NASA SBIR/STTR Technologies

S3.04-9213 - Improved Rhenium Thrust Chambers for In-Space Propulsion

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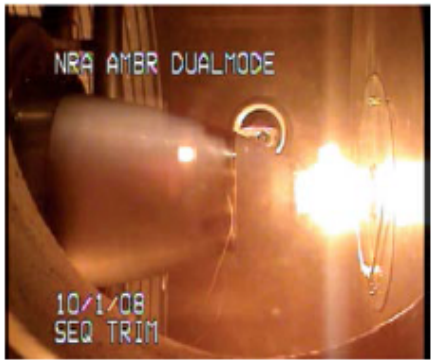
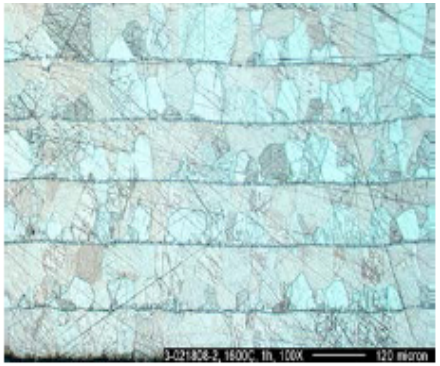
Identification and Significance of Innovation

- Rhenium chambers with improved mechanical properties are needed, i.e., 40ksi yield strength and 10% elongation at RT.
- Recent EL-FormTM work has shown the ability of a multi-layered deposit comprised of a tailored microstructure, i.e., Engineered Re, to achieve these properties goals.
- Multi-component processing has the ability to significantly reduce the cost of producing Ir-Re chambers, i.e., >30% cost savings.
- Plasma Processes and Aerojet are working together to develop Re based in-space engines with improved properties at a reduced cost.





(Left) - Hot-fire testing of the Advanced Material Bipropellant Rocket (AMBR) engine produced by Plasma and Aerojet. (Right) - Engineered Re structure after annealing at 1600° C for 1 hr. Note the pinning layers have prevented grain growth between the ductile rhenium layers.

Estimated TRL at beginning and end of contract: (Begin: 4 End: 5)

Technical Objectives and Work Plan

- Optimize the Eng. Re processing techniques to produce an AMBR size chamber that has RT YS of 40ksi and 10% elongation.
- Perform detailed characterization of the pinning layers and tailor the architecture of the Eng. Re to achieve the desired properties.
- Perform extensive materials properties testing and down select the most promising Eng. Re fabrication method.
- Optimize the multi-component processing technique to produce Eng. Re deposits on multiple AMBR size mandrels.
- Demonstrate repeatability of the optimized Engineered Re fabrication technique.
- Produce an AMBR size combustion chamber that incorporates the Engineered Re structure and test at Aerojet.

NASA Applications

NASA propulsion applications include, apogee insertion, attitude control, orbit maintenance, repositioning of satellites/spacecraft, planetary descent/ascent, reaction control systems (i.e., Orion MPCV Reaction Control System)

Non-NASA Applications

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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