Phase I Project Summary

PSI-6294

Firm: Physical Sciences Inc.
Contract Number: NASA Contract # NNX11CE21P
Project Title: Green Liquid Monopropellant Thruster for In-space Propulsion

Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)
Physical Sciences Inc. is developing 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; and (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.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)
The objective of this SBIR program is to develop, demonstrate, and deliver a proof-of concept engineering prototype liquid monopropellant thruster at end of Phase II.

The Specific Phase I Objectives were to:

(1) Establish pressure and mass flow ranges for injector configurations that provide reliable ignition and stable combustion, and
(2) Develop space thruster designs incorporating the proposed monopropellant and the new ignition system

The Phase I Work Plan Tasks were:

(1) Task 1: Experimental Investigation of Monopropellant Ignition and Combustion Processes, (2) Task 2: Monoprop Space Thruster Design Concepts and Analysis, and (3) Task 3: Management and Reporting

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)

(1) Demonstrated feasibility of ignition and stable combustion of the monopropellant using the new ignition scheme, and
(2) Developed ignition and combustor configuration concepts based on experimental data from Task 1.

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)
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 Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)
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 potential DoD applications include liquid engines for highly maneuverable, throttlable tactical missiles.

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