일반강연 I-7

CO_2분리용 Pore-filled 막의 제조 및 투과성능

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Selective permeation of CO_2 through Pore-filled type membrane and its performances

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1. Introduction

Membrane suited for gas separation should exhibit a high permeability and a high separation capability. Both properties can be combined in composite membranes consisting of a high permeable supporting membrane coated with a thin and highly selective separation layer [1,2]. Recently, however, the 'pore filling' concept for pervaporation was proposed for the first time by Yamaguchi and Nakao and was quite successful [3]. We used the pore-filling concept in CO_2 separation. The membrane is composed of two kinds of polymer materials: the porous substrate and the filling polymer which fills the pore of the substrate. A porous polyacrylonitrile(PAN) membranes for UF used as a substrate and acrylate monomers were used as a photoinitiated graft polymer, respectively. The solubility selectivity of the filling polymers causes the permselectivity while the substrate matrix offer the mechanical strength of whole membrane. In the present study, the permeation properties of the filling-type membranes were confirmed by varying monomer concentration.

2. Experimental

Solutions of the photoinitiator (Irgacure 907, 2-methly-1-[4-(methlythio)phenyl]-2-morpholinopropan-1-one), acylate monomers and 2-propanol(IPA) were prepared. After the solutions were completely mixed, they were bubbled for 30 minutes with nitrogen. Then a PAN UF membrane was fully soaked with the IPA solutions of monomer and photoinitiator and nipped to tight this solution. Graft polymerizaion was carried out using a 450 watt UV lamp (Ace Glass Co.) at a distance of 10 cm for 30 min. After the graft membrane was dried for one day, it was rinsed overnight in ethanol to remove the nonreacted monomer and homopolymer and dried again at 50℃.

The permeation experiments were carried out with high presure and time lag methods.

3. Results and discussion

There are lots of method to make a composite membrane for gas separation such as coating, vapor deposition and interfacial polymerization. We tried to make a composite membrane using these method, but did not achieve successful results because the selectivity was too low. In this study, however, we used a new concept, called the filling-polymerized membrane, and found it was very successful.

This pore-filling membrane showed very high CO_2/N_2 separation, for example permeability coefficient of CO_2, P_{CO2} = 7 GPU and permeability ratio of CO_2 over N_2, P_{CO2}/P_{N2}=31 at 30℃. This permselectivity is attributed to high solubility selectivity due to the affinity of CO2 to acrylates. Upon lowering the temperature, P_{CO2} decreases but P_{CO2}/P_{N2} does not change significantly.

4. References

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2. W. Pusch, A et al., Chem. Int. Ed., 21 (1982) 660
3. T. Yamaguchi et al., Macromolecules, 24(1991) 5522