Exploring the effect of cellulose nanowhiskers isolated from oil palm biomass on polylactic acid properties

ABSTRACT

In this work, polylactic acid (PLA) reinforced cellulose nanowhiskers (CNW) were prepared through solution casting technique. The CNW was first isolated from oil palm empty fruit bunch microcrystalline cellulose (OPEFB-MCC) by using 64% H2SO4 and was designated as CNW-S. The optical microscopy revealed that the large particle of OPEFB-MCC has been broken down by the hydrolysis treatment. The atomic force microscopy confirmed that the CNW-S obtained is in nanoscale dimension and appeared in individual rod-like character. The produced CNW-S was then incorporated with PLA at 1, 3, and 5 parts per hundred (phr) resins for the PLA-CNW-S nanocomposite production. The synthesized nanocomposites were then characterized by a mean of tensile properties and thermal stability. Interestingly to note that incorporating of 3 phr/CNW-S in PLA improved the tensile strength by 61%. Also, CNW-S loading showed a positive impact on the Youngôs modulus of PLA. The elongation at break (Eb) of nanocomposites, however, decreased with the addition of CNW-S. Field emission scanning electron microscopy and transmission electron microscopy revealed that the CNW-S dispersed well in PLA at lower filler loading before it started to agglomerate at higher CNW-S loading (5 phr). The DSC analysis of the nanocomposites obtained showed that Tg,Tcc and Tm values of PLA were improved with CNW-S loading. The TGA analysis however, revealed that incopreated CNW-S in PLA effect the thermal stability (T10,T50 and Tmax) of nanocomposite, where it decrease linearly with CNW-S loading.

Keyword: Cellulose nanowhiskers; Microcrystalline cellulose; Polylactic acid; Tensile properties; Thermal analysis