Project Title: Adaptive Polymer Composites with Dynamically Reversible Matrices

Advisor: Evan Lloyd (PhD student in ChBE), Prof. Scott R. White (AE)

Project Description:
Composite materials owe their exceptional performance, in part, to high-strength (irreversible) bonding. While these bonds provide for long-term, stable performance, the irreversibility makes healing of the material following damage impossible and disposal of the materials at the end of life problematic both for industry and the environment. As such, there is a need for the design of new polymer matrices that can undergo cycles of degradation and reformation under mild conditions. Currently, several classes of polymers that incorporate dynamic reversibility or metastability into their backbones are under investigation as suitable matrices for fiber-reinforced polymer composites. As an undergraduate research assistant, your project will be to fabricate fiber-reinforced polymer composites subject to processing constraints defined by the newly designed polymers. You will then aid in identifying and characterizing the conditions necessary to initiate healing or recycling. You will also examine the mechanical properties of the materials before and after healing or recycling. The goal is to find matrices that provide for exceptional mechanical properties and can undergo healing or recycling in response to mild conditions to afford materials with similar properties as the virgin material.

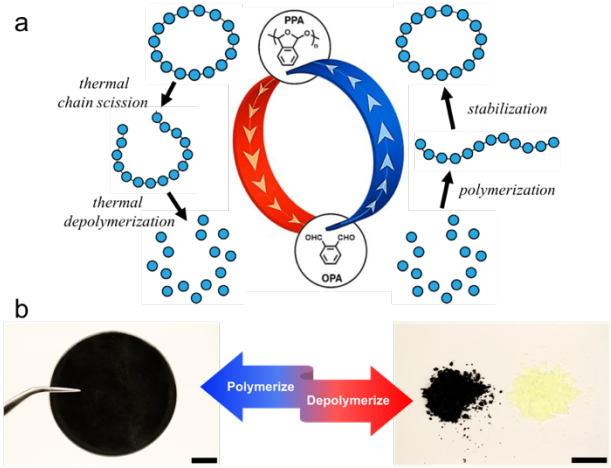

Figure 1. a) Schematic detailing the thermally mediated recycling of a metastable polymer – cyclic-poly(phthalaldehyde). b) Thermally-mediated recycling of cyclic-poly(phthalaldehyde)/ carbon nanofiber composites (left). Depolymerization products and nanofibers are obtained separately following exposure to 120°C for one hour (right). All scale bars are 10 mm.

Student Background and Expected Research Activities:
We are seeking a self-motivated and enthusiastic student who is interested in *smart materials, composite manufacturing,* and *polymer chemistry*. Hands-on experience in these fields is desired, but not required. The student should be able to operate manufacturing and testing equipment, follow strict safety protocol, follow procedures in a precise manner, and possess strong communication skills.

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