Wolfson Department of Chemical Engineering Seminar

Wednesday, November 19th, 2025, at 13:00 (IL time)

Zoom: https://gtiit.zoom.us/j/97238573635?pwd=TUaNJj2iD8UAwnVtbfiLXyBg1Ek1F3.1

Capturing CO_2 by a Fixed-Site-Carrier Polyvinylamine-based Facilitated Transport Membrane

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PhD final seminar

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Faced with mounting global concerns over climate change driven by greenhouse gas emissions, the Paris Agreement has established international commitments for CO_2 capture and removal from emission streams prior to atmospheric release. This has accelerated the development of cost-effective carbon capture technologies, among which membrane-based gas separation has emerged as a leading candidate, transitioning steadily from laboratory research toward industrial-scale application. Facilitated transport membranes (FTMs) function with selective and reversible carriers-CO_2 reactions can break the Robenson upper bond limit, showing high-performing gas separation. In this study, PVAm with tailored molecular weights and degrees of hydrolysis (DOH) was synthesized via inverse emulsion polymerization (IEP) and acid hydrolysis. FTMs with ultraselective layers were prepared with the amine-rich polyvinylamine (PVAm) as fixed-site carriers, amino acid salts (AAs) and ionic liquids (ILs) as mobile carriers, nanofillers and covalent organic framework as auxiliary agents. Simultaneously, the crystallization of polymer, steric hindrance as well as CO_2-philic ethylene oxide groups effects on gas separation performance were systemically investigated. Moreover, molecular dynamics (MD) simulations further revealed the synergistic interplay between the facilitated transport of amine groups and the molecular sieving and high adsorption capacity of COF-JLU2. By strategically engineering molecular structures and modulating FFV, the selectivity of PVAm-based FTMs was significantly enhanced, demonstrating a promising and scalable pathway toward CO_2-ultraselective membranes for flue gas carbon capture.