



MIE498H1: Research Thesis 2023-2024

Supervisor	Patrick Lee
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Number of Positions	1
Open to	Mechanical Engineering Students
Term Offered	Full-Year (Y)
Research Area	Materials
Research Topic	In-situ Multi-optical Visualization of Phase Change of Polymer/Supercritical Fluid Mixture

Project Description

Microcellular foaming process of polymer/supercritical fluid (SCF) mixed system is an advanced forming technology preparing the lightweight and functional polymer with micro/nano scaled porous structure. However, due to the diversity of polymer materials and their high sensitivity to the environment, determining the foaming process scheme and improving product performance by optimizing the cell structure is a time-consuming and costly process for engineers. In order to solve this problem and master the phase change mechanism of polymer/SCF mixture, our lab will develop a new multi-optical in-situ high pressure visualization device. Based on an autoclave with two sapphire windows, this project will build three optical path systems (microscopy optics, polarization optics and small angle laser scattering) to observe the bubble nucleation & growth, and crystal morphology evolution of polymer/SCF mixed system. With this device, this project will study: 1) the bubble collapse and the suppression methods in foaming process of elastic polymers; 2) the limited crystallization behavior of polymer films with nanoscale thickness; 3) the formation and texture orientation of fibrous crystals; and 4) the influence mechanism of high-pressure gas on the morphology and growth kinetics of polymer crystals.

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