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STUDY OF FLOW CHARACTERISTICS FOR LIQUID FILM IN THE IMPINGING STREAM VORTEX CHAMBER BY CFD AND EXPERIMENT

Abstract

The Impinging Stream Vortex Chamber Concept (ISVC) is a concept of new operation for cooling liquid rocket engine. With the development of new injection technique, the wall of combustion chamber is covered by liquid film. Thus, the side wall prevented from the high excessive heat loads of the inner hot combustion zoon. It is significant for reducing the wall's temperature. Because of the lower temperature, the thruster chamber can be operated without the using of any cooling techniques. This vortex flow also creates strong turbulence that promotes the propellant mixing process. Consequently, the subject chamber concepts not only offer system simplification, but they also can enhance combustion performance. Beyond that, it may be operated at various operating conditions including power level and propellant mixture ratio variations. This paper hope to find the necessary prerequisite for forming stable liquid films to make sure the cooling performance of engine. We will concerned on the formation of impinging liquid film and the jet impingement between the LOX and kerosene. And we will solve these problems by computation and experiment. Firstly, we hope to obtain the key parameters of the liquid film such as thickness distribution, area size and shape distribution by solving the Navier-Stokes equations with implicit finite volume method. Secondly, the measurements for the thickness of the impinging films which won't contact measure instrument will be presented by the experiment equipment. The high speed photography will be employed to the experiment. Use the corresponding relation between the liquid film's grayscale map and thickness to get the thickness distribution and area size of impinging films. At last, the summarizing experimental data also can be used to revise calculation model. We hope to get the necessary prerequisite for forming stable liquid films to make sure the cooling performance of engine by the result analysis of the computation and experiment. ISVC possesses good application prospects, and is worth research. The paper hopes to demonstrate a study of the formation mechanism of imping liquid film. The reasonable scheme of the engine structure with its fundamental parameters can be tentatively determined based on the computation and experiment. This study may provide theoretical basis for the design of ISVC engine.