

Supplementary material

Tuning the primary selective nanochannels of MOF thin-film nanocomposite nanofiltration membranes for efficient removal of hydrophobic endocrine disrupting compounds

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This supplementary material contains 8 pages, including 6 figures (namely Fig. S1, Fig. S2... and Fig. S6).

Calculation of cross-linking degree of membranes

The O/N ratio of control membrane was directly obtained from XPS results, while the O/N ratio of TFN membrane was obtained after calibrating oxygen element content by excluding element ratio of MIL-101(Cr) [Cr₃O(OH)(H₂O)₂[C₆H₄(CO₂)₂]₃·25H₂O] based on Cr concentration. Equation S1 was then used to calculate the cross-linking degree:

$$\frac{O}{N} = \frac{3m + 4n}{3m + 2n}, \quad m + n = 1 \quad (S1)$$

where m and n are the cross-linking portion and linear portion, respectively.

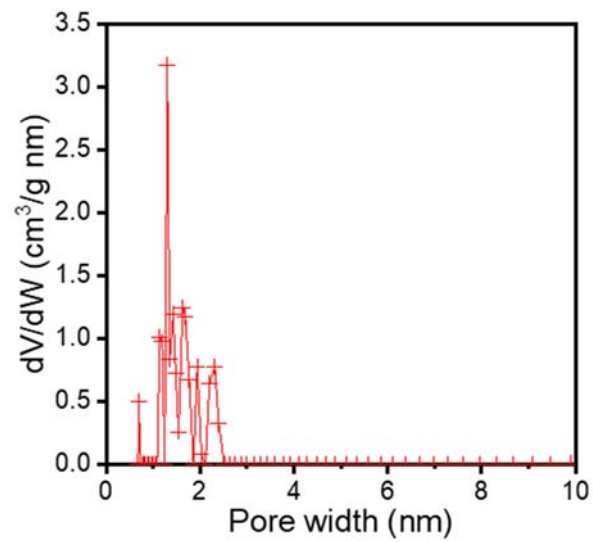


Fig. S1. Pore size distribution of synthesized MIL-101(Cr) calculated from N₂ adsorption-desorption measurement.

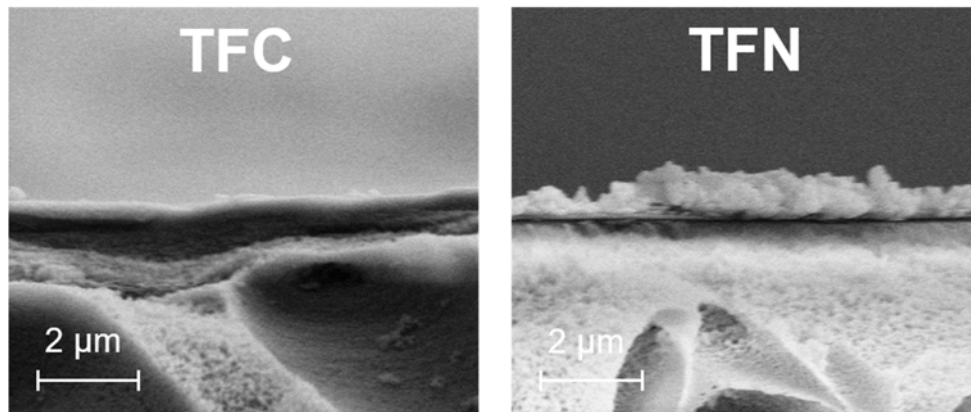


Fig. S2. SEM cross-sectional characterizations of the TFC-C3 and TFN-C3 membranes. All membranes before SEM characterization were sputtered by Au and Pd. The accelerate voltage for the measurement is 5 kV.

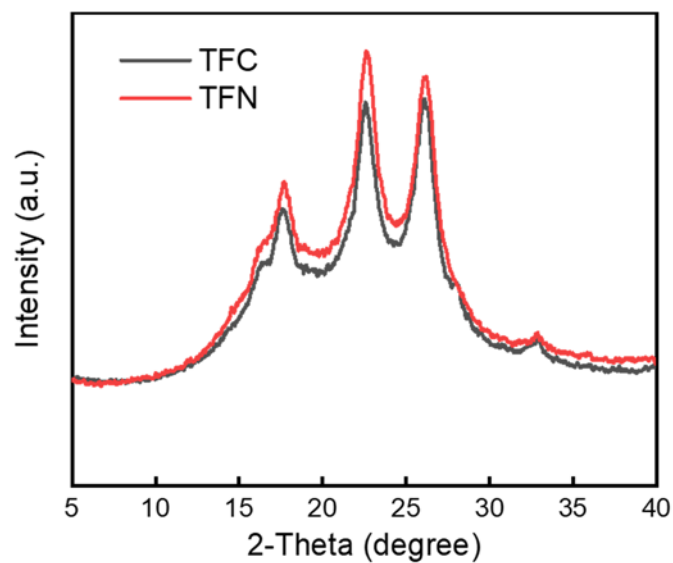


Fig. S3. XRD characterizations of the TFC-C3 and TFN-C3 membranes.

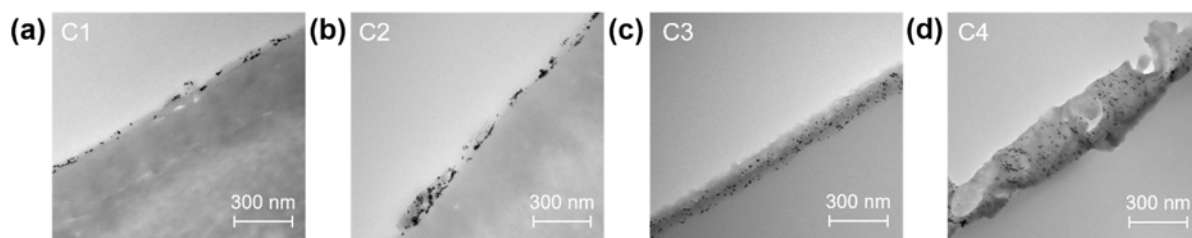


Fig. S4. GNPs-TEM characterization and corresponding schematics of primary water transport pathways of TFC membranes with different monomer concentrations: (a) C1 of 0.5 wt%, (b) C2 of 1.0 wt%, (c) C3 of 1.5 wt% and (d) C4 of 2.0 wt% PIP in water. GNP solution (1.0×10^{12} particles/mL) was dosed to a dead-end filtration cell for dynamic filtration under 5.0 bar pressure. The accelerate voltage of TEM characterization is 120 kV.

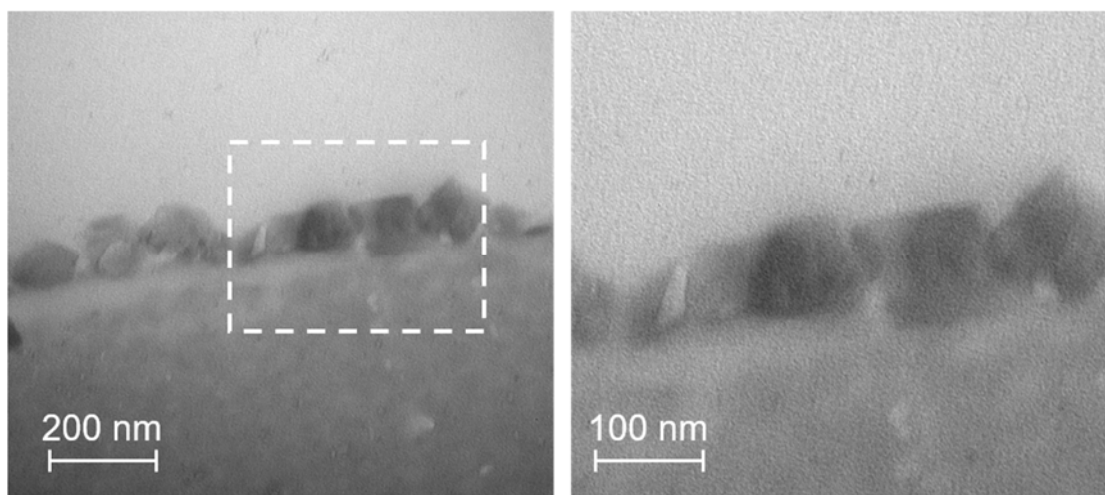


Fig. S5. TEM characterizations of static tests of gold nanoparticle deposition on TFN-C3. Static adsorption tests with no pressure applied were conducted for 12 h in the dead-end cell filled with the same GNP solution to that in the dynamic filtration test (1.0×10^{12} particles/mL). The accelerate voltage of TEM characterization is 120 kV.

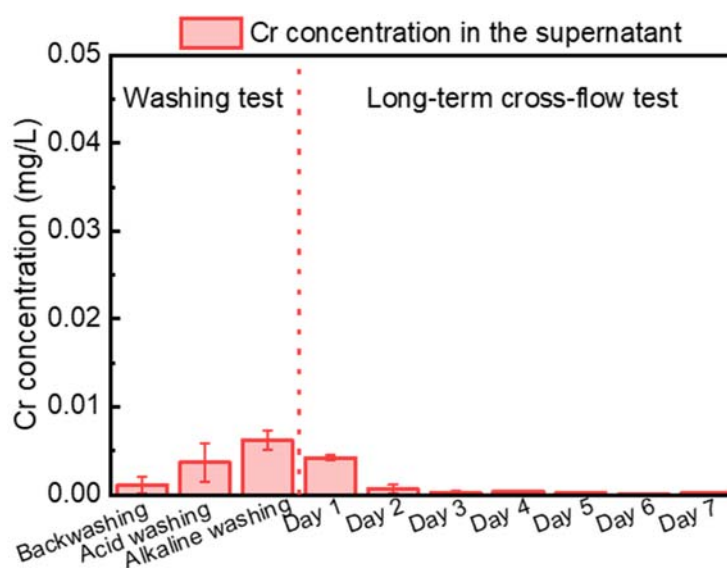


Fig. S6. Leaching test at different operational mode and time for MOF0.05-C3 membrane ($n = 3$). In membrane leaching tests at different times, the membrane was cut into a rectangular shape with an area of 4 cm^2 , and was subsequently soaked in a 15 mL sealed centrifuge tube filled with Milli-Q water. The tubes were shaken at $30 \text{ }^\circ\text{C}$ with 150 rpm rotation, while the water in them was replaced every 24 h. Two bar pressure was used for backwashing of the membrane. The acid washing solution was 2% citric acid, while the alkaline washing solution was 1% EDTA-4Na and 0.1% NaOH. All experiments were performed in triplicate and water samples were collected and analyzed by an inductively coupled plasma mass spectrometry (ICP-MS, 7700, Agilent, USA). The detection limit of the ICP-MS for chromium is $0.001 \text{ } \mu\text{g/L}$.