Effect of Carbon Nanotubes on Shape memory properties of poly (L-lactide)/poly (ε-caprolactone) blends

Maryam Amirian[1*], Ali Nabipour Chakoli[2], Hossein Afarideh[3*],

[1]Teachers University, Shahrak Ghods, Niayesh Blv, Tehran, Ferdosi Center, Baghestan, Karaj, Iran,

[2]Agricultural, Medical and Industrial Research School, NSTRI, P. O. Box: 14395-836, Karaj, Iran,

[3]School of Energy & Physics, Amirkabir University of Technology, P.O. Box 15875-4413, Tehran, Iran,

[*]E-mail: hafarideh@aut.ac.ir, maryamamirian@yahoo.com,

Abstract:

Shape memory properties of Poly (L-lactide)/Poly (ε-caprolactone) (PLLA/PCL) blends reinforced with Multiwalled Carbon Nanotubes (MWCNTs) was investigated. PLLA biodegradable shape memory implants have advantages in repair and regeneration of healing tissues. One of the drawbacks of PLLAs for biomedical applications is their brittleness. One of the most practical strategies for tuning the properties of PLLA is blending with PCL. In this research, we have studied the shape memory and mechanical behavior of MWCNT/PLLA/PCL blends nanocomposites. To avoid aggregation and bundling, MWCNTs were washed with ethanol. The samples with various contents of each component were prepared by solution casting. The microstructure, mechanical properties and shape memory effect of the blends and composites were investigated by means of differential scanning calorimetry (DSC), X-ray diffraction (XRD), scanning electron microscopy (SEM), polarizing optical microscopy (POM) and tensile testing. The relationship between the microstructure and shape memory properties was illuminated. Differential scanning calorimetry (DSC) of MWCNTs/PLA/PCL blends shows two glass transition temperatures (Tg) and two melting points (Tm) at positions close to the pure components revealing phase separation. The Tg and Tm of composites were increased with increasing the MWCNTs content in composites.. The XRD analysis of prepared composites shows there is a significant increase in PCL crystallization in composites by MWCNTs. The tensile tests results shows that the mechanical strength and shape recovery rate were significantly increased with increasing the MWCNTs contents in composites. The crystallinity of blend was increased with increasing the PCL in composition and in composites also the crystallinity was increased with increasing the amount of MWCNTs. The mechanical behaviour of blends and composites shows large strain after yielding and high elastic strain characteristics and exhibition good shape memory effect in which the PLLA crystal and the PCL amorphous serve as fixed phase and reversible phase, respectively. The shape recovery ratio of blend at first was decreased (15%) with increasing the amount of PCL up to 20wt%, then increased (10%) with increasing the amount of PCL until 40wt%. the shape recovery ratio of composites was increased (15%) with increasing the amount of MWCNTs up to 3wt%.

Keywords: Carbon nanotubes, Shape memory polymers, Biodegradable polymers, Poly (L-lactide), Poly (ε-caprolactone).