High Performance Solid ADN Propellants for Space Applications

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Abstract
Spacecrafts are today propelled using chemical or electrical rocket propulsion systems. Electrical propulsion provides superior specific impulse but very low thrust, whereas chemical propulsion provides low specific impulse but high thrust. If high thrust is required, chemical rocket propulsion is thus the only viable alternative. Depending on the propellants used, chemical rocket propulsion systems are divided in three major categories;

- Liquid propellant rockets (monopropellant and bi-propellant systems)
- Hybrid propellant rockets (solid fuel, liquid oxidizer)
- Solid propellant rockets

Of these three, liquid rockets provide the highest performance and adjustable thrust, but they are complex, costly and use toxic propellants such as hydrazine, mono-methyl hydrazine (MMH) and nitrogen tetroxide (NTO).

Current hybrid rockets are safer and less complex than liquid rockets. They provide excellent theoretical performance, but in reality these performance levels are hard to obtain due to poor combustion efficiency and low fuel regression rate.

The benefits of solid rockets are their storability, compactness and simplicity. No propellant delivery system is required which enables a huge improvement in reliability and cost. However, current solid rockets suffer from two major drawbacks; once ignited the thrust cannot be altered and their specific impulse is low.

The HISP project (www.hisp-fp7.eu) of the European Commission's Seventh Framework Program addresses the latter by developing high performance solid propellants using the high energy density oxidizer ammonium dinitramide (ADN), glycidyl azide polymer (GAP) and high energy density fuels such as aluminium hydride (AlH_3), micron- and nano-aluminum and activated aluminum.

The paper presents an overview of the HISP project and focuses on the work performed at FOI concerning ADN particle production, propellant formulation and thermochemical calculations.