포스터 발표 P-13

폴리이미드실록산/PVP 블렌드로부터 제조한 고투과성 탄소-실리카/알루미나 복합막의 제조 및 특성

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Preparation and Characterization of High Permeable C-SiO_2/alumina Composite Membrane Derived from Poly(imide siloxane)/PVP Blend Membranes

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1. Introduction

Carbon molecular sieve membranes (CMSM) have been attracted owing to their superior gas separation properties. The gas separation performances of CMSM can be controlled by changing the precursors and pyrolysis conditions (pyrolysis temperature, heating rate, pyrolysis atmosphere). In the previous study, we have prepared high permeable C-SiO_2 membranes derived from poly(imide siloxane) (PIS)/polyvinyl pyrrolidone (PVP) using polymer-blending method and looked into their gas separation properties. In this study, we have fabricated composite type C-SiO_2 membranes using previously prepared membranes and will discuss the gas separation performance of their composite membranes.

2. Experimental

The chemical structure of poly(imide siloxane) (Si-PI) synthesized in this study is illustrated in Fig. 1. Polyvinylpyrrolidone (PVP, MW 10,000) was used as into pore forming agent. The thermal labile polymer, PVP (2 and 5% by weight) was added to Si-poly(amic acid) solution, respectively. Then, from their solution, we prepared the composite membranes through dip-coating in alumina tube support. In this process, the control of the dip-coating time and the speed to extract the alumina tube in the polymer solution is very important to coat the surface of alumina with the viscous polymer solution. Also, dip-coated composite membranes are heat-treated with suitable conditions. Fig. 2 is composite membranes treated with heat.

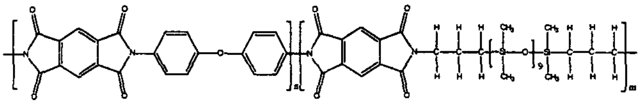


Figure 1. The structure of Si-polyimide

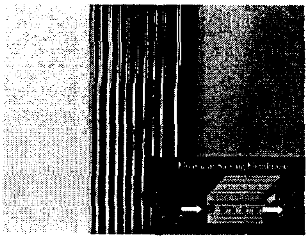


Figure 2. Composite membrane treated with heat

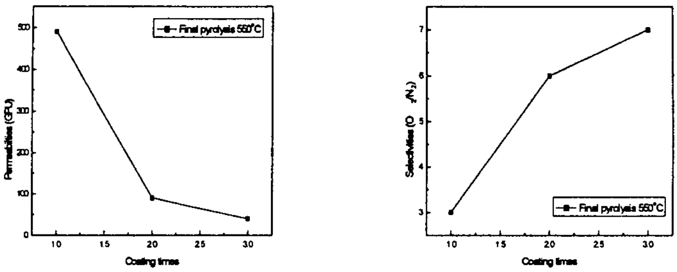
3. Results and Discussion

Fig. 3 is of scanning electron microscope imiges (SEM) of surface of the C-SiO_2 composite membranes. The thickness of coating layer is about 1-3μm.

(a) (b) (c)

Fig. 3. (a) coated surface and (b) support surface and (c) cross section of membrane of composite membranes

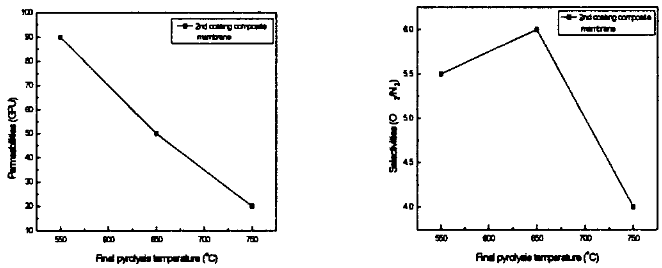
The gas permeation properties through the pyrolized composite membranes were investigated at 25 °C for single gas molecules [O_2 (3.46 Å)].



(a) (b)

Fig. 4. (a) Gas permeabilities (GPU) and (b) selectivities of C-SiO_2 composite membranes pyrolyzed at 550 °C as a function of the times of dip-coating.

As shown in Fig. 4, the C-SiO_2 compostie membranes derived from Si-PI/PVP showed that the gas permeabilities decreased with the times of dip-coating and their selectivities showed tradeoff relations. Fig. 4 shows the gas permeabilities and selectivities of CMS composite membranes pyrolyzed with different pyrolysis temperatures (550, 650, and 750 °C). As a result, their permeabilities and selectivities significantly affected by the times of dip-coating and the pyrolysis temperature. Among them, CMS membranes pyrolyzed at 550 °C showed the highest permeabilities.



(a) (b)

Fig. 3. (a) Gas permeabilities and (b) selectivities of C-SiO_2 compostie membranes derived from Si-PI/PVP as a function of pyrolysis temperature

4. Conclusions

To develop the gas separation performances of composite membrane, we need much effort because of various conditions such as heat treatment temperature and time, coating layer, heat rate and so on. In this study, from pyrolysis temperature and coating layer standpoint, we prepared and investigated the C-SiO_2 composite membrane through the dip-coating alumina support in C-SiO_2 polymer solution that PVP added by polymer-blending method. The gas permeabilities of C-SiO_2 composite membranes were decreased with coated times but selectivities is increased. Equally, the gas permeabilities is decreased with final pyrolysis temperature rising. Consequently, the C-SiO_2 composite membranes pyrolyzed at 550 °C and coated two times showed O_2 permeability of 90 GPU [10^{-6} $cm^3(STP)/cm^2 \cdot s \cdot cmHg$] and the O_2/N_2 selectivity of 5.5.

Acknowledgement

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