National Aeronautics and Space Administration

NASAfacts

Space Technology

Game Changing Development

Heatshield for Extreme Entry Environment Technology

The Heatshield for Extreme Entry Environment Technology (HEEET) project seeks to mature a game changing Woven Thermal Protection System (TPS) technology to enable in situ robotic science missions recommended by the NASA Research Council Planetary Science Decadal Survey committee. Recommended science missions include Venus probes and landers; Saturn and Uranus probes; and high-speed sample return missions.

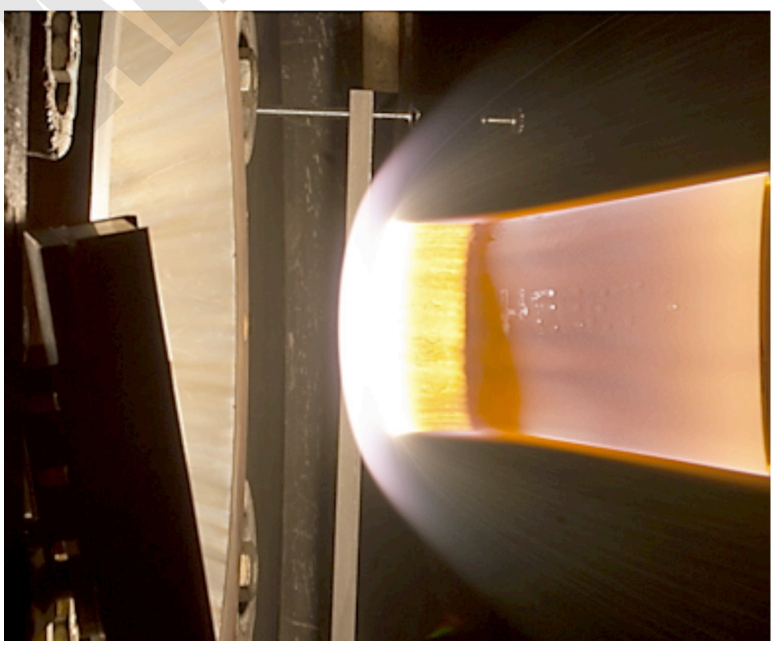
Currently, these missions are limited to the use of heritage materials such as carbon phenolic (CP) as their only TPS solution, Due to its inherent properties, heritage CP constrains the mission, and in the long term, poses significant sustainability challenges.

The goal of HEEET is to develop a woven TPS technology to test readiness level (TRL) 5/6 that will provide an alternate TPS solution for these missions. The tailorable woven TPS will reduce entry loads and significantly reduce heatshield mass by 30-40% for extreme entry environments missions.

Woven TPS is a science enabler that will allow for a high return on investment made by both NASA's Space Technology Mission Directorate and Science Mission Directorate.

The goal of the project is to mature woven TPS heatshield architectures to TRL 5/6 by 2017.

The HEEET WTPS architecture consists of a high-density all-carbon surface layer (designed to manage recession) below which is a lower density layer composed of a blended CP yarn (insulating layer to manage heat load). This woven architecture



HEEET material during arc jet testing at NASA's Ames Research Center.

is then infused with a mid-density level of phenolic resin. A layer-to-layer weave is utilized in HEEET, which mechanically interlocks the different layers together.

This dual-layer approach allows greater mass efficiency by limiting the thickness of the high-density outer layer. By varying the thicknesses of the different layers, the mass can be optimized for a given mission.

To date, the HEEET materials have been tested to conditions of ~5000 W/cm^2 heat flux and five atmospheres of pressure and have shown excellent performance.

The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit
http://gameon.nasa.gov/

HEEET material before (top) and after arc jet testing.

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