Mechanical & Industrial Engineering
UNIVERSITY OF TORONTO

MIE498H1: Research Thesis 2023-2024

Supervisor	Patrick Lee
Supervisor email	patricklee@mie.utoronto.ca
Number of Positions	1
Open to	Mechanical Engineering Students
Term Offered	Full-Year (Y)
Research Area	Materials
Research Topic	Optimizing the Microstructure of Bioplastic PLA with Lignocellulosic Biobased Nanofibrils

Project Description

Crystallization kinetics are of interest in industrial processes for the mechanical, barrier, and optical transparency qualities of any PLA-based composites and materials. As a rather slow crystallizer, PLA is generally enhanced by a nucleating agent such as talc in order to produce desirable microstructures. A recent study has demonstrated that cellulose-derived products have tremendous potential to act as nucleating agents. Moreover, such products would be widely accessible around the world, cheap, offers a vector to repurpose waste products from the pulp industry, and is 100% bio-based and biodegradable. Within this body of work, lignocellulosic nanofibrils (LCNFs) are synthesized in-house and spray dried before melt compounding into PLA at varying concentrations. An isothermal crystallization procedure will be created in order to produce a desired crystal microstructure. The resultant composite's tensile and barrier properties will be evaluated in order to corelate the performance of the composite with the crystal microstructure, crystallization procedure, and LCNF concentration to develop material-process-structure-property relationships. If time permits, the inclusion of a small amount of polyethylene glycol (PEG) will be investigated to observe synergistic benefits of PEG with LCNF in enhancing the aforementioned properties of PLA. These are the most pertinent performance indicators that must be established in the development of bio-degradable PLA-based packaging alternatives.

Additional Information	N/A
Application Instructions	Please submit CV, unofficial transcript, to Prof. Patrick Lee (patricklee@mie.utoronto.ca)