

学位論文内容の要旨（英文）
Thesis Abstract (English)

PHAM THI NGOC DIEP

1. 論文題目（英文）

Thesis Title (English)

Studies on Effects of Small-Amount Loading of Plasticizers on Poly(L-lactic acid) Crystallization

2. 論文題目（和文）

Thesis Title (Japanese)

ポリ L 乳酸の結晶化に与える微量添加可塑剤の効果に関する研究

3. 論文要旨（英文 300 語程度）

Thesis Abstract (In approx. 300 English words)

Poly(L-lactic acid) (PLLA) is one of the most popularly utilized biobased polymer, as PLLA can be synthesized from renewable sources such as sugar, carbohydrate, etc. In recent several decades, scientists are interested in PLLA because of environment-friendly characteristics. However, there existing some big problems of PLLA, which are low crystallization rate and low crystallinity. In order to overcome such drawbacks, nucleation agents have been incorporated into PLLA. These are talc, clay, sodium salts, etc., playing its role in a solid state. On the contrary, it has been known that a special plasticizer (organic acid monoglyceride; OMG) can improve the crystallizability of PLLA. The results are

significant because plasticizers are believed to delay crystallization of polymers by reducing the thermodynamical driving force of crystallization. Therefore, I intended to clarify the effects of plasticizers on the crystallization of PLLA in detail in this thesis. And finally, I propose a plausible mechanism to explain the role of plasticizer upon the crystallization of PLLA. In Chapter 1, I reported the experimental results of the effects of a plasticizer as an agent of improving crystallizability of PLLA. In Chapter 2, the effects of loading amount of plasticizers on improved crystallization of PLLA is carefully investigated by using a special plasticizer, OMG, and a general one, dioctyl phthalate. In order to identify the effect of the plasticizers, I conducted time-resolved small- and wide-angle X-ray scattering and differential scanning calorimetric measurements to follow, respectively, the isothermal and non-isothermal crystallization of PLLA/plasticizer specimens. Moreover, polarizing optical microscopic observation was conducted to evaluate the growth rate of a spherulite and the number of nuclei formed as a function of time. Finally, for understanding the role of plasticizer upon the crystallization of PLLA, a plausible model is proposed in Chapter 3. In the presence of the plasticizer molecules, the better folding of the PLLA chains was resulted, which has been experimentally confirmed by the fact that the surface free energy (σ_e) of the crystallites plane become lower. The free energy change upon the formation of a primary nucleus is then drawn as a function of the thickness of the primary nucleus using the values of σ_e (using the Hoffman – Lauritzen theory) and it was found that the energy barrier for the crystallization is decreased by the loading of plasticizers. This explains the enhancement of the crystallizability of PLLA in the presence of plasticizers.