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Mechanophore-Grafted Polymers to Form Stress-Responsive Thermoset Network

Identifying damage detection is critical in many industries to reduce catastrophic failure. Mechanochemistry is the study of stress-responsive molecular units that sense force changes in their local environment to allow for determination of the stress, strain, or damage applied. Certain mechanophores have a florescent emission when undergoing stress. This stress-responsive quality is desirable in damage detection. Although mechanochemistry has provided useful insight, stress-sensitive epoxy thermoset polymer networks have yet to be studied. Therefore there is a need to examine stress-responsive epoxy thermoset polymer networks in order to improve the overall quality of damage detection.

Researchers at ASU have developed novel approaches to grafting photoactive mechanophore units into epoxy matrixes. These methods have created a successful formation of self-sensing nanocomposites and achievement of the early damage detection functionality. Compression tests were used to apply damage to the mechanophore-embedded networks, and fluorescent early damage detection occurred immediately after the yield point for both the cinnamamide and di-cinnamamide systems. Early damage detection is necessary because it reduces cost by identifying damage prior to catastrophic failure and eliminating the need for self-monitoring sensors.

Potential Applications

- Damage Detection in pipeline structures
- Damage Detection in laminates
- Damage Detection in wind turbines

Benefits and Advantages

- Florescent Early Damage Detection – damage detection occurred immediately after the yield point
- Self-Sensing – a chemical reaction caused during stress or strain is induced revealing damage detection under florescent lighting
- Lowers Cost – eliminates the need for self-monitoring means such as crack sensors

For more information about the inventor(s) and their research, please see

Dr. Lenore Dai's directory webpage

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