CARS and Fluorescent Study of Ignition of H_2-O_2 Mixtures upon Photo-Dissociation of O_2 Molecules

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The methods of resonant and nonresonant laser radiation impact of the working mixture leading to ignition as a result of gas heating, optical breakdown, photoionization or photodissociation are considered.

An experimental setup is described that allows to investigate the ignition process of various gaseous fuels with oxygen, whose reactivity is instantly (within 20 nsec) activated in relation to chain reactions by oxygen atoms, obtained as a result of dissociation of O2 molecules. It is important to note that the ignition volume of mixture does not contain impurities of the recombining plasma characteristic of methods of optical or electrical breakdown.

When the values of temperature, pressure, composition and energy of the laser for O_2/H_2 mixtures ignition vary, the interrelated threshold values of the listed parameters were determined above which the ignition of the combustible mixture is observed.

Based on the study of spatiotemporal distributions of OH radicals in the field of laser ignition of O_2/H_2 mixtures heated below the self-ignition temperature, data on ignition delays after exposure to laser radiation are obtained and the propagation velocity of the flame front in the space filled with a combustible mixture is measured. The induction times were measured, which was defined as the interval of time from pulse initiation to the "start of combustion", where the "start of combustion" accepted "moment" of emergence of the observed zone of the chemiluminescence of OH radicals with size tending to zero.

Temperature measurements by means of a CARS spectroscopy made it possible to experimentally observe the presence of a high temperature ≥ 1000 K at delay times of 30 μs and to establish that starting from this time there is ignition with transition to steady burning.

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