

POLY (LACTIC ACID)-NANOCELLULOSE COMPOSITES: PREPARATION, PROPERTIES AND TOUGHENING MECHANISMS

by Joseph Kinyanjui Muiruri

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Abstract

Although poly (lactic acid) (PLLA) is currently the most promising biobased biodegradable polymer, it's limited in applications where ductility and impact strength are decisive factors in material selection. Therefore, this work aimed at development of tough PLA-based biodegradable composites by incorporating various modified nanocellulose into PLLA matrix via solution cast-injection molding technique. Various characterization techniques are employed to evaluate the performance of the PLLA composites in this work.

Firstly, a systematic study of PLLA-nanocellulose composites ascertained the effects of rubber content (length) in CNC-rD-PDLA and nanofiller concentration on the tensile toughness of the composites. Secondly, the effective toughening mechanism responsible for the outstanding tensile toughness improvements in PLLA-nanocellulose composites was found to be crazing induced plastic deformation. However, there was no significant improvement in impact strength for the binary PLLA-nanocellulose composites. In this respect, PLLA ternary composites were fabricated using CNCaq-rD, and CNCaq-rD-PDLA fillers. By varying the dual fillers in the composites, both tensile toughness and impact strength were enhanced simultaneously through the synergetic effect of cavitation and crazing mechanisms. In conclusion, this thesis reveals deep insights and knowledge on nanocellulose modification and their use in toughening of PLLA, which increases the portfolio of sustainable PLA materials

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Biography

Joseph Kinyanjui Muiruri is a Ph.D candidate in Assoc. Prof. He Chaobin' group at National University of Singapore (NUS) and Institute of Material Science and Engineering (IMRE). Joseph graduated with a Masters degree from University of Nairobi, Kenya in 2011. He holds a Bachelor's degree in Textile engineering from Moi University, Kenya. His research interests focuses on biobased polymers and composites for industrial applications.

ALL ARE WELCOME!

A/Prof Xue Jun Min Host