NASA SBIR/STTR Technologies

S3.04-8888 - Green Liquid Monopropellant Thruster for In-space Propulsion

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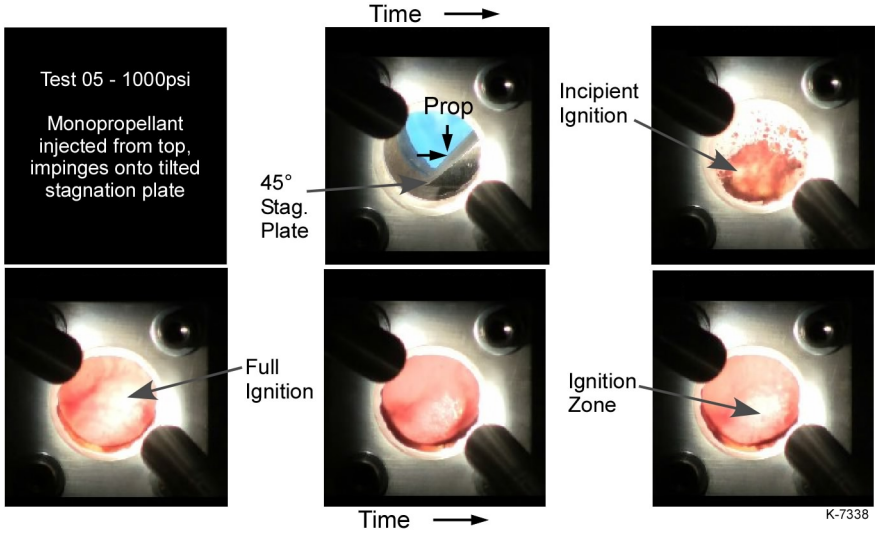
Identification and Significance of Innovation

PSI proposes to develop a unique in-space chemical propulsion system for the future NASA science spacecraft and long-duration missions. Our innovations are:
(1) Choice of Propellant: A high density, high specific impulse, high density-impulse, low freezing point, storable, green monopropellant with improved safety and simplified, low-cost ground operations.
(2) High reliability, long-life Ignition System: A new type of ignition system that will significantly improve the operational life and reliability of propulsion systems on long-duration missions.
(3) Combination of above propellant and ignition system into a Liquid Rocket Engine:
The high density-impulse propellant will provide performance close to a bipropellant system while keeping the smaller, simpler, and lighter hardware advantages of a monopropellant system. The ignition system will save significant electrical power, provide faster thruster response, and lower system cost compared to the state-of-the-art.



Estimated TRL at beginning and end of contract: (Begin: 3 End: 4)

Technical Objectives and Work Plan

The goal of Phase II is to demonstrate operation of a prototype liquid monopropellant thruster incorporating the new fast response, high reliability, and long-life ignition system. The specific objectives and work tasks are:
1. Develop ignition system designs: Igniter concepts identified in Phase I will be fabricated and experimentally evaluated at PSI to optimize performance.
2. Develop a modular small scale test thruster incorporating the above ignition system: A small scale thruster will be developed to allow rapid changeability of components representative of different ignition/combustor designs.
3. Characterize the operation and performance of the small scale thruster: The small scale thruster modules will be tested at Orbitec to demonstrate propulsive performance and ignition system start/stop/restart.
4. Develop functional prototype of a large scale thruster and demonstrate its operation: Experimental data from small scale thruster tests will be used to select designs for scaled up prototype thruster, which will be fabricated and tested at Orbitec.
5. Develop complete propulsion system design: A full propulsion system design, incorporating the proposed in-space thruster technology, will be developed for a candidate NASA mission.
6. Identify approaches for advancing the TRL beyond Phase II: A Phase II Enhancement program and a Phase III program advancing the TRL to 5 and 6, respectively, will be developed in collaboration with NASA and industry.

NASA Applications

NASA's future science missions need propulsion systems with demanding performance in challenging environments, with long operational life and high duty cycles. Examples of missions include sampling atmospheres of planets, their moons, and other small bodies, descent and landing on their surfaces, ascent propulsion for sample return, and rendezvous and docking with orbiting mother ships. Missions to the earth's moon, Venus, Mars and its moons, moons of Jupiter, and asteroids are envisioned.

Non-NASA Applications

Non-NASA applications include the Air Force, National Reconnaissance Organization (NRO), and the Army. They are respectively interested in liquid thrusters for in-space propulsion; fast response, long-life thruster for maneuvering propulsion; and green monopropellant based high pressure gas generators for pressurizing gelled propellants. Other DoD application is maneuverable tactical missiles.

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NON-PROPRIETARY DATA