MARKET SHEET

Molecular Systems for Polymer Durability

Sandia National Laboratories

By addressing thermal expansion mismatch, this innovative molecular system can enhance polymer durability for a wide range of applications.

US Patent Pending

Technology Readiness Level 4-5

Business Problem

Polymers are lightweight, cost-effective, easily molded, and have good chemical resistance so they can be used in many diverse environments. A limitation in polymer manufacturing is they can expand and contract more than other substances with temperature changes, which can lead to issues like dimensional instability or stresses when combined with other materials like metals. Repeated exposure to temperature fluctuations can build up stresses in a system, leading to cracking and warping. This thermal expansion mismatch affects durability and performance, and it requires a solution that mitigates these issues. Furthermore, it is challenging for companies to design and manufacture products that have numerous components with differing material characteristics that need to interact compatibly.

Customer Need

There is a demand for enhanced polymers that demonstrate controlled thermal expansion properties comparable to metals, to address challenges arising from differences in thermal expansion. Customers seek a versatile solution that can be incorporated into polymers used in electronics, automotive components, aerospace applications, defense systems, and more. A solution that does not require the use of excess fillers is needed to avoid adding weight to products.

Sandia Approach

Researchers at Sandia National Laboratories have developed a unique molecular system that, when incorporated into polymers, modifies their properties and enables them to match the expansion and contraction values of metals, addressing heat-induced mismatch issues. This enables polymers to behave more like metals when heated, effectively reducing thermal expansion mismatch. The molecules can be added to different kinds of polymers at varying percentages, allowing for design flexibility and 3D printing.

Competitive Advantage

Sandia's solution offers controlled thermal expansion in polymers on par with metals. This innovation allows companies to more efficiently design and manufacture products that contain a wide variety of materials. Existing solutions to address coefficient of thermal expansion mismatch often rely on the use of fillers or compliant layers. These approaches have limitations such as increasing the weight of objects, reducing mechanical properties, adding complexity to a product's design, or incomplete elimination of thermal mismatch.

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Next Steps

Sandia is actively seeking partners to develop and commercialize this technology. Collaborating with Sandia can enable further refinement and implementation of the molecular system's integration into various applications.

For more information, please contact Sandia National Laboratories' Licensing and Technology Transfer office.

Technical Benefits

- **Enhanced Durability:** The modified polymers with the innovative molecule exhibit reduced thermal expansion, improving their resistance to cracking and warping.
- **Design Flexibility:** The molecule enables the creation of structures with tailored thermal behaviors, opening design space for future innovations.
- **Weight Reduction:** By eliminating the need for heavy fillers, the molecule helps reduce the weight of materials, making it valuable in weight-sensitive applications such as aerospace and defense systems.

Industries & Applications

- **Electronics:** Circuit boards, connectors, and protective coatings.
- **Automotive:** Engine parts, interior trim, and exterior body panels.
- **Aerospace:** Structural elements, interior components, and protective coatings.
- **Defense Systems:** Military equipment, vehicles, and protective gear.
- **Consumer Products:** Plastic phone cases, household appliances, sporting goods, and more.
- **Industrial Applications:** Manufacturing, construction, and packaging industries that utilize polymers.

Contact Us

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U.S. DEPARTMENT OF ENERGY NNSA National Nuclear Security Administration

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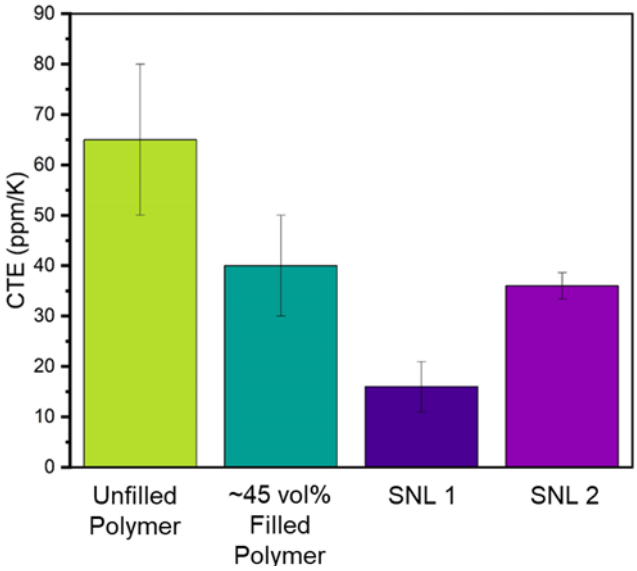

Above: Coefficient of thermal expansion (CTE) across polymer types

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