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INVESTIGATION ON THE FEASIBILITY OF USING OXIDIZER LIQUID FILM COOLING FOR A BIPROPELLANT ORBIT AND ATTITUDE CONTROL ROCKET ENGINE

Abstract

A study to determine the applicability of oxidizer film cooling to a bipropellant orbit and attitude control rocket engine operating at a chamber pressure of 2MPa and thrust of 1000N is presented. The accuracy of the computational model was verified with hot-fire test data. By comparing with the fuel film cooling which is popular for bipropellant orbit and attitude control rocket engines, the advantages and disadvantages of oxidizer liquid film cooling are discussed in detail. The heat-transfer calculation, which involves the convective heat-transfer from the hot gaseous combustion product to the chamber wall as well as the radiation heat-transfer from the hot gas to the chamber wall and that from the high temperature chamber wall to the outside environment, for this N2O4/MMH rocket engine thrust chamber with oxidizer liquid film cooling was carried out by using a self-developed code combined with the commercial CFD software Fluent. The computational model and numerical algorithm of the self-developed code is given in the paper. In order to ascertain the computational model of the self-developed code, a hot-fire test with duration of 3-seconds was performed. A modification of the heat-transfer model was introduced on the basis of comparison between the first-round computational results with the experimental measurements. Then, series of heat-transfer calculations were accomplished and the steady state structural thermal status of the thrust chamber was obtained. The results showed that when the mass flow rate of the oxidizer liquid film reached to about 20