Materials and Coatings

Shape Memory Alloys

Ideal for high force, large stroke, and modest frequency response operations

NASA's Glenn Research Center invites companies to establish partnerships to investigate potential applications for Shape Memory Alloys (SMAs). SMAs are materials that can be deformed at low temperature and recover their original shape upon heating. Glenn Research Center has been working to develop new alloys that can operate up to ~300 °C, compared to ~80 °C for commercially available alloys. In addition, NASA has been working on supporting technologies (modeling tools, design methodologies, test standards, material supply chain, etc.) that will promote the application of shape memory alloys for adaptive structures and actuators.

BENEFITS

- Provides high force (per volume/weight) allowing lightweight compact actuator designs
- Eliminates extraneous systems (hydraulic, pneumatic, etc.)
- Responds to temperature change, which eliminates the need for sensors and electronics
- Enables simple, frictionless designs that result in less maintenance

technology solution

THE TECHNOLOGY

SMAs are alloys that have memory. The materials are deformed at low temperature and recover to their original shape upon heating. Applications of SMAs have been limited due to their low transformation temperatures. Glenn has been working to develop new high transformation temperature SMAs and as a result has developed a suite of high work output SMAs as well as design application tools and expertise.

SMAs can be used in passive, active, or superelastic design applications. Passive design applications result from the material heating during normal operation resulting in an actuation force. Active design applications use the material below its transformation temperature and of supplemental heat to provide an "on-demand" actuation force. Superelastic design applications use the material above its transformation temperature resulting in transformation due to stress.

SMAs are ideal for high force, large stroke, and modest frequency response operations. One example application currently being developed has an SMA to replace a traditional motor/gearbox actuation system at significant weight savings.

A spring made from a shape memory alloy.

APPLICATIONS

The technology has several potential applications:

- Adaptive structures
- Actuators
- Heat detection devices
- Medical devices
- Oil/gas down-hole
- High-temperature automotive
- Aeronautics
- Military

PUBLICATIONS

U.S. Patent 7,501,032

More Information

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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