

Thermal Protection System Technology Maturation and Sustainment in Support of In-situ Science Missions: HEEET and PICA

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Abstract

Among the challenges faced by the Entry Descent and Landing (EDL) community have been: the lack of a matured forebody heatshield thermal protection system (TPS) capable of meeting the demanding entry environments for the high priority in-situ science missions identified in the decadal survey at Venus, Saturn and the Ice Giants, and the continued sustainment of thermal protection systems/materials. In response to the identified shortfall in TPS technologies capable of extreme entry environments NASA's Space Technology Mission Directorate (STMD) and Science Mission Directorate (SMD) initiated the Heatshield for Extreme Entry Environment Technology (HEEET) project which has matured a 3D-Woven TPS to Technology Readiness Level 6 and which is ready for infusion into these high priority missions. During the development of HEEET long term sustainability was a key consideration. However existing TPS also continue to face sustainability issues. Phenolic Impregnated Carbon Ablator (PICA) has been/is being utilized by many SMD Missions (Stardust, Mars Science Laboratory, OSIRIS-Rex, Mars 2020, Dragonfly) and is under consideration for others including Mars Sample Return, so maintaining PICA for the long term is a priority for NASA. This presentation will discuss raw material sustainability challenges faced by PICA and the efforts by NASA to work with Fiber Materials Inc (FMI) to resolve these challenges with a more sustainable supply chain. In addition, NASA is working with FMI to increase the manufacturing scale for single piece PICA heatshields and to expand the aerothermal performance envelop maturing PICA for larger sized heatshield and more aggressive entry environments. This presentation will also identify challenges and limitations with these systems, particularly around understanding failure modes in these materials and systems and how understanding these may allow use of these systems in environments that are difficult to achieve in ground based testing.

Keywords: Thermal Protection System, Phenolic Impregnated Carbon Ablator (PICA), Heatshield for Extreme Entry Environment Technology (HEEET)
