הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע״ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

Monday, September 8th, 2025 at 14:00

Conference Room - 3rd floor

The effect of Polymerization Rate on the Morphology and Performance of Desalination Membranes

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MSc Seminar

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Reverse osmosis (RO) membranes are a critical technology for addressing global water scarcity through efficient desalination. These membranes rely on a thin polyamide selective layer, typically fabricated via interfacial polymerization (IP) between *m*-phenylene diamine (MPD) in the aqueous phase and trimesoyl chloride (TMC) in the organic phase. The membrane's separation performance strongly depends on the morphology of this layer, which is sensitive to polymerization kinetics and monomer transport across the interface.

This study investigates how polymerization rate affects membrane morphology by isolating the influence of MPD transfer rate during IP. Two systems were selected, one with a co-solvent (ethyl acetate) and one with a surfactant (sodium dodecyl sulfate, SDS), with interfacial tension (IFT) matched to ensure comparable susceptibility to instability and energy barrier for MPD transfer.

Although both additives reduced IFT, we used UV-Vis spectrophotometry to show that only the co-solvent significantly enhanced MPD transfer into the organic phase. We assessed hydrodynamic stability by tracking fluorescent microparticles in the aqueous phase with real-time confocal microscopy, which revealed greater instability in the ethyl acetate system. We fabricated the membranes using a support-free IP (SFIP) technique to eliminate support-induced artifacts. Using scanning electron microscopy (SEM) and atomic force microscopy (AFM), we characterized the membrane morphology and found that, under high MPD concentration, the ethyl acetate system resulted in multilayered structures, while the SDS system produced a crumpled morphology.

These findings demonstrate that increased MPD transfer rate (higher polymerization rate) induces morphological instability, which significantly influences membrane morphology. By decoupling IFT from transport phenomena, this work offers new insight into the synthesis–morphology relationship in RO membranes.