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

Wolfson Department of Chemical Engineering Seminar

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Ionomer Based Polyelectrolyte Complex Nanofiltration Membranes for Secondary Effluent Wastewater Treatment

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Wastewater reuse is a large resource of potable and irrigation water in water-stressed areas. underutilized today, but advanced treatment is needed to achieve the required water quality. Nanofiltration (NF) is an optimal solution, yet NF membranes need to be tailored for this application, as available ones do not possess necessary selectivity.

To this end, our group is developing novel polyelectrolyte complex (PEC) NF membranes based on ionomers (charged amphiphilic polymers). The approach is conceptually similar to layer-by-layer deposition of water-soluble polyelectrolytes. However, the new process involves only two coating steps: first, an evaporation coating of the anionic Nafion ionomer, which determines the final membrane thickness, followed by a dip-coating stage using a water-soluble polycation. Following previously demonstrated tunable ion selectivity of such membranes, here we focus on optimization towards organic micropollutants (OMP) removal along with low salt rejection. We find the PEC-based NF membranes outperform polyamide NF270 membranes in rejecting hydrophobic OMP molecules. Furthermore, rejection of charged molecules and ions can be tuned by modulating membrane charge and chemistry in the second coating step by varying the type and concentration of polyelectrolyte, as well as coating time and pH.

To better understand the complexation mechanism and resulting membrane structure and charge, we study the complexation kinetics using Nafion films exposed to polyelectrolyte solutions of different concentrations. ATR-FTIR spectroscopy is used to monitor and quantify the diffusion of polycations into Nafion. This yields diffusion coefficients of the order 10^{-15}-10^{-17} m²/s, indicating that converting the entire film to PEC would require several minutes for a 100 nm layer and hours for micron-thick films. The study is ongoing to quantify the relation between the polycation solution composition and resulting membrane charge and extend this approach to other ionomer-polyelectrolyte systems.