

Improved Rhenium Thrust Chambers

Reduces chamber fabrication costs by 30 percent or more

Radiation-cooled bipropellant thrust chambers are being considered for ascent/descent engines and reaction control systems on various NASA missions and spacecraft, such as the Mars Sample Return and Orion Multi-Purpose Crew Vehicle (MPCV). Currently, iridium (Ir)-lined rhenium (Re) combustion chambers are the state of the art for in-space engines. NASA's Advanced Materials Bipropellant Rocket (AMBR) engine, a 150-lb_f Ir-Re chamber produced by Plasma Processes and Aerojet Rocketdyne, recently set a hydrazine specific impulse record of 333.5 seconds.

To withstand the high loads during terrestrial launch, Re chambers with improved mechanical properties are needed. Recent electrochemical forming (EL-Form™) results have shown considerable promise for improving Re's mechanical properties by producing a multilayered deposit composed of a tailored microstructure (i.e., Engineered Re).

The Engineered Re processing techniques were optimized, and detailed characterization and mechanical properties tests were performed. The most promising techniques were selected and used to produce an Engineered Re AMBR-sized combustion chamber for testing at Aerojet Rocketdyne.

Applications

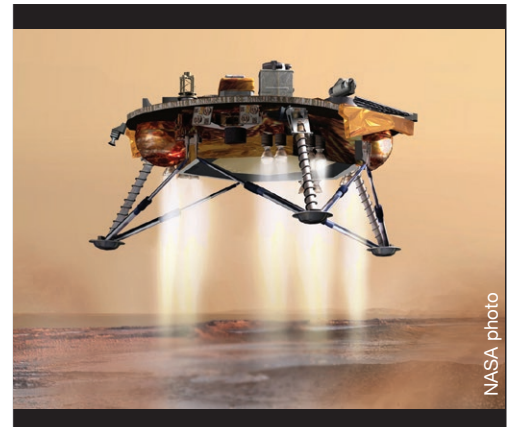
NASA

- ▶ Ascent/descent engines and reaction control systems for missions:
 - Mars Sample Return
 - Orion MPCV
- ▶ In-space propulsion components for:
 - Apogee insertion
 - Attitude control
 - Orbit maintenance
 - Repositioning of satellites/spacecraft
 - Reaction control systems
 - Descent/Ascent engines
 - Nuclear power/propulsion
 - Microgravity containment crucibles and cartridges

Commercial

- ▶ Defense
- ▶ Material research and development

- ▶ Nuclear power
- ▶ Aerospace
- ▶ Propulsion
- ▶ Automotive
- ▶ Electronics
- ▶ Crystal growth
- ▶ Medical
- ▶ Net-shaped fabrication of refractory and platinum group metals for:
 - Rocket nozzles
 - Crucibles
 - Heat pipes
 - Propulsion subcomponents
- ▶ Advanced coating systems for:
 - X-ray targets
 - Sputtering targets
 - Turbines
 - Rocket engines
 - Wear and thermal/electrical insulation



Phase II Objectives

- ▶ Optimize the Engineered Re processing techniques to produce an AMBR-sized chamber that has room temperature yield strength of 40 ksi and 10 percent elongation
- ▶ Perform detailed characterization of the pinning layers and tailor the architecture of the Engineered Re to achieve the desired properties
- ▶ Perform extensive materials properties testing and select the most promising Engineered Re fabrication method
- ▶ Optimize the multicomponent processing technique to produce Engineered Re deposits on multiple AMBR-sized mandrels
- ▶ Demonstrate repeatability of the optimized Engineered Re fabrication technique
- ▶ Produce an AMBR-sized combustion chamber that incorporates the Engineered Re structure and test

Benefits

- ▶ Reduces chamber fabrication costs by 30 percent or more

Firm Contact

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