Supporting Information

Hollow fibers with encapsulated ionic liquid for gas dehydration

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Synthesis of amino acid-based ionic liquid

Tetrabutylammonium L-prolinate, [$N_{4,4,4,4}$][L-Pro], was produced via a straightforward neutralization procedure, as outlined by Allen et al. [74] and Santis et al. [75] nitially, an aqueous solution of l-proline was mixed with [$N_{4,4,4,4}$][OH] (1 equivalent, 40 wt% in water) in a 1.1 equivalent ratio at ambient temperature. Following a 2 hour stirring period, the resultant ionic liquid was separated from water by applying pressure. The remaining material was dissolved in acetonitrile, filtered twice to remove excess amino acid, and subsequently concentrated under reduced pressure. The compound underwent a moderate temperature treatment to ensure complete dryness while subjected to a high vacuum for at least 48 hours. The water mass fraction of the ionic liquid was determined via coulometric Karl Fischer titration and found to be below 0.05 wt%. The purity of the compound, exceeding 99%, was confirmed through ^{1}H and ^{13}C NMR spectroscopic analysis [56].

Encapsulation of amino acid-based ionic liquid

The synthesis of the carbon sub-micro capsules consisted of three primary stages: silica template preparation, carbon capsule formation, and washing [51, 76]. Initially, a silica template was fabricated with a dual-layer structure comprising a dense inner core and a porous outer shell. Subsequently, the template undergoes functionalization with aluminium and was calcined to yield carbon capsules. Paraformaldehyde resin was introduced into the solution to seal the capsules, followed by pyrolysis. In the washing phase, a 48% v/v hydrofluoric acid solution was employed to eliminate any residual silica template. The resultant compound was washed with water and dried in an oven for 48 hours. The amino acid-based ionic liquid was dissolved in either ethanol or methanol to lower its viscosity and carefully applied onto the carbon capsules to encapsulate the compound. Gradual vacuuming was employed to remove the solvent. In this study, elemental

analysis revealed that approximately 67% w/w of the amino acid-based ionic liquid was incorporated.

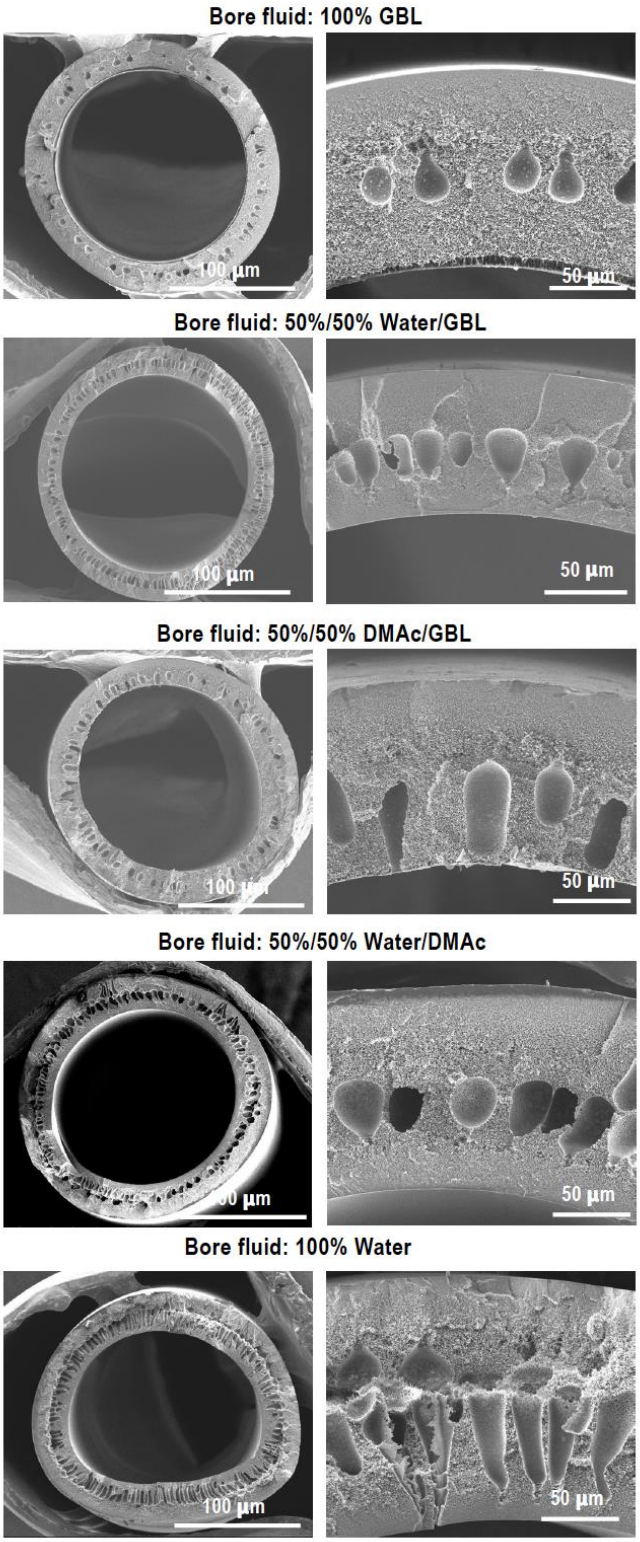

Figure S1. Cross-sectional morphologies of hollow fibers spun with different bore fluid compositions.

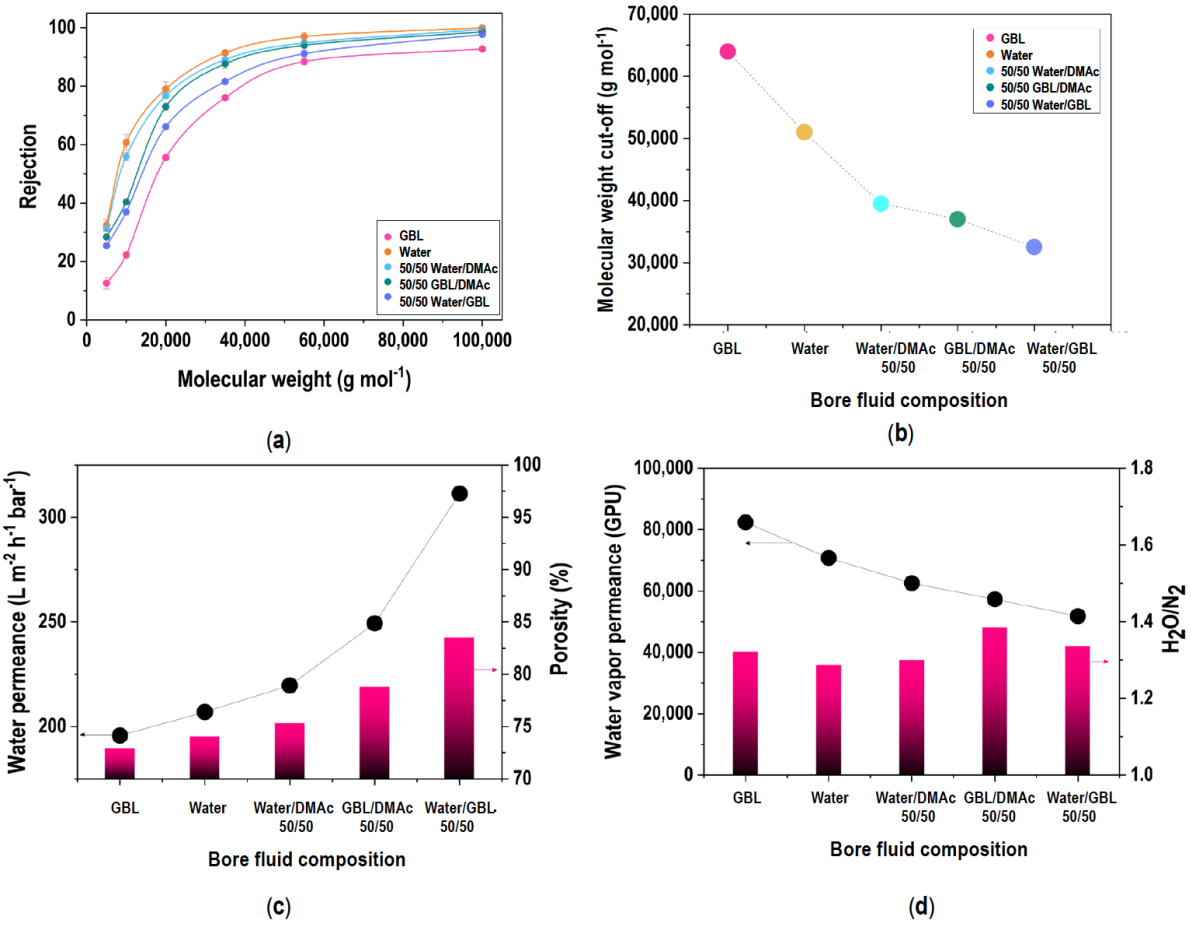

Figure S2. Uncoated hollow fiber characterization. (a) Solute rejection; (b) Molecular weight cut-off (MWCO); (c) Water permeance and porosity; (d) Water vapor permeance and H_2O/N_2 selectivity for polyetherimide support spun with different bore fluids.