Structures and Properties of Injection-Molded Biodegradable Poly(Lactic Acid) Nanocomposites Prepared With Untreated and Treated Multiwalled Carbon Nanotubes

M.F. Mina, M.D.H. Beg, M.R. Islam, A. Nizam, A.K.M.M. Alam and R.M. Yunus
Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Gambang, Kuantan, Malaysia

ABSTRACT
Structural, mechanical, thermal, and electrical properties of low-loaded (0−1.5 wt%), untreated, and treated (with heat and nitric acid) multiwalled carbon nanotubes (MWCNTs)/poly (lactic acid) (PLA) nanocomposites have been studied. Among all synthesized composites, acid-treated 1.0 wt% MWCNTs reinforced PLA shows superior tensile strength and modulus to those shown by other samples. All nanocomposites including the pure PLA exhibit the orthorhombic β-form crystalline structure with low degree of crystallization, as demonstrated by X-ray diffraction study. Differential scanning calorimetry (DSC) of injection molded samples, respectively, reveals an enhancement of PLA crystallinity by 8% and 14% for untreated and treated nanotubes, relating to the observed improvement in mechanical properties. Nanocomposites show double melting behavior when crystallized nonisothermally by DSC, whilst the pure PLA shows single melting character. Thermogravimetric analysis discloses that the MWCNTs-loaded sample degraded faster than PLA. Surface resistivity of the nanocomposites is found to be dropped drastically by a factor of 10^{13} with a low loading of MWCNTs (1.5 wt%). A detailed discussion and correlation of the observed structures and properties are presented in this study.

DOI: 10.1002/pen.23564