



# Sulfated Polyelectrolyte Complex Nanoparticles Structured Nanofiltration Membranes for Dye Desalination

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## Abstract:

- Polysaccharide nanofiltration membrane with traditional modification suffers from poor water permeability for its tight packing of polymeric chains.
- A novel membrane building block based on sulfated polyelectrolyte complex nanoparticles (SPEC NPs) is developed using chitosan and dextran sulfate sodium.
- Special aggregation structure combined with hydrophilic sulfate groups effectively attenuates packing density of polymeric chain and increases free volume.
- As-prepared membranes (SPECMs) feature prominent perm-selectivity and antifouling property in practical dye desalination for a long-term process.

## Introduction

### Preparation of the SPECMs

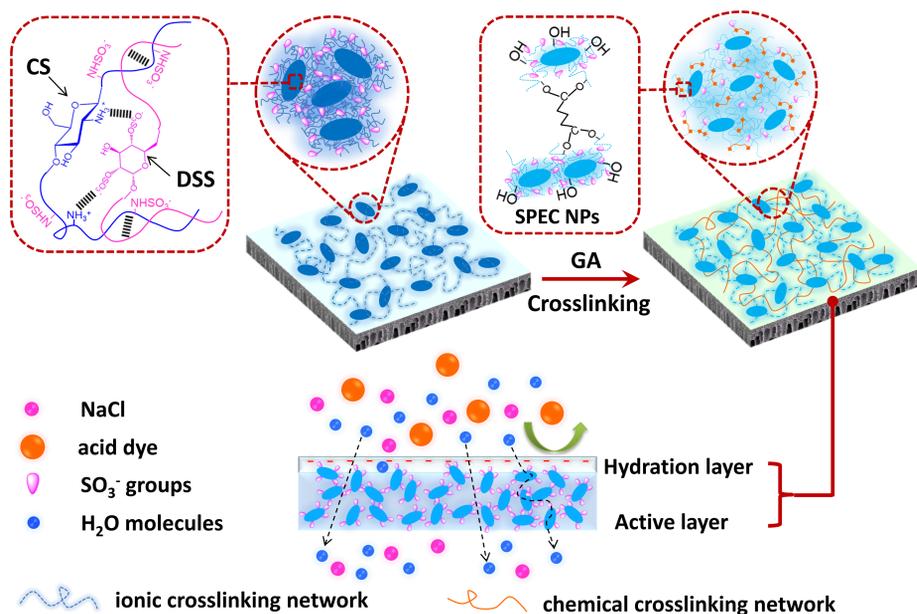


Fig. 1. Schematic diagram of chemical structure, membrane fabrication and dye/salt mixture separation process of SPECMs.

### Characterizations of SPEC NPs and SPECMs

Table 1 Compositions of PEC and their SPECs determined by XPS.

Sample	Feed ratio (mol%) (sulfate agent : CS)	S (At.%)	N (At.%)	S : N	DC <sup>a</sup> (mol%)	DS <sup>b</sup> (mol%)	Membrane
PEC	—	2.97	6.60	0.45	45	—	—
SPEC-1	1.0	3.95	6.27	0.63	45	18	M-1
SPEC-2	2.0	4.46	5.95	0.75	45	30	M-2
SPEC-3	3.0	5.02	5.84	0.86	45	41	M-3
SPEC-4	3.5	5.26	5.72	0.92	45	47	M-4
SPEC-5	4.0	5.27	5.67	0.93	45	48	M-5

<sup>a</sup> DC: Degree of complexation, <sup>b</sup> DS: Degree of sulfation

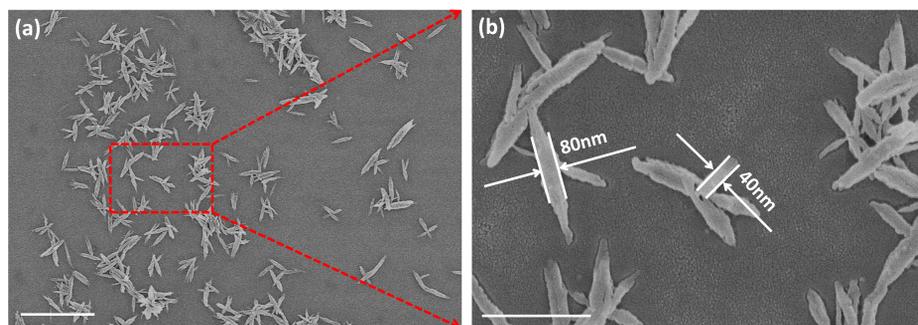


Fig. 2. (a) FESEM micrographs of SPEC nanoparticles aqueous dispersions (scale bar: 2μm) and (b) magnified image in (a) (scale bar: 500 nm), solvent was dried on silicon wafers at 30 °C (0.1 g L<sup>-1</sup>).

## Conclusions

- The novel NF membrane building block SPEC NPs anchored with tunable sulfated groups is fabricated from chitosan and dextran sulfate sodium.
- SPECNPs reduce transfer resistance and promote transport of water molecules, thus render SPECMs with remarkable elevation in flux and antifouling property.
- The selectivity for NaCl/Na<sub>2</sub>SO<sub>4</sub> and NaCl/methyl blue dye are as high as 13.1 and 850, exhibiting good separation performance in a long-term operation.

## Acknowledgement

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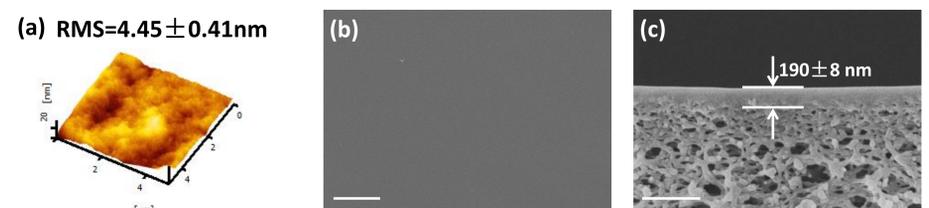


Fig. 3. AFM/FESEM surface micrographs (scale bar: 1μm) of (a)/(b) M-4; Cross-section of (c) M-4 (scale bar: 500nm).

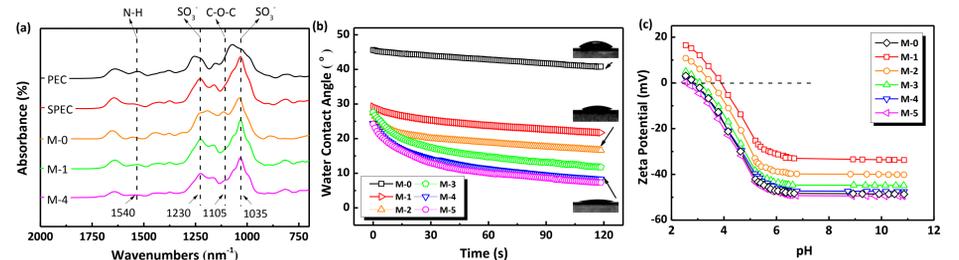


Fig. 4. (a) ATR-FTIR spectra of SPEC, M-0, M-1, M-4 and FTIR spectrum of PEC; (b) Water contact angle of M-0 and SPECMs; (c) Zeta potential varies with pH of M-0 and SPECMs tested with 1.0 mmol L<sup>-1</sup> KCl aqueous solution at 25 °C.

### Nanofiltration performances of M-0 and SPECMs

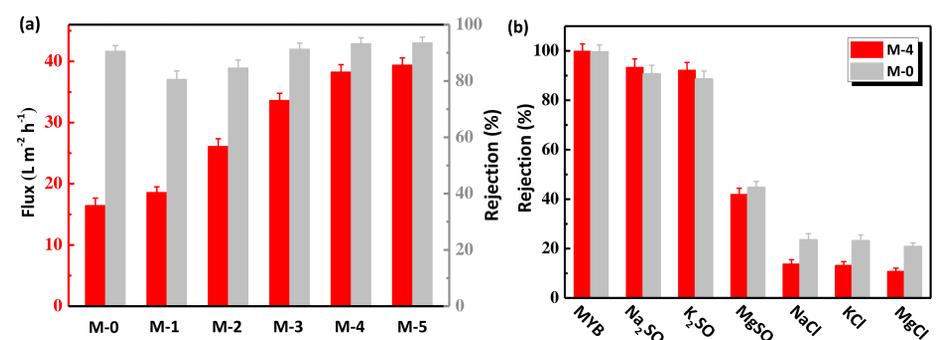


Fig. 5. (a) NF performance of M-0 and SPECMs tested with 1.0 g L<sup>-1</sup> Na<sub>2</sub>SO<sub>4</sub> aqueous solution and (b) organic dye and different inorganic electrolytes (pH=6.5) at 25 °C under 0.6 MPa.

### Dye desalination and antifouling property

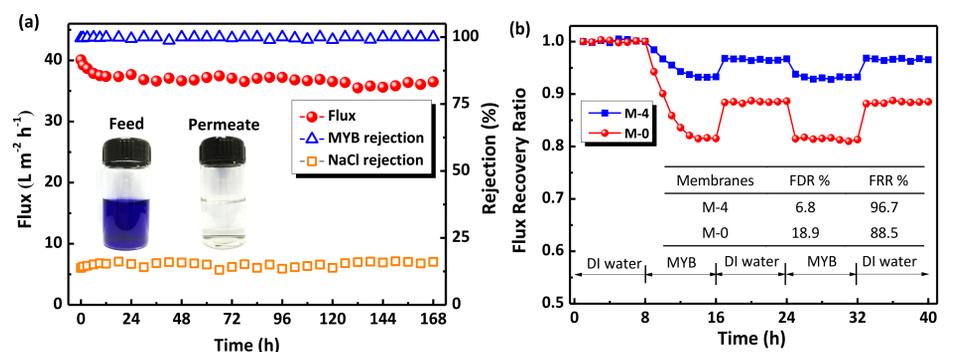


Fig. 6. (a) Time-dependent flux and rejection of 1.0 g L<sup>-1</sup> NaCl and 0.1 g L<sup>-1</sup> MYB solution of M-4 (inset: decolorization effect of M-4) and (b) Flux evolution of M-4 and M-0 tested with 0.1 g L<sup>-1</sup> dye solution (pH=6.5) at 25 °C under 0.6 MPa (inset: FDR and FRR of M-4 and M-0).

## References

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