SPACE PROPULSION SYMPOSIUM (C4)
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CERAMIC CATALYST BED FOR A GREEN LIQUID BI-PROPELLANT ROCKET ENGINE USING 98% HYDROGEN PEROXIDE AS OXIDIZER

Abstract

The purpose of the paper is to present the technical feasibility of ceramic catalysts based on manganese oxides supported on aluminum oxide for propulsive application. This type of a catalyst is a promising candidate to decompose the highest grade hydrogen peroxide: 98%. The highest concentration of peroxide is beneficial especially for space application.

Hydrogen peroxide is a non-toxic, non-carcinogenic non-volatile and almost non-corrosive transparent liquid. It is also characterized by relatively high density, low viscosity, high oxidative potential (second after LOX), monopropellant properties and rather low cost.

According to open literature manganese oxides are as active or just slightly less active (with respect to hydrogen peroxide) than platinum. Moreover, precursors of manganese oxides are even one thousand times less expensive than the precursor of platinum. Silver cannot be used to decompose the highest class peroxide due to the temperature limitation. Following this logic manganese oxides have been selected as promising candidates for decomposition of 98% hydrogen peroxide.

A number of manganese oxide catalysts supported on - and -alumina were investigated under this activity. As a result of down-selection, four most promising candidates were qualified for further investigation. The catalyst chamber design was based on an open literature review. On the basis of internal know-how three catalyst bed configurations were designed, assembled and preliminarily tested. Test results provided useful data applied to the trade-off analysis aimed at the assessment of these three catalyst beds. Finally one optimal configuration was selected and tested for various operating and starting conditions.

This test campaign was a preface to the next step of research - bi-propellant rocket engine testing. Catalyst bed is a critical component of a non-hypergolic (staged combustion) rocket engine using hydrogen peroxide as oxidizer (both liquid and hybrid). This test campaign was managed in order to answer the question: if a catalyst bed packed with ceramic supported manganese oxide catalyst is able to survive defined test conditions, duration and propellant throughput.