

## Faculty of Engineering

### Summer Research Program 2022-2023

Project Title: Stereolithographic 3D Printing of Semicrystalline Thermoplastics

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#### Objective

The objective of this project is to develop an approach for rapid, stereolithographic additive manufacturing using photopolymerisation of ring-opening monomers. We will study the influence of resin formulation on photopolymerisation kinetics, crystallisation, and anisotropy to increase fabrication rates and improve polymer properties and reprocessability.

#### Project Details

Additive manufacturing (AM) methods enable facile fabrication of exceptionally complex objects with internal features unobtainable by conventional methods. Commonly called 3D printing, these technologies typically produce three-dimensional structures by successive addition of thin layers of material. The ability to create complex objects without the constraints of conventional manufacturing has made AM very attractive, particularly for the production of prototype and low-volume parts in a variety of industries. While current AM technologies are able to address bespoke and low volume opportunities, significant gaps remain that prevent their use for high volume, durable applications.

This project involves a vat polymerisation process known as stereolithography (SLA) where a patterned illumination source is used to cure cross-sectional layers of a photopolymerisable resin in a vat to form the desired geometry. Unfortunately, the speed of many SLA processes is limited either by adhesion of cured polymer to the projection window or by resin surface disturbances, necessitating time-consuming separation or recoating steps between successive layers. This limitation will be addressed by employing a dual-wavelength system to precisely control the photopolymerisation of ring-opening monomers in stereolithographic AM. Moreover, in contrast to the cross-linked polymer networks (i.e., thermosets) employed ubiquitously as SLA printing media which are ill-suited for reprocessing or recycling, the semicrystalline thermoplastics employed here provide not only excellent mechanical, thermal, and chemical properties but offer sustainable options for end-of-life reprocessing.

#### Prerequisites

Completion of coursework units in organic or polymer chemistry would be advantageous.