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**Title**

# Hypergolic ignition of amine-based fuels with hydrogen peroxide

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## Abstract

Conventional liquid bipropellant propulsion systems for in-space applications are powered by the hypergolic combination of hydrazine and its as fuels and dinitrogen tetroxide (NTO) as oxidizer. These couples are characterized by long heritage, high propulsive performance and long-term stability. However, these liquids are difficult to handle in light of their universally cited toxicity. Nowadays, academies, companies and space agencies are extensively studying the so-called green propellants. Among the oxidizer candidates, high concentration hydrogen peroxide has gained significant attention due to its low toxicity, high density, low vapor pressure, and environmentally safe decomposition products. However, pure substances which exhibit hypergolic behavior with $H_2O_2$ are scarce [1], leading in the last decades to the development and investigation of different nontoxic fuel blends. In particular, fuels having amino functionalities have been shown to have vigorous reactions with high-test peroxide [2], while the addition of a solvent in the formulation may be a viable solution to improve the physical properties of the fuel formulations, such as the freezing point and the viscosity. Solvents such as alcohols are cheap, stable on storage and have low freezing points and good combustion performance. Hence, the addition of an alcohol may be beneficial [2].
The present paper aims at investigating the hypergolic ignition capability of several amine-based fuel formulations with copper chloride as catalytic additive and ethanol as solvent. In particular, a parametric analysis in terms of additive amount is performed to investigate the ignition delay time with 87.5% hydrogen peroxide by a drop test experimental campaign. Additionally, a theoretical investigation presents the ideal rocket performance and analyses the green character of the blends.

## References

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