Properties and Structure of Poly(vinyl Alcohol) Film Containing Electrolytes

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Abstract

We have investigated the properties of poly (vinyl alcohol)-film obtained by casting from the solution PVA/electrolytes (NaCl, KCl, $MgCl_2$, $CaCl_2$)/water systems at room temperature. The removed electrolytes films have got high crystallinity as well as high draw ratio. The removed electrolytes films had layer-structure while a film without electrolytes didn't have it. A relation between draw ratio and thickness or number of layers, were recognized.

Introduction

Sugar and salts added PVA hydrogels, was known to get thermal and dynamic stability [(1)]. In our previous studies, films obtained from the PVA/NaCl/water system at room temperature have got water resistance and high crystallinity as well as high draw ratio after removing NaCl [(2)].

PVA/NaCl/water system serves as non-toxic to the products used to a living body or environment, and will have some advantages. Here, the properties of the film obtained from PVA/ electrolytes (KCl, $MgCl_2$, $CaCl_2$)/water system.

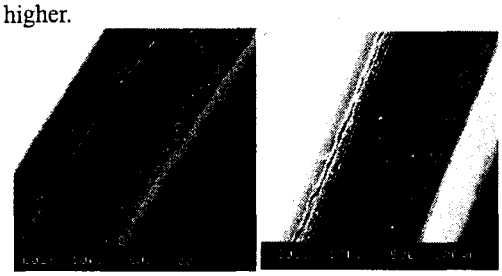
Experimental

In this experiment, *atactic* PVA (*a*-PVA) offered from JAPAN VAM & POVAL CO., Ltd. was used having a degree of polymerization of 1730 and a degree of saponification of 99.39mol%. As electrolytes, NaCl, KCl, $MgCl_2$ hexahydrate and $CaCl_2$ hexahydrate produced by Wako Pure Chemical Industries, Ltd. were used.

The PVA (0.5g) was dissolved in the sealed test tube to the aqueous solution with various electrolytes concentration at 120°C. The films with electrolytes were obtained from these solutions casting on a petri dish at the room temperature. The present electrolytes into the film were removed by dipping into distilled water for 72 h. Thereafter degree of crystallinity, draw ratio, DSC, and tensile test of the removed electrolytes PVA films as well as the cross-sectional SEM photographs of the films were observed.

Results and Discussion

In DSC thermogram, melting point of removed electrolytes films was about 229°C regardless of kind and concentration of electrolytes. However, heat of fusion varied with kind and concentration of electrolytes. It is considered that the number of crystals of PVA changes, while crystal size doesn't change. Even if each electrolyte was added, electrolytes removal films got high draw ratio as well as high crystallinity. In Fig.1, it is seen that the cross-section of films without drawing has been stratified. This layer became finer and more stratified when draw ratio was higher.



(a) No Electrolytes
Draw Ratio:11.7
$Thickness_{Approx}$:10(μ m)

(b) KCl 1.6wt%
Draw Ratio:16.3
$Thickness_{Approx}$:1.6(μ m)

Fig.1 SEM Photographs of a Cross-Sectional removed KCl Films.

Conclusions

These films obtained from PVA/electrolytes /water system got high dynamic properties and water resistance. These high performance films might be able to improve environment and living body with low damage and simple preparation.

References

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