IAF SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations - IAF SPACE PROPULSION SYMPOSIUM (IP)

Author: Mr. Mohammed Bouziane
Royal Military Academy, Belgium

Prof. Artur Bertoldi
University of Brasilia, Brazil
Dr. Praskovia Milova
Université Libre de Bruxelles, Belgium
Prof. Patrick Hendrick
Université Libre de Bruxelles, Belgium
Prof. Lefebvre Michel
Royal Military Academy, Belgium

EXPERIMENTAL INVESTIGATION OF INJECTORS DESIGN AND THEIR EFFECTS ON 1KN PERFORMANCE HYBRID ROCKET MOTOR

Abstract

To investigate the effects of injection on the performance of hybrid rocket motors (HRMs), we have designed, manufactured and tested two types of injector: showerhead (SH) and pressure-swirl (PSW). This paper analyses the influence of the oxidizer injector design on the main performance parameters, such as the fuel regression rate, the specific impulse and the combustion efficiency. First, in order to observe the injector spray qualities, a series of cold tests using liquid water and liquid nitrous oxide are carried out, providing a good understanding of the spray profiles. Then, the motor performance data are obtained by a series of firing tests using N_2O as oxidizer and paraffin as fuel. Due to its simplicity, large database and its easy manufacturing, the showerhead is used as a benchmark in this work. During this experimental analysis, the SH injector exhibits the highest regression rate. In terms of spray properties, the PSW has significant differences, generates the smallest Sauter Mean Diameter (SMD) in the formed spray and achieves good atomization. In spite of the fact that the PSW injector leads to the lowest regression rate, it results to a good specific impulse, increases the oxidizer-to-fuel ratio (O/F), and a uniform and smooth consumption of the paraffin fuel grain. Concerning the stability, SH injector exhibits lower oscillations in the chamber pressure. Some observations are made on exhaust plume intensity developed during combustion, and in firing tests with SH a blow-out phenomenon is strongly present.