# ANALYSIS OF THE α'/α-CRYSTAL TRANSITION IN POLY (L-LACTIC ACID) (PLLA)

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## ABSTRACT

Crystallization of PLLA at temperatures higher than about 120 °C leads to formation of orthorhombic α-crystals while at lower temperatures growth of pseudohexagonal, conformationally disordered α'-crystals with lower packing density, increased lattice spacings, and lower specific enthalpy of melting compared to the α-phase is favored. Both crystal modifications may develop during industrial processing, and knowledge about the prevailing crystal form is of importance due to the large impact on ultimate properties. The α'-form of PLLA is only metastable at the temperature of its formation and at lower temperatures. On heating it transforms irreversibly into the stable α-form or into liquid phase, depending on the heating rate.

In this paper, the mechanism of the α'/α-crystal phase transition is investigated, as well as there are discussed the effects of molar mass and the presence of D-isomers in the PLLA chain on the kinetics of the phase transformation. As a main result of the research performed by fast scanning chip calorimetry it was found that the α'/α-crystal transition can completely be suppressed on heating a rates higher than about 30 K/s in case of the PLLA homopolymer and that the α'-phase can be melted with prior transformation into the stable α-crystal form. Both, presence of D-isomers and increasing molar mass lead to a decrease of the critical heating rate for suppression of the α'/α-crystal transition. Isothermal reorganization experiments showed that phase transformation proceeds via melting of unstable α'-crystals followed by recrystallization of the melt into stable α-crystals at identical temperature.

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