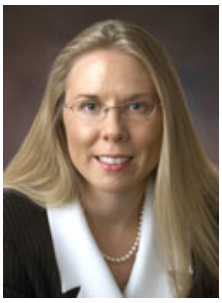
Brown University

Institute for Molecular and Nanoscale Innovation

# "Mechanochemically Active Polymeric Materials"




## Nancy Sottos

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## Thursday, November 6, 2008
## Barus & Holley, Room 168
## 4:30 PM

## Abstract


Damage in polymeric materials is preceded by complex spatial and temporal changes in stress state. Mechanical force activates covalent bonds in the polymer, but the typical result is chain scission and ultimately failure. The goal of current research is to utilize changes in stress state to mechanically activate, without human intervention, chemical changes that favorably alter the material properties of the polymer, prior to failure. While biology is replete with examples of active materials systems that respond to mechanical stimuli (*e.g.* ion channels, cellular motility, bone regeneration), a synthetic analog in solid state polymers is lacking. This seminar discusses a new strategy to impart productive mechanochemical response in both elastomeric and glassy polymers. Mechanophore linked polymers are prepared and subjected to a range of loading conditions. Evidence of local chemical reaction is provided by a color generating mechanophore that undergoes an electrocyclic ring opening reaction under tensile mechanical deformation. Testing of the polymer samples was conducted in one of two ways depending on the viscoelastic nature of the polymeric solid. Elastomeric materials consisted of mechanophore polymerized into poly(methyl acrylate) (PMA) containing a single mechanophore per chain. This polymer was molded into a dogbone specimen, which could then be stretched or fatigued under displacement control while monitoring the applied stress. Glassy materials consisted of mechanophores that were suspension copolymerized with methyl methacrylate (MMA) into micron-scale beads. These PMMA beads were compressed with an actuator coupled to a load cell, which allowed for strain rate control while monitoring the resulting stress. In both cases a bulk color change was observed after loading past the yield point of the polymer. Color intensified significantly with the accumulation of plastic strain as a result of the mechanochemical transduction event in these polymer systems.


**Please join us after the seminar at the IMNI Science Mixer at 5:30pm**

**in Barus & Holley, Room 723/724 for conversation on *Imaging*.**

Host: L.B. Freund, Professor of Engineering with the Institute of Molecular and Nanoscale Innovation
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