# Superhydrophilic and antibacterial zwitterionic polyamide nanofiltration membranes for antibiotics separation

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## Research background

Zwitterions as a new type of molecules with high hydrophilicity and antifouling property are becoming a promising material for nanofiltration membranes. Superhydrophilic and antibacterial zwitterionic polyamide thin film composite nanofiltration membranes (ZTFCMs) with excellent water permeability and antibiotics selectivity were prepared through the interfacial polymerization of N-aminoethyl piperazine propane sulfonate (AEPPS) monomer with trimesoyl chloride (TMC) monomer on top of polysulfone ultrafiltration supporting membranes (PSF-UF).

## Experiment

### ➢ Membrane preparation

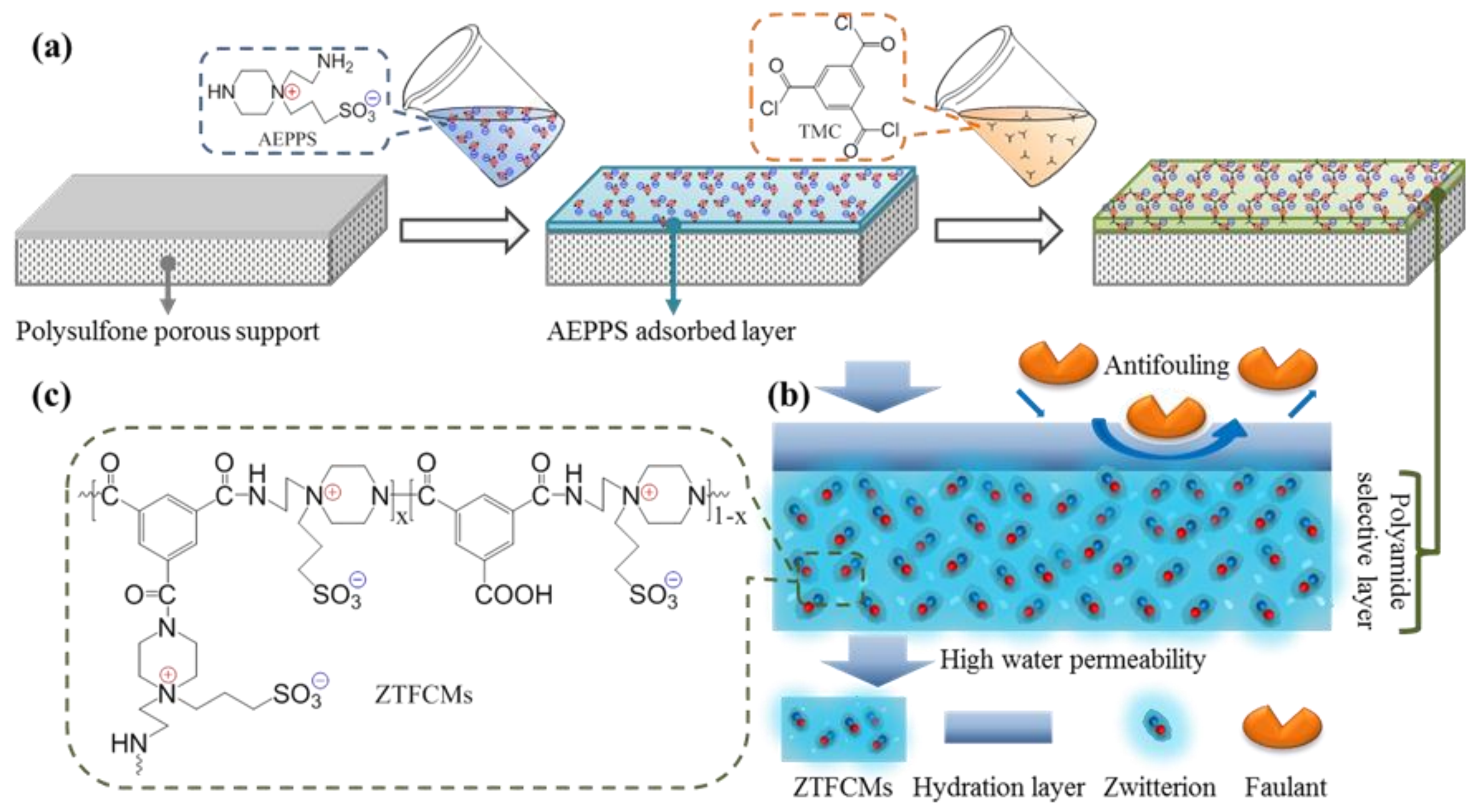


Fig. 1 (a) Schematic diagram for preparing ZTFCMs. (b) schematic model for water transport and antifouling illustration of ZTFCMs. (c) chemical structure of ZTFCMs.

## Results and discussion

### ➢ Membrane structure

Table 1. Membrane labels and characteristic properties of ZTFCMs.

| Membranes | AEPPS Conc. (wt%) | AEPPS content (mol%) | Cross-linking extent | Thickness (nm) | RMS (nm) | SAD |
|---|---|---|---|---|---|---|
| M1 | 0.5 | 11.4 | 43.9% | 243 | 6.49 | 1.9% |
| M2 | 1.0 | 14.0 | 67.3% | 248 | 11.0 | 2.5% |
| M3 | 3.0 | 23.1 | 98.5% | 233 | 21.0 | 4.6% |
| M4 | 4.0 | 25.8 | 92.7% | 229 | 29.3 | 7.0% |
| M5 | 6.0 | 31.0 | 84.8% | 253 | 49.3 | 8.6% |

### ➢ Membrane morphologies and hydrophilicity

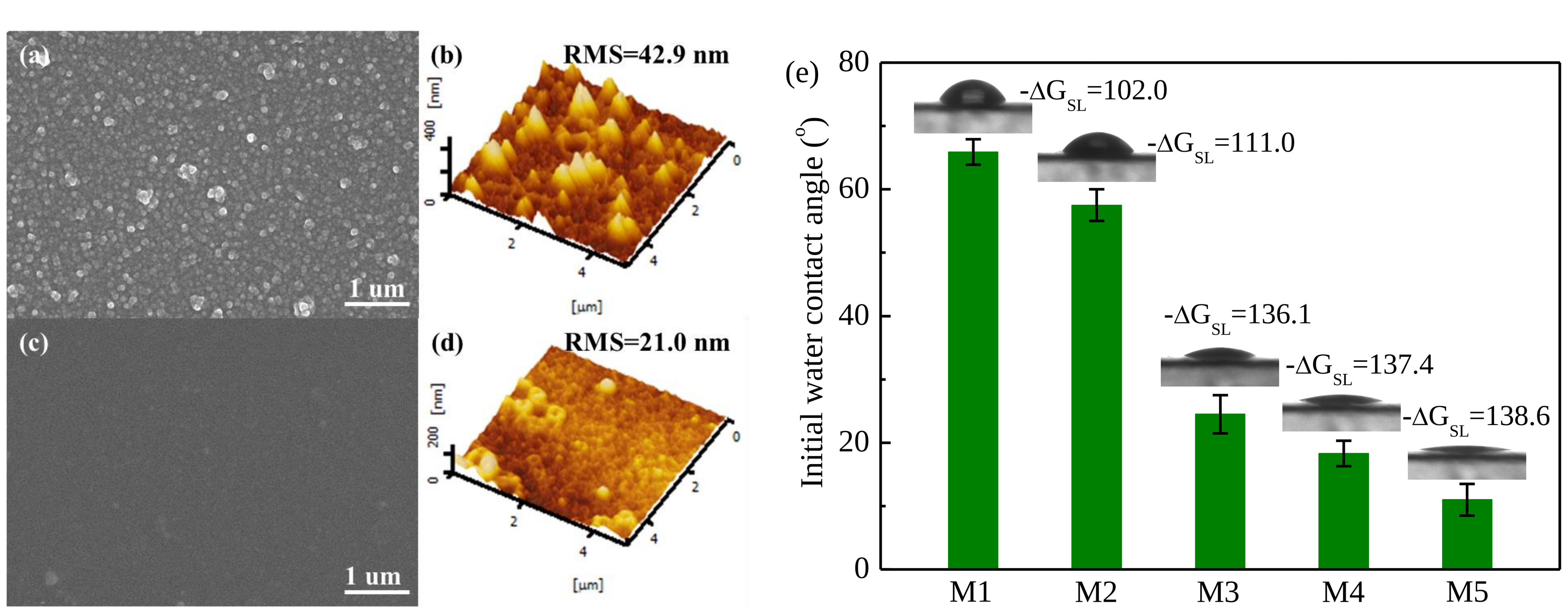


Fig. 2 SEM surface morphologies (×20.0k) of (a) M0 (PIP-TMC) and (c) M3. AFM surface morphologies of (b) M0 and (d) M3. (e) Initial water contact angle of M1, M2, M3, M4 and M5 (Insert: adjusted solid-liquid interfacial free energy (mJ m$^{-2}$)).

### ➢ Erythromycin/salt mixture concentration

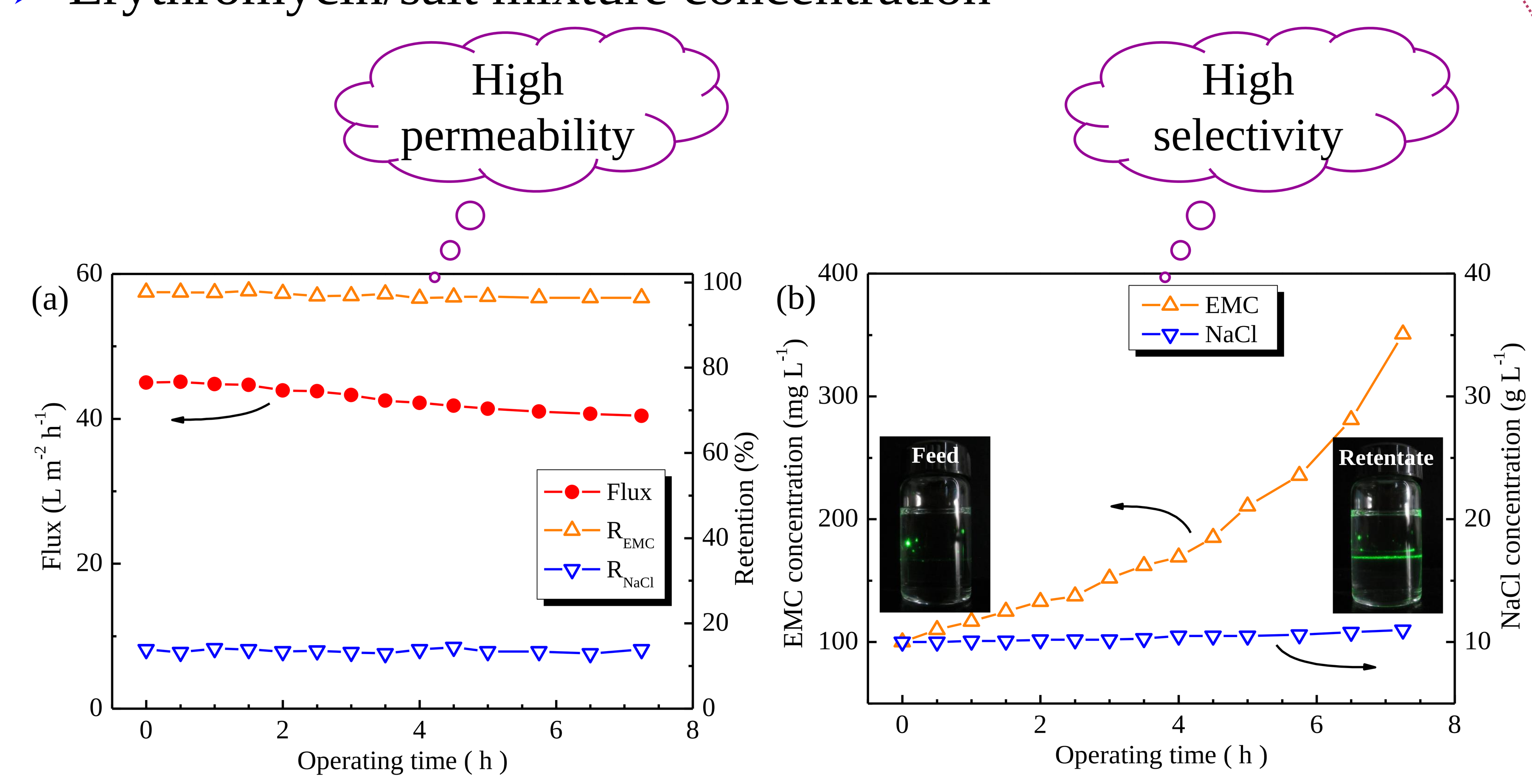


Fig. 3 (a) Nanofiltration performance and (b) erythromycin (ERY) and NaCl concentrations of the feed as a function of operation time for M3 testing with 100 mg L$^{-1}$ ERY/10 g L$^{-1}$ NaCl mixture solution at 25 $^{o}$C under 0.6 MPa (Insert: Tyndall effect of the feed and retentate).

### ➢ Stability and antibacterial property

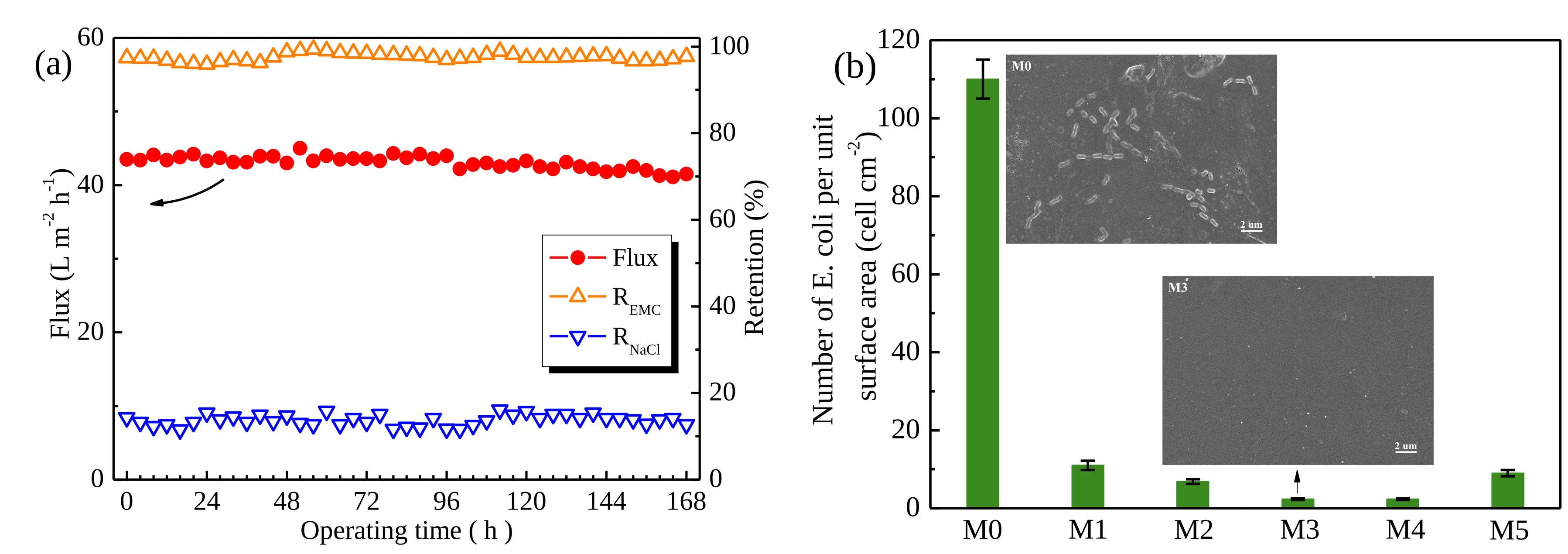


Fig. 4 (a) Effect of operation time on flux and solute retention of M3 tested with a mixture solution of 100 mg L$^{-1}$ ERY and 10 g L$^{-1}$ NaCl at 25 $^{o}$C and 0.6 MPa. (b) number of E. coli adhered onto the membrane surfaces estimated by SEM images (×5.0k). (Insert: SEM images displaying E. coli at the surface of M0 and M3 after immersion in E. coli suspensions for 24 h).

## Conclusions

➢ Novel ZTFCMs have been prepared through interfacial polymerization of AEPPS with TMC on PSF-UF and the chemical structures can be tuned by varying the AEPPS aqueous concentration.

➢ ZTFCMs are smooth and superhydrophilic, and show exceptional antibacterial property.

➢ ZTFCMs exhibit excellent perm-selectivity and are well-suited for antibiotics separation.