Supplementary Material for:

Comparison of performance and biofouling resistance of thin-film composite forward osmosis membranes with substrate/active layer modified by graphene oxide

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1 Graphene Oxide (GO) Characterization

Fourier transformed infrared (FTIR) spectra were collected using a PerkinElmer,
Miracle-Dou spectrometer (PerkinElmer, Miracle-Dou). X-ray photoelectron
spectroscopy (XPS) was performed on a thermo-scientific spectrometer with a
monochromatized AI X-ray source (ESCALAB 250XI, K-Alpha). The zeta potential of
the GO was measured using an analyzer (Zetasizer Nano ZS90, Malvern Instruments)
for surface charge analysis.

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9 Results and Discussion

10 Characterization of Graphene Oxide

The fundamental properties of GO nano-sheets was characterized using FTIR, 11 XPS, AFM and Zeta potential, as shown in Fig. S1. The peaks of O-H groups (3418 12 cm⁻¹), C=O bonds in carboxyl groups (1718 cm⁻¹), sp² C=C bonds (1618 cm⁻¹) and C-13 O bonds in epoxy groups (1067 cm⁻¹) can be confirmed in the FTIR spectrum of the 14 GO (Fig. S2A). The XPS spectra (Fig. S1B) reveal that approximately 40.33% of 15 carbon was not oxidized, and the main oxygenated functional groups are -COOH (only 16 4%), -C-OH and -C-O-C- groups (approximately 55.67%). The morphology of the GO 17 nanosheet was observed using AFM (Fig. S1C), and the plane-size and thickness (Fig. 18 S1D) of the commercial GO ranged from 300 to 1000 nm and 1.2 to 1.8 nm, 19 respectively, which indicated that the GO was fully exfoliated to a single or double 20 layer. The zeta potential (Fig. S1E) was measured at 1.0 mM ionic strength (KCl) at 21 different pH levels (adjusted with KCl or HCl). The zeta potentials of the GO nanosheet 22 varied from -40 to -25 mV, possessing a strong negative charge. 23

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Fig. S1. Characterization of GO nanosheets. (A) FTIR spectra of the GO, identifying the different functional groups; (B) XPS spectra identifying the relative abundance of the different functional groups of GO; (C) AFM image of GO sheets. The white bar indicates the thickness profile represented in panel; (D) representative sheet thickness profile obtained by AFM, indicating that GO sheets were mostly single or two layers and (E) Zeta potential of GO disperision at different pH values.

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47 Fig. S2. Blank experiments of the pristine and modified membranes. Synthetic
48 wastewater was used as the feed solution, 2M NaCl solution as the draw solution.
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