



3D Printing Heat Shields

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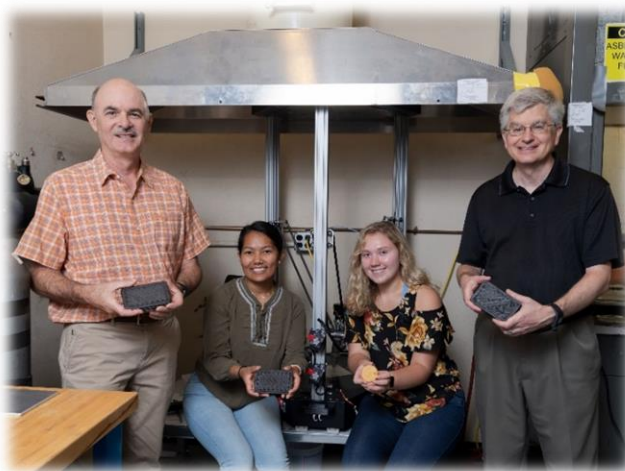
Description: Heat shields that protect spacecraft from the heat of entering a planet's atmosphere are labor intensive to manufacture, cost prohibitive and the heat shield design is constrained by the manufacturing process. During FY19 material property tests were conducted on candidate thermoplastics that were 3D printed using a filament-based printer. Even though the char yield and thermal expansion characteristics were good, exposure to simulated reentry environments in a plasma torch resulted in swelling and the formation of an unstable char. Therefore, the investigation into thermoplastics stopped, and the focus changed to thermoset-resin mixtures and how to print them. We designed, built and installed a custom auger-based extruder on a commercial printer; and additionally, we demonstrated the capability to deposit the material on a small sphere-cone shape representative of a heat shield for a small capsule.

NASA Technology Area: TA 9.1.1 Entry Descent and Landing (EDL)

Technology Readiness Level: Start 2/Current 3

Success Story / Innovation:

A key technical challenge of this project has been to find materials that can be 3D printed and also perform well as a heat shield material. Two technical approaches were used. For one approach, filaments of thermoplastic material are fed into an extruder, then heated, and deposited onto the structure. For the other approach, a thermoset resin mixture is fed into a different type of extruder and deposited. It should be noted, that most current heat shield materials use high-temperature thermoset resins.



L-R: Project Principal Investigator Stan Bouslog and team, Alina Rai, Katie Moody and Richard Hagen *Photo: NASA*

Benefit: The biggest benefit of this technology, according to Project Principal Investigator Stan Bouslog is, "Changing the approach to manufacturing heat shields so that automation can be used. With feasibility demonstrated, the technology is going to be used to print a heat shield for a small capsule flight test." The technology is being transferred to small businesses through the SBIR/STTR programs.

Lead NASA Center	Johnson Space Center
Funding Organization	JSC Chief Technologist Office / STMD
Date of Success	FY 2019