

FROM SEPARATION TO RECOGNITION THROUGH NANOCONFINEMENT: PRECISION NANOCHANNEL MEMBRANES

Speaker

Prof. Xiwang Zhang

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Abstract

Selective separation of ions and molecules with similar size, charge, and physicochemical properties remains a grand challenge in membrane science. Membranes inherently create confined environments through nanopores, sub-nanometre channels, and the intrinsic free volume of dense polymers. Within these confined spaces, the physicochemical properties of solvents and solutes—including hydration, hydrogen bonding, dielectric response, diffusion, and molecular interactions—can differ substantially from those in bulk environments. These confinement-induced effects provide new opportunities for molecular recognition and precision transport. This talk will first discuss nanoconfinement as a defining feature of membrane systems and examine how confinement reshapes molecular behaviour. And then highlight how advanced membrane materials provide well-defined platforms for understanding confinement-induced molecular interactions. Particular emphasis will be placed on the evolution from static interactions, toward dynamic interactions involving hydration, desolvation, and transient molecular recognition within nanochannels.

Biography

Prof. Xiwang Zhang is the Endowed Dow Chair in Sustainable Engineering Innovation at the University of Queensland, Director of UQ Dow Centre, and Director of ARC Centre of Excellence for Electrochemical Transformation of Carbon Dioxide (GetCO₂). He was the Founding Director of ARC Industry Transformation Research Hub for Energy-efficient Separation (EESep) and the Deputy Director of Monash Centre for Membrane Innovation (MCMI) at Monash University before he moved to UQ in early 2022. Prof. Zhang has more than 15 years of R&D experience in both academia and industry with demonstrated achievements in technology development and translation. His research focuses on membrane and advanced oxidation technologies for energy-efficient separation, resource recovery, green chemical synthesis, carbon dioxide conversion and renewable energy generation. Prof. Zhang was the recipient of the prestigious ARC Australian Research Fellowship, Future Fellowship and Monash Larkins Fellowship. In 2024, he was elected as a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE).



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