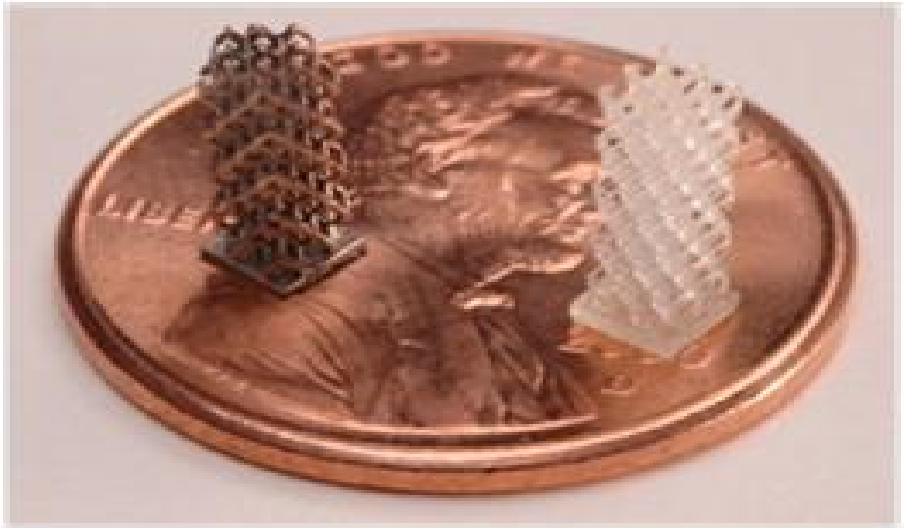
NASA SBIR/STTR Technologies

X2.02-9698 - Lattice Regenerative Cooling Methods (LRCM)

PI: J. Arthur Sauer
Orbital Technologies Corporation - Madison, WI

Identification and Significance of Innovation

ORBITEC proposes to develop and demonstrate a novel cooling concept called Lattice Regenerative Cooling Methods (LRCM) for future high thrust in-space propulsion systems. Incorporation of ORBITEC's innovative lattice structures in the fabrication of thrust chambers for expander cycle engine systems will maximize the heat transfer into the coolant fluid, expand design options, enable substantial cost savings, and reduce lead times for component fabrication. Using rapid prototyping technology, the LRCM hybrid fabrication approach allows for the rapid casting of near-net shape metallic thrust chamber components. The lattice passages allow for turbulent flows through the cooling jacket which induces mixing in the coolant. During Phase I, monolithic chamber wall sections incorporating the LRCM lattice structure will be fabricated and tested in a hot-fire test conditions in ORBITEC's propulsion testing facilities.



Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)

Technical Objectives and Work Plan

The Phase I effort will prove the feasibility of the LRCM approach through analysis, component fabrication, and experimental hot firings. The Phase I work will focus on the following key objectives:
1. Perform systems analyses to provide the detailed definition of the LRCM hardware and to quantify the operational, performance, and cost characteristics of mature LRCM components for expander cycle engine systems with thrust levels up to 50,000 lbf.
2. Conduct material property testing on samples created through the fabrication process, including measurements of dimensional accuracy, dimensional precision, density, tensile strength, and surface finish.
3. Incorporating ORBITEC's LRCM lattice components for integration into an existing lab scale thrust chamber assembly.
4. Manufacture the LRCM components to demonstrate the reduced fabrication costs resulting from the fabrication process. The LRCM costs will be compared to costs associated with fabricating a TCA assembly through traditional means.
5. Conduct hot-fire testing at ORBITEC's facility to evaluate the performance of the fabricated components.
6. Analyze and interpret the chamber performance, specifically the specific impulse efficiency and chamber temperatures, with respect to the operating conditions and engine geometry.
7. Develop preliminary plans for demonstration of a prototype LRCM TCA assembly in a 3000 lbf thrust chamber in Phase II.

NASA Applications

The primary focus of this activity is to develop innovative cooling approaches for rocket combustion devices that will expand the performance envelope and reduce the manufacturing cost of future high thrust in-space propulsion systems for NASA. LRCM components and subassemblies will be developed for implementation in an operational engine system during the Phase III program. The same high performance cooling approaches could be used in a wide range of propulsion applications including large-s

Non-NASA Applications

The LRCM approaches could be used in a wide range of Air Force, DoD, or commercial applications including booster engines, RCS thrusters, and other in-space propulsion systems. The LRCM manufacturing technology will be integrated into ORBITEC TCAs for other customers future commercial launch applications and will be marketed to other rocket engine manufacturers.

Firm Contacts

Eric Rice
Orbital Technologies Corporation
Space Center, 1212 Fourier Drive
Madison, 537171961
PHONE: (608) 827-5000
FAX: (608) 827-5050