Improved Rhenium Thrust Chambers for In-Space Propulsion

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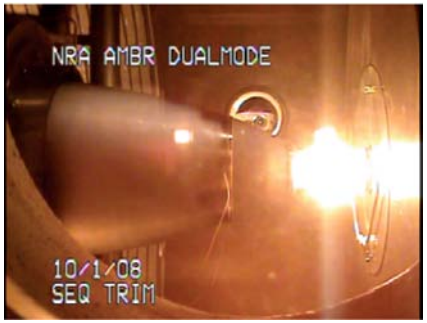
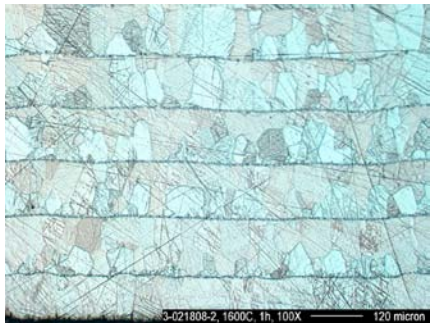
Proposal No: S3.04-9213

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-Form work has shown promise for improving the mechanical properties of Re by producing a multi-layered deposit comprised of a tailored microstructure, i.e., Engineered Re.
- The multi-component processing ability has the potential to significantly reduce the cost of producing Ir-Re thrust chambers.
- PPI and Aerojet will work together to develop Re based in-space engines with improved mechanical properties at a reduced cost.
- **TRL at the conclusion of Phase I: 4**





(Left) - Hot-fire testing of the Advanced Material Bipropellant Rocket (AMBR) engine produced by PPI 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.

Technical Objectives and Work Plan

- Develop improved Ir-Re thrust chambers for in-space propulsion applications.
- Evaluate the mechanical properties of Engineered Re produced in a configuration similar to an AMBR size chamber.
- Perform high temperature post-deposition heat treatments to simulate the effect of hot-fire testing on Engineered Re.
- Characterize the samples through microstructural analysis.
- Perform room and elevated temperature tensile tests.
- Evaluate the effect of the Engineered Re fabrication method on multi-component processing.
- Partner with Aerojet to determine the appropriate design of the thruster for fabrication and development during the Phase II investigation.
- **Subcontractor: Aerojet - Redmond**

NASA and Non-NASA Applications

- NASA 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