Paper ID: 22840
student

SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic and Combined Cycle Propulsion (9)

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IGNITION AND FLAMEHOLDING CHARACTERISTICS OF LIQUID ALKANE FUELS IN THE SUPERSONIC COMBUSTOR

Abstract

The ignition and flameholding characteristics of three kinds of one-component alkane fuels, namely n-decane, n-dodecane and isooctane, were experimentally investigated in the Beihang University Direct-Connect Supersonic Combustion Facility. High enthalpy clean air was heated to the total temperatures ranging from 900K to 1200K through storage heater, entering the isolator entrance at a Mach number of 2.03 through a convergent-divergent nozzle. The inflow mass flow rate was approximately 2.0Kg/s. The integrated transverse injector and dual-cavity was employed as the main flame-holding mechanism. The fuel was injected through eight transverse injectors upstream of the first cavity. A dependent gas generator, normally located at the bottom of the cavity, acted as the igniter at the start of experiment. The experimental results showed that the isooctane had the best ignition and flameholding characteristics, next came the n-decane and n-dodecane. Theoretical analysis were also performed to obtain the reaction characteristic time of three fuels, which demonstrated that the isooctane had the smallest reaction characteristic time, next came the n-decane and n-dodecane. The combustion efficiency and air-specific impulse of three fuels were calculated through a one-dimensional analysis code. Furthermore, the influence of the injector configuration was also experimentally investigated. The injector with smaller diameter resulted in a better fuel atomization and mixing, which obviously improved the fuel ignition and flameholding characteristics. Compared with the normal injector, the effervescent atomization nozzle can efficiently enhance the fuel ignition and flameholding characteristics.