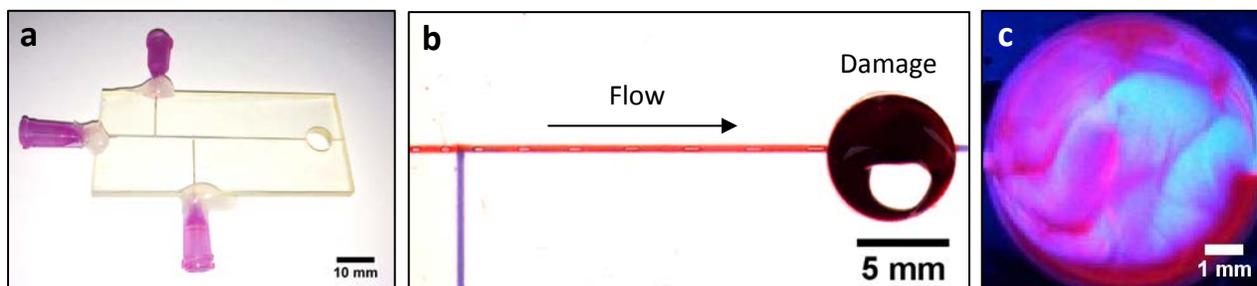


**Project Title:** Mechanical Testing of Material Regenerated via Multiphase Microvascular Flow

**Advisor:** Leon Dean (PhD student in MatSE), Prof. Nancy Sottos (MatSE)

**Project Description:**

Our research group has developed a bioinspired two-stage healing chemistry that can regenerate polymeric material lost as a result millimeter-scale damage events such as puncture. The chemistry is delivered to the damage area via microvascular networks embedded in the native polymeric substrate. One of the inherent limitations of the microvascular system is incomplete mixing of the healing agents. Recent results demonstrate enhanced mixing by using segmented gas-liquid (multiphase) microvascular flow to deliver the healing agents. We hypothesize that enhanced mixing will lead to improved mechanical properties of the regenerated material. As an undergraduate research assistant, you will help to test this hypothesis. You will fabricate epoxy polymer specimens with internal microvascular networks shaped by 3D printing of a sacrificial ink (see **Fig. 1a**). You will then run healing experiments with these specimens with various microfluidic delivery schemes (see **Fig. 1b**). Finally, you will test the mechanical properties, including interfacial strength, of healed specimens using a custom setup. The goal is to demonstrate and quantify an improvement in mechanical properties associated with multiphase microvascular flow. Note: if desired, there is also opportunity to be involved in the organic synthesis of healing components.



**Fig 1. a)** Microvascular epoxy specimen with simulated damage region. **b)** Multiphase microvascular flow and material regeneration during the course of a healing experiment. **c)** Fluorescent dyes reveal the poor mixing associated with liquid-liquid laminar flow.

**Student background and expected research activities:**

We are seeking a motivated, enthusiastic student with interests in *self-healing materials*, *polymer chemistry*, *mechanical testing*, and/or *microfluidics*. Hands-on experience in these fields is desired, but not mandatory, as the student will receive the necessary training to perform the experiments in question. The student should be comfortable handling chemicals and operating testing equipment, be able to follow procedures in a precise manner, and possess strong communication skills.

**Points of Contact:**

Leon Dean (lmdan2@illinois.edu), Prof. Nancy Sottos (n-sottos@illinois.edu)

**Funding:** Air Force Office of Scientific Research (AFOSR)