

Materials and Coatings

A New Family of Low-Density, Flexible Ablators

Simple and versatile manufacturing approach to produce heat shields

NASA has developed a class of low-density, flexible ablators that can be fabricated into heatshields capable of being packaged, stowed and deployed in space. The key characteristics of this new ablative Thermal Protection System (TPS) are its flexibility, conformability, and tailorability. Flexibility allows the material to be stowed in the shroud of a launch vehicle and deployed in space, without compromising functionality. Conformability allows the material to be attached to a curved surface without precise and expensive machining. Tailorability allows the density and composition to be optimized for the requirements. This flexible TPS can be used to cover and thermally protect a large, blunt shape that provides aerodynamic drag during hypervelocity atmospheric flight. It can be used with minimal modification for large aeroshells whose deployment relies mainly on mechanical means and through inflation. Such devices are called Hypersonic Inflatable Aerodynamic Decelerators (HIADs). Large blunt body aeroshells may be used to deliver large payloads (40 metric tons) to the surface of Mars.

BENEFITS

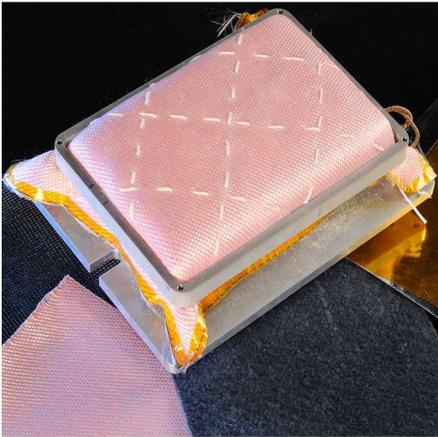
- Simple and versatile manufacturing, machining and attachment methods
- Withstand a range of heating rates
- Potentially lower lifecycle cost compared to rigid TPS
- The amount and composition of pyrolyzing resin and fiber substrate can be readily tailored

technology solution

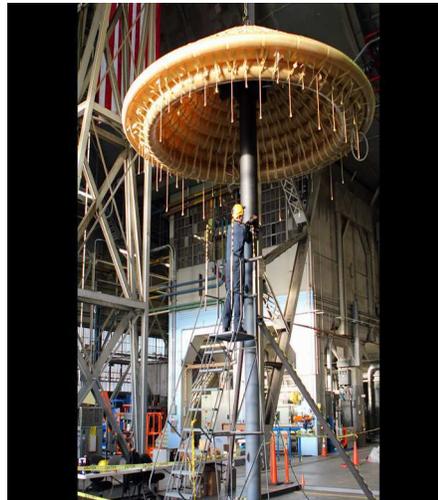


THE TECHNOLOGY

The low-density, flexible ablators are comprised of a polymer resin embedded in a fibrous substrate, with a density range of 0.2g/cm cube-0.6 g/cm cube to date. The polymer resin thermally decomposes during ablation. The resin can be a thermo setting resin, athermoplastic polymer, or alternatively, a co-cured mixture. The fibrous substrate is flexible or conformable to a curved surface, with high thermal stability. The thickness of the fibrous substrate is between 1.3 and 7.6 cm, where the diameters of the fiber are between 7 and 25 micrometer. Embodiments of the fibrous substrates can include various woven, stitched or loosely packed carbon, polymer and ceramic felts as high-temperature substrates. One feature of this innovation is that it can withstand a range of heating rates with the upper limit approaching that of NASA rigid ablators. The amount and composition of polymer resin can be readily tailored to specific mission requirements. This technology offers a simple and versatile manufacturing approach to produce large areas of heat shields that can be relatively easily attached on the exterior of spacecraft.



Thermal protection for Hypersonic Inflatable Aerodynamic Decelerators (HIADs)



HIADS testing at ARC

APPLICATIONS

The technology has several potential applications:

- ➔ Space exploration
- ➔ Systems engineering
- ➔ Thermal Protection Systems
- ➔ Materials engineering
- ➔ Mechanical engineering

PUBLICATIONS

Patent No: 10,752,386

Patent Pending

National Aeronautics and Space Administration

Agency Licensing Concierge

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