NASA SBIR/STTR Technologies

H2.01-9267 - Thermo-Catalytic Ignition of Cryogenic Oxygen-Methane

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Identification and Significance of Innovation

Liquid oxygen and methane propellants for in space chemical propulsion of future space exploration vehicles are desired for increased performance and elimination of toxicity of conventional hypergolic storable propellants. All types of liquid oxygen/liquid methane engines need to be provided with safe and reliable ignition systems. The majority of current ignition systems use heavy spark torch igniters. Spark torch igniter systems require high voltage electronics to generate the spark which may interfere with other spacecraft electronics. Catalytic ignition significantly reduces energy requirements in comparison with other methods. Plasma Processes proposes an investigation of thermo-catalytic ignition of cryogenic methane-oxygen and the development of an ignition system using innovative nanocrystal catalysts on high temperature metal foams. This catalyst was successfully used for ignition of advanced non-toxic AF-M315E monopropellant in a 100lbf class engine.

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

Technical Objectives and Work Plan

Technical Objectives
The overall project objective is to demonstrate ignition of cryogenic oxygen/methane bipropellant using innovative metal foam catalyst and develop reliable, low energy, low weight ignition system for a flight weight reaction control engine.

-Demonstrate the ability to combine innovative processes such as EL-Form® and hydrothermal growth technique and design an advanced low mass thermo-catalytic reactor with metal foam catalysts for ignition investigation;
-Design a catalytic system for oxygen/methane ignition;
-Fabricate an experimental facility and instrumented reactor and catalyst for ignition studies
-Investigate the ignition and combustion of oxygen/methane propellant on metal foam catalysts. The study will include the determination of critical ignition temperature for cold propellant, and ignition conditions for different oxidizer/fuel mixtures, pressure and propellant flow rate;
-Formulate a compact, weight efficient, low power design concept for thermo-catalytic igniter.

Work Plan

-Design and Build Experimental Facility for GOX-GCH4 Ignition Study

NASA Applications

Propulsion for ORION MPCV, Commercial Crew Vehicles (Boeing CST-100, Space-X Dragon), Commercial Cargo vehicles (Orbital Cygnus, Space-X Dragon), RCS for launch vehicles, Apogee/Upper stage engines.

Non-NASA Applications

Replacement Engine for banned Russian engines (RD-180), Commercial Crew Vehicles (Boeing CST-100, Space-X Dragon), Commercial Cargo vehicles (Orbital Cygnus, Space-X Dragon), RCS for launch vehicles, Apogee/Upper stage engines.

Firm Contacts

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