SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic and Combined Cycle Propulsion (5)

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RAMJET THRUSTER USING OZONE DISSOCIATION ENERGY FOR HIGH ALTITUDE OPERATION

Abstract

In this paper we present an innovative high altitude propulsion unit using the chemical energy stored in the typical chemical compounds (e.g.: ozone) encountered at higher altitudes within the atmosphere. Our thruster is basically a ramjet initially propelled at a certain minimum velocity. The ozone enters the ramjet thruster through an inlet and by using a special geometrical arrangement within the thruster the ozone is determined to dissociate chemically in oxygen. The heat generated by the dissociation accelerates the resulted oxygen through a special designed outlet, hence, generating thrust. The amount of thrust depends both on the mass flow of ozone in the thruster and the fraction of ozone that actually dissociates. A detailed thermo-chemical calculation is shown that takes into account the enthalpies of input and output chemical substances. The thermo-chemical calculation is then coupled with gas dynamic equation of ozone flow through the ramjet thruster. Detailed thermo-chemical equations as well as quantities used are shown in the paper, as well as step by step computation for a given set of input data. At the same time, usage is made of thermo-chemical computer codes in order to validate the data determined as described above. Next, the paper presents the dynamics equation for the overall thruster taking into account gravity force, aerodynamic force and thrust force all of them being functions of mass, velocity and geometrical dimensions. The thruster can produce thrust that can overcome aerodynamic force (drag in horizontal flight) only above a certain minimum velocity for a given ozone density. Connecting the ozone density with altitude by using standard high altitude atmospheric models we derive the minimum velocities needed as function of altitude, hence, deriving a very useful operation table containing these velocities. One of the big advantages of such a thruster is that it allows continuous operation at high altitudes without the need of a storable fuel onboard. Once the minimum velocity for the given altitude is reached, the thruster can work indefinitely from the propulsion point of view. In conclusions we summarize the ozone ramjet thruster, the main thermo-chemical results as well as the dynamical model used to determine the main performances of the ozone ramjet thruster. As a future development we propose a high altitude experiment to validate some of the theoretical models and refine the results for further technological optimization.