Polymer Architecture Effects on Mechanochemical Reactions

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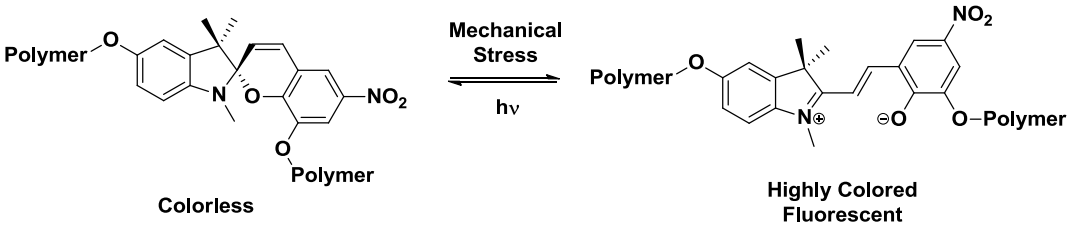
Mechanophores are molecules that utilize mechanical forces to initiate chemical transformations. Recently, polymer-functionalized spiropyrans have been established as mechanophores in both solution and in the solid-state. When correctly attached to a polymer of sufficient molecular weight, a visible color change and fluorescence can be observed when the polymeric material is subjected to mechanical deformation. This color change is attributed to a 6-π electrocyclic ring-opening of the spiropyran initiated by mechanochemical transduction of macroscopic forces the molecular level to yield the highly conjugated merocyanine form of the mechanophore.



Furthermore, polymer architecture is thought to play a significant role in influencing these mechanochemical reactions. Building off our group's previous work with linear and crosslinked polymers, this project investigates a new class of mechanophore-linked star polymers with the use of our well-characterized spiropyran mechanophore. We seek to answer the following fundamental questions: 1) How does the rate of mechanochemical reactivity of star polymers compare to linear polymers? 2) Is the rate of reactivity a function of total molecular weight of the polymer or individual arm length? 3) Is there a difference in mechanochemical reactivity of star polymers in solution and the solid state? Herein, a description of the synthesis, testing, and preliminary results for mechanophore-linked star polymers will be described.