Richard P. Feynman Center for Innovation

Technology Snapshot

Technology Licensing Opportunity

Los Alamos NATIONAL LABORATORY

Real-Time Polymer Cure Monitoring System

A non-destructive method for continuous monitoring of polymer curing during processing

Value Proposition

This technology enables real-time, non-destructive monitoring of polymer curing, providing direct insight into when a material has reached its desired performance state. By correlating chemical transformation with stiffness development, the system improves process control, reduces material waste, minimizes rejected parts, and enhances manufacturing consistency across a wide range of polymer-based systems.

Technology Readiness Level 3

IP Information

This technology is disclosed under "*Real-Time Polymer Cure Monitoring System*."

Contact: licensing@lanl.gov

Please include LANL Reference ID **S-167716.001** when reaching out.

Overview

Polymers such as epoxies, adhesives, coatings, and composite matrices undergo complex transformations as they cure. Determining when a material has fully developed its required mechanical properties can be challenging, particularly when relying on time-based estimates or post-process inspection.

Inaccurate cure assessment can result in inconsistent performance, unnecessary delays, excess energy usage, or premature material failure. A reliable, in-place monitoring approach provides greater confidence in process outcomes and material readiness.

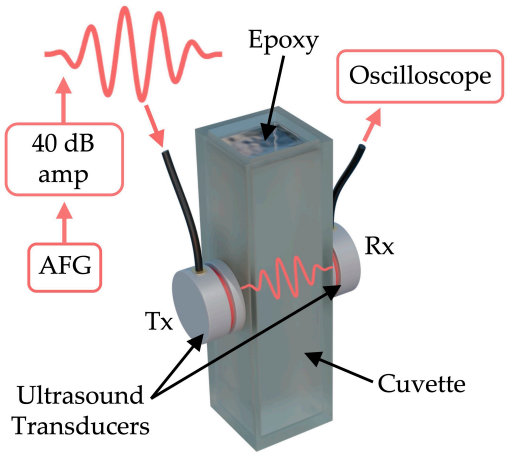

Fig 1. This schematic shows an ultrasound system used to monitor epoxy curing in real time. A function generator and power amplifier create a controlled sound pulse, which is converted into an ultrasonic wave by a transmitting transducer (Tx). The wave travels through the epoxy sample, which is contained in a small mold (cuvette), and is detected on the other side by a receiving transducer (Rx).

An oscilloscope records how the signal changes over time, allowing us to calculate the speed of sound in the material.While the schematic illustrates a cuvette-based configuration, the monitoring approach can also be adapted to different mold geometries, flowing materials, or in-place manufacturing processes where the polymer is curing during application or assembly.

Advantages

- Real-time, in-place monitoring during processing
- Non-destructive evaluation
- Direct linkage between chemical change and mechanical performance
- Improved process control and reproducibility
- Reduced scrap and rework
- Applicable across a broad range of polymer and composite materials

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Technology Description

Los Alamos researchers developed an integrated monitoring platform that tracks curing progression in real time without disrupting the material or process.

The system uses ultrasonic measurements to continuously evaluate changes in material stiffness as curing advances. A controlled acoustic signal passes through the polymer, and changes in sound speed provide a direct indicator of structural development. Because sound propagates faster as the material stiffens, these measurements offer a clear, continuous measure of cure state.

This acoustic monitoring is aligned with complementary chemical-state measurements, enabling correlation between molecular evolution and bulk mechanical performance. Automated data acquisition allows continuous monitoring at user-defined intervals, supporting both laboratory development and scalable manufacturing environments.

The monitoring approach is not limited to a specific mold geometry or laboratory configuration. While the schematic illustrates testing within a cuvette, the system can be implemented across varying mold sizes and types, integrated into flowing or actively mixed materials, or applied directly during manufacturing processes. This enables characterization during adhesive bonding, coating application, composite layup, or other in-place curing scenarios where no mold or cuvette is used.

Market Applications

This technology is relevant to organizations involved in:

- Polymer and composite manufacturing
- Adhesive and coating formulation
- Advanced materials development
- Quality assurance and process optimization
- High-performance structural materials
- Industrial production environments requiring cure verification

Contact

To learn more or to discuss potential interest in this technology, please contact the Feynman Center for Innovation at licensing@lanl.gov.

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