Nontoxic Ionic Liquid Fuels for Exploration Applications

For safer, less expensive propulsion systems

The toxicity of propellants used in conventional propulsion systems increases not only safety risks to personnel but also costs, due to special handling required during the entire lifetime of the propellants. Orbital Technologies Corporation (ORBITEC) has developed and tested novel nontoxic ionic liquid fuels for propulsion applications. In Phase I of the project, the company demonstrated the feasibility of several ionic liquid formulations that equaled the performance of conventional rocket propellant monomethylhydrazine (MMH) and also provided low volatility and low toxicity.

In Phase II, ORBITEC refined the formulations, conducted material property tests, and investigated combustion behavior in droplet and microreactor experiments. The company also explored the effect of injector design on performance and demonstrated the fuels in a small-scale thruster. The ultimate goal is to replace propellants such as MMH with fuels that are simultaneously high-performance and nontoxic. The fuels will have uses in NASA's propulsion applications and also in a range of military and commercial functions.

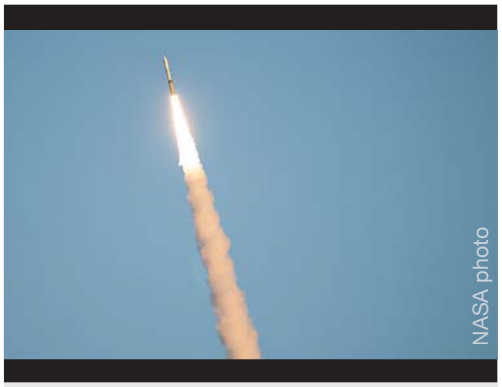
Applications

NASA

- Propulsion systems
- In-space science missions
- Lunar and planetary exploration activities
- Satellites

Commercial

- Launch systems
- Missiles
- Ballistic defense systems
- Satellites



Phase II Objectives

- Synthesize ionic liquid fuels that ignite hypergolically with nitrogen tetroxide
- Characterize ignition and combustion through drop and microreactor tests
- Measure the material properties of the candidate fuels
- Determine the molecular structures via nuclear magnetic resonance spectroscopy
- Predict performance and analyze integration into propulsion systems
- Scale up synthesis
- Investigate the effects of the injector design on ignition and combustion
- Determine the influence of chamber size on combustion efficiency
- Conduct ignition tests and small rocket test firings to demonstrate performance

Benefits

- Increased performance
- Reduced toxicity
- Reduced cost
- Increased safety

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