

선형과 스타형 Poly(L-lactic acid)의 열적, 유변학적 특성

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The Thermal and Rheological properties of Linear and Star-shaped Poly(L-lactic acid)

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1. Introduction

Poly(lactic acid) is a thermoplastic and biodegradable polymer[1-3]. It has a wide range of application in medical fields such as sutures, screws for bone fractures and drug delivery systems. It has additional potential in other fields like agriculture and packaging.

In recent years, there has been an increased interest in star-shaped polymers because they have a higher segment density within the distance of its radius of rotation than linear polymers have under the same conditions.[4] The excluded volume effects are more pronounced in star-shaped polymers. Star-shaped polymer has low melting point because of branched structure. Thus star-shaped polymer may be used much more fields than linear polymers in the future because of their peculiar physical properties.

In this paper the thermal and rheological properties of linear and star-shaped PLLA were investigated and discussed.

2. Experimental

Materials

Linear and star-shaped PLLA ($M_w = 200,000$) were obtained from Korea institute of Science and Technology(KIST).

Viscosity measurement

Viscometric measurements were carried out using a dilution Ubbelohde viscometer which was immersed in a constant-temperature bath at 25 °C. The viscosity samples were prepared dissolving linear and star-shaped PLLA were measured in chloroform.

Thermal Analysis

Thermal properties were measured using a DSC (TA instruments) under N_2 . The heating rate was 10 °C/min over the temperature range from 30 to 240 °C and the cooling rate was 2 °C/min.

Rheological measurement

Dynamical mechanical measurements were carried out by ARES using a parallel-plate

geometry, at a dynamic strain amplitude of 5% (gaps were 1 mm). Frequency sweep over 0.05 to 400 rad/s were performed at 195 °C, 210 °C and 225 °C

3. Results and discussion

3-1 Viscosity behavior

Figure. 1 show the plots of η_{sp}/c vs concentration for linear and star-shaped PLLA. It can be seen that all plots are linear over the whole range of concentration. Intrinsic viscosity [η] of star-shaped PLLA is larger than that of linear PLLA.

3-2 Thermal properties

The star-shaped PLLA gives lower T_m and higher T_g . In addition it gives greater crystallization exotherm in DSC analysis. Crystallinity of linear PLLA was higher than that of star-shaped PLLA.

3-3 Rheological properties

Both linear and star-shaped PLLA's show shear-thinning phenomena (Figure. 2). On the whole, star-shaped PLLA gives higher viscosity at the similar M_w . The star-shaped PLLA shows greater dependence on temperature.

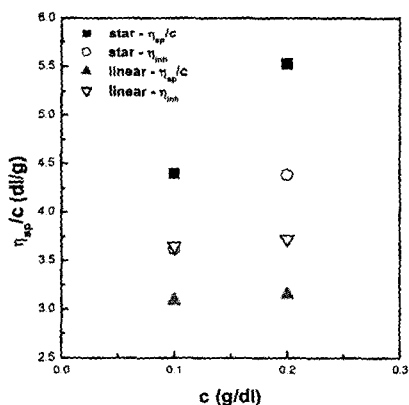


Fig. 1 Plots of η_{sp}/c and η_{inh} vs concentration for linear and star-shaped PLLA.

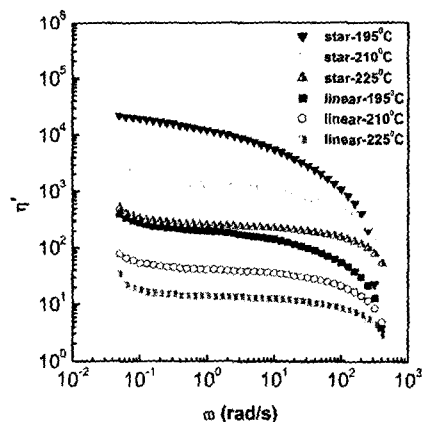


Fig. 2 Viscosity curves of linear and star-shaped PLLA.

4. References

1. Doi Y, editor, biodegradable plastic handbook. NTS; 1995.
2. Mikos AG, Thorsen AJ, Czerwonka LA, Bao Y, Langer R. polymer 1994;35:1068-77.
3. Ma PX, Zhang RY. J Biomed Mater Res 1999;46:60-72.
4. Takano A, Okada M, Nose T. Macromolecules 1992;25:1301-1306.