Materials

Coating Reduces Ice Adhesion

Developed for the space shuttle, this coating may be used on aircraft and automobiles.

John F. Kennedy Space Center, Florida

The Shuttle Ice Liberation Coating (SILC) has been developed to reduce the adhesion of ice to surfaces on the space shuttle. SILC, when coated on a surface (foam, metal, epoxy primer, polymer surfaces), will reduce the adhesion of ice by as much as 90 percent as compared to the corresponding uncoated surface. This innovation is a durable coating that can withstand several cycles of ice growth and removal without loss of anti-adhesion properties.

SILC is made of a binder composed of varying weight percents of siloxane(s), ethyl alcohol, ethyl sulfate, isopropyl alcohol, and of fine-particle polytetrafluoroethylene (PTFE). The combination of these components produces a coating with significantly improved weathering characteristics over the siloxane system alone.

In some cases, the coating will delay ice formation and can reduce the amount of ice formed. SILC is not an ice prevention coating, but the very high water contact angle (greater than 140º) causes water to readily run off the surface. This coating was designed for use at temperatures near –170 ºF (–112 ºC). Ice adhesion tests performed at temperatures from –170 to 20 °F (–112 to –7 ºC) show that SILC is a very effective ice release coating.

SILC can be left as applied (opaque) or buffed off until the surface appears clear. Energy dispersive spectroscopy (EDS) and x-ray photoelectron spectroscopy (XPS) data show that the coating is still present after buffing to transparency. This means SILC can be used to prevent ice adhesion even when coating windows or other objects, or items that require transmission of optical light. Car windshields are kept cleaner and SILC effectively mitigates rain and snow under driving conditions.

This work was done by Trent Smith of Kennedy Space Center; Michael Prince, Charles DeWeese and Leslie Curtis of Marshall Space Flight Center; and Erik Weiser and Roberto Cano of Langley Research Center. For more information, contact the Kennedy Space Center Innovative Partnership Program Office at (321) 861-7158. KSC-13100/1.

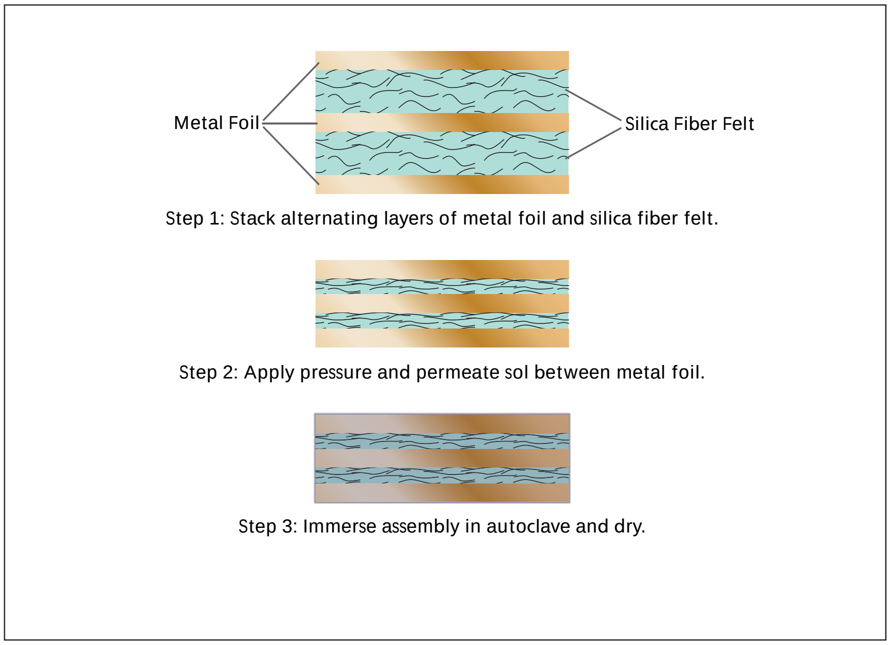
Hybrid Multifoil Aerogel Thermal Insulation

Aerogel used in place of astroquartz makes lighter, more efficient insulation.

NASA's Jet Propulsion Laboratory, Pasadena, California

This innovation blends the merits of multifoil insulation (MFI) with aerogel-based insulation to develop a highly versatile, ultra-low thermally conductive material called hybrid multifoil aerogel thermal insulation (HyMATI). The density of the opacified aerogel is 240 mg/cm^3 and has thermal conductivity in the 20 mW/mK range in high vacuum and 25 mW/mK in 1 atmosphere of gas (such as argon) up to 800 ºC. It is stable up to 1,000 ºC. This is equal to commercially available high-temperature thermal insulation. The thermal conductivity of the aerogel is 36 percent lower compared to several commercially available insulations when tested in 1 atmosphere of argon gas up to 800 ºC.

Layers of metal foil block infrared radiation (IR), which are separated by thin (100–1,000-micron) layers of opacified aerogel (see figure) The aerogel further reduces IR transport and, more importantly, significantly reduces gas and solid conduction when compared to the astroquartz used in heritage MFI (that used



HyMATI Blends Multiple Layers of Foil Separated by Fiber Reinforced, Opacified Aerogel. Fabrication consists of: (a) stacking alternating layers of reflective metal foil and high purity quartz fiber, (b) applying slight pressure to the stack to control the spacing between metal foil layers, and (c) permeating the liquid aerogel precursor into the stack, followed by solidification and supercritical drying.