PhD Open Days

Asymmetric membranes based on poly(ionic liquid)s for CO_2 separation

PhD in Chemical Engineering

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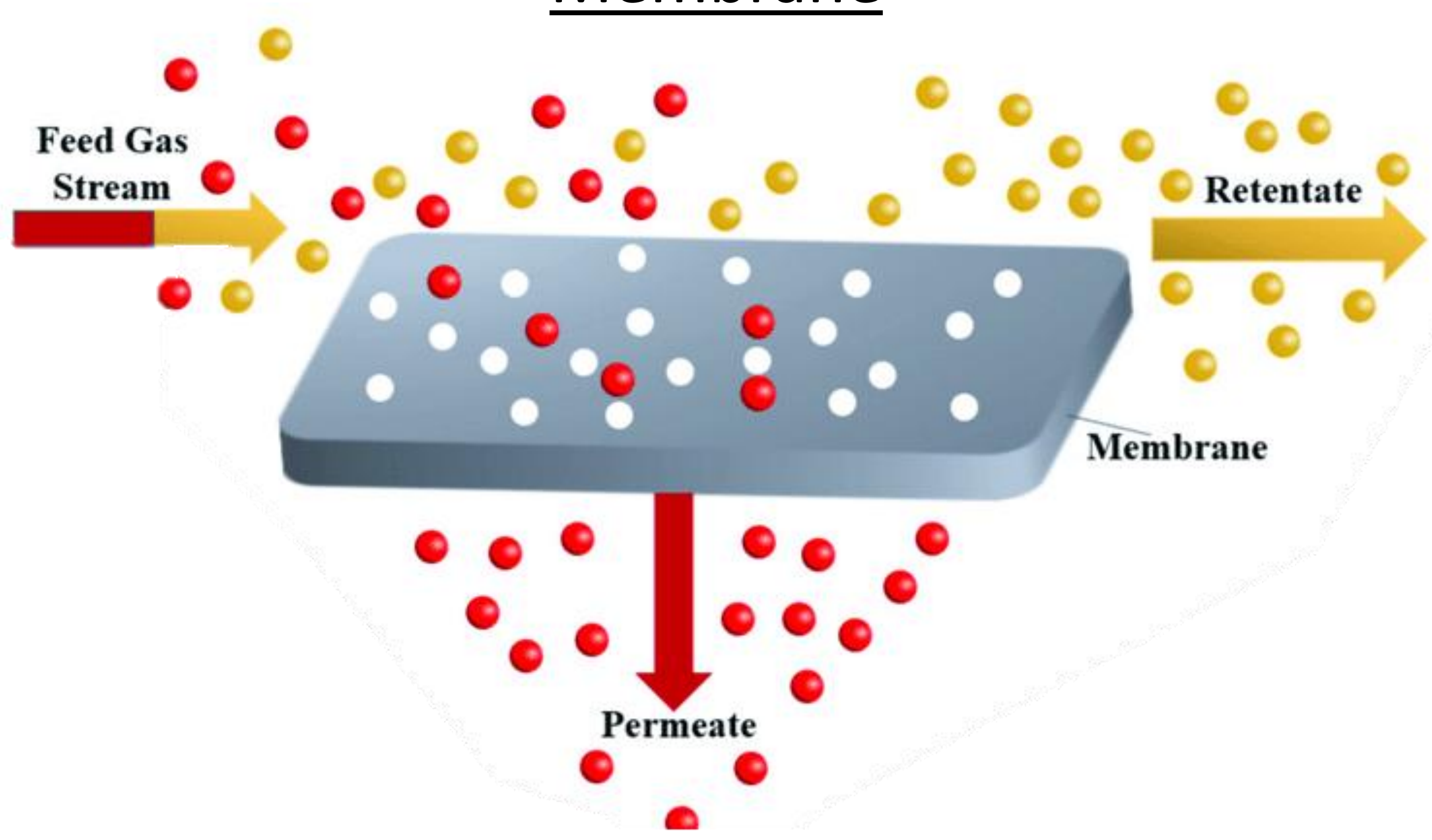
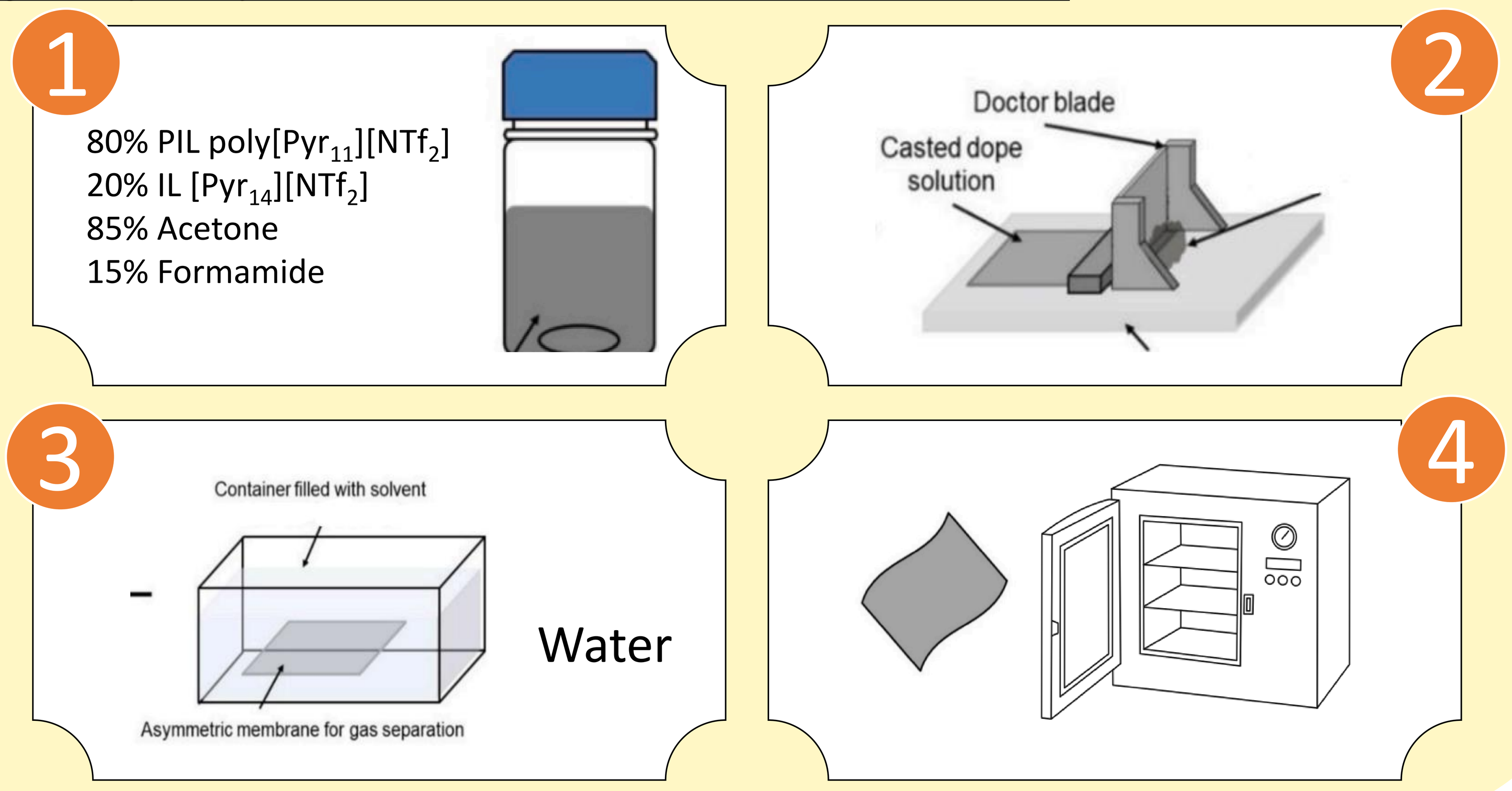
One of the most popular methods for creating **polymeric membranes** from a wide range of polymers is **non-solvent-induced phase separation (NIPS)**[1]. The creation of poly(ionic liquid) (PIL)-based membranes for **gas separation** applications has never been done using this technique. In order to create membranes with better **CO_2 separation**, the usage of PILs and the materials they are generated from that incorporate ionic liquids (PIL-IL) has emerged as a very promising method[2]. This study is a step towards the **preparation of integral asymmetric PIL-IL membranes**, with a top dense thin layer and a bottom porous layer, given that membrane thickness is a crucial characteristic for their industrial scale implementation.

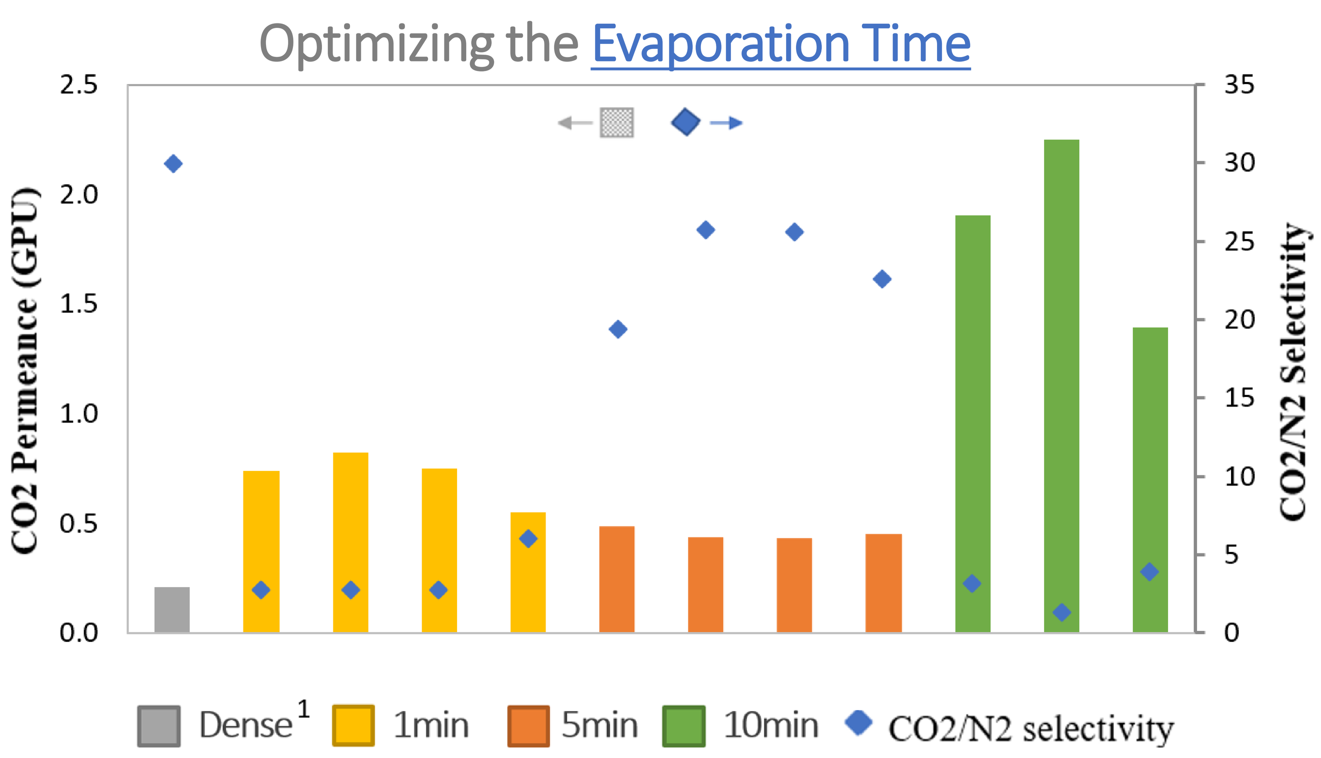
Membrane

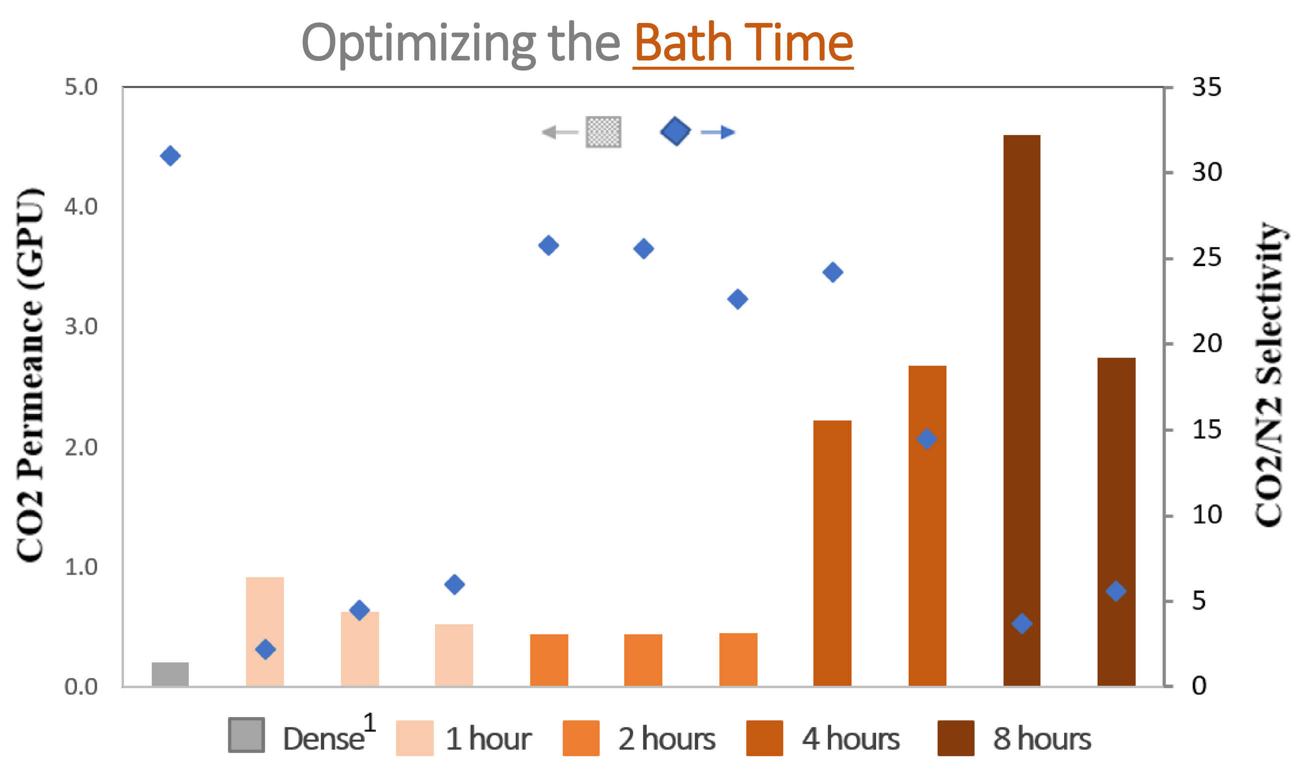


Phase inversion technique was used to create integrally asymmetric PIL-IL membranes.

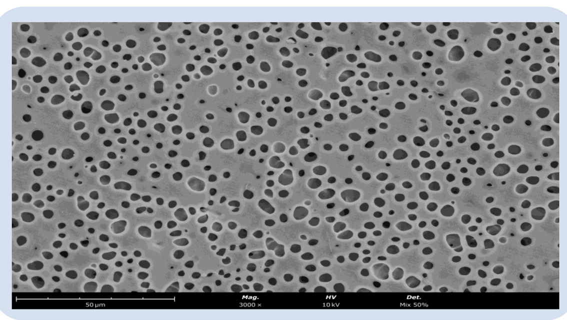
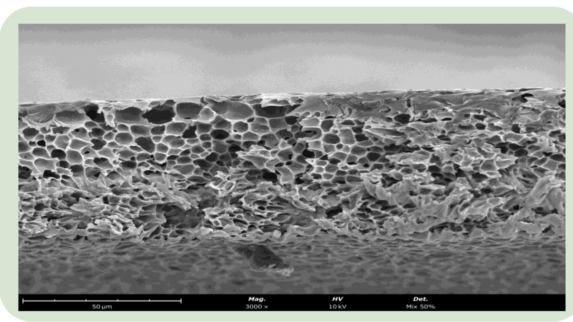
1. The critical optimum polymer concentration ((w/v)%) for acetone/formamide solvent mixtures was taken into consideration for preparing solutions of the synthesized poly([Pyr11][NTf2]) PIL and 20 wt% of [C4mpyr][NTf2] IL.
2. Then, to produce a consistent layer thickness, each PIL-IL solution was distributed on a glass plate at room temperature using a casting knife with a predetermined thickness of 300 m. Controllable solvent evaporation took place over a period of time that was tailored to each solvent mixture employed.
3. To guarantee complete mass coagulation, the solution was then placed in a non-solvent (water) coagulation bath for at different times.
4. In order to eliminate any remaining solvent, the resulting films were then peeled off the glass plate and baked in an oven at 40ºC for at least two days.







The CO_2 and N_2 permeances measured at T=20 ºC of some of the prepared membranes are displayed below, as well as those of the dense PIL–20 IL NTf_2 membrane for comparison. Two different variables were studied, evaporation time and bath time.

Most Promising Results	CO_2 Permeance	CO_2/N_2 Selectivity	Top Layer	Cross-Section
5 min Evap. 4 hours Bath	11-fold	0.8-fold		

References

[1] Kahrs, C.; Schwellenbach, J., Polymer 2020, 186, 122071.

[2] Gouveia, A. S. L. , Soares, B. and Marrucho, I. M. Ionic Liquid with Silyl Substituted Cation: Thermophysical and CO2/N2 Permeation Properties. Israel Journal of Chemistry 2019, 59, 852–865

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