RPeterson

From: "RPeterson" <10SNE2@prodigy.net>
To: "Virginia Hawke" <virginiahawke@earthlink.net>
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Frozen Smoke

NASA Scientists Discuss Implications of Aerogel Research

Originally posted March 5, 1997
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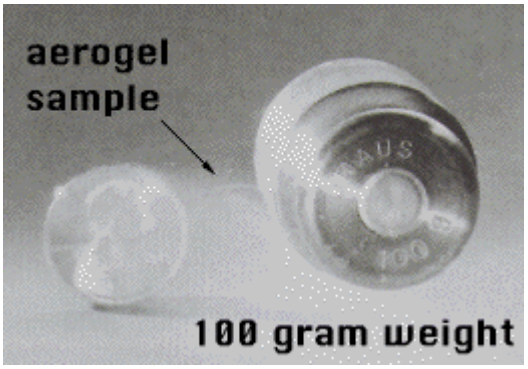


Your household windows may one day have a whole new look - one that saves energy and money - but you won't be able to see it. NASA scientists from the Space Sciences Laboratory at the Marshall Space Flight Center in Huntsville, Alabama, in collaboration with the Lawrence Berkeley National Laboratory in Berkeley, Calif. led by Dr. Arlon Hunt, are experimenting in space with a fascinating material called Aerogel.

Aerogel is the lightest solid material known - only three times the density of air - and has tremendous insulating capability. However, when made on the ground, it has a hazy or smoky appearance. NASA scientists are experimenting with Aerogel in space and believe that they may be able to learn how to make the foam-like material transparent. A host of new products may result for insulating windows that conserve energy and save money, by lowering heating and cooling costs.

Dr. David Noever, a member of Marshall's three-man Aerogel experiment team, believes results from recent space research indicate that they are on the right track to making the hazy material transparent enough to see through clearly. Aerogel is sometimes called "frozen smoke" because of its appearance. In its current form, Aerogel has been used in the space program as the insulating material aboard the Mars Rover launched last December.

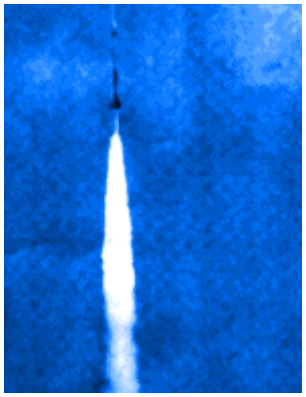
Discovered in the 1930s by a Stanford University researcher, it's the lightest solid known. A block the size of a human weighs less than a pound, but is able to support the weight of a subcompact car or about half a ton.

"To make Aerogel clear is the challenge," said Noever. "Once you make it clear, it becomes a whole

new product and it opens up a whole new world of applications. We're trying to advance technology through space research and then pass on the results to American industry for ground production."

A one-inch thick Aerogel window has the same insulation value as 15 panes of glass and trapped air - which means a conventional window would have to be ten- inches thick to equal a one-inch thick Aerogel window.

Aerogel is a good insulator because of the material's large internal surface area. "Like the radiator in a car," said Raymond Cronise, a member of the Marshall Aerogel research team, "it disperses heat throughout its complex structure. It has so many sides and surfaces that if you could unfold a sugar cube-sized portion of Aerogel, it could cover a basketball court. This is why it disperses heat so well."



But scientists aren't exactly sure why Aerogel made on the ground is cloudy instead of clear. "We decided to take the challenge to space," said Cronise. Last April, NASA produced 16 test samples of Aerogel aboard a Starfire Rocket in a sub-orbital flight. The launch of the Starfire Rocket is shown here.

"We are very encouraged with the results from these tests," said Dr. Laurent Sibille, a staff scientist with the Universities Space Research Association and a member of the Marshall research team. "So far, the samples produced in microgravity indicate a change in the microstructure of the material compared to ground samples. These results were achieved after only seven minutes of low-gravity."

Noever said his Marshall team is preparing for the January 1998 launch of Space Shuttle Discovery, which will "fly our experiment up to where we'll be able to test Aerogel with longer exposure to low-gravity."

Aerogel tutorial : Visit the "**House of the Future**!"
A Desktop 24 GigaHertz Computer by 2006?
NEW Hear what scientists are saying about Aerogel! (link to Japan's only 24 hour science and technology news channel - on the web! This link uses RealAudio, text is also printed.)

Aerogel Specifications:

Apparent density: **0.003-0.35 g/cc**
Internal surface area: **600-1000m^2/g**
% solids **0.13-15%**
Mean pore diameters **~20 nm**
Primary particle diameter **2-5 nm**
index of refraction **1-1.05**
Thermal tolerance **to 500 C**
Coefficient of thermal expansion **2-4x10^{-6}**
Poisson ratio **0.2**
Young's modulus **10^6-10^7 N/m^2**
tensile strength **16 kPa**
Fracture toughness **0.8 kPa*$m^{0.5}$**
Dielectric constant **1.1**
Sound velocity through medium **100 m/s**

For more information on Aerogel research at NASA, contact

Dr. David Noever
Mail Code ES-71

Space Sciences Laboratory
NASA/Marshall Space Flight Center
Huntsville AL 35812
david.noever@msfc.nasa.gov

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Curator: Linda Porter
NASA Official: Gregory S. Wilson