Improved Rhenium Chambers for In-Space Propulsion

NNX12CA25C

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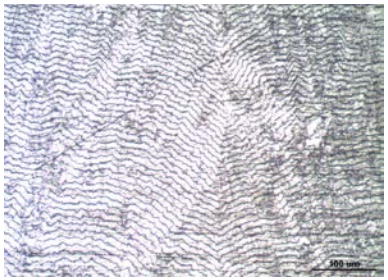
Identification and Significance of Innovation

•Radiation-cooled, bipropellant thrusters are being considered for future Lunar and Mars missions
•Currently, Ir-Re combustion chambers are the state-of-the-art for in-space engines such as NASA's Ir-Re AMBR chamber which set a hydrazine I_{sp} record of 333.5 seconds.
•Improving the mechanical properties of the material is critical to withstand high loads during terrestrial launch
•Tailoring the microstructure of Re (i.e. Engineered Re) has shown promise to increase the mechanical properties
TRL at the conclusion of Phase II: 6



Left: Successful hot-fire test of AMBR Chamber

Right: Micrograph of Engineered Re Structure

Phase II Accomplishments

•Engineered Re structure was produced by utilizing an electroforming (EL-Form®) fabrication method , which enabled the deposition of advanced microstructure through compositional manipulation
•Mechanical properties of the Phase II Engineered Re material had UTS values > 130 KSI, YS values > 40 KSI, and a % Elongation > 20%.
•Engineered Re structure was shown to be produced on three AMBR size mandrels during multi-component processing.
•Utilizing EL-Form®'s ability to produce multiple components, two AMBR chambers are being produced during the Phase II Enhancement effort.
•One Engineered Re AMBR chamber will be shock and vibration tested while the second one will be delivered to NASA and will be available for future hot-fire testing.

NASA and Non-NASA Applications

•Targeted NASA applications are the ascent/descent engines and reaction control systems for missions such as the Mars Sample Return and Orion MPCV. Other NASA applications include in-space propulsion components for apogee insertion, attitude control, orbit maintenance, repositioning of satellites/spacecraft, reaction control systems, and descent/ascent engines.
•Targeted commercial applications include net-shape fabrication of refractory and platinum group metals for rocket nozzles, crucibles, heat pipes, and propulsion subcomponents.

Firm Contacts

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NON-PROPRIETARY DATA