Fibrillation in TLCP/Polyester Binary Blends

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Abstract

TLCP/Polyester binary blends were prepared by melt blending. Rheological, morphological, and thermal properties of of TLCP/polyester blends were investigated with viscosity ratio. Diameter of TLCP fibrils decreased with viscosity ratio. More and smaller TLCP fibrils were obtained at higher shear rate. Lower viscosity ratio was necessary for the fibrillation of TLCP in the binary blends.

Introduction

Recently, the melt blends of thermoplastic liquid crystal polymers (TLCPs) with thermoplastic polymers have been widely used because of their potential applications for higher performance polymers with high mechanical properties, high thermal stability, and good processability [1-5]. Major advantages of these systems are that TLCP can act as the reinforcing agent and processing aids simultaneously. Fibril formation of TLCP in the blends is influenced by various factors, such as thermal behavior of polymers, TLCP content, the viscosities of polymers and their viscosity ratio, interfacial tension of polymers, shear rate, and processing conditions. In this research, TLCP/ polyesters having different intrinsic viscosities and TLCP were prepared by melt blending, and effect of viscosity ratio on fibrillation in TLCP/ polyester blends was investigated.

Experimental

Thermoplastics used were two types of PEN with intrinsic viscosities of 0.93dL/g and 0.46dL/g that were supplied by Hyo Sung Corp., and two types of PET with intrinsic viscosities of 1.07dL/g and 0.64dL/g that were supplied by SK Chem. Co. TLCP composed of 80mol% PHB and 20mol% PET was purchased form Unitika Co. Ltd. Melt blending of TLCP and polyesters was performed by using a Haake rheometer equipped with a twin screw. Thermal and rheological properties of the binary blends were investigated using DSC (TA instrument 2010), and a Rosand RH10-D capillary rheometer (Bohlin instruments). Morphology of the binary blends was observed with FE-SEM.

Results and Discussion

The TLCP, polyesters, and their blends exhibited a non-Newtonian behavior. The viscosity of the binary blends was decreased by adding TLCP, which suggested that the introduction of TLCP reduced melt viscosity of the blends, resulting in improvement of the processability. Crystallization temperature of TLCP/polyester binary blends was lowered on the addition of TLCP, indicating that TLCP acted as a nucleating agent to enhance the crystallization of polyesters. At lower viscosity ratio, TLCP have been elongated into fibrils. The dispersed TLCP changed from spheres to fibrils, and the size of TLCP fibrils was decrease with viscosity ratio. The average diameter of TLCP fibrils was decreased with increasing shear rate, and it was found that higher shear rate can elongate TLCP more effectively, and was required to develop the dispersed TLCP fibrils in the blends.

Conclusions

The viscosity of TLCP/polyester binary blends was decreased by adding TLCP, which was attributed to the lower TLCP viscosity combined with the deformability of spherical domains of TLCP in the blends. The diameter of TLCP fibrils was decreased with decreasing viscosity ratio and increasing shear rate. More and smaller TLCP fibrils were obtained at high shear rate. The lower viscosity ratio of TLCP to polyesters can favor fibrillation of TLCP in the binary blends.

References

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