

SPACE PROPULSION SYMPOSIUM (C4)  
Propulsion Technology (3)

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NUMERICAL SIMULATION OF THE IGNITION PROCESS IN A GOX/CH<sub>4</sub> VORTEX THRUSTER

**Abstract**

Recent years, a type of cold wall vortex thruster attracted many scholars' interest. This bidirectional vortex combustor has very low wall temperature. Based on the research of USA, a lab scale cold wall vortex thruster was studied by experiments and numerical simulation. Methane was chosen as fuel and oxygen was oxidant.

In the experiments, the side wall temperature was kept less than 100 and the working process was very stable. But the ignition of the thruster was uncertain. A series of tests were performed to study the ignition process. To compare with the experiments, both stable combustion flowfield and transient ignition process were simulated by CFD method.

A fluid structure coupling method was used to calculate the stable combustion process and the heat transfer in the vortex combustor. Reynolds Stress Model (RSM) and PDF model were used to simulate the stable combustion flowfield. Both convection and radiation were considered in thermo couple. The CFD results show detailed flow structure in the vortex combustor. The predicted side wall temperature agrees well with the experimental value.

For ignition process simulation, the finite reaction rate model was used. A simplified reaction mechanism which contains 5 elementary reactions was used to calculate the combustion of methane. The unsteady results described the flame spread process and predicted the pressure increasing at ignition. Based on the numerical simulation of ignition, one can study the startup characteristic of vortex thruster.