IN-SITU COMPOSITES BASED ON BLENDS OF A POLY(ETHER ETHER KETONE) AND THERMOTROPIC LIQUID CRYSTALLINE POLYMERS UNDER INJECTION MOULDING CONDITIONS

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Introduction

In recent years, in-situ composites containing thermotropic liquid polymers (LCPs) have received increasing attention because of their scientific and technological importance. The premise behind the in-situ composite concept is the existence of an immiscible mixture of LCP and isotropic polymer, in which the dispersed LCP phase is deformed into a fibrillar form during processing, acting as a reinforcing phase. Consequently, significant improvements in physical properties could be achieved by using a small portion of LCP.

In this sense, in situ composites are akin to short fiber reinforced thermoplastic composites. The two most distinct advantages are: 1) The reinforcing fibrillar structure is formed in situ, i.e., the formation of the reinforcing phase and the composite itself is completed in a single step. A separate process to produce the reinforcing fiber, as in short fiber reinforced composites, is unnecessary. Hence it is a potentially economical process to generate high performance materials; 2) LCP functions as a processing aid because of its extremely low melt viscosity, thereby making the use of high viscosity thermoplastics possible. Obviously, the in situ composite concept offers a new method for tailoring physical properties of polymers without having to go through expensive chemical procedures.
Experimental

Experimental

Materials. The LCP used in this research was synthesized by our lab. The poly(ether ether ketone) (PEEK) was purchased from JHPM company.

Processing. Composite strands (fibers) were produced by mixing pellets of the LCP and PEEK in the dry state, feeing the mixture through an extruder, and drawing the resulting strand. The extruder was a twin-screw extruder with a WPZXK30P9P twin-screw extruder (Germany). The downstream barrel temperatures were set at 350℃.

Instrumentation. Differential scanning calorimetry measurements were conducted on a Mettler Toledo DSC 821^e under a nitrogen atmosphere. Heating rate was 20 ℃/min.Tensile properties of the extruded stands were measured on a SHIMADZU AG-1 Testing machine (10m/min). Flex properties of the extruded stands were measured on a SHIMADZU AG-1 Testing machine (5m/min). The Izod impact properties of the blends were measured on a XJ-6 Impact Testing machine. Morphologies of the extruded strands were obtained by examining the fracture surfaces with a SSX-550 SHIMADZU scanning electron microscope with low working voltages. All SEM samples were sputter coated with a thin layer of gold to avoid charing.

Results and Discussion

The result of DSC traces showed that T_g and T_m of the blends are almost same to those of the matrix. T_g are about 143 ℃,and T_m are about 334℃.

Variations of elastic modulus and tensile strength with draw ratio for PEEK/LCP strands are shown in table 1. The flex properties and impact properties of the blends were shown in table 2.

The data showed that when the content of LCP was 2%, the tensile properties and the flex properties were the best, but the impact properties were the worst among a series of blends. The movement of tensile properties was unconspicuous, but when the content of LCP was 1% and 2%, their tensile strength, Youngs' moduli and elongation were better than those of matrix.

Table1. Tensile properties of the blends

Blends LCP/PEEK	Tensile strength (MPa)	Youngs' moduli (GPa)	Elongation
0%	80.5	1.60	7.2
1%	81.5	1.61	7.3
2%	84	1.66	7.5
3%	79.5	1.62	7.1

table 2. Flex properties and impact properties of the blends

Blends LCP/PEEK	Flex strength (MPa)	Flex moduli (GPa)	Izod impact (KJ/m^2)
0%	117	2.51	14.3
1%	120	2.60	12.8
2%	143	2.84	7.0
3%	131	2.60	9.26

Morphologies of the extruded strands were showed in Figure 1.

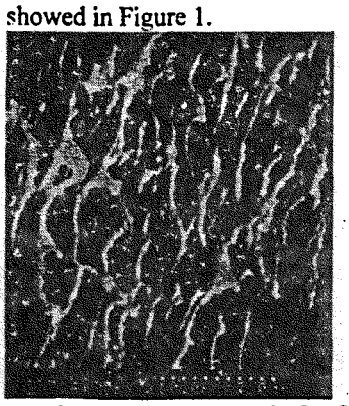

Figure 1. SEM micrographs of the fracture surfaces of drawn strand of LCP/PEEK=2%

Conclusions

We processed a series of blends by mixing pellets of the LCP and PEEK in the dry state. The thermal properties of the blends almost were same to those of matrix. The some mechanical properties of the blends were better than their matrix, others were worse than the matrix, but the downtrend of the properties was very placid.

References and Notes.

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