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EXPERIMENTAL RESEARCH ON ATOMIZATION PERFORMANCE OF LIQUID-CENTERED DOUBLE-PHASE PINTLE INJECTOR FOR LRE

Abstract

Reusable rockets have been proven as an effective solution to reduce space launch costs, and the deep throttling injector technology for variable thrust liquid rocket engines has become a research hotspot. The pintle injector has attracted the interest of researchers once again due to its deep throttling capability and other excellent advantages. The atomization performance of LRE injectors can affect the evaporation, mixing, combustion and other processes in the thrust chamber, thereby affecting the overall performance of LRE. In this study, a liquid-centered double-phase pintle injector for liquid oxygen and gas methane is designed, and its atomization characteristics experiments are carried out with compressed air and liquid water as alternative working fluid. The atomization angle α ,flow distribution, droplet velocity and size(SMD, Sauter Mean Diameter) are measured with photography system and PDPA(Phase Doppler Particle Analyzer) system. And the effect of BF(Blockage Factor), shape and layout of radial orifice and LMR(Local Momentum Ratio) are studied. The results show that the gas-liquid pintle injector has a better atomization performance respect to liquid-liquid pintle injector, and exhibit some different performance characteristics. The flow coefficient becomes larger with the increase of total pressure drop, while it is almost independent of the orifice shape. SMD decreases with radial distance, but the distribution changes little along the axial direction. With the increase of LMR, SMD increases, and with a higher total flow rate, the variation range of SMD will be enhanced. The atomization angle α increases with the increase of LMR while the shape and layout of radial orifice have little effect on α.