SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (1) (1)

Author: Mr. Christian Hendrich
DLR (German Aerospace Center), Germany

Dr. Michele Negri
DLR (German Aerospace Center), Germany
Mr. Marius Wilhelm
Germany
Mr. Niklas Wingborg
Sweden
Mr. Linus Gediminas
Sweden
Mr. Leif Adelöw
Sweden
Mr. Corentin Maleix
CNRS, France
Mr. Pierre Chabernaud
France
Mr. Rachid Brahmi
France
Dr. Romain Beauchet
Université de Poitiers, France
Dr. Yann Batonneau
France
Prof. Charles Kappenstein
France
Dr. Robert-Jan Koopmans
Austria
Mr. Sebastian Schuh
Austria
Mr. Tobias Bartok
Austria
Dr. Carsten Scharlemann
University of Applied Science Wiener Neustadt, Austria
Mr. K.S. Anflo
Swedish Space Corporation (SSC), Sweden
Mr. Mathias Persson
Sweden
Mr. Wilhelm Dingertz
ECAPS AB, Sweden
Mr. Ulrich Gotzig
Airbus Safran Launchers, Germany
Dr. Martin Schwentenwein

IGNITION OF ADN-BASED MONOPROPELLANTS – RESULTS OF THE EUROPEAN PROJECT RHEFORM

Abstract

The proposed paper will give an overview of the project RHEFORM. RHEFORM is a European project in which 7 universities, research centers, and industries develop new technologies for replacing hydrazine with monopropellants based on ammonium dinitramide (ADN).

The paper will be focused on one of the goals of RHEFORM: the development of igniters which require less power and allow a more prompt ignition compared to the pre-heated catalysts currently used. Currently ECAPS uses pre-heated catalysts on the 1 N thrusters for the ignition of the ADN-based propellant LMP-103S. The drawback of the current technology is that the power required for larger thrusters increases strongly; therefore for such applications an improved igniter would be beneficial. In the project two types of igniter are considered: improved catalyst igniters and thermal igniters.

Two catalyst supports are considered: granulates and monoliths. The support material should have an excellent resistance to thermal shocks and extreme temperatures, as well as a large specific surface area. To fulfill these requirements different types of silicon-doped aluminas and hexaaluminates have been synthetized and shaped in granulated form. The granules have been impregnated with different active phase and a preliminary selection was conducted in a batch reactor. Monolithic supports have been 3D printed using the technology called Lithography-based Ceramic Manufacturing (LCM) developed from Lithoz, one of the project partners. Different designs of the monoliths have been considered. The monoliths have been coated with washcoat layers to increase the surface area. Procedures to deposit different kinds of washcoats have been developed. The active phases were deposited on the washcoats. A demonstrator has been developed to conduct a preliminary selection of the catalysts.

Different types of thermal igniters were considered in the project. Preliminary studies were conducted on laser and resistive ignition. No clear ignition was observed with these methods. Subsequently tests have been conducted with a demonstrator using a H2/O2 torch igniter. This igniter provides a large amount of power and allows multiple re-ignitions. In the tests conducted with the torch igniter vaporization of the propellant was observed, but no ignition. In order to achieve thermal ignition, variations of the demonstrator with improved combustion chambers have been designed, and are currently tested.