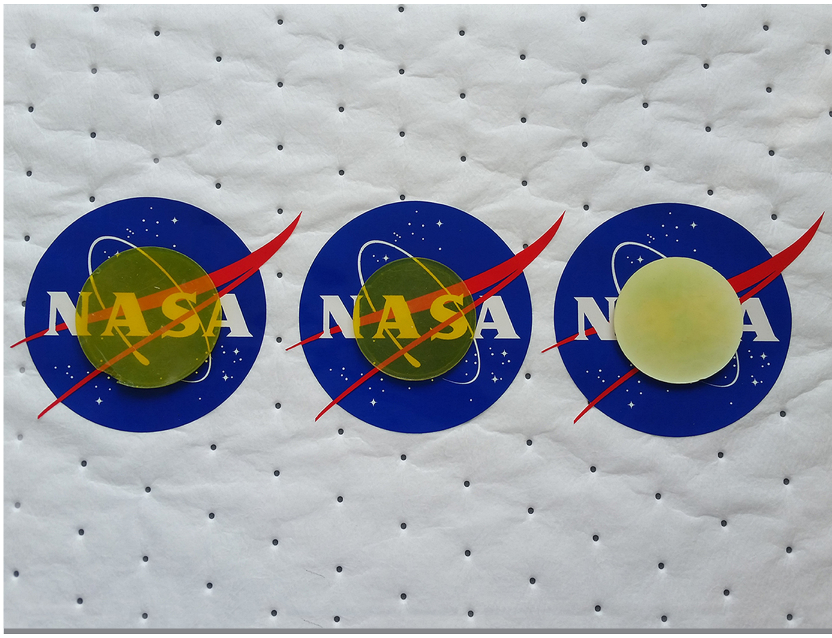


National Aeronautics and
Space Administration

TECHNOLOGY SOLUTION

Materials and Coatings

Optically Transparent Polyimide Aerogels

Highly porous aerogels with low thermal conductivity

Innovators at NASA's Glenn Research Center have expanded their growing portfolio of aerogels to include a new optically transparent polyimide aerogel. Aerogels - low density, highly porous, ultralight materials derived from gels - can be fabricated to achieve specific, desirable traits, including various ranges of optical transparency. In the past, high optical clarity was most commonly produced in silica aerogels, which shed dust particles and are notoriously fragile and brittle. In contrast, polyimide aerogels possess remarkable strength and flexibility. They are often used in aerospace applications due to their ability to retain their physical and mechanical properties in thermally and chemically demanding environments. Glenn's new polyimide aerogel maintains the robust nature of a polyimide network, while providing the added feature of extremely high surface areas and uniform pore size and distribution. This unique combination of strength, transparency, and exceptional insulating properties make these aerogels ideal for replacing windows, windshields, and more at a fraction of the weight and without the use of harmful or toxic chemical coatings.

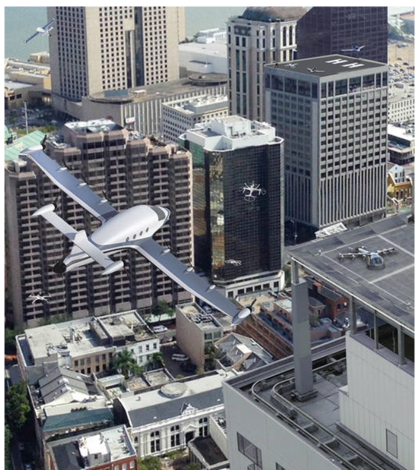
BENEFITS

- Optically transparent: With a refractive index close to 1, this aerogel technology has high optical transmission, low haze, and high optical clarity
- Low thermal and acoustic conductivity: These aerogels are ideal for advanced thermal and acoustic insulation applications
- Strong: A crosslinked polyimide skeletal structure, homogenous pore size and large surface area make these aerogels impact resistant and exceptionally strong
- Flexible and lightweight: Offers multiple levels of flexibility and can be crafted into thin, lightweight films
- Robust: Can retain physical and mechanical properties in thermally and chemically demanding environments

THE TECHNOLOGY

Innovators at NASA Glenn have devised a new method for harnessing the high transmission and clarity associated with optical glasses in a robust polyimide aerogel. This process uses sol-gel synthesis technology with aromatic dianhydrides and diamines as the precursors, and a trifunctional triacid chloride that arranges itself into a three-dimensional (3D) matrix with a low refractive index. The liquid portion of the gel is then removed by supercritical fluid extraction in order to produce the polyimide aerogel and maintain the desired 3D structure without pore collapse. The result is a cross-linked polyimide aerogel that allows for light wave transmittance while retaining low thermal conductivity. This unique material can be made into thin blocks, or highly flexible films as thin as 0.5 mm. While some embodiments have a yellow color, other embodiments may be nearly colorless. When compared to high-opacity polyimide aerogels, they have much greater surface area (up to 880 m^2/g) and a very homogenous pore size (10 to 20 nm) with only a minor penalty in density (0.15 g/cc vs 0.10 g/cc). These strong, optically transparent aerogels incorporate a number of unique properties with applicability to a host of potential new applications, making this innovation a game-changer in the global aerogel market. Glenn welcomes co-development opportunities.

Windows in buildings could be replaced with transparent aerogels that allow light transmission while remaining thermally insulating



These aerogels could be used to create impact resistant, lightweight windshields with low thermal and sound conductivity for autonomous vehicles

APPLICATIONS

The technology has several potential applications:

- Acoustic insulation (e.g. sound proofing)
- Aeronautics and aerospace (e.g. windshields, coatings)
- Antennas
- Architecture and construction (e.g. skylights, windows)
- Automotive
- Camping and exercise gear (e.g. water bottles, coolers)
- Optoelectronics (e.g. screen protectors)
- Optical sensors
- Protective clothing and gear
- Thermal insulation

PUBLICATIONS

Patent No: 10,800,883

More Information

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