Tensile testing performance and shape memory effect of melt extruded PLA/PCL blends

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The current investigation is focused on the mixing of two green polymers at several definite ratios which has resulted in the manufacturing of biodegradable polylactic acid (PLA)/polycaprolactone (PCL) blends with outstanding macromechanical and shape memory properties. A range of non-compatibilized polymer compositions were prepared by using a twin screw melt extrusion technique allowing a homogeneous dispersion of the PCL droplets in the PLA matrix and boosting the interfacial adhesion between the two phases. The macromechanical behavior of the samples was explored by tensile experiments applying three distinct crosshead motion speeds. It has been discovered that the presence of PCL as soft segment contributed to an increment of toughness and elongation at ultimate strength of the polymer composite at expense of the maximum tensile stress and Young's modulus. The strength-stiffness related parameters were found to be more sensitive, in terms of getting to higher values, to the weight content of PLA as hard segment in the polymer blend. Performing of thermally-induced shape memory tests revealed an exceptional reversibility between the temporary and permanent states of the composite materials including impressive shape fixation (R_f) and shape recovery (R_r) rates. SEM analysis of the PLA/PCL compositions unveiled an apparent phase-separated microstructure approving the immiscibility of the two polymers in the blend (Fig. 1).

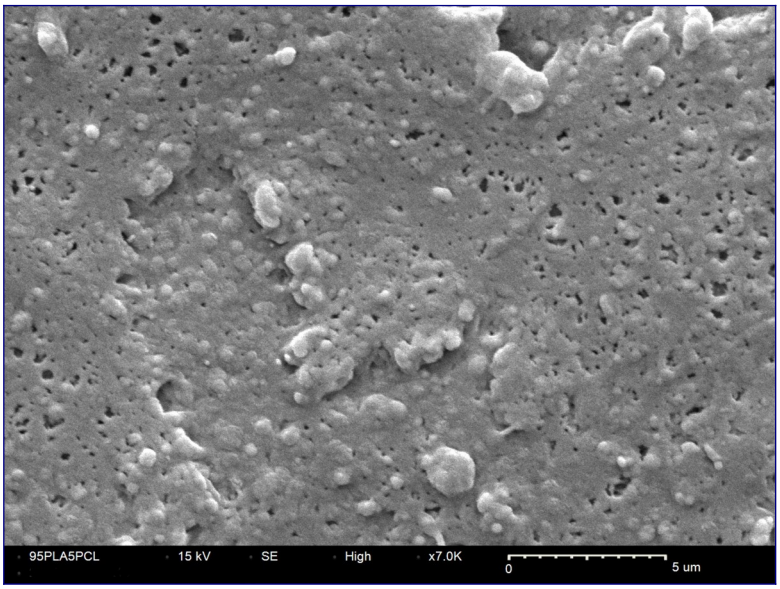

Figure 1. SEM image of melt extruded polymer blend

Keywords: biodegradable polymer blends; tensile testing; shape memory effect

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