Morphological, Structural, Thermal and Dielectric Properties of PLA/PCL based nanocomposites

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Poly (lactic acid) (PLA) is a biopolymer that has attracted scientific interest due to its good biodegradability, facile processability and excellent biocompatibility. In fact, the combination of good mechanical properties and reduced production cost, have made it the most suitable environmentally friendly material for the substitution of the traditional petroleum-based polymers. However, disadvantages like poor thermostability, high brittleness and low impact strength, are limiting its practical applications [1]. For this reason, blends of PLA with other polymers have been explored. In this orientation, polycaprolactone (PCL) is thought to be an appropriate candidate, since it is biocompatible, miscible with several polymers, easily processed and can be used in a wide range of applications, especially in tissue engineering, drug delivery and food packaging [2-4]. In the framework of this study, PLA/PCL blends were prepared via twin-screw extrusion in percentages of 90/10, 80/20, 70/30, 60/40 and 50/50 wt%. Scanning Electron Microscopy (SEM) was employed to assess the degree of dispersion of PCL and study the miscibility of the two polymers. Differential Scanning Calorimetry (DSC) reveals partial miscibility of the two components. X-Ray Diffraction (XRD) was also employed in order to study the crystal structure of the components. Furthermore, the dielectric behavior of the blends was studied by means of Broadband Dielectric Spectroscopy (BDS). A variety of relaxation mechanisms, attributed to PLA and PCL counterparts, were recorded and their dynamics was analyzed. Last, nanocomposites of PLA/PCL (80/20) and halloysite nanotubes (HNTs) in filler contents of 1, 3, 5, 7 and 10 wt% were prepared via twin-screw extrusion and studied using the same experimental techniques. HNTs were selected as nanofillers, since they have the potential to enhance the biocompatibility, they improve the mechanical properties of the polymer matrix and are good carriers of biologically active substances [5, 6]. The purpose of this addition was to investigate the effect of the nanofillers on the miscibility of PLA and PCL and possibly achieve the enhancement of the properties of these blends.

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