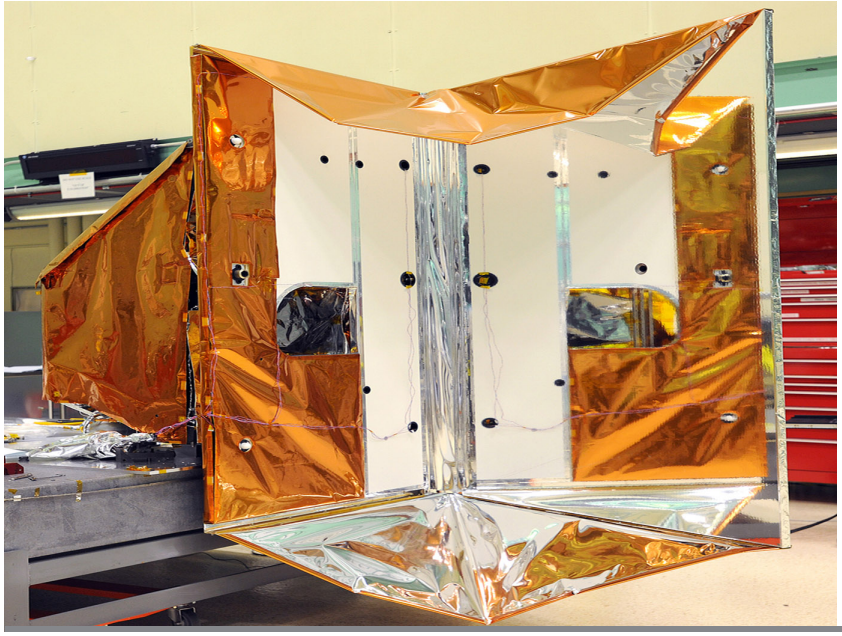

National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Materials and Coatings

Silicon Oxide Coated Aluminized Polyimide Film Radiator Coating

A thermal coating by tailoring the absorptance and emittance of silicon oxide (SiOx) coated aluminized polyimide film for CubeSat thermal management

A miniature satellite, or CubeSat, has deployable solar arrays and/or body mounted solar cells to generate adequate electrical power to meet mission power requirements. The CubeSat's internal components dissipate heat. In order to maintain the component temperatures within allowable flight limits, the waste heat needs to be radiated from its exterior to deep space. Depending on the orbit parameters, one or more of the exterior surfaces could be exposed to sunlight, planet albedo (reflection of solar radiation from Earth), or infrared radiative flux. Additionally, lithium ion batteries, often used on CubeSats, are required to be above 0 °C during charging. Conventionally, a combination of radiator thermal coatings, multilayer insulation (MLI) blankets, and active heater control are used to meet component thermal requirements, which are all relatively expensive. Furthermore, MLI blankets not only increase the volume of the CubeSat, but also increase the risk of entanglement during solar array deployment. The SiOx Coated Aluminized Polyimide Film Radiator Coating regulates temperature for CubeSats without these drawbacks.

BENEFITS

- Lowers power demand
- Eliminates the need for voluminous heat regulation

THE TECHNOLOGY

The SiOx Coated Aluminized Polyimide Film Radiator Coating uses all the exposed surfaces on the six sides of a CubeSat as radiators. All the internal components are thermally coupled to the radiators. Waste heat from the internal components is transferred by conduction to the radiators through its aluminum structure or frame. SiOx thin film coated aluminized polyimide film is used as the radiator coating. Its total thickness is approximately 0.05 mm, which is predominately the polyimide film thickness. Polyimide film is known commercially as Kapton. The coating is bonded to the CubeSat exterior by using an acrylic transfer adhesive.

SiOx Coated Aluminized Polyimide Film Radiator Coating's absorptance and emittance can be tailored to meet the component thermal requirements by altering the SiOx thickness. Since the SiOx is a thin film, altering its thickness has no significant effect on the total thickness of the radiator coating. An indium tin oxide (ITO) thin film can be added to make the coating conductive, if needed, without affecting the absorptance or emittance. This coating, with or without ITO, can be used for various CubeSat applications. By tailoring the absorptance and emittance of this coating, external MLI blankets and active heater control are eliminated. The thermal connection between heat generating components and the battery eliminates the need for a battery heater.

APPLICATIONS

The technology has several potential applications:

- Satellite manufacturing
- Thermal management and regulation

PUBLICATIONS

Patent Pending

technology.nasa.gov

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More Information

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