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

Wednesday, June 11th, 2025 at 17:30 (China Time)/12:30 (Israel Time)

https://gtiit.zoom.us/j/95463226139

Development of nanocomposite gas separation membranes based on polymers of intrinsic microporosity (PIMs)

Ziyi Yuan

PhD Final Seminar

Advisor: Prof. Viatcheslav Freger; Prof. Xuezhong He
Department of Chemical Engineering, Technion-Israel Institute for Technology

Global environmental problems induced by huge amounts of CO_2 emissions have attracted increasing attention. Membrane separation has been investigated as a promising strategy for carbon capture and storage (CCS) due to its properties of small footprint, environmentally friendly, high efficiency, and low cost, which shows the potential for upscaling. Polymers of intrinsic microporosity (PIMs) are attractive in gas separation for their high fractional free volume, while the relatively unsatisfactory selectivity cannot be ignored. The molecular imprinting technique (MIT) is a versatile approach to introducing three-dimensional holes into polymer matrixes, which contain specific recognition sites for the templates. This work employed MIT to prepare a molecular imprinting polymer containing rich CO_2 adsorption sites for fabricating PIM-1-based CO_2 separation mixed matrix membranes (MMMs). The obtained MMM enhanced CO_2 permeability from 6000 to 10000 barrer. In the next step, the UiO-66-NH_2 was introduced as the core for surface molecular imprinting. With the imprinted UiO-66-NH2 as filler, the obtained MMMs showed good CO_2/N_2 separation performance with CO_2 permeability of over 12,000 barrer and CO_2/N_2 selectivity of about 32, which is beyond the 2019 Robinson upper bound. To further enhance the membrane selectivity, thermal-treated amidoxime-modified PIM-1 (AOPIM-1) was used as the polymer matrix instead of PIM-1. Though a certain sacrifice in permeability was observed, the CO_2/N_2 selectivity improved significantly, demonstrating that thermal crosslinking effectively optimizes the membrane's pore structure.