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INFLUENCES OF STRUCTURAL PARAMETERS ON ATOMIZATION AND COMBUSTION PERFORMANCES OF LOX/METHANE PINTLE INJECTOR

Abstract

LOX/methane has been being considered as one combination of the green propellants. The advantages of LOX/methane include high performance, non-toxic, low cost propellant, easier and safer to handle. Pintle injector, which uses a removable component to alter the injector area in order to change the mass flow rate of both oxidizer and fuel, has the characteristics of deep throttling, fast response and face shut off. In this paper, influences of main structural parameters on atomization cone angle and combustion performances of LOX/methane pintle injectors were studied by experiments and numerical simulation. The results indicate that, with increase of gas-liquid mass flow ratio, the atomization cone angle decreases. When the gas-liquid mass flow ratio is larger than 0.224, the atomization gas-liquid boundaries appear in a column with an invariant diameter approximately and changes little. Moreover, in the condition of same gas-liquid mass flow ratio, the bigger injection angle of liquid propellant is, the bigger the atomization cone angle becomes. Two big recirculation zones in the combustor lead to combustion stability of pintle engines. Owing to the viscous effects of the pintle tip, with increase of the "skip distance", which is defined as the length that the annular flow must travel before impacting the radial slots divided by the pintle diameter, the atomization cone angle gets larger. Additionally, when the value of the "skip distance" is near 1, the combustion efficiency of pintle engines is highest. The research results provide a reference for the structural optimization of pintle injectors.