Mechanical & Industrial Engineering
UNIVERSITY OF TORONTO

MIE498H1: Research Thesis 2025-2026

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	Highly Stretchable and Self-Healable Organic Semiconductors for Health Monitoring Wearable Sensor

Project Description

One of the main challenges in stretchable electronics is developing conductors that maintain performance and durability despite repeated deformation. Stretchable conductors with self-healing properties offer a promising solution, as they can repair themselves after damage. However, most existing self-healing conductors cannot simultaneously heal both conductive and insulating layers. In this work, we present a novel approach to synthesize stretchable self-healing conductors based on partially silane-terminated polyurethane (PU) reinforced with carbon-based conductive fillers: graphene nanoplatelets (GNPs), carbon nanotubes (CNTs), and carbon quantum dots (CQDs). We hypothesize that silane terminations provide chemical bonding between the PU matrix and conductive fillers, enhancing interfacial adhesion and preventing disruption of the conductive network under strain. To test our hypothesis, we will compare the electrical properties of composites containing different fillers and correlate them with their self-healing abilities. We will measure the electrical conductivity of the conductors under cyclic loading and their fatigue strength before and after self-healing. This will allow us to determine which filler provides the best balance between conductivity and self-healing ability. Additionally, we will investigate the effect of processing conditions on the properties of the composites, including filler content, mixing time, and curing temperature. By optimizing these conditions, we aim to develop stretchable self-healing conductors with improved performance and durability. Overall, our research has the potential to significantly advance stretchable electronics by providing a new approach to developing self-healing conductors with enhanced performance and durability. This could have wide-ranging applications in wearable electronics, soft robotics, and biomedical devices.

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