

생분해성 poly(butylene succinate) 이오노머의 합성과 비등온 결정화에 대한 고찰

임정섭, 임승순*

한양대학교, 섬유고분자 공학과

Synthesis and Non-isothermal Crystallization Behavior of the Lightly Sodium Sulfonated Poly(butylene succinate) (PBS) Ionomers

Jung Seop Lim and Seung Soon Im*

Department of Fiber & Polymer Engineering, College of Engineering

**Hanyang University, Haengdang-dong, Seongdong-gu, Seoul 133-791, Korea*

1. Introduction

The electrostatic crosslinks that arise from intermolecular ionic associations commonly may enhance the rheological and mechanical properties of an ionomer relative to the non-ionomer. Recently, we synthesized the biodegradable poly(butylene succinate) ionomer (PBSi) and found that it has noticeable potential as the industrial application due to the excellent physical properties and biodegradability [1,2].

On the whole, the final physico-chemical properties of polymers are strongly dependent on the extent of crystallinity and its crystalline morphology, which may be greatly controlled by crystallization kinetics [3]. As for ionomer, the ionic group units into polymer backbone have a dramatic effect on its crystallization behavior [4]. Therefore, influence of the ionic group on the crystallization kinetic holds considerable academic interest as well as practical importance. Especially, the non-isothermal crystallization behavior has commercial importance and needs a detailed understanding, given that most industrial processing proceeds under non-isothermal conditions. However, in spite of the significance for industrial application, little attention has been paid to the relationship between the ionic group and non-isothermal crystallization kinetics compared with the investigations of isothermal crystallization behavior of ionomer. In this study, PBS-based ionomers (PBSi) containing the sodium sulfonated ionic group were synthesized by 2-step polymerization and the effect role of the ionic group on the non-isothermal crystallization behavior was investigated. The addition of ionic groups to the PBS backbone may influence markedly the non-crystallization kinetic, which is of great importance for the technological optimization and manufacture of high performance materials. Therefore, it can be anticipated that this approach can not only control the processing of new PBS ionomer more straightforward but also provide fundamental information about how ionic group regulates the non-isothermal crystallization behavior.

2. Experimental

Ionic-bearing sulfonated dimethyl fumarate (SDMF) was synthesized using dimethyl fumarate (DMF) and sodium hydrogen sulfite (NaHSO₄) [5]. Pure poly(butylene succinate) PBS and PBS ionomers

containing 1.0, 3.0, and 5.0 mol% SDMF were prepared, as detailed in our previous study [6].

3. Results and discussions

The effect of sodium ion group on the molecular structure in PBS backbone was investigated by solid-state ^{23}Na -NMR analysis and confirmed that the creation of aggregated sodium ion (multiplets) predominated with the ionic group concentration, which generate not only the remarkable heterogeneity but also the large degree of clustering in the PBS molecular chains. At low ion group concentrations, well-dispersed multiplets operated as effective nuclei during the crystallization of the PBS ionomer and accelerated its crystallization rate. As ionization level grew higher, clusters, formed among the numerous multiplets, reduced the crystallization rates relative to low ion concentrations. Ozawa non-isothermal equations were applied to evaluate the non-isothermal crystallization kinetics of PBS ionomer. However, the accurate analysis cannot be performed as a result of some curvature in plot of samples. On the other hand, the combined Ozawa and Avrami equation may be more effective in describing the non-isothermal crystallization kinetics of PBS and its ionomers. The nucleation activity exhibited various values depending on the added ionic group concentration.

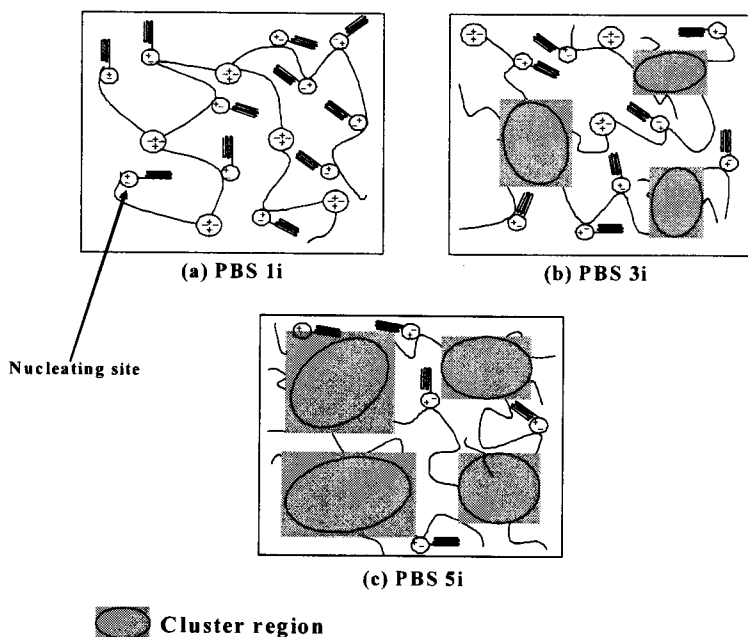


Figure 1. Mechanism for the creation of clusters in PBS ionomers.

4. References

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