The Melting Behavior of a Mixture of Poly(ε-caprolactone) and 8OCB

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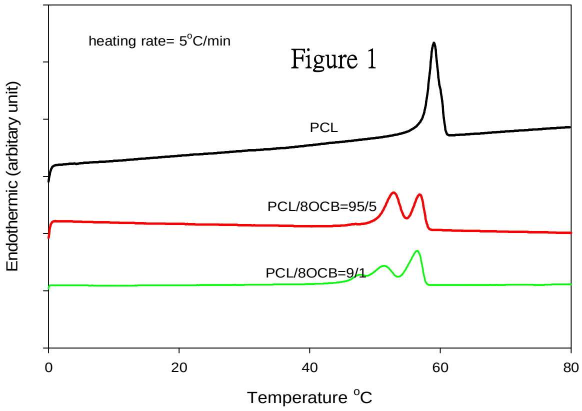
Polymers blending with liquid crystalline materials to enhance physical properties have been a major interest in industries and academics. Studies of crystallization and melting behavior are therefore of importance to various sectors. The present work investigates the melting behavior of the mixture of poly(-caprolactone) (PCL) and 4-cyano-4'actyloxy biphenyl(8OCB) by DSC, SAXS and WAXS.



Shown in Figure 1 are the heating traces of PCL and the polymer dominant mixtures of PCL/8OCB. Neat PCL shows a simple melting peak in the melting process while the polymer dominant mixtures show multiple peaks, while melting. The multiple peaks indicate that there exist the crystallites differing in sizes, crystalline form or lamellar thickness.

Fig 2a and 2b show the SAXS spectra of the mixture with PCL/8OCB=95/5 in a heating process. The spectra resemble those of neat PCL. With increasing temperature scattering peak related to the lamellar dimension of the crystallite of PCL shifts from 0.4 nm^{-1} to 0.38nm^{-1}. The range of shifting is large enough to exclude the effect of thermo expansion, hence the shifting could imply a growth in lamellar thickness of the crystallites. The area of the peak shows a slight increase until at 51°C it starts to decrease. The temperature range in which the peak shifts and changes its intensity (area) coincides that of the melting peak detected by DSC, thus the intensity change indicate that the total mass of the crystallites increases and then decreases during the melting process.

Shown in Figure 2c is the WAXS spectra of the mixture with PCL/8OCB=95/5 in the same heating process. The spectra shows three scattering peaks at q values of the typical lattice parameters of the PCL crystallite, which denies the possibility that introduction of 8OCB induces different crystalline form of PCL. The multiple melting peaks in the DSC trace could be caused by crystallites of different sizes and/or different lamellar thickness. The large range shifting of the scattering peaks in the SAXS spectra indicates the thickenning of the lamellar and increases in the peak intensity implies that recrystallization occurs while melting. However, the possibility of the existence of crystallites of different sizes referred by the multiple peaks in DSC trace can not be excluded since the increase in the intensity is not large enough to match the relative amount of the endothermic energies of the peaks, which is proportional to the relative amount of crystallites in different size or lamellar thickness.