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SPRAY AND COMBUSTION CHARACTERISTICS OF LOX/GH2 COAXIAL INJECTORS AT SUPERCRITICAL PRESSURES

Abstract

This research has concentrated on the characterization of spray and combustion for typical LOX/LH2 rocket engine coaxial injector element at supercritical pressure. Cold flow spray tests utilizing LN2 and He to imitate LOX/GH2 at sub/super-critical conditions for coaxial injector element have been done. The spray test conditions of interest have encompassed subcritical to supercritical ambient pressure, the gas to liquid jet momentum flux ratio, the liquid-phase temperature, with and without gas-phase. Based on the spray results of coaxial injector element at supercritical pressure, numerical simulation of combustion flow field for LOX/GH2 single-injector at supercritical pressure have been completed. The results show that the spray characteristics is governed primarily by the gas to liquid jet momentum flux ratio, and on whether the ambient pressure is subcritical and supercritical. The spray characteristics show a significant difference at sub/super-critical conditions. The LOX-jet disintegrates into O2-clumps of larger size at supercritical conditions than typical liquid entities in subcritical case. The LOX-jet shows higher dispersion of liquid phase and decreasing visible intact core length with the momentum flux ratio increasing. The analysis shows that surface tension, vaporization enthalpy, and liquid/gas phase changes diminish at supercritical pressures. As a result, the oxygen no longer experiences liquid atomization but, rather, diffuses directly through turbulent mixing similar to turbulent gas phase jets. As the understanding, it is reasonable to simulate LOX/GH2 combustion at supercritical pressure utilizing two-fluid real gas model.