일반강연 A-1

플라즈마 중합법에 의해 제조된 불균일한 이온교환기 분포를 가진 이온교환막의 특성분석

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Characterization of nonuniformly charged ion-exchange membrane prepared by plasma-induced graft polymerization

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The performance of ion-exchange membrane depends on its chemical nature and the conditions of the surrounding liquid medium. The former includes the type of a membrane (cationic or anionic), the amount of fixed charges and its distribution. The latter includes the operating condition and the flow field near the liquid membrane interface. Increasing fixed charge in a membrane can improve the performance of an ion-exchange membrane [1]. A particular distribution of fixed charge groups inside the membrane plays a significant role. Many researchers have studied the effect of fixed charge distribution on the performance of ion-exchange membrane [2-11]. However, since prepararation of ion-exchange membrane with nonuniform or uniform fixed charge distribution (Fig. 1) is difficult, most of the studies have been carried out only theoretically without experimental investigation.

Graft polymerization is a good method to prepare morphologically controlled ion-exchange membrane (ion-exchange membrane with nonuniform or uniform fixed charge distribution) [12]. Yamaguchi et al [13] reported that membrane morphology with the plasma graft polymerization could be controlled by solvent-dependent activity. Varying the monomer solvent composition (water and methanol) could affect the graft polymerization rate by changing the monomer diffusivity relative to the reactivity. Using the water solvent, surface region was rich in grafted polymer compared to the middle of the film, which led to nonuniform distribution of the grafted polymer across the membrane whereas the use of mixture of water and methanol led to uniform membrane (Fig 2).

The objectives of this study are: (1) to prepare nonuniformly charged sulfonated PP-g-GMA (Fig. 3) by the use of plasma graft polymerization (Fig 4) for cation-exchange membrane. (2) to evaluate and compare their properties systemically. The prepared membranes with various fixed charge distribution were characterized in terms of physical and electrochemical properties such as transport number, ion exchange capacity, water content, membrane electric resistance, I-V relation and chronopoteniometric reponses. Also, the chemical structure and morphology of the prepared membrane were investigated using attenuated total reflection Fourier transform infrared spectroscopy (ATR-FTIR), electron probe microanalyzer (EPMA) and scanning electron microscopy (SEM).

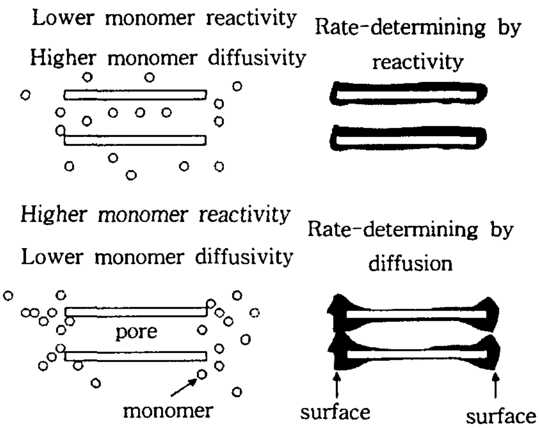

Fig. 1. Control of grafting distribution using solvent-dependency

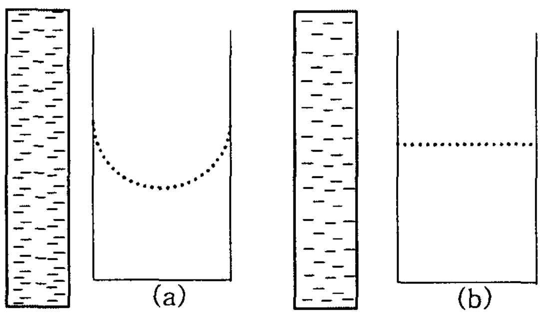

Fig 2. Nonuniformly charged membrane(a) and uniformly charged membrane (b)

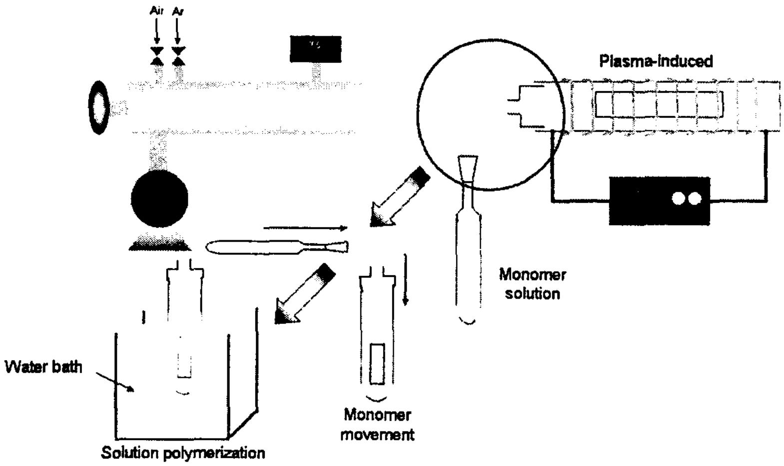

Fig. 3. Apparatus for plasma graft polymerization

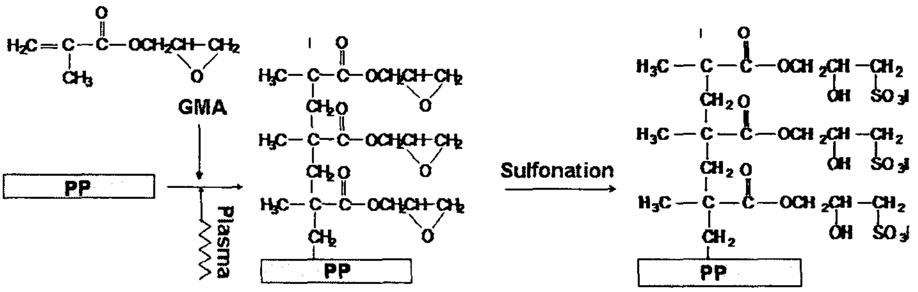

Fig. 4. Preparation scheme for cation-exchange membrane

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