Allylurea로 개질된 다공성막에서의 pH변화에 따른 투과 거동

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Permeation Behavior through pH-Responsive Allylurea Grafting Porous Membrane

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1. Introduction

Stimuli-sensitive polymers grafted on surfaces of porous membrane as polymer brush[1-4] show drastic property changes in response to small variations in physical or chemical stimuli, such as pH, ionic strength, temperature, redox reaction.

The pore size was regulated by the extent of the polymer brush. As a result, the substance permeation through the porous membrane was controlled in response to the signals. These specific functionalities can be acquired by selecting appropriate funcional monomers.

Many methods such as UV irradiation, γ-irradiation, plasma treatment have been used to modify polymers and membranes for specific application. Of these methods, the UV-irradiation method has been widely used in many applications because it is a more convenient and cheaper operation than are other methods.

In this study, we aimed to prepare a pH-sensitive polysulfone ultrafiltration membrane grafted with Allylurea using a UV-irradiated graft - polymerization technique. A FeCl permeation experiment was done to show pH-dependent permeation of the solute through a novel

membrane at different pH. Elemental compositions depending on the location in the compose matrix were analyzed with EDX.

2. Experimental

Materials and Preparation of AU-grafted PSf Membrane

Polysulfone (PSf) UF membrane was used as a base material for modification. The pre-irradiation grafting method was used. Irradiation chamber system with the ultraviolet light(UV) was used to modify the membranes. UV lamp (450W power, Ace Glass Co., NJ, USA) having mixed wavelength of 303, 313, 348 and 363 nm(ëmax). The surface immobilization of Allyurea on the PSf membrane was carried out as following. The PSf membrane was dipped in to the solution containing AU (10, 20, 30, 40 wt %/ethanol). Then the Allylurea-dipped PSf membranes were placed at a distance of 10cm from a UV source and irradiated in air at room temperature with a medium pressure mercury for 10, 20, and 30 min and washed with distilled water. Then membrane was dried in a vaccum at 40°C for 48h.

Pure water and FeCl solution permeation through AU-g-PSf membrane

A dead-end stirred cell filtration system was used to characterize the filtration performances of the unmodified and the modified PSf membranes. The pH of the permeated solution was adjusted using H_2SO_4 and NaOH. The rate of water permeation was calculated by measuring the mass of water that was able to pass through the membrane per minute. After pure water permeation, FeCl(0.1g/L) solution permeation was carried. Elemental compositions depending on the location in the compose matrix were analyzed with EDX.

3. Results and discussion

The absorption band changed with an grafting in the range of 1608 and 1599 cm^{-1} for the AU-g-PSf membranes. This peak, the

characteristics of an NH deformation, indicated the appearance of NH groups of grafted AU. Also, an intense new IR absorption band appeared at 1653 cm^{-1} and attributed to carbonyl stretching which was the characteristics of AU.

AFM images of the surface of the PSf membranes illustrated a change in the surface topologies of the membranes, indicating that grafted PSf membranes were found to be rougher than were virgin PSf membrane. The pure water permeability through the original PSf membrane and the PSf-g-AU membranes is shown in Figure 1, measured at different pH values and UV irradiation time. Note that the Virgin Psf membrane exhilbits no response to the change in pH, whereas the PSf-g-AU membrane are responsive to the pH change.

The FeCl solution permeability through the PSf-g-AU and elemental compositions depending on the location in the compose matrix analyzed with EDX (Atomic % of Cl is 48.06 at pH 2, but 0% at pH12).

An explanation is given that at lower pH regions, the protonated chains of AU graft are contracted to open the pores, whereas at higher pH regions, the graft chains became extended to cover the pore.

4. References

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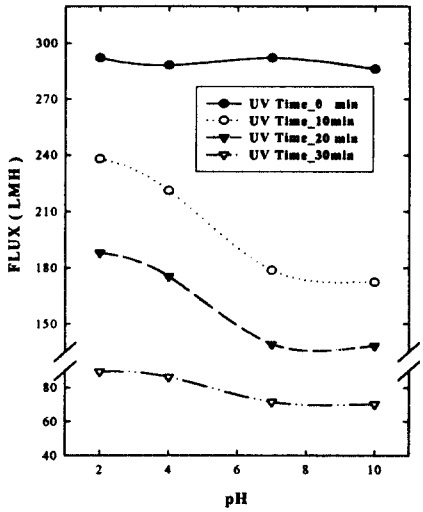

Fig. 1. Effect of pH and UV irradiation Time on the pure water permeation