일반강연 2-6

Characterization and pervaporation of chitosan/ polyacrylic acid polyelectrolyte complex membranes

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Introduction

Polyanion-polycation complexes had been known for a long time on an empirical basis from the mutual precipitation of proteins, before Kossel at the end of the previous century recognized the electrostatic nature of the interaction between oppositely charged polyions.

The formation of polyelectrolyte complexes is essentially a result of the electrostatic nature of the interaction between oppositely charged polyions. This interaction in the macroscopic homogeneous system, the phase transition by polysalt precipitation as well as the chemical and physical structure of polyelectrolyte complex membranes have been intensively investigated from the thermodynamical and kinetical point of view.

Experimental

The polyelectrolytes selected for polyelectrolyte complex formation were the polyanion polyacrylic acid, and the polycation chitosan, a natural polymer deacetylated from chitin. Polyacrylic acid was purchased from Aldrich Chemical and has 450,000 molecular weight. Chitosan was purchased from Tokyo Kasei Co. and has a 76% deacetylation degree measured by titration method, and 500,000 molecular weight calculated by Mark-Huwink equation.

The solution of PAA(1wt%) and chitosan(1wt%) in 3.5wt%solution of formic acid in water were mixed in different ratios. Then they were cast on polystyrene support and dried at 30°C in a convection oven over 24 hours and also in vacuum for removing any remaining solvent. The films were washed from formic acid with distilled water up to the neutral pH value. The washed films were dried in air. Thus, the polyelectrolyte films of different composition by weight, 8:2, 6:4, 5:5, 4:6, 2:8 were obtained.

Thermal properties of polyelectrolyte complex membranes were determined by dielectric analyzer, DuPont Instruments DEA2970. FT-IR spectra were performed on the Nicolet Model 5DXFT-IR spectrometer. The wettability of membranes was studied by means of a contact angle measurement apparatus. X-ray diffraction patterns were performed on the Rigaku Denki RAD-C X-ray diffractometer.

Results and discussion

The characterization study of polyelectrolyte complex membranes based on chitosan and polyacrylic acid have provided a better understanding of relationships between membrane preparation conditions and their resulting characteristics. During the polyelectrolyte complex formation a arrangement of pairs of positive(chitosan) and negative(polyacrylic acid) charges occurs.

FT-IR investigation has shown that the membranes can form the polyelectrolyte complex. FT-IR spectra from chitosan/polyacrylic acid complex membranes show a carboxylate and amine salt peaks at 1400cm^{-1}, 1400cm^{-1} as

shown in Fig 2. The wettability of polyelectrolyte membranes is determined by hydrophilic and hydrophobic balance from chitosan and polyacrylic acid. Thermal properties of various blend ratio of polyelectrolyte from chitosan and polyacrylic acid has shown the typical chracteristics of polyelectrolyte. X-ray diffraction patterns are shown in Fig 2.

Pervaporation performance of the membranes is shown in Figs 3 and 4. Varying the feed concentrations from 40wt%- 95wt%feed ethanol concentrations, permeate showed a only water component at about 75%ethanol concentration with lower permeation rate. Varying polyacrylic acid content from 75:5 to 75:25 ratio, permeate showed a only water component besides 75:5.

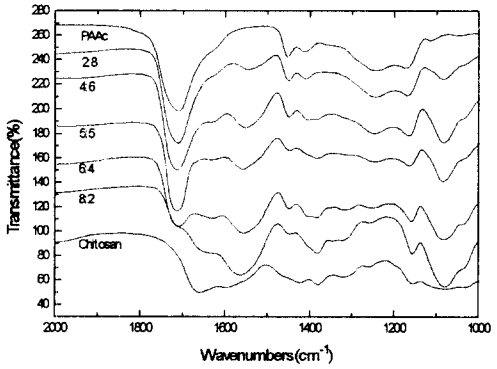

Fig 1. FT-IR spectra of PEC membranes.

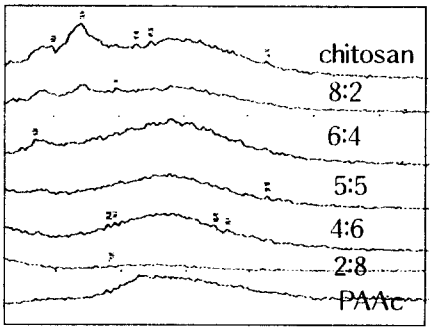

Fig 2. X-ray diifraction patterns of PEC membranes.

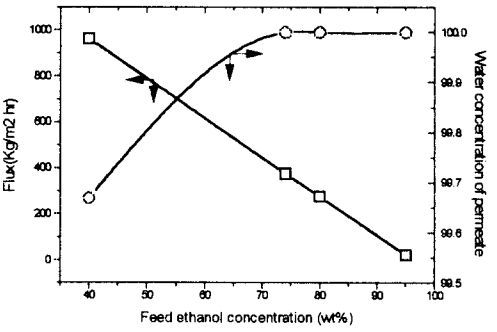

Fig 3. Effect of feed ethanol concentration on pervaporation performance

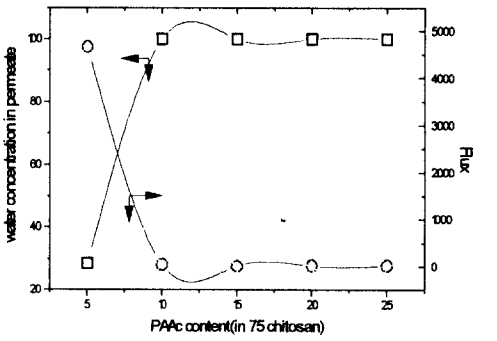

Fig 4. Effect of PAAC content on pervaporation performance

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