High Performance Bipropellant Space Engines

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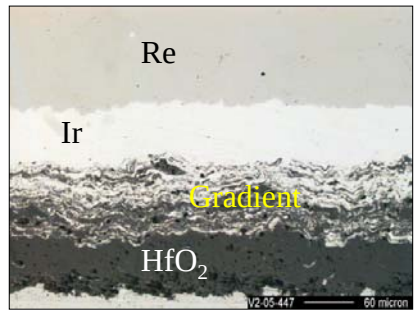
Identification and Significance of Innovation

•Currently, Ir-Re combustion chambers are the state-of-the-art for in-space propulsion applications.
•To increase performance of bipropellant engines, improved chamber materials are needed that will allow higher operating conditions and better resistance to oxidation.
•Using advanced vacuum plasma spray and electrochemical forming techniques, oxide-Ir-Re combustion chambers will be developed that will simplify engine design and allow higher operating conditions.
•As a result, a lower cost, higher performance bipropellant space engine will be produced.



A) Examples of EL-Form Re and Ir-Re thrusters and nozzles produced by PPI. B) Micrograph showing HfO_2, gradient, Ir, and Re deposit produced by VPS forming.

Technical Objectives and Work Plan

•The primary objective is to develop a high performance space engine for use with bipropellants such as MMN/NTO.
•Using VPS fabrication techniques, produce samples with different HfO_2, gradient, and Ir thicknesses and close-out with EL-Form Ir-Re layers for metallurgical evaluation and other screening tests.
•Conduct thermal cycle tests to evaluate the ability of the functional gradient layers to prevent cracking and delamination.
•Perform material screening tests to determine the compatibility of liquid oxidizers, liquid fuels and their combination with the hafnium oxide liners.
•Produce a 100-lbf combustion chamber comprised of a HfO_2-Ir liner and Re structural wall to demonstrate proof-of-concept and for hot-fire testing.

Subcontractor: Aerojet-Redmond

NASA and Non-NASA Applications

• In-space propulsion applications include, apogee insertion, attitude control, orbit maintenance, repositioning of satellites/spacecraft, reaction control systems, and planetary descent/ascent.

• Commercial propulsion, nuclear industries, high temperature furnaces, corrosion resistant containment cartridges, crucibles for glass/advanced ceramic processing, heat pipes, thermal protection systems, and joining of advanced ceramics to metals.

Firm Contacts

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NON-PROPRIETARY DATA