THE UNIVERSITY OF HONG KONG

DEPARTMENT OF CIVIL ENGINEERING

SEMINAR

Mechanochemistry Enabled Polymer of Intrinsic Microporosity for pH-Responsive Adsorptive Membrane

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Time: 2:00 p.m. – 3:00 p.m.
Venue: Room 612B, 6/F Haking Wong Building, The University of Hong Kong

ABSTRACT

Membrane separation plays a critical role in achieving net zero. Current membrane fabrication replies on large volumes of toxic solvents and fossil-fuel derived polymers using wet chemistry, ultimately eroding the advantages of membrane technology.

We proposed a mechanochemistry method for sustainable manufacture of polymer of intrinsic microporosity (PIM) where polymer synthesis was expedited in an environmentally friendly, solvent-free approach. PIMs have been highlighted as an ideal polymer for membrane to break permeability/selectivity trade off, due to their high specific surface area, interconnected free volume elements, structural diversity, and flexible processibility. We conducted a comprehensive Life Cycle Assessment (LCA) to compare and simulate the environmental impacts of both wet chemical and mechanosynthesis methods for PIM production. Our findings indicated the successful qualitative synthesis of PIM-1 through mechanochemistry, resulting in a notable reduction of environmental impacts, approximately 1.5 times less compared to the conventional wet chemical synthesis route. This advancement holds great promise for advancing sustainable and eco-friendly polymer synthesis.

Using the mechano-synthesised PIM, we further designed and fabricated a novel pH-responsive amidoxime modified (AOPIM) membrane for selective separation of charged dyes under varying pH conditions. The membrane was fabricated using non-solvent induced phase separation method with ethanol as the non-solvent. Utilizing the amidoxime group as the selective affinity site, the AOPIM membrane manifested charge reversals, enabling high adsorption capacity, notably with methylene blue (MB) uptake reaching 444.2 mg g^{-1}. In dye filtration, it achieved substantial separation efficiencies for both anionic (IC: 94.7 L $m^{-2}h^{-1}bar^{-1}$; 80% rejection) and cationic dyes (MB: 94.9 L $m^{-2}h^{-1}bar^{-1}$; 99% rejection). Furthermore, the AOPIM membrane also possesses high separation selectivity for cationic dye in dual dye mixture at high pH environment. Results reported here underscored the unique pH-responsive property of the AOPIM membrane, shedding light on the application of adsorptive membranes for pollution removal and wider environmental applications.

ABOUT THE SPEAKER

Dr Ming Xie is a Lecturer of Chemical and Environmental Engineering at University of Bath and an Industrial Fellow by the Royal Academy of Engineering. His research focuses on membrane-based technologies at the food-water-energy nexus. Dr Xie was the recipient of the Australia Cheung Kong Endeavour Award in 2018. Dr Xie has published more than 70 peer-reviewed articles in leading journals, such as, Nature Reviews Earth & Environment, Nature Water, Nature Communication, Environmental Science and Technology, and Water Research. His research attracted more than £15M research funding from Engineering and Physical Sciences Research Council, Royal Society of Chemistry, Royal Society, British Council and Leverhulme Trust. He also serves in the Technical Advisory Committee for IChemE Sustainability Hub.

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