일반강연 I -5

The Correlation between Gas Transport Properties and Physical Properties of Modified Polysulfones

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변형 폴리술폰의 기체 투과 성질과 물리적 성질의 상관관계

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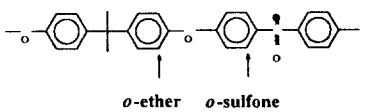
1. Introduction

Gas transport through dense polymeric membranes is predominantly determined by the chain packing density as well as the chain flexibility. Thus, improved permeation properties can be obtained by controlling these two factors.

In this work, the introduction of bulky substituents was attempted to improve permeation properties. Polysulfone, widely used material for gas separation membrane, was the starting material of this modification.
Gas transport properties of resulting modified polysulfones were examined, and the improved properties were explained by probing the change of physical properties.

2. Results and Discussion

The chemical structure and the substitution sites of polysulfone are illustrated.



The permeation properties and chemical structures of modified polysulfones are listed in table 1.

The effects of substituents are clearly shown in *ortho*-ether substituted cases. Bulky trimethylsilyl side groups (DS=2.0) substituted on the

ortho-ether sites resulted in a more than six times increase in O_2 permeability, whereas the O_2/N_2 selectivity decreased only marginally from 5.8 to 5.3. However, the O_2 permeability decreased unexpectedly by replacing the methyl group with bulkier phenyl group, having moderately higher selectivity and similar permeability to the unmodified polymer.

The reason of these results was identified in terms of free volume which is known as the passage for gas molecule transportation. Wide angle x-ray scattering (WAXS) and dynamic mechanical thermal analysis (DMTA) were utilized to estimate free volume.

Table 1. Properties of Modified Polysulfones

Substitution Site	*ortho*-ether			*ortho*-sulfone			unmodified polysulfone
Substituent	$Si(CH_3)_3$	$Si(CH_3)_2Ph$	$Si(CH_3)Ph_2$	$Si(CH_3)_3$	$Si(CH_3)_3$	$Si(CH_3)Ph_2$	
DS	2.0	1.9	1.3	1.0	2.0	0.5	0
P_{O_2}	7.1	1.4	1.0	2.2	4.2	1.1	1.1
P_{O_2}/P_{N_2}	5.3	5.9	6.5	5.7	5.4	6.4	5.8

(remarks) DS: degree of substitution per repeating unit,
P_{O_2}: oxygen permeability in Barrer unit