Thesis title:

Small-Angle X-ray Scattering Studies on Poly(oxyethylene) Crystallites Formed in Poly(oxyethylene) and Its Blends with Poly(*d,l*-lactide)

Thesis abstract:

Poly(lactic acid) (PLA) plays an important role in the family of biodegradable aliphatic polyester due to its various fields of application especially in the drug delivery system or for biomedical products. However, the application of PLA has been rather limited until now due to its relatively poor thermal stability, poor long-term durability, lower impact strength and high cost. Therefore, blending PLA with other polymers was used to improve the properties of PLA. Since poly(oxyethylene) (PEG) is miscible with PLA in the amorphous phase, being also biodegradable and nontoxic, it has been incorporated in this research for a promising increase of water transmission and biodegradation rate of PLA. In this study, I use non-crystalline PLA (PDLLA) for blending with PEG. Small-angle X-ray scattering (SAXS) was utilized to investigate the higher-order crystalline structures in PEG as well as in blends.

This dissertation includes four Chapters. Chapter 1 provides the general introduction of the research. In Chapter 2, a quite regular stacking of the PEG crystalline lamellae, which was spontaneously formed in the as-cast sample of the PEG 100% sample as well as PDLLA/PEG (20/80) blend was observed. Moreover, a lamellar particle scattering was found just 1°C below melting temperature. In Chapter 3, comprehensive melting behaviors of the blend with various blend compositions were investigated. Further structural analyses using SAXS enabled us to obtain abundance of crystalline lamellae as a function of the lamellar thickness. As a result, it was found that the sharp distribution of the lamellar thickness in the as-cast sample moves toward the larger value (in other words, lamellar thickening) as temperature approaches to the melting point. In Chapter 4, the effect of high pressure on the higher-order structures of PEG crystallites in PDLLA/PEG blends during melting and recrystallization was elucidated by in-situ SAXS measurements. It was found that the regularity of crystalline lamellar stacking of PEG became better after a cycle of pressurizing-and-depressurizing treatment. Finally, a brief summary of the findings is given in Summary section.