

Project Title: 3D Printing of Frontally Polymerizable Resins with Tunable Stiffness

Advisor: Jia En Aw (PhD student in AE), Prof. Nancy Sottos (MatSE)

Project Description:

Additive manufacturing has widespread uses across many industries due to its versatility and capabilities. However, fabricating free-form thermoset polymers remains a technical challenge. Our group recently developed a technique to print free-form structures (Fig. 1a) by curing our dicyclopentadiene-based (DCPD) printing ink as it is being extruded (Fig. 1b,c). Upon extrusion, the viscoelastic ink is cured via frontal polymerization (FP). The FP process is initiated by an external thermal stimulus to generate a localized exothermic polymerization that transforms gel to solid polymer. The heat from this local polymerization then activates adjacent gel to further the curing process, thereby forming a self-sustaining propagating reaction wave that polymerizes the extruded filament. The polymerized segment of the filament can structurally support its own weight, allowing for fabrication of three-dimensional (3D) free-form prints without additional supports (Fig. 1d,e). Current work involves blending the printing ink with other resins to achieve tunable stiffness. As an undergraduate research assistant, you will be trained to prepare the resins for 3D printing via *in situ* rheological measurements. The manufactured samples will be characterized using differential scanning calorimetry (DSC), dynamic mechanical analysis (DMA), and mechanical testing.

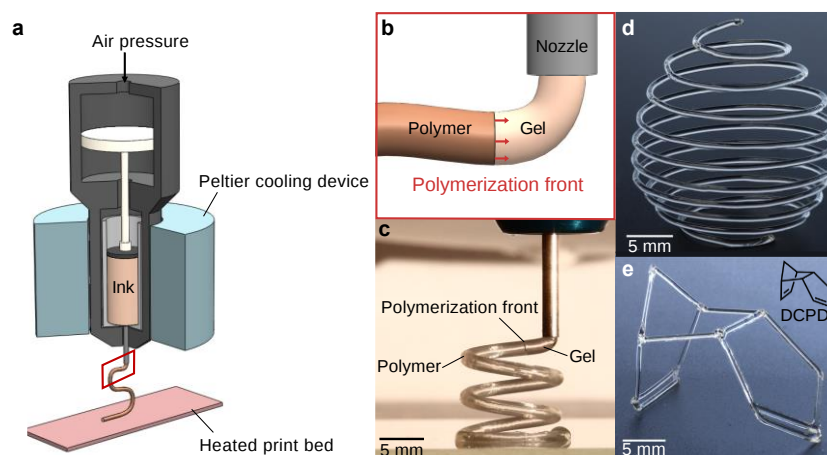


Fig. 1 (a) Schematic of the 3D printing assembly and (b) close-up of the FP front following the print nozzle. FP free-form printing of (c) a helix, (d) a ball helix, and (e) a DCPD chemical molecule.

Student background and expected research activities:

We are seeking a highly motivated student interested in *polymer science and/or additive manufacturing*. Prior experience in polymer characterization is desirable. The student should feel comfortable working in a wet lab environment, be able to follow procedures in a precise manner, and possess strong communication skills.

Points of Contact:

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