

Supplementary Information

Surface zwitterionic functionalized graphene oxide for a novel loose nanofiltration membrane

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S1. Synthesis of Graphene Oxide (GO)

Firstly, while maintaining agitation, graphite powder (4 g) was added into the mixture of sulfuric acid and phosphoric acid (9:1) in an ice bath, and potassium permanganate (27 g) was slowly added while preserving the temperature below 25°C for 15 min. Then the mixture was transferred to an oil bath and kept at 50°C for 20 h. The product was slowly poured into the mixture of ice (ca. 1200 mL) and H₂O₂ (30%, 20 mL). A resulting bright yellow GO suspension was obtained. And then the suspension was washed with pure water and centrifuged several times to remove residual salts until a neutral pH was reached. Finally, GO was obtained by freeze drying for future use.

S2. Synthesis of BTPAm

Amidation between BIBB and APTES was performed as follows: APTES (9 mL, 0.04 mol), TEA (6 mL, 0.04 mol) was dispersed into dried toluene (40 mL) under continuous stirring in an ice bath. Then BIBB (8.64 g, 0.04 mol) in 20 mL dried toluene was added dropwise into the above mixture, followed by stirring at 0°C for 3 h. Finally the reaction was further carried out at room temperature for another 10 h. The obtained liquid was separated from the white solids by filtration and then left in the flask to remove toluene using a rotary evaporator under vacuum. Finally the products (BTPAm) were sealed up and stored in a low temperature incubator before use.

S3. Silanization between Si-OH of BTPAm and the functional groups of GO was carried as follows. Briefly, exfoliation of GO (200 mg) in dried toluene (40 mL) was achieved with ultrasonic treatment for 30 min. After adding BTPAm (1.2 g), the

mixture was refluxed under N₂ protection at 120°C for 10 h. Finally the product (GO-Br) was collected by three cycles of centrifugation followed by drying in a vacuum oven at 40°C.

S4. XPS survey spectra of (a) GO and (b) GO-PSBMA

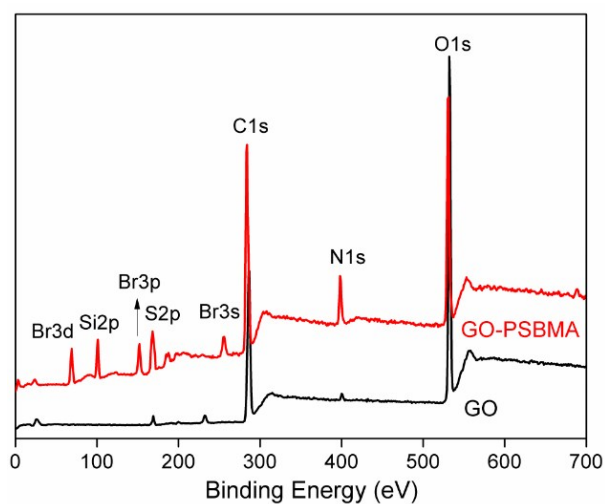


Fig. S4 XPS survey spectra of (a) GO and (b) GO-PSBMA

S5. Cross-sectional morphologies of GO-PSBMA/PES hybrid membranes

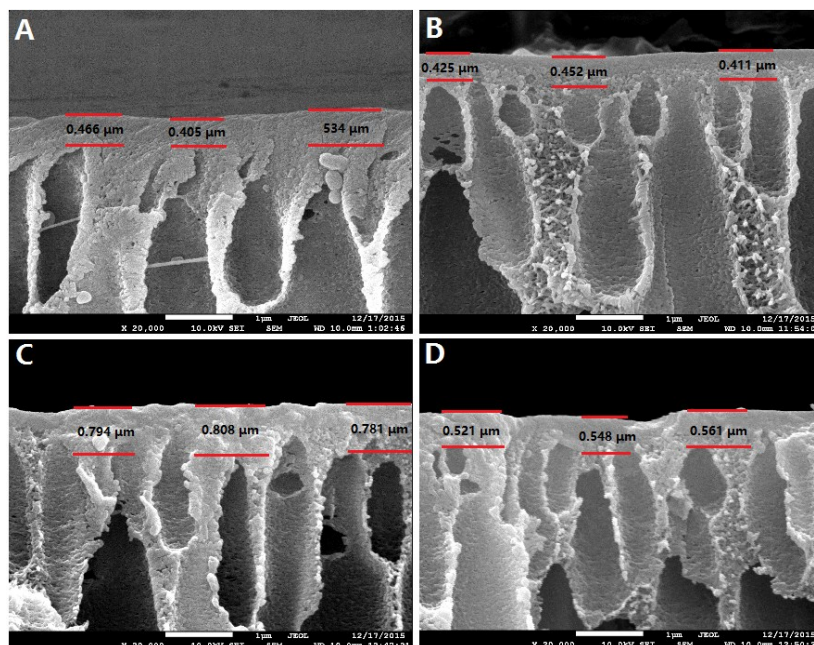


Fig. S5 Magnified cross-sectional morphologies of GO-PSBMA/PES hybrid membranes ($\times 20,000$): (A) NFM-0, (B) NFM-1, (C) NFM-2, (D) NFM-3

S6. XPS survey spectra of (a) pristine membrane and (b) GO-PSBMA/PES membrane

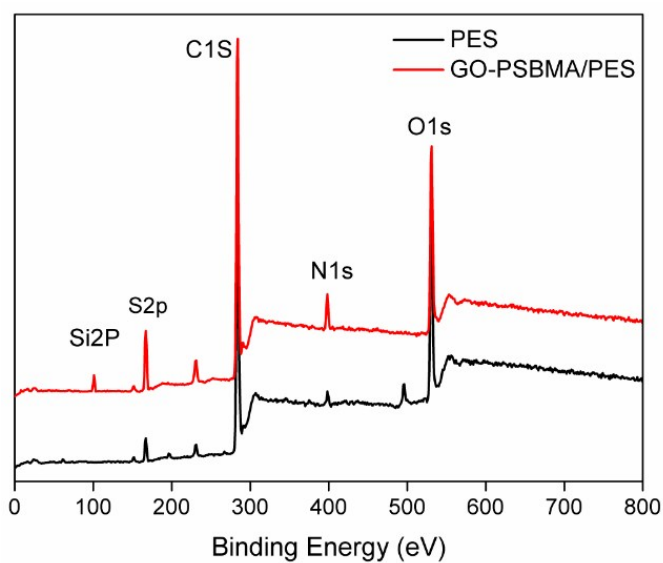


Fig. S6 XPS survey spectra of (a) pristine membrane and (b) GO-PSBMA/PES membrane (NFM-3)

S7. Porosity of Membranes

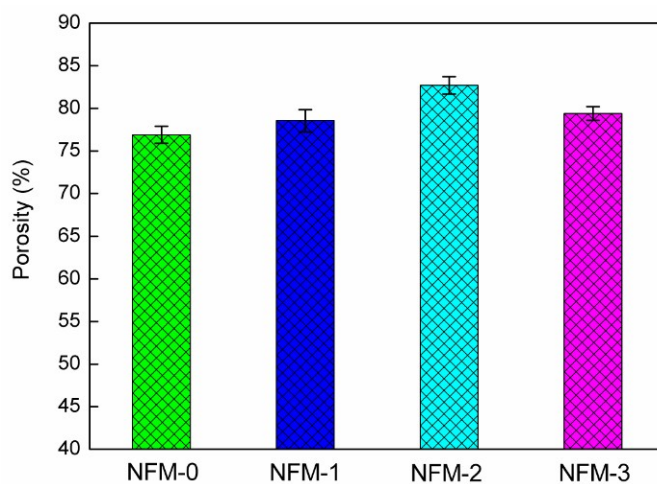


Fig. S7 Overall porosity of pristine membrane and GO-PSBMA/PES hybrid membranes

S8. Surface roughness of Membrane

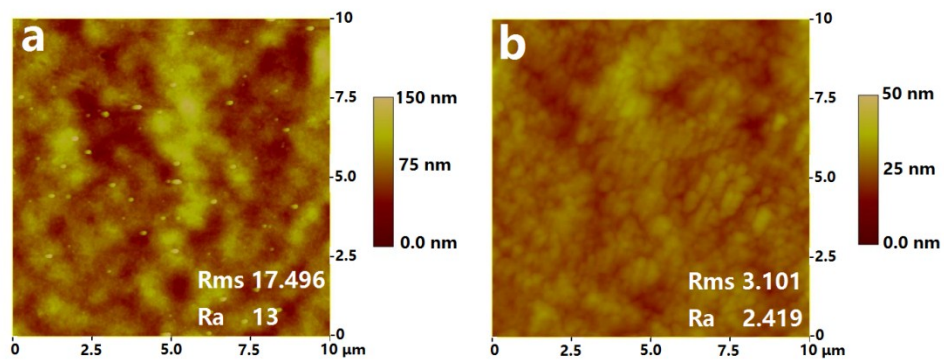


Fig. S8 AFM morphologies of (a) pristine membrane and (b) NFM-3