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INFLUENCING FACTORS ON THE MODE TRANSITION IN A DUAL-MODE SCRAMJET COMBUSTOR

Abstract

Experiments and numerical simulations were performed to investigate the mode transition of a dual-mode scramjet combustor with the wall injection configurations in the Beihang University. High enthalpy vitiated air was heated to four different total temperatures through hydrogen-oxygen combustion, entering the isolator entrance at a Mach number of 2.0. The fuel (hydrogen or ethylene) was firstly injected into the combustor through a four-hole aero-ramp or transverse injector, and ignited by a gas-pilot flame. Three different combustion modes, namely the Late Scram Mode, Early Scram Mode, and Ram Mode, were classified in detail at a total temperature of 1200K by a series of experimental measurements. A total of 26 pressure-tap ports were located along the combustor to obtain the axial pressure distributions. High speed Schlieren and camera images of the flame structure were captured to illustrate the flow features around the injectors. The transition from Late Scram Mode to Ram Mode and back was obtained by keeping the inflow stagnation conditions fixed while increasing or decreasing the fuel flow rate to add or reduce combustion heat. The influences of inflow total temperature, fuel type, fuel injector type, and fuel injection location on the critical point were experimentally investigated, respectively. The experimental results were in accordance with the analytical analysis. Limited to the experimental measurements, 3D steady RANS simulations were also conducted at a total temperature of 1200K to obtain the flow features in detail, which were in accordance with the experimental results. The axial variations of several parameters, such as total temperature, Mach number, combustion efficiency and so on, were obtained to help classifying the combustion modes.