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RESEARCH ON THE HIGH FREQUENCY COMBUSTION INSTABILITY IN THE MODEL OF LOX/KEROSENE ROCKET ENGINE

Abstract

High-frequency combustion instability is one of the most important factors inhibiting the development of liquid rocket engine which is supposed to be the main power unit of aerospace engineering in the future. Turbulent two-phase reacting flow in the chamber of LOX/Kerosene bipropellant liquid rocket engine is numerically investigated using three-dimensional transient RANS method in this paper.The predicted pressure and mean axial velocity are qualitatively consistent with the experimental measurements. Self-excited pressure oscillations are obtained without any disturbance through the initial and boundary conditions, and the corresponding frequency is in good agreement with test data, which validates the present numerical simulation method. In order to further analyse the causes of self-excited high-frequency pressure oscillations, the "pressure peak" is studied and the conclusion is obtained which is "local quasi-constant volume combustion process exists in the chamber and the instant gasification of fuel droplets reaching their critical state is the prerequisite". And based on the generating mechanism of "pressure peak", a third Damköher number is defined as the ratio of the characteristic time of a chemical reaction to the characteristic time of a pressure wave expansion, which can be used to interpret self-excited high-frequency pressure oscillations effectively.

Key Words: Lox/Kerosene rocket engine; Combustion Instability; Damköher number; Constant Volume Combustion