Fabrication of PSS-PDADMAC membranes via salt dilution-induced aqueous phase separation

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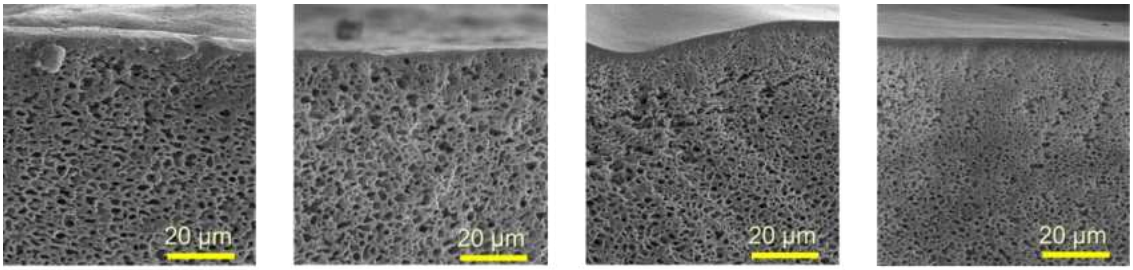
Polyelectrolyte complex membranes are materials based on oppositely charged polyelectrolytes that are typically soluble in water. Interaction between oppositely charged polyelectrolytes creates an insoluble substance that can form solids in aqueous environments. Such a process does not require organic solvents, and such an aqueous salt-dilution-induced phase separation process induces polyelectrolyte complexation through a pH or salinity switch [1]. Due to the low dielectric constant polyelectrolyte complex membranes are stable in organic solvents, which makes them suitable for a wider range of separation processes [2].
In this study membranes based on poly (sodium 4-styrene sulfonate) (PSS) and poly (diallyl dimethyl ammonium chloride) (PDADMAC) were obtained using the method proposed by J. Kamp et al. [1]. The investigation focused on assessing the impact of polymer concentration and forming knife thickness on the membrane properties. Solutions containing 20% and 25% PSS and PDADMAC were utilized, along with casting knives of 200 µm and 400 µm thickness. The physicochemical properties were investigated using AFM, SEM, IR and EDX.
The average pore size of the membranes depends on the polymer solution's concentration. A sponge-like asymmetric structure was revealed in all membranes (Fig.1).



1) 2) 3) 4)

Fig.1 . *Cross-section SEM images of the samples cast with:*
1) 200 µm, 2) 400 µm (based on 20 wt %), 3) 200 µm, 4) 400 µm (based on 25 wt %)

Water permeability tests of membranes demonstrate typical nanofiltration flow characteristics, making it a promising candidate for ion retention applications. And organic solvent resistance of the membranes represents a promising step towards the development of sustainable membranes without the use of toxic organic solvents and crosslinkers for the separation of organic solvent-based solutions.

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References

[1] J. Kamp et al., *Journal of Membrane Science* **2021**, *618*, 118632.
[2] K. Sadman et al., *ACS Applied Materials and Interfaces* **2019**, 11, 16018–16026.