nal Aeronautics and Space Administration

Materials and Coatings

Durable Aerogel Technologies

For thermal insulation and lightweight structures

NASA-developed polyimide aerogels are 500 times stronger than conventional silica aerogels. The innovation represents a revolutionary advance over fragile silica aerogels because it is highly flexible and foldable in thin film form. As a thin film, it can be used to insulate industrial pipelines, automotive shields, temporary housing structures, and within protective clothing such as firefighting jackets, space suits, and parkas. As a thicker part, it can be easily molded to a shape, or sanded and machined to provide insulation as well as mechanical support. No other aerogel possesses the compressive and tensile strength of the NASA innovation while still retaining its ability to be flexibly folded to contour to whatever shape is needed.

BENEFITS

- Thin and flexible—can be manufactured in a flexible form yet maintain excellent tensile properties
- Strong—500 times stronger than traditional silica aerogels; thick panels can be used as multifunctional insulation
- Versatile—can be custom manufactured as molded shapes and thin films
- Low thermal conductivity—2 to 10 times improved performance over polymer foams in ambient condition and up to 30 times improved performance in vacuum conditions
- Heat resistant up to 200 to 300 degrees Celsius for long-term use
- Moisture resistant

technology solution

THE TECHNOLOGY

Aerogels are highly porous, low-density solids with extremely small pore sizes, making them superior insulators. However, the most studied silica aerogels are fragile. The NASA Glenn team is the first to synthesize polyimide aerogels by cross-linking through an aromatic triamine or polyhedral oligomeric silsesquioxane, octa-(aminophenyl)silsesquioxane, and chemicalyl imidizing at room temperature. The resulting product is a cross-linked polyimide aerogel that retains the beneficial characteristics and strength of polyimide materials and adds the beneficial properties of aerogels, but without the brittle and fragile nature of silica aerogels.

Current silica aerogels on the market are available in particulate form or as a composite blanket. These aerogels are fragile and shed dust particles in use. The cross-linked polyimide aerogels have much better mechanical properties than silica aerogels and do not shed dust particles. They can be fabricated or machined into thick net shape parts, which are strong and stiff, or cast as thin flexible films with good tensile properties. Extremely customizable, the innovation can be formed into whatever configuration is required (e.g., wrapped around a pipe, sewn into protective clothing, or molded into a panel to act as a heat shield in a car) so it has an advantage over other aerogels that exist in block form and must be modified or chemically altered to function as a form-fitting insulation.

APPLICATIONS

The technology has several potential applications:

Thermal insulation – for refrigeration, housing, industrial pipelines, automotive, and medical supplies

Lightweight sandwich structures – to reduce weight of automobiles and aircraft

Antennas – low dielectric materials for antennas (aircraft, cell phones, satellites, etc.)

Filtration media – for air and water purification and gas separation

Flexible, thin insulation – for protective clothing, space suits, and shelter applications

PUBLICATIONS

Patent Pending

More Information

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