Advanced Passive Cooling Composite Design:

Development of a New High-Emissivity Aerogel Microsphere Composite for Enhanced Passive Thermal Control

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ssive Thermal Control:

l is the radiating heat away from a
chanical means or stored cryogens. This
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tical elements, and refrigeration systems.
l systems have the benefit of being able
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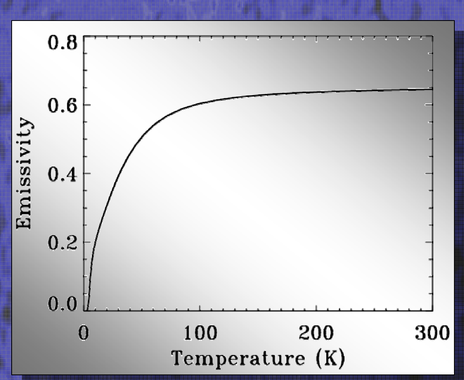

Emissivity of NS43G paint as a function of temperature (current technology)

Starting Point

composite of a commercially available
Stycast 2850 and stainless steel
ion to significantly improved flexibility,
e to thermal cycling, the material exhibits
er previous composites.

Significantly improved emissivity of the Stycast 2850/stainless steel composite over current technology

Objective

Improve upon the emissivity of current passive cooling technology by developing a composite with higher dielectric contrast.

Desired Material Properties

- High emissivity at infrared through millimeter wavelengths
- Dielectric constant matched to loss tangent to minimize surface reflection
- Good adhesion to surfaces and self
- Controllable application of layers as thin as 1500 microns

What Makes a Good High-Emissivity Composite?

The composite consists of solid particles dispersed in a host epoxy. To maximize the dielectric contrast, and thus emissivity of the composite, it is desirable that the particles in the epoxy:

- Are under 10 microns in diameter
- Are electrically conductive

$$e = \frac{2n\tan(\delta)t}{\lambda}$$

Equation for the emissivity of a layer of dielectric where n is index of refraction, tan(δ) is the loss tangent, λ is the wavelength of incident radiation, and t is the thickness of the layer.

This is a challenging set of material parameters, since most materials with a low dielectric constant are electrically insulative!

Enhancing Emissivity With Aerogels, Presented by the Wisconsin Space Grant Consortium

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