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Tailoring compatibility in ultrapermeable polymer blends to switch off plasticization and physical ageing

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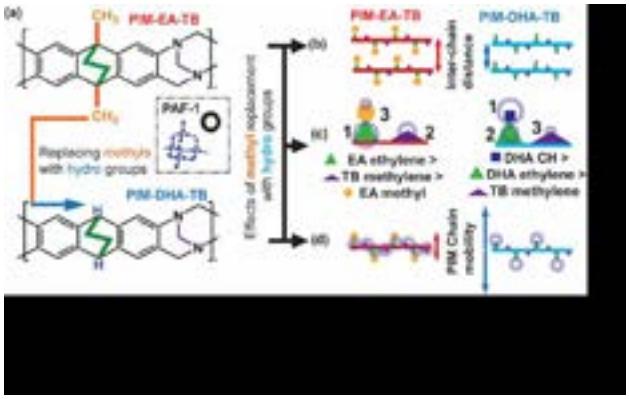
Despite the rapid evolution of material science, it remains difficult to deploy new polymers that are inadequate to meet the stringent demands of industrial membrane separations. Polymer membranes must be ultrapermeable, selective, and resistant to both physical aging, and plasticization. Polymers with intrinsic microporosity (PIMs) are ultrapermeable, yet vulnerable to physical aging and plasticization. Here we show that aging and plasticization in PIMs can be switched on and off through compatibility with a microporous polymer, porous aromatic frameworks (PAFs). By replacing bulky methyl groups with smaller hydro groups, we remove the ability of a PIM polymer matrix to interact with PAFs; accelerating both physical aging and plasticization. Meanwhile PAFs tailors physical aging and annihilates plasticization in the original methylated PIM via physical interactions at specific locations on the PIM polymer chains. This benefits hydrogen recovery at realistic operating conditions; enabling the implementation of polymer membranes as a stand-alone separation technology, a paradigm shift from existing hybrid methods.



Biography

Dr. Cher Hon (Sam) Lau is a Chancellor's Fellow at the University of Edinburgh. His current research focuses on the scale-up production of microporous materials that are compatible with various polymer matrices, and polymer membranes for liquid separations. Prior his appointment at UoE, he spent 5 years at the Commonwealth Scientific Industrial Research Organisation (CSIRO), Australia as a post-doctoral fellow, subsequently as a research scientist. At CSIRO, he discovered the world's first anti-aging membranes for gas separations and solvent purifications. His anti-aging membrane research is also the cornerstone of membrane research and commercialization efforts in CSIRO. He also co-led several industrial projects working on gas separation and capture using porous frameworks, scale-up production of porous nanoparticles, and membrane separations. He received his Ph. D. degree from the Chemical Engineering department at the National University of Singapore in 2012. He has published more than 20 papers and 4 patents on membrane science and technology in high impact journals.

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