Poly(L-lactide)/C_{60} Nanocomposites: Effects of C_{60} on Crystallization of Poly(L-lactide)

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ABSTRACT: The effects of solvent type and concentration of C_{60} on the crystallization of poly(L-lactide) (PLLA) during solvent evaporation, heating from room temperature, and cooling from the melt were investigated by polarized optical microscopy and differential scanning calorimetry. The addition of C_{60} enhanced the PLLA crystallization during solvent evaporation, during heating of the melt-quenched films, and during cooling from the melt of As-cast films, except for heating and cooling of the PLLA film with 1 wt % of C_{60} prepared with dichloromethane. In the case of solvent evaporation, the difference in crystallinity between the PLLA films with and without C_{60} became higher for the solvent with a lower boiling point. In the case of heating of melt-quenched films, the addition of C_{60} had a small effect on the crystallinity of PLLA, whereas significantly lowered the peak top and ending temperatures of cold crystallization, except for melt-quenched PLLA film with 1 wt % of C_{60} prepared with dichloromethane. The crystallinity of PLLA was determined by the solvent type, rather than by the C_{60} concentration. In the case of cooling from the melt of As-cast films, the addition of C_{60} elevated the crystallinity and cold crystallization temperature values of PLLA films, except for PLLA films prepared with dichloromethane.
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INTRODUCTION

Biomass-derived poly(L-lactide), that is poly(L-lactic acid) (PLLA) has been intensively explored because it is biodegradable, compostable, producible from renewable resources, and nontoxic to the human body and the environment. The improvement of mechanical properties and thermal stability of PLLA is a matter of concern, especially when used in industrial and commodity applications.[1–12] The enhancement of crystallinity with the aid of a nucleating agent is commercially advantageous to improve the mechanical properties and thermal stability. Talc is a representative and cost-effective nucleating agent for PLLA to improve crystallinity and, therefore, mechanical properties and thermal stability.[13–16] Recently, poly(D-lactide), that is poly(D-lactic acid) (PDLA), or stereocomplex formed upon the addition of PDLA to PLLA, was found to be a more effective nucleating agent compared with talc because stereocomplex

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