Separation of VOCS from Water using Fluorinated Polyimide Membranes

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INTRODUCTION

Fluorinated polymers have potential as ideal materials for pervaporation separation of the VOCs from water because of their unique hydrophobic characteristic or low surface energy[1,2]. In this study, two polyimides with fluorinated side groups and two polyimides without fluorinated side groups were prepared by polycondensation of 2-(perfluorohexyl)ethyl-3, 5-diamino benzoate (PFDAB) and *m*-PDA with four aromatic dianhydrides. The fluorinated diamine, PFDAB was synthesized through Scheme 1. The incorporation effects of fluorinated groups into the polyimides on their physical properties were investigated in terms of membrane materials. The effects of fluorinated side groups on sorption/preferential sorption and pervaporation properties were investigated in connection with the nature of aqueous organic solutions. The effects of operation conditions on pervaporation properties were also investigated with a polyimide membrane with fluorinated side group.

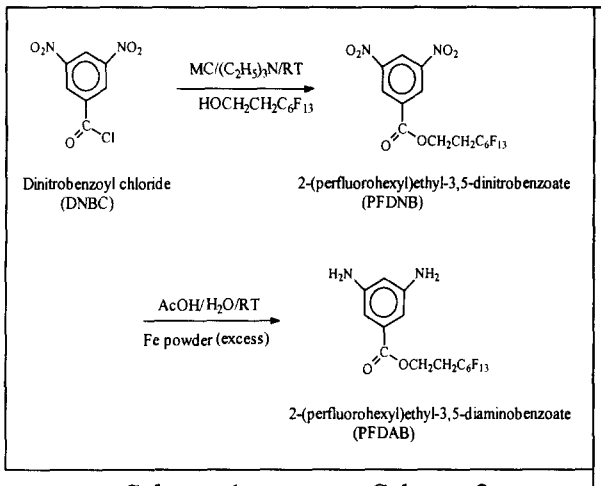
EXPERIMENTAL

Synthesis and Characterization of Monomer and Polymer Membranes

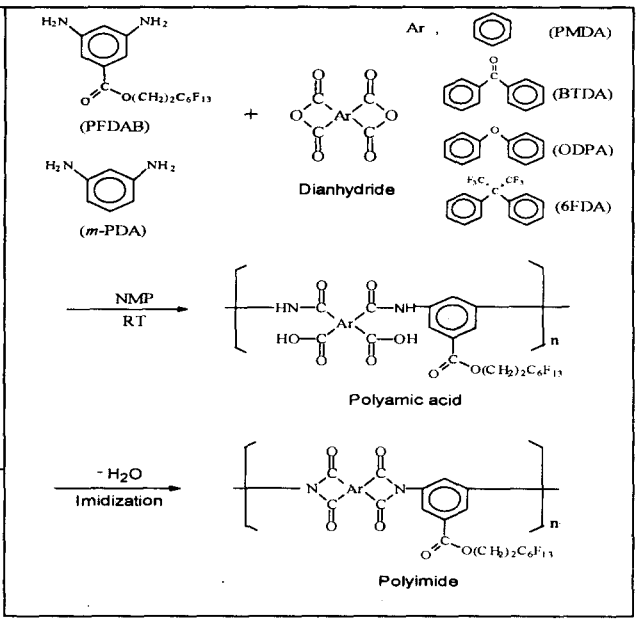
The synthetic route of PFDAB is outlined in Scheme 1. Chemical structures of the monomers and the synthetic route of the fluorinated and non-fluorinated polyimides are shown in Scheme 2. The fractional free volume, surface free energy and solubility parameter of the polyimides were measured.

Preferential Sorption and Pervaporation Tests

Organic solvents used were isopropyl alcohol(IPA), acetic acid(AA), acetone(AC), methylethyl ketone(MEK), ethyl acetate(EA), methylene dichloride(MC), trichloroethylene (TCE), toluene(TOL) and hexane(HX). Degree of sorption of mixed solvents Φ_m, and sorption selectivity $\alpha^S_{O/W}$ were measured by a sorption test apparatus. Total permeate flux J and pervaporation selectivity $\alpha^P_{O/W}$ were measured with the pervaporation apparatus



Scheme 1.



Scheme 2. =>

RESULTS AND DISCUSSION

Pervaporation Properties

Pervaporation selectivities and permeation flux of these membranes are shown in Figs. 1 and 2. The 6FDA-PFDAB and ODPA-PFDAB membranes show higher pervaporation selectivity and permeation flux than the 6FDA-m-PDA and ODPA-m-PDA membranes toward more hydrophobic solvents. The enhanced pervaporation properties of two membranes are explained in terms of their enhanced FFVs and sorption selectivities due to introduction of hydrophobic fluorinated side groups.

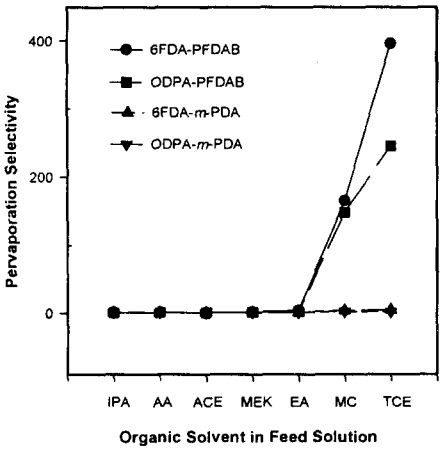


Fig. 3. Pervaporation Selectivity.

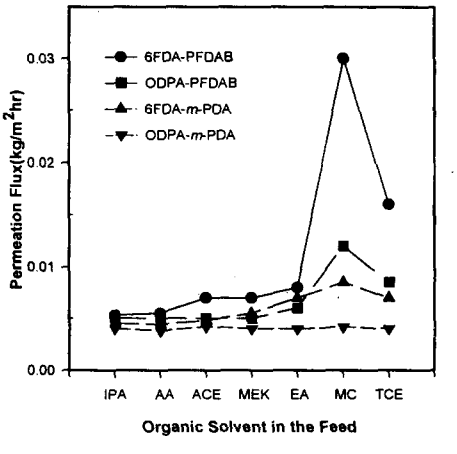


Fig. 4. Permeation Flux.

References

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