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Modification of Thin Film Composite Polyamide Membranes with 3D Hyperbranched Polyglycerol for Simultaneous Improvement in Filtration Performance and Antifouling Properties

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Section S1. The Preparation of Pristine and Linear PEG Chain Modified TFC Membranes

The pristine and linear PEG chain modified TFC polyamide membranes were fabricated via interfacial polymerization on a nanoporous PSf support according to the reported protocol.[1,2] To prepare the PSf support membrane, the homogenous PSf casting solution (12 wt.%) was first obtained by dissolving PSf beads in *N, N*-Dimethylformamide (DMF) under stirring for 8 h and degassing in a desiccator for 12 h. Then PET non-woven fabric was attached to a clean glass plate using waterproof adhesive tape and N-methyl-2-pyrrolidone (NMP) was applied to prewet the PET fabric, followed by removal of the excess NMP using Kimwipes (Kimberly-Clark, USA). After that, the PSf solution was poured into the PET fabric covered glass plate and cast using a casting knife (Tianjin Hong Ju Li Experimental Equipment Factory, China) with a gate height of 200 μm at an ambient temperature of 25 ± 1 °C and humidity of 40 ± 5 RH%. Finally, the glass plate was immediately immersed into deionized (DI) water coagulation bath for 10 min. The PSf membrane was formed and transferred to fresh DI water for storage.

Pristine TFC polyamide membranes were fabricated by interfacial polymerization of MPD in the aqueous phase and TMC in organic phase on top of the as-prepared PSf support membrane. Typically, a wet PSf membrane was taped to a clean glass plate and then immersed in a 30-mL aqueous solution of 3.4 wt.% MPD for 2 min. After removing excess MPD solution from the membrane surface using a rubber roller, the MPD-containing PSf membrane was then covered with a 0.15 wt % trimesoyl chloride solution in hexane for 1 min to form an ultrathin polyamide film. Finally, the TFC composite membrane was cured in DI water at 95 °C for 2 min. After a thorough rinse with DI water, the prepared TFC FO membranes were stored in DI water at 4 °C before characterization and measurement.

The fabrication procedure difference between pristine and linear PEG modified TFC membranes was that after draining the excess TMC organic solution, the nascent polyamide layer was immersed again into the mPEG-NH_2 aqueous solution (2.0 wt.% in DI water) for 2 min to incorporate linear PEG on polyamide layer via the second interfacial reaction between the primary amine groups of PEG and the acyl chloride groups on the polyamide layer surface. The membrane surface was rinsed three times with DI water to remove unbound PEG before curing in a DI water bath at 95 °C for 2 min.

Section S2. BSA adsorption and desorption process on polyamide layer of TFC membranes

Typically, the samples were adhered firmly onto the sample holders with double-sided adhesive tape and were tailored precisely to the size of 20 mm x 10 mm using a knife. Then the sample holders were inserted into the adjustable gap cell apparatus and adjust the gap height reaching 100 ± 5 μm. The zeta potential of the sample before BSA adsorption was measured using 0.001 M PBS buffer solution as electrolyte solution. The target pressure and measurement time was 300 mbar and 1200 s, and the zeta potential of membrane was recorded with a time interval of 10 s. To perform an BSA adsorption measurement, the electrolyte solution of PBS buffer solution in the system was drained thoroughly and the system was refilled with 0.5 g L^{-1} BSA PBS buffer solution (0.001 M). The measurement process and parameters were the same as that of the previous measurement. After completing the adsorption measurement, the system was rinsed with 0.001 M PBS buffer solution for 100 s, and then a desorption measurement with 0.001 M PBS buffer solution as electrolyte solution was performed to record the zeta potential of membranes.

References

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2. Yip, N. Y.; Tiraferri, A.; Phillip, W. A.; Schiffman, J. D.; Elimelech, M., High Performance Thin-Film Composite Forward Osmosis Membrane. *Environ. Sci. Technol.* **2010,** *44* (10), 3812–3818.

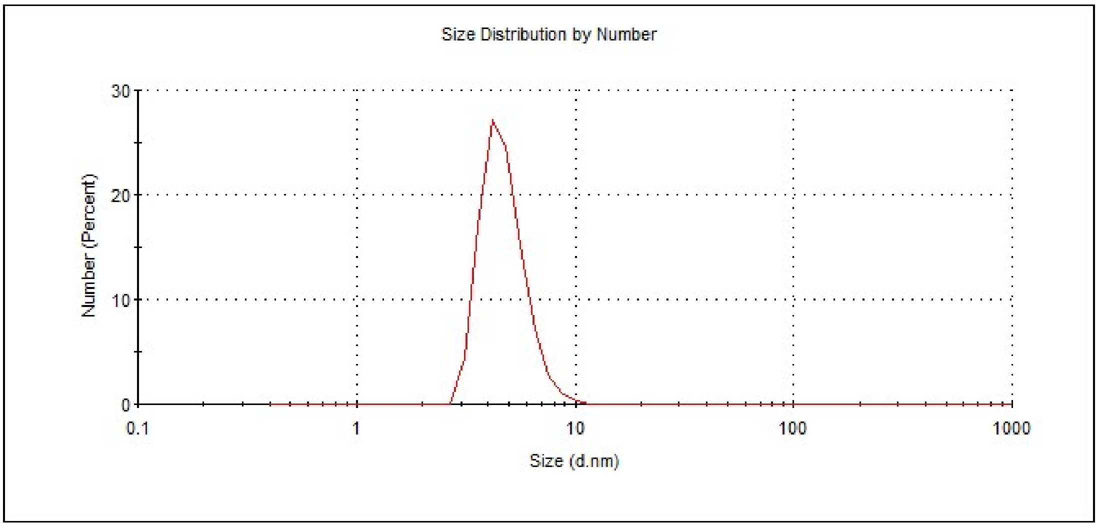

Figure S1. The size distribution of synthesized hPG determined by dynamic light scattering (DLS)

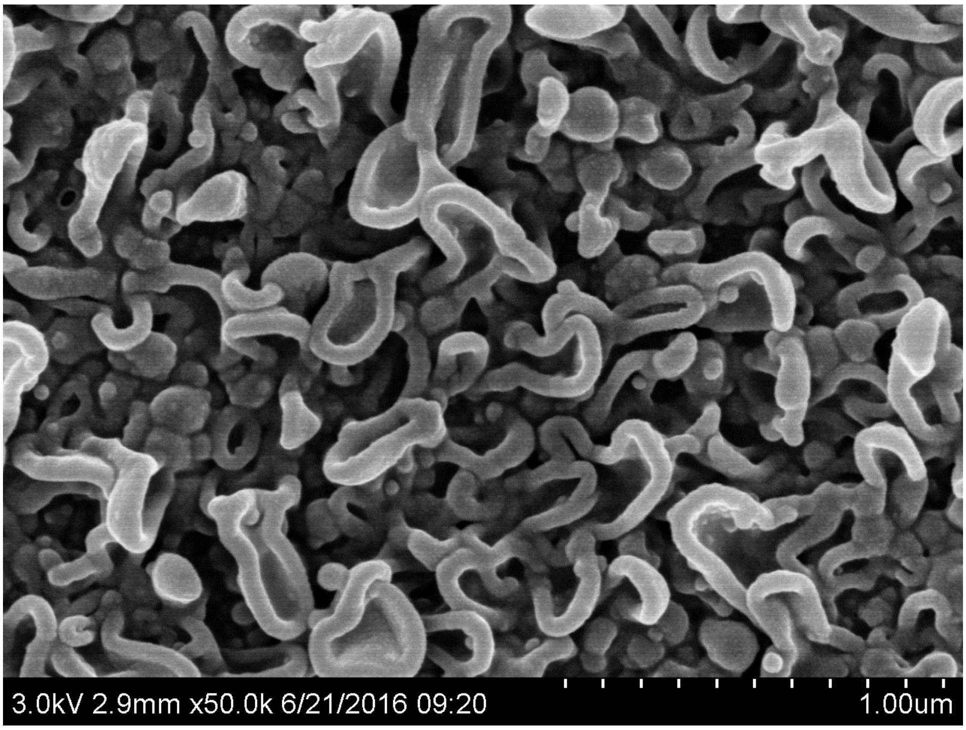

Figure S2. Surface morphology of Polyamide layer of pristine TFC membrane

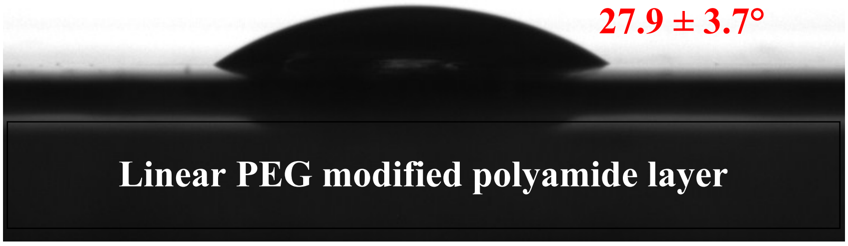

Figure S3. The water contact angel of polyamide layer of the linear PEG modified TFC FO membrane. The static contact angle was detected using an optical instrument (OCA20, Data Physics, Germany). Using the sessile drop method, a 2 μL of water droplet was placed on the air-dried membrane surfaces and photographed with a digital camera after 5 s.