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CATALYST-DRIVEN GREEN PROPELLANT DEVELOPMENT FOR HYPERGOLIC SYSTEMS

Abstract

Hypergolic fuels are crucial in the space industry, particularly in satellite propulsion systems, where their ability to ignite spontaneously upon contact is extremely valuable. Among the most established hypergolic propellants are hydrazine and nitrogen tetroxide. However, their high toxicity not only drives up the cost of satellite integration but also poses significant environmental risks. To address these challenges, researchers have been focusing on developing new environmentally friendly hypergolic bipropellants using high-concentration hydrogen peroxide as an oxidizer. This study explores the use of different catalysts in the decomposition of 90% hydrogen peroxide, aiming to propose a new green fuel blend based on n-butanol and monoethanolamine (MEA). The catalyst and the optimized fuel composition were selected in terms of the ignition delay time (IDT) with hydrogen peroxide (90%). Finally, a fuel solution consisting of 31.5% n-butanol, 60% MEA, and 8.5% copper nitrate trihydrate with a minimum IDT of 20 ms was achieved, and a characterization of the green fuel blend was made in terms of viscosity, density, flashpoint, and combustion enthalpy. The findings suggest that n-butanol can serve as an additive to enhance MEA, improving the freezing point, IDT, and viscosity of the hypergolic pair with hydrogen peroxide (90%).