DEFLAGRATION-TO-DETONATION TRANSITION IN THE HETEROGENEOUS SYSTEM “OXYGEN – LIQUID n-DECANE FILM”

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Abstract: Deflagration-to-detonation transition (DDT) in the system “gas (oxygen) – liquid n-decane film” was obtained experimentally for the first time using a weak ignition source. In a series of experiments with ignition by an exploding wire that generates a weak primary shock wave with Mach numbers ranging from 1.03 to 1.4 in a straight smooth channel of rectangular cross section 54×24 mm, 3- and 6-meter long with one open end, the DDT is obtained at distances 1 to 4 m from the ignition source 3 ms to 1.7 s after ignition. The DDT is obtained for n-decane films 0.3–0.5 mm thick, which corresponds to the fuel-to-oxygen equivalence ratios of 20–40. The registered detonation velocity was 1400–1700 m/s. In a number of experiments, a low-velocity quasi-stationary detonation-like combustion front propagating at an average velocity of 700–1100 m/s was recorded. The structure of this front includes the leading shock wave followed by the reaction zone separated from each other by a time delay of 90 to 190 μs. The results obtained are important for better understanding of the operation process in the continuous-detonation and pulse-detonation combustors of advanced rocket and air-breathing engines with the supply of liquid fuel in the form of a wall film.

Keywords: deflagration-to-detonation transition; stratified gas–film system; weak ignition; detonation engine

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