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A microporous polymer ultrathin membrane for the highly efficient removal of dyes from acidic saline solutions

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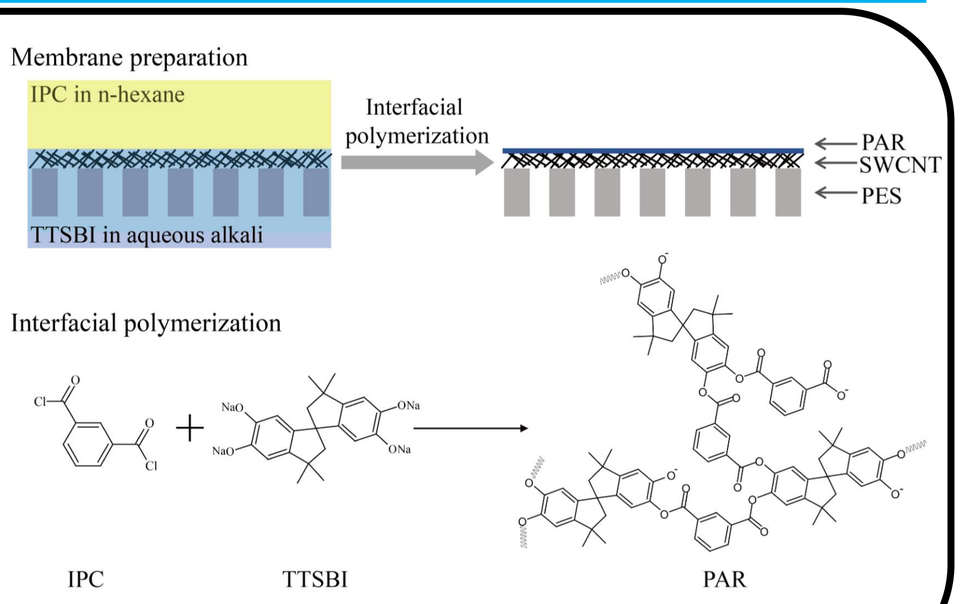
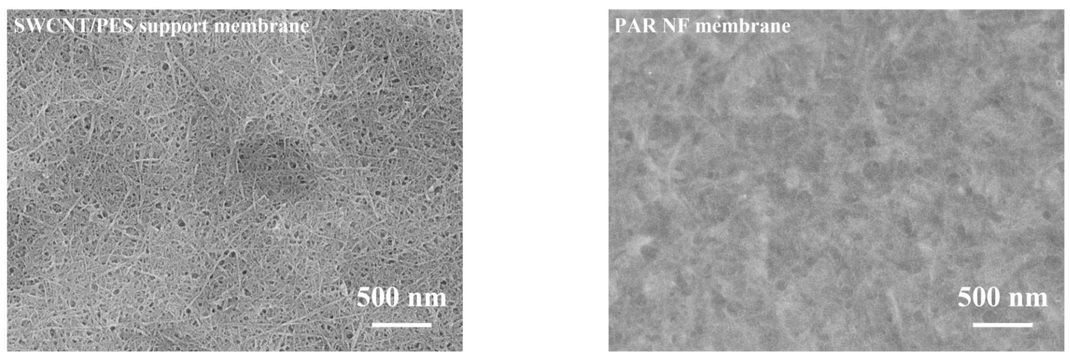
Introduction

Thin film composite (TFC) membranes formed by interfacial polymerization on top of a porous support membrane, are commonly used for highly efficient separation. To treat textile industry wastewater efficiently, TFC membranes with excellent water permeance and high dye removal efficiency are urgently desired. However, the high acidity and salinity usually exist in textile wastewater, imposing great challenges in dye removal efficiency for conventional polyamide-based TFC membranes. This study presents a type of acid-tolerant polyarylate (PAR) TFC membrane to tackle such challenges. The PAR active layer was produced via interfacial polymerization using 5,5',6,6'-tetrahydroxy-3,3,3',3'-tetramethyl-1,1'-spirobisindane (TTSBI) and isophthaloyl dichloride (IPC) as monomers, and formed on top of a single-walled carbon nanotube (SWCNT) nanofilm.

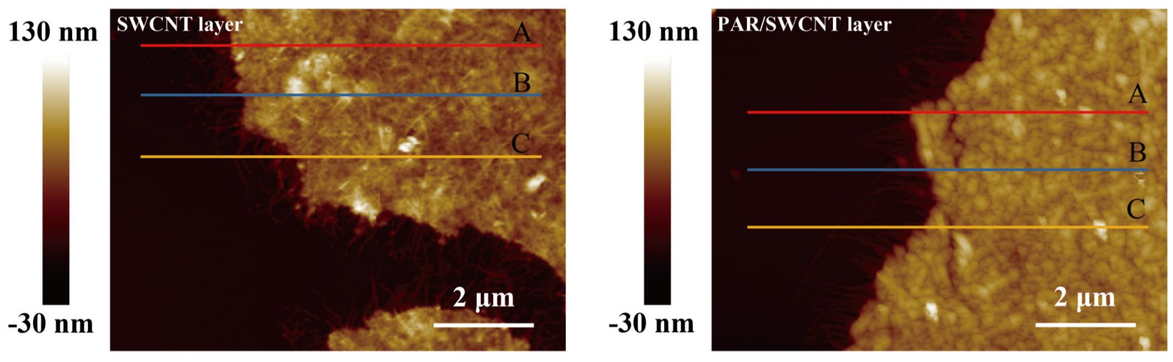


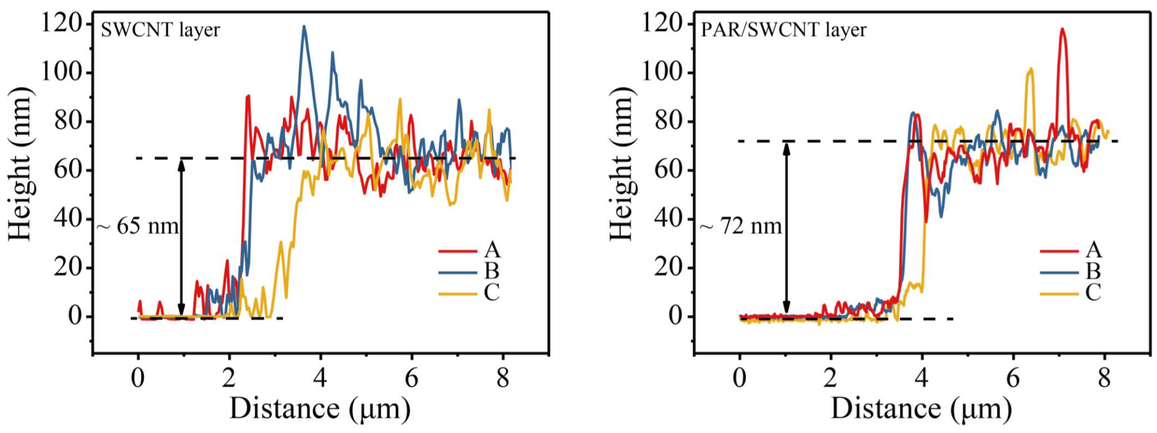
Membrane characterization

Morphology

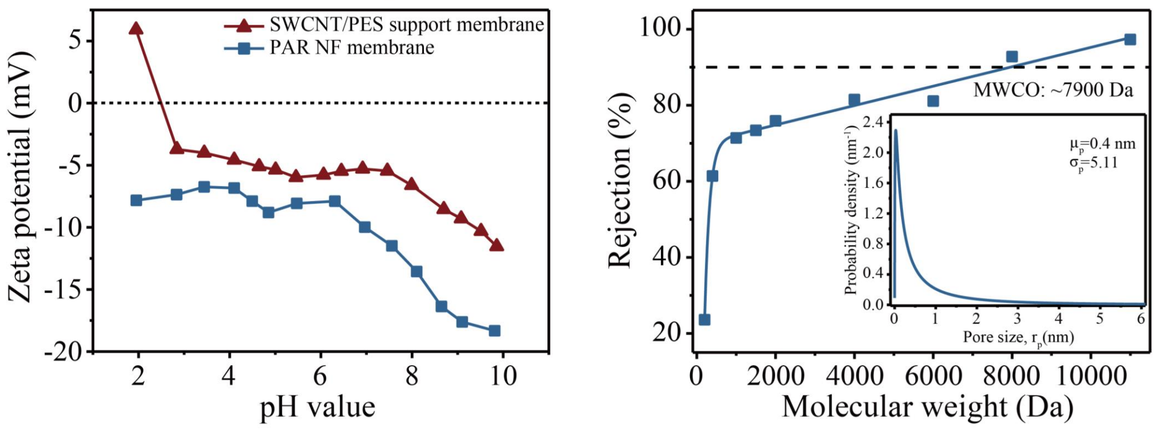


PAR layer thickness

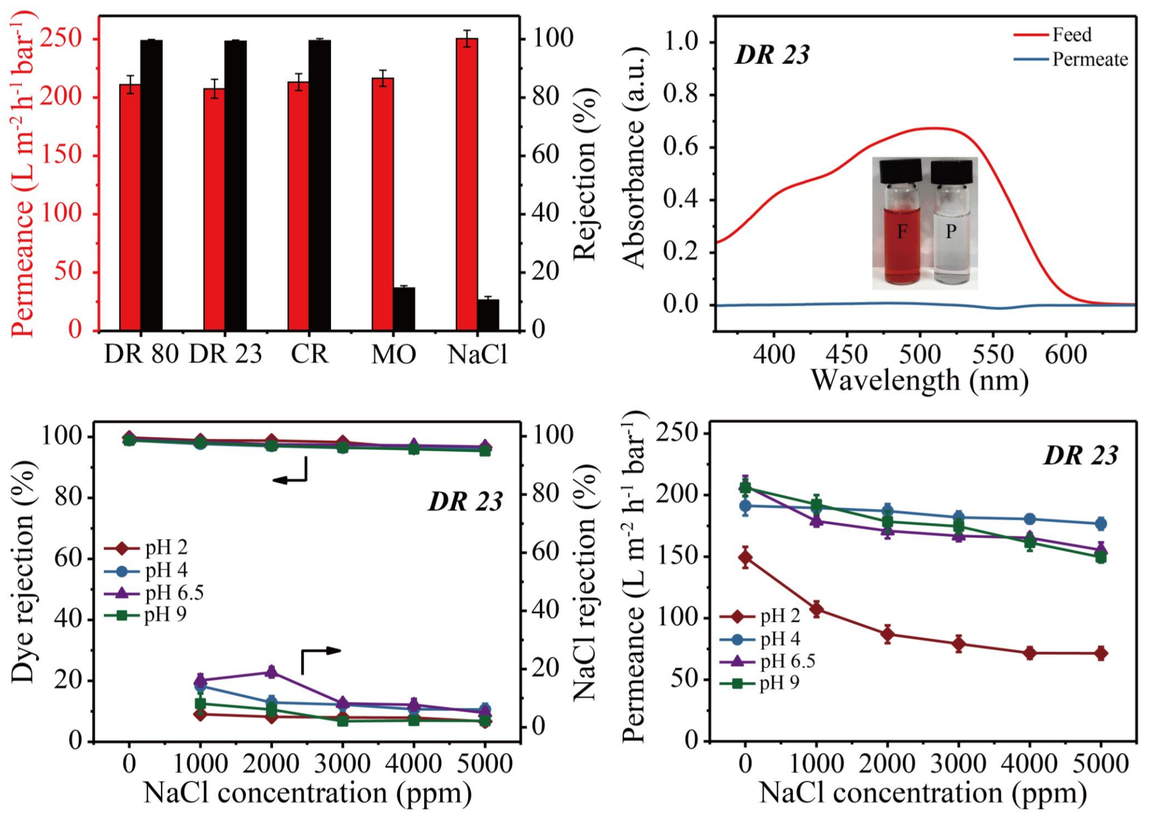




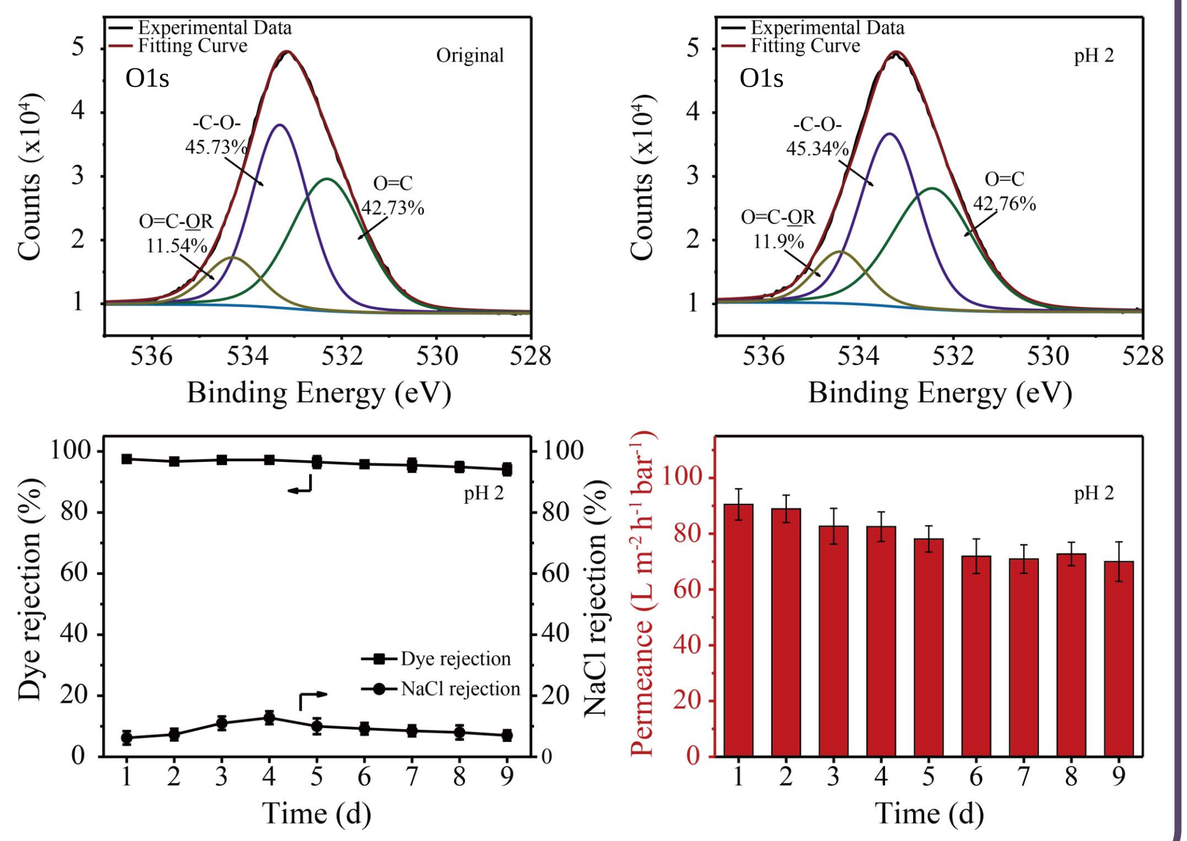
Zeta potential and pore size



Separation performance



Acid resistance



Conclusions

The ultrathin PAR active layer (~7 nm) was obtained, and the PAR TFC membrane exhibited the extremely high membrane permeating flux of ~210 L m^{-2} h^{-1} bar^{-1}, while the negatively charged surface of the PAR active layer made a high dye rejection of >99% at a wide range of feed solution pH. In addition, a high selectivity for dye and NaCl was observed with a stable NaCl rejection of <20%, when the membrane was tested at a pH ranging from 2 to 9 and feed NaCl concentration ranging from 1000 to 5000 ppm. The PAR TFC membrane also kept a stable selectivity for dye and NaCl under acidic conditions during the long-term continuous filtration experiment. Therefore, the PAR TFC membrane is a promising tool for the highly efficient treatment of acidic and high salinity textile wastewaters.