Advanced Composite Thrust Chambers for the Altair Lunar Lander

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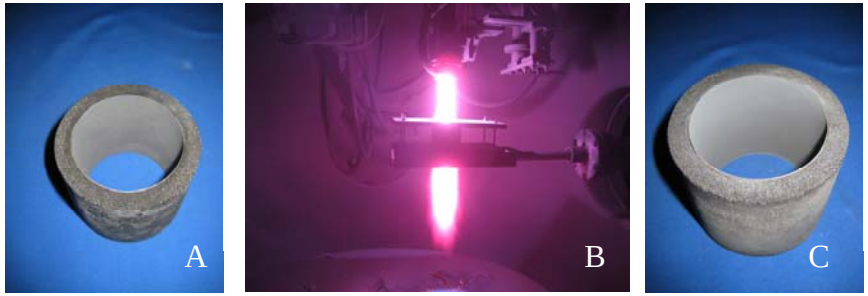
Identification and Significance of Innovation

•Radiation-cooled, bipropellant thrusters are being considered for the Ascent Module main engine of the Altair Lunar Lander.
•Currently, Ir-Re combustion chambers are the state-of-the-art.
•Recent hot-fire tests of HfO_2-Ir-Re chambers have shown a 200°C performance increase is possible.
•Replacement of the Re structural wall with a C-C composite could result in a mass savings of >600%.
•Therefore, an innovative C-C composite thrust chamber is being developed that incorporates advanced HfO_2 and Ir liners.
TRL at the conclusion of Phase II: 6



A) HfO_2-Ir lined C-C cylinder after fabrication
B) Hot gas testing of HfO_2-Ir lined C-C cylinder
C) HfO_2-Ir lined C-C cylinder after hot gas testing showing no sign of damage to the HfO_2-Ir liner

Phase II Technical Objectives & Work Plan

•Model Ascent Module chamber to determine the optimum wall architecture to minimize stress and maximize thermal performance
•Determine the optimum fabrication approach for producing HfO_2-Ir-C/C composite chamber
•Optimize the VPS and EL-Form deposition parameters
•Determine the optimum C-C application method and carburization/densification cycle for the coated mandrels
•Produce samples for characterization and properties testing
•Perform high temperature, i.e., >1500°C, hot gas and furnace tests
•Using the optimized fabrication techniques, produce a 3000 lbf composite chamber comprised of a HfO_2-Ir liner and C-C structural jacket for delivery to NASA-MSFC and subsequent hot-fire testing.
Subcontractors: ATK Launch Systems and MR&D

NASA and Non-NASA Applications

•Targeted NASA application is for the Altair Ascent Module main engine. Other NASA applications include in-space propulsion components, nuclear power/propulsion, oxygen generators, and lunar regolith processing.
•Targeted commercial applications include net-shape fabrication of refractory and platinum group metals for rocket nozzles, crucibles, heat pipes, and propulsion subcomponents; and advanced coating systems for x-ray targets, sputtering targets, turbines, rocket engines, wear and thermal/electrical insulation.

Firm Contacts

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NON-PROPRIETARY DATA