Spiropyrans as Color-Generating Mechanophores

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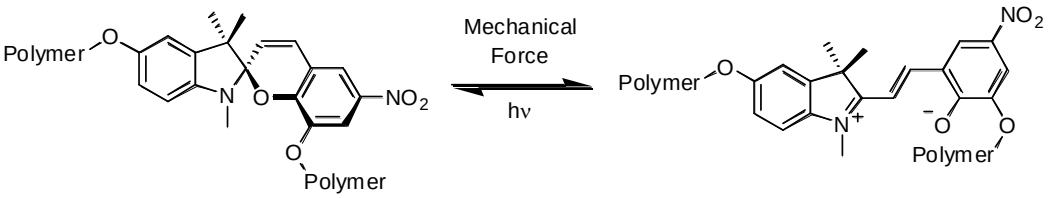
Mechanically activated reactions are emerging as a complement to traditional activation methods that use light, electrical, or thermal energy. Previous efforts by our group have shown that ultrasound can be used to stress mechanophore-linked polymers to study mechanochemical reactivity. Azo-linked polymers and benzocyclobutene-linked polymers were respectively shown to undergo site-specific cleavage and 4π electrocyclic ring opening in response to mechanical stress. In an effort to expand this work, we have designed and synthesized a spiropyran-linked polymer that undergoes a 6π electrocyclic ring opening and consequently changes color upon application of stress.



The spiropyran-linked polymer has exhibited reversible color changes upon the application of mechanical force in solution (sonication) and in the solid-state (stretching or indentation). It has also been shown that the solid state color change can occur in polymers both above and below their glass transition temperatures. A mechanically inactive control spiropyran, functionalized on only one side of the spiro C-O bond, did not exhibit mechanochromic properties. These results have interesting applications in both the chemical and engineering fields as stress-responsive, self-assessing materials that could be used for damage detection.

Unstressed **Stressed**