National Aeronautics and Space Administration

Woven Thermal Protection System

NASA has developed a new technology for producing Woven Thermal Protection System (TPS) materials that uses precisely engineered 3D weaving techniques. The woven TPS approach utilizes commercially available weaving technology, consisting of equipment, modeling and design tools, to optimize the weave. Using woven TPS, sustainable, scalable, mission-optimized solutions can be achieved with relatively low life-cycle costs compared with the high costs and long development schedules currently associated with material development and certification.

Woven TPS leverages the mature state-of-the-art (SOA) weaving technology that has evolved from the textile industry to design materials with tailorable performance by varying material composition and properties via the controlled placement of fibers within a woven structure. The resulting material can be designed to perform optimally for a wide range of entry conditions encompassing NASA's current and future mission needs. Woven TPS enables these optimized designs to be translated precisely into mission-specific, manufactured materials that can dramatically increase the efficiency, utility, and robustness of heat shield materials compared to the current SOA material options.

This technology is available for licensing from NASA's space program to benefit U.S. industry.

Technology Details

This invention presents a revolutionary approach to designing and manufacturing TPS materials using/augmenting design tools and infrastructure already in place in the weaving industry. Woven TPS is a concept that leverages the mature weaving technology that has evolved from the textile industry to design TPS with tailorable performance by varying a material's composition and properties by the controlled placement of fibers within a woven structure. The resulting woven TPS can be designed to perform optimally for a wide range of aerothermal environments encompassing NASA's future mission needs.

The woven TPS approach can tailor a material's properties by the accurate placement of fibers of different composition with different spacings. This allows for the control of material composition and density in three dimensions, resulting in tailored material performance. Given that the constituent properties of the fibers are known, the performance of the material can be predicated with existing tools. In this way, a material can be optimized for a given mission. Testing will still be required to certify the final product for the mission, but this should substantially reduce the overall testing requirements and, hence, reduce the cost and schedule time.

Commercial Applications

- Aerospace
- Systems Engineering
- Thermal Management Systems
- Manufacturing Technologies

Patent

This technology is protected by a pending U.S. Non-Provisional Patent Application. (Reference No. ARC-16797-1)

Benefits

- Revolutionary approach to producing thermal protection systems
- TPS material optimized for each mission
- Reproducible and predictable material performance
- Reduces mass margins and development/certification costs
- Introduces robust new class of TPS materials to address future NASA mission needs
- Woven TPS lowers development costs

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Contact the Ames Technology Partnerships Office at 1-855-627-2249 or ARC-TechTransfer@mail.nasa.gov