포스터 발표 P-17

폴리 이미드 실록산과 PVP 혼합물로부터 유도된 고 투과성 C-SiO2 막의 개발

이 지 민, 김연국, 박호범, 이영무*
국가 지정 분리막 연구실, 한양대학교 응용화학공학부, 서울 133-791, 한국

Development of high permeable C-SiO_2 membranes derived from poly (imide siloxane) / PVP blends

Ji Min Lee, Youn Kook Kim, Ho Bum Park, Young Moo Lee*

National Research Laboratory for Membranes, School of Chemical Engineering, College of Engineering, Hanyang University, Seoul 133-791, Korea

1.Iroduction

Carbon molecular sieve (CMS) membranes have superior gas permeation and separation performance compared with polymeric membranes[1-3]. Up to now, CMS membranes mostly have been mostly focused on the kinds of precursor and pyrolysis condition (pyrolysis temperature, heating rate, pyrolysis atmosphere). In this study, we prepared high permeable C-SiO_2 membranes derived from Si-polyimide/polyvinylpyrrolidone using polymer-blending method, and we will discuss the gas separation properties of the flat of composite type C-SiO_2 membranes.

2. Experimental Section

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.

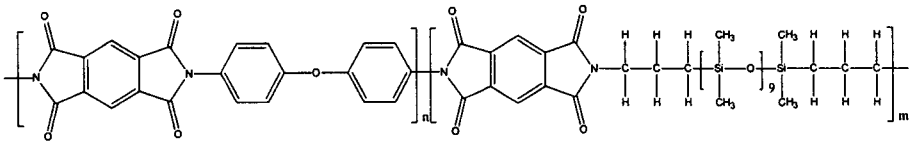
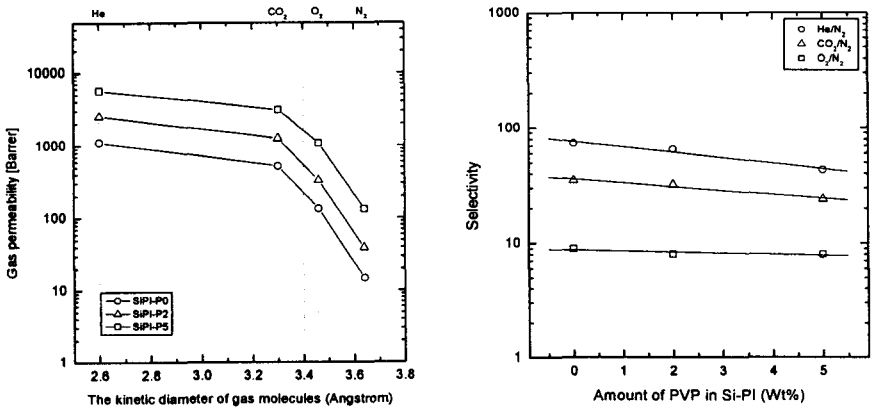


Fig 1. The structure of Si-polyimide

3. Results and Discussion

The Si-PI/PVP has distinguished thermal decomposition steps. The first decomposition was observed around 400-450 °C due to the thermal exclusion of PVP. The second decomposition began at 500 °C by the cleavage of imide ring in the siloxane domain. Finally, the degradation of imide ring was observed at 550 °C.

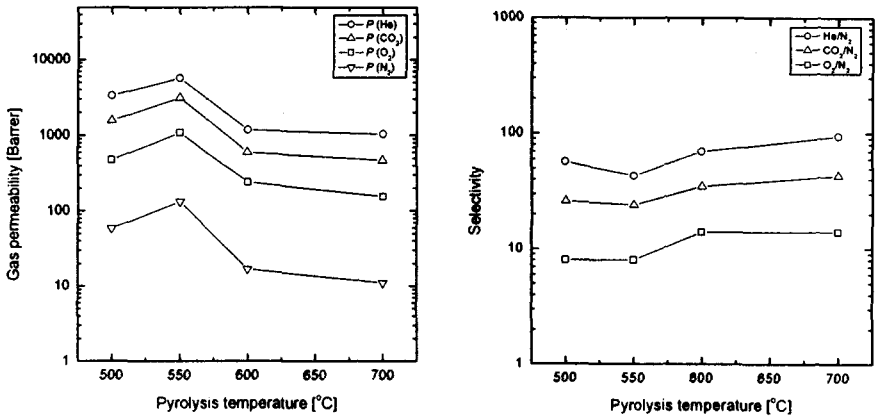
The gas permeation properties through the CMS membranes were investigated at 25 °C for single gas molecules [He (2.6 Å), CO_2 (3.3 Å), O_2 (3.46 Å), and N_2 (3.64 Å)].



(a) (b)

Fig. 2. (a)Gas permeabilities and (b)selectivities of C-SiO_2 membranes pyrolyzed at 550 °C as a function of the amount of PVP in Si-PI

As shown in Fig. 2, the C-SiO_2 membranes derived from Si-PI/PVP showed that the gas permeabilities increased with the amount of PVP and their selectivities showed tradeoff relations. Fig. 3 shows the gas permeabilities and selectivities of CMS membranes pyrolyzed with different pyrolysis temperatures (500, 550, 600, and 700 °C). As a result, their permeabilities and selectivities significantly affected by 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 membranes derived from Si-PI/PVP as a function of pyrolysis temperature

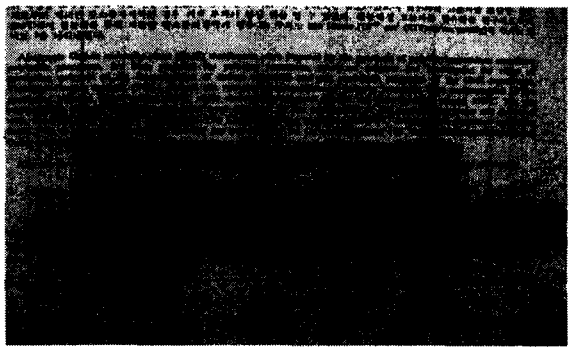


Fig 4. Dip-coated alumina tube and the pyrolyzed composite membrane.

Fig 4 show the dip-coated alumina tube. and the pyrolyzed composit membrane at 550 °C. Above all, to control the dip-coating time and speed to extract the alumina tube in the polymer solution is important to coat the alumina with the polymer solution.

4. Conclusions

By the polymer-blending method, the gas permeabilities of C-SiO_2 membranes were improved because the thermal labile polymer acted as a pore forming agent during the pyrolysis. Up to now, the gas permeabilities and selectivities of CMS membranes mainly controlled by the pyrolysis conditions. However, the performances of CMS membranes should be improved by the polymer-blending method as confirmed in this study. Consequently, the C-SiO_2 membranes pyrolyzed at 550 °C showed O_2 permeability of 135 Barrers [10^{10} cm^3(STP)cm/cm^2·s·cmHg] and the O_2/N_2 selectivity of 9 whereas the carbon-silica membranes prepared using the polymer-blending method showed O_2 permeability of 1080 Barrers and O_2/N_2 selectivity of 8.

References

1. H. B. Park, I. Y. Suh, and Y. M. Lee, Novel pyrolytic carbon membranes containing silica: Preparation and characterization, Chem. Mater., 14 (2002) 3034.

2. Y. K. Kim, J. M. Lee, H. B. Park, and Y. M. Lee, The gas separation properties of carbon molecular sieve membranes derived from polyimides having carboxylic acid groups, J. Membrane Sci., 2004, in press

3. C. W. Jones, and W. J. Koros, Carbon molecular sieve gas separation membranes. I. Preparation and characterization based on polyimide precursors, Carbon, 32 (1994) 1419.