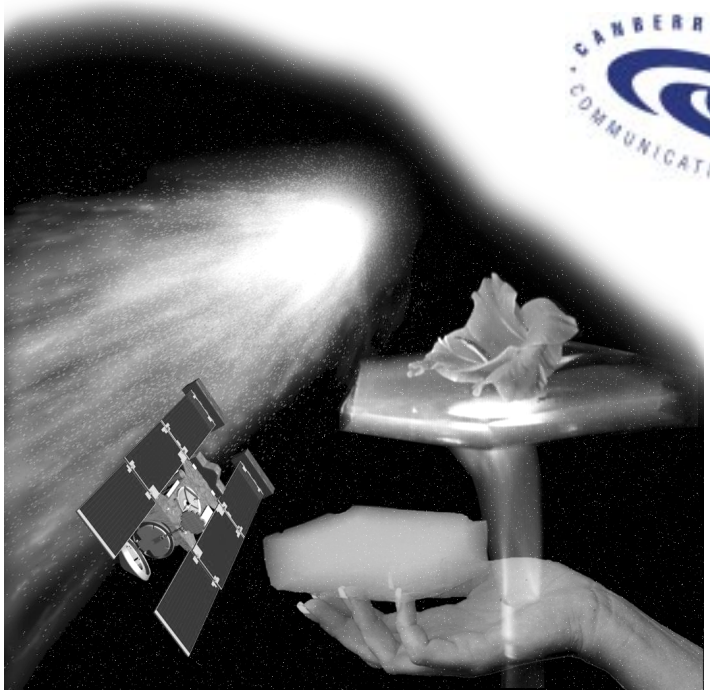

The incredible material that is resistant to heat and cold, is delicate but can stop a bullet, and be used in spacecraft, houses, cars and clothing.

Canberra Space Centre

FACT SHEET

www.cdscc.nasa.gov

Aerogel

99.8% air, but full of surprises

Aerogel represents what technology experts consider the best insulation material ever invented. It weighs virtually nothing, has enormous strength for its density, can be flexible, translucent, and can hold up under extremes of heat and cold.

Aerogels also provide ultra low energy conductivity, as well as sound and shock absorption characteristics.

Aerogels have an extremely fine and highly porous structure, composed of individual features only a few nanometers in size. It can be made from various materials including silica, alumina, titania, hafnium carbide, and a variety of polymers.

By mass, it is 99.8% air, making it the least dense man-made substance (1,000 times less dense than glass), A fact now recognised by the Guiness Book of World Records.

NASA and the Jet Propulsion Laboratory (JPL) have prepared and flight qualified Aerogel for use in space, and have found it a useful tool on a variety of space missions.

To protect onboard systems, JPL used Aerogel as an insulative material for the Pathfinder/ Sojourner Rover Mars mission in 1997. As Aerogel is strong and easily survives launch and space environments, JPL particle capture experiments have flown previously and been recovered on Shuttle flights, carrying the Spacelab II and Eureca modules.

Its latest voyage into space is on the Stardust mission. This spacecraft is designed to fly through the cloud of dust that surrounds the nucleus of a comet - the 'coma'.

The Aerogel laden collector on Stardust will allow material that streams off the comet to be captured in the gel and, for the first time ever, bring cometary material back to Earth for detailed study.

Stardust will fly through the 'coma' of Comet "Wild 2" (pronounced 'Vild') on January 2, 2004. Returning to Earth on January 15, 2006, the samples will be parachuted into the atmosphere inside a small capsule.

Back on Earth, Aerogel is finding many uses. Better insulation in homes, and in improved glass double-glazing (1,000 times better than air-based double-glazing). A new flexible version of Aerogel is now being used in protective clothing.

New lightweight jackets and insulated coveralls using flexible versions of Aerogel are being used by scientists working in the harsh conditions of Antartica.

HOW TO MAKE AEROGEL

SINGLE-STEP BASE CATALYZED SILICA AEROGEL

This will produce an aerogel with a density of approx. 0.08 g/cm^3. The gel time should be 60-120 minutes, depending on temperature.

Mix two solutions:

- Silica solution containing 50 mL of TEOS, 40 mL of ethanol
- Catalyst solution containing 35 mL of ethanol, 70 mL of water, 0.275 mL of 30% aqueous ammonia, and 1.21 mL of 0.5 M ammonium fluoride.
- Slowly add the catalyst solution to the silica solution with stirring.
- Pour the mixture into an appropriate mold until gelation.

TWO-STEP ACID-BASE CATALYZED SILICA AEROGEL

This will produce an aerogel with a density of approx. 0.08 g/cm^3. The gel time should be 30-90 minutes, depending on temperature.

Mix two solutions:

- Silica solution containing 50 mL of precondensed silica (Silbond H-5, or equivalent), 50mL of ethanol
- Catalyst solution containing 35 mL of ethanol, 75 mL of water, and 0.35 mL of 30% aqueous ammonia.
- Slowly add the catalyst solution to the silica solution with stirring.
- Pour the mixture into an appropriate mold until gelation.

More information on the Internet:

Aerogel:
http://eande.lbl.gov/ECS/aerogels/satoc.htm

Stardust mission:
http://stardust.jpl.nasa.gov/index.html

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