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CO_2 separation performances of composite membranes of 6FDA-based polyimides with a polar group

Kwang-Je Kim [a], Sang-Hee Park [a], Won-Wook So [a], Dong-June Ahn [b], Sang-Jin Moon [a,*]

[a] *Advanced Chemical Technology Division, Korea Research Institute of Chemical Technology, P.O. Box 107, Yusong, Daejon 305-600, South Korea*

[b] *Department of Chemical Engineering, Korea University, 5 Anam-dong, Sungbuk-gu, Seoul 136-701, South Korea*

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Abstract

2,2-bis(3,4-Dicarboxyphenyl) hexafluoropropane dianhydride (6FDA)–based polyimides with a polar group of hydroxyl or carboxyl such as 6FDA–BAPAF, 6FDA–DAP, and 6FDA–DABA were synthesized by the thermal imidization method. The corresponding composite membranes were then prepared by the dip-coating technique using a poly (ether sulfone) (PES) membrane as a supporting layer. Some alcohols and glycol ethers were used as coating solvents during the membrane preparation. The solubility of the polyimides synthesized in this study in these solvents depended on the nature of polymers and solvents. CO_2 permeances for these composite membranes were measured in comparison with those for other gases such as H_2, O_2, N_2, and CH_4. The membrane performances were affected considerably by the preparation conditions such as the kinds of diamine moiety, coating solvent, and coating polymer concentration. It was expected that these composite membranes could be applied usefully to the CO_2 separation, considering the CO_2 permeances in the range of 20–38 gas permeation unit (GPU) and the selectivities for CO_2/N_2 and CO_2/CH_4 equal to or even higher than those of other dense or asymmetric membranes of 6FDA-based polyimides reported in the literature.

Keywords: Gas separation; Composite membrane; 6FDA-based polyimide; Dip-coating method

1. Introduction

In general, two kinds of membranes, i.e. an asymmetric and a composite membrane are employed to achieve higher flux in gas separation processing. These membranes require the selective membrane layer to be as thin as possible to get economical fluxes. However, since it is generally difficult to make thin composite membranes with glassy selective layers, the multi-layer composite membrane is formed by overcoating a microporous support membrane with a thin layer of selective polymer, which is a different material from the support layer. Additional layers of very permeable materials such as silicone rubber are also applied to protect the selective layer and to seal any defects [1].

It has been reported that polyimides with 2,2-bis(3,4-dicarboxyphenyl) hexafluoropropane dianhydride (6FDA) exhibit both higher selectivity and permeability for gas separation compared to common polymers [2,3]. 6FDA-based polyimide membranes for gas separation have been mainly studied with

* Corresponding author. Tel.: +82-42-860-7517; fax: +82-42-860-7590.
E-mail address: moonsj@krict.re.kr (S.-J. Moon).

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