Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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In-situ damage detection system for mechanpohore-embedded fiber reinforced composites

Composites often fail due to mechanical wear, abrasion, friction and stress they experience during use. Mechanophores have emerged as a strategy for detecting damage caused by these mechanical loads. Mechanophores embedded in composites undergo a chemical reaction when significant damage occurs and typically change to a fluorescent color as a signal for damage detection. However, there are limitations with using current mechanophore strategies for testing composites. Current methods are only able to detect damage after significant or permanent damage has occurred. Furthermore, this strategy generally only works for transparent composites, as opaque composites embedded with mechanophores only detect damage at the surface. Private and commercial manufacturers are constantly testing new composites and are in increasing need of better strategies to manage composite deficiencies.

Researchers at Arizona State University have developed an innovative new damage detection system for mechanophore composites using Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy (ATR-FTIR). The ATR-FTIR system is composed of an UV camera, UV lamp, band-pass filter and load-frame. Mechanophore embedded composites under mechanical loading form UV fluorescence which is captured by the system. In addition, this form of detection occurs while in-situ and before any early stage of mechanical deformation occurs. ATR-FTIR is also advantageous over current detection systems as it allows for surface characterization of composites and is capable of testing composites with higher densities and little-to-no transparency. Furthermore, the cooperation of features in this innovative system detects damage continuously, providing detailed composite data.

Potential Applications

- Composite Development (DoD, Civil, Mechanical)
- Structural Health Monitoring
- Non-Destructive Examination
- Thermoplastics

Benefits and Advantages

- Innovative – The system provides a simpler, faster, and more sensitive

system for detecting damage with a wider availability over current mechanophore detection methods
- Detailed – Minimal impact and damage can be detected and analyzed before composites suffer permanent deformation
- Precise – System allows a linear relationship between force and UV fluorescence providing better composite behavior analysis.
- Versatile – Real-time detection and vast material compatibility provide limitless potential

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

Aditi Chattopadhyay's Directory Page

Lenore Dai's Directory Page