

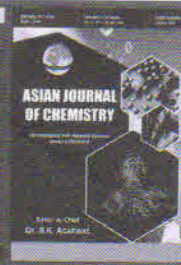


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MINI REVIEW

Emerging Approaches in Membrane Preparation from Phase Separation to 3D Printing

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Membrane technologies are receiving increasing attention as effective solutions to global challenges such as water treatment, energy efficiency and environmental protection. This mini-review summarizes advances in polymeric materials and membrane fabrication methods. A wide variety of polymeric and non-polymeric materials, ranging from natural clays to synthetic polymers like polysulfone, are used to fabricate membranes for applications including reverse osmosis and ceramic separations. Fabrication techniques such as non-solvent induced phase separation (NIPS), thermally induced phase separation (TIPS), vapour-induced phase separation (VIPS), and liquid-induced phase separation (LIPS) enable the production of microporous membranes, while electrospinning is employed to create ultrathin fibrous structures. In addition, emerging 3D printing technologies allow precise control over membrane architecture, including pore size and porosity, supporting the development of next-generation membrane systems.

Keywords: Membranes, Materials, Phase separation, Electrospinning, 3D Printing technology.