DATA SHEET

NASA's Glenn Research Center's Mechanically Strong, Flexible Polyimide Aerogels

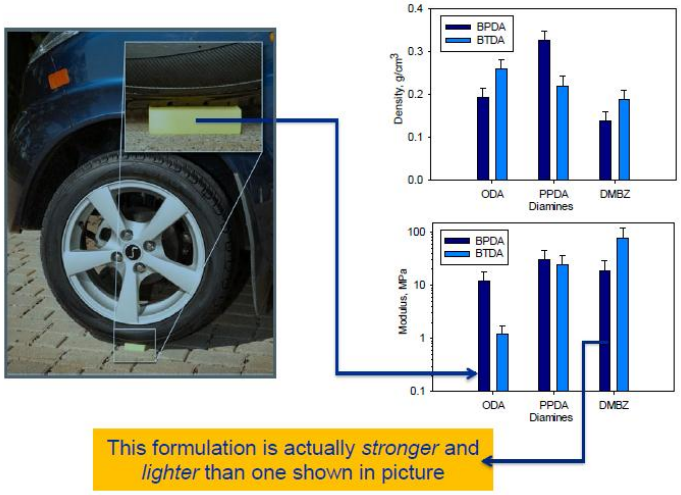
Current aerogel products on the market today are silica–based and break down on handling, shedding small dust particles. Hence, they require encapsulation for most applications and insulation properties degrade over time as particles settle. In contrast, polyimide aerogels are flexible, mechanically robust and do not shed dust. Other properties (thermal conductivity, dielectric, etc.) are similar to silica aerogels.

Thin and flexible: Polyimide aerogels can be manufactured in as a thin film which is flexible and yet maintain excellent tensile properties

Strong: Polyimide aerogels are 500 times stronger than traditional silica aerogels

Versatile: Polyimide aerogels can be custom manufactured as thicker parts or thin films – no need to encapsulate or layer on a flexible matrix ("blankets").

Low thermal conductivity: k values of 14-20 mW/m-K offering 2-5 times improved performance over polymer foams; R values range from 2 to 10 times higher than polymer foams, which is in line with silica aerogels of the same density



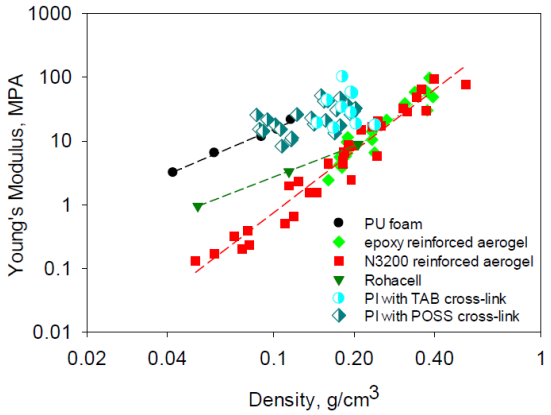
Lightweight: Polyimide aerogels are composed of more than 95 percent air by volume, have densities as low as 0.08 g/cm^3, and surface areas as high as 512 m^2/g

Heat resistant: Polyimide aerogels withstand temperatures up to 300 ^{0}C

Ease of installation: polyimide aerogels can be applied as a thin film or tape to objects needing insulation, such as industrial pipes or automotive

Customizable: Polyimide aerogel properties can be tailored to suit specific applications as is described in the physical properties table. Many formulations have been developed and evaluated. Two methods of cross-linking polyimide aerogels have been developed using either aromatic triamine (TAB) or polyhedral oligomeric silsesquioxane (POSS).

Property	Value
Density	As low as 0.08 g/cm^3
Porosity	> 90%
Thermal Conductivity (at room temperature)	14 mW/m-K
Dielectric constant (X-band)	1.1 to 1.3
Maximum Use Temperature	300 ^{0}C
Onset of Decomposition	460-610 ^{0}C
Young's Modulus	1-100 MPa depending on density
Average Thickness for Flexible Films	0.5 mm



Polyimide aerogels are stronger than polymer reinforced silica aerogels and compare favorably with typical structural foams at the same density.

The table below compares NASA GRC's polyimide aerogel to commercially available aerogel products.

Factor	Aspen Aerogels	Nanopore	Cabot	Polyimide Aerogel	Competitive Advantage
Thermal conductivity at room temperature	Products range from 13.9 to 21.0 mW/m-k	18 to 21 mW/m-K	20 to 25 mW/m-K	14 to 20 mW/m-K	Tailorable to the application
Thickness	Products range from 2 to 10 mm	Varies with application	3.5 to 8 mm	Varies with application; can be as thin as 0.5 mm	Tailorable to the application
Mechanically robust	No. Products produce significant dust and must be encapsulated to prevent contamination	No. Aerogel is encapsulated in sealed film	No. Products produce significant dust and must be encapsulated to prevent contamination	Yes. Not only will they not produce dust, but they can also support a load	Higher compressive strength, tensile strength, resistance to shedding
Density	Products range from 110 to 180 mg/cm^3	150 to 170 mg/cm^3	About 70 mg/cm^3	80 to 300 mg/cm^3	Tailorable over a wide range for the application
Maximum use temperature	Products range from 200 to 650 C	800 C	125 C	Varies with formulation; 200-300 C	
Cost	$$	$$	$$	$$	Completely tailorable to specific application; uses simplified manufacturing process

For More Information

For more information about this and other technology licensing opportunities, please visit:
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NASA's Glenn Research Center
E-mail: ttp@grc.nasa.gov
Phone: 216-433-3484
http://technology.grc.nasa.gov

Licensing and Partnering Opportunities

Glenn's Office of Technology Partnerships and Planning seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing its polyimide aerogel suite of technologies (LEW-18864-1 and LEW-18486-1) for commercial purposes.

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