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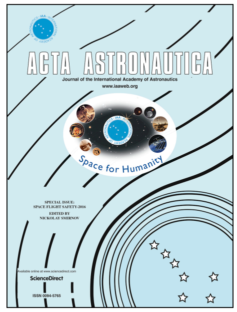

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Characterization of ignition transient processes in kerosene-fueled model scramjet engine by dual-pulse laser-induced plasma

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Abstract: Dual-pulse laser-induced plasma ignition of kerosene in cavity at model scramjet engine is studied. The simulated flight condition is Ma 6 at 30 km, and the isolator entrance has a Mach number of 2.92, a total pressure of 2.6 MPa and a stagnation temperature of 1650 K. Two independent laser pulses at 532 nm with a pulse width of 10 ns, a diameter of 12 mm and a maximum energy of 300 mJ are focused into cavity for ignition. The flame structure and propagation during transient ignition processes are captured by simultaneous CH* and OH* chemiluminescence imaging. The entire ignition process of kerosene can be divided into five stages, which are referred as turbulent dissipation stage, quasi-stable state, combustion enhancement stage, reverting stage and combustion stabilization stage. A local closed loop of propagations of the burning mixtures from the shear layer into the recirculation zone of cavity is revealed, which the large-scale eddy in the shear layer plays a key role. The enhancement of mass exchange between shear layer and the recirculation zone of cavity could promote the flame propagation process and enhance the ignition capability as well as extend the ignition limits. A cavity shear-layer stabilized combustion of kerosene is established in the supersonic flow roughly 3.3 ms after the laser pulse. Chemical reactions mainly occur in the shear layer and the near-wall zone downstream of the cavity. The distribution of OH* is thicker than CH* at stable combustion condition.

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