS characterization of pristine SiO\(_2\) and F-SiO\(_2\). An obvious peak at 686 eV is attributed to F\(^{1s}\), which prove the successful grafting of FOTS onto the surface of SiO\(_2\) nanoparticles.

**Figure S3.** TGA curves for calculating the loading of F-SiO\(_2\) on superhydrophilic PVDF membrane surface
Figure S4. (a, b) Micro-structure and roughness of Janus-A side; (c, d) The micro-structure and roughness of Janus-B side

Figure S5. SEM image of Janus M-2 membrane with 2% F-SiO$_2$ loading
Figure S6. Pore size distribution of our Janus membrane.

Figure S7. Water flux and reserve salt flux with superhydrophobic A side facing to FS (FO mode) and DS (PRO mode) respectively.

Figure S8. Water flux and reserve salt flux as a function of draw solution concentration.
**Figure S9.** WCA as a function of time

**Figure S10.** Water flux and reserve salt flux change as a function of time.

**Table S1.** The structure of three different membranes M-1, M-2, M-3.

<table>
<thead>
<tr>
<th>Membrane</th>
<th>A Side</th>
<th>B Side</th>
<th>Thickness (µm)</th>
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<tbody>
<tr>
<td>M-1</td>
<td>F-SiO₂</td>
<td>Superhydrophilic PVDF</td>
<td>220</td>
</tr>
<tr>
<td>M-2</td>
<td>Excess F-SiO₂</td>
<td>superhydrophobic PVDF</td>
<td>220</td>
</tr>
<tr>
<td>M-3</td>
<td>F-SiO₂</td>
<td>Superhydrophilic PVDF</td>
<td>220</td>
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