일반강연 I-11

Characterization of Ovalbumin-containing Polyurethane Microcapsules with Different Structures

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1. Introduction

Polyurethane is attractive polymer group with widespread characteristics by molecular composition [1-3]. Especially, segmented polyether polyurethanes have been studied so much due to their excellent physical properties, resistance for infectiousness, and superior blood compatibility [4-5]. Increase of hard segments content in polyurethane structures could result in polymers with higher elastic modulus, and polyurethanes with modified properties could be produced by molecular weight and chemical structures of soft segments and the structure differences of chain extenders [6]. However, microcapsule applications need general polyurethanes composed of diisocyanate and polyol with low molecular weight more than the segmented polyurethanes from polyol with high one, due to the formation of hard segment alone. As it were, the microcapsule membrane with hard segment alone can have superior mono-dispersiveness and less-stickiness than that with hard and soft segments at the same time, making shorter methylene chain of polyol in the resultant wall membrane.

In this study, polyurethane microcapsules containing ovalbumin as hydrophilic model material are prepared and investigated on their structures, thermal properties, and morphologies by changing polyols.

2. Experimental

The first w/o emulsion was formed between 0.05M TDI and 3ml of

10% ovalbumin aqueous solution under 0.3 ml of Span 80 as an emulsifier. The emulsification was vigorously stirred for 1 min with homogenizer. Subsequently, the emulsion was added to the 150ml of 0.5 % PVA aqueous solution for production of (w/o)/w second emulsion with homomixer. Stirring rate was reduced to 10,000 rpm. 0.05M three polyols of glycerol, ethane diol and propylene glycol, and a catalytic content of DBTDL were added into the (w/o)/w solution to produce polyurethane wall membrane onto the emulsion globules. The stirring rate in the solution was decreased to accelerate wall-formability onto the emulsion globules, and polymerization onto the particles was carried out for 5 hrs.

3. Results and discussion

IR spectra were obtained by Nicolet Impact 400D Fourier transform infrared spectrometer (Seiko Co., Japan). Mean number diameter and particle size distribution were determined by Galai CIS-1 particle sizer (Galai Production Ltd., Israel). The test with few drops of microcapsule slurry was carried out after sonication for 5 min. Scanning electron microscopy (SEM) was performed using a Hitachi S-4200, Japan. Microcapsules were sprinkled onto a double-sided tape, sputter-coated with platinum and examined in the microscope.

Fig. 1 shows FT-IR spectra of polyurethane microcapsules from different polyols of glycerol, ethane diol and propylene glycol. All the spectra show absorption bands at 1740-1700 cm-1 for the C=O stretching of urethane, and at 1690-1650 cm-1 for urethane-urea formation. The N-H stretching vibrations indicating the formation of strong hydrogen bond on the wall membranes are observed at 3400-3300 cm-1. All the spectra indicate the completion of reaction between diisocyanate and polyols from disappearance of a NCO absorption band at 2270 cm-1 and appearance of the N-H and C=O absorption bands. C-H stretching vibrations of aliphatic diamine are shown at 2950㎝-1 and 2850㎝-1, respectively. From these characteristic peaks, it is convinced that wall membranes of the microcapsule are polyurethanes.

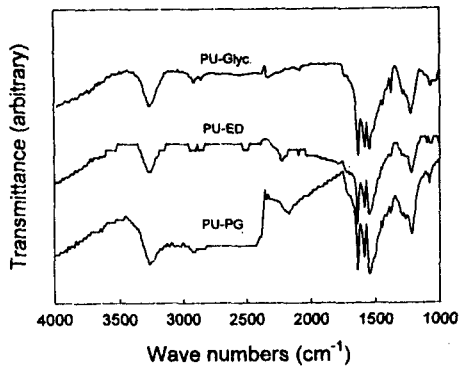

Fig. 1 FT-IR Spectra of polyurethane microcapsules

Fig. 2 shows the particle size distribution of polyurethane microcapsules from different polyols. Over 80 % of all the microcapsules are in the size range of 0.1~3.0um. The small particles could form much larger specific surface area than the greater ones and make the highly controlled and sustained release profiles of core material. Therefore, the particle size distribution can be very important factor in release profiles of OVA because narrow distribution means the formation of many small particles, which give different surface area.

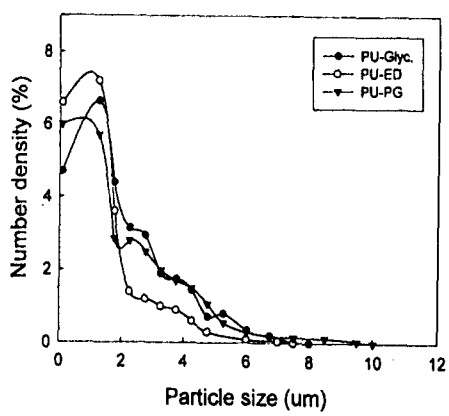

Fig. 2 Particle size distribution of polyurethane microcapsules

4. References

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