EFFECT OF FAST GAS HEATING ON THE IGNITION OF H2 / AIR MIXTURES BY PULSED NANOSECOND DISCHARGE [[1]](#footnote-1)\*)

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The problem of fast non-equilibrium ignition of combustible mixtures under the action of gas-discharge plasma has been widely discussed recently [1]. Depending on the reduced electric fields E/N, the production of various chemically active particles and various gas heating occur. As a result, the analysis of the effect of gas discharges on the ignition processes is rather complicated.

In [2] the results of measurements of the dynamics of gas temperature and OH radical density in a stoichiometric H2 : air mixture at P0 = 1 atm and T0 = 300 K, excited by a pulsed nanosecond discharge, are presented. To ignite the combustible mixture was used nanosecond spark discharge with typical duration of the discharge pulse about 10 ns. OH radical density in the afterglow was measured using the LIF technique, and the temperature was determined from the ratio of LIF OH intensities of the P2(8) and Q1(11) lines under the assumption that the rotational distribution of OH radicals is thermalized at times t < 10 μs after the discharge.

**Figure 1** shows the calculation results of the composition of a stoichiometric H2 : air mixture and the dynamics of gas heating for the experimental conditions of [2]. The calculations were carried out in the framework of current approximation using the model [3] and the experimentally measured current pulse [2]. An important feature of these calculations is a detailed account of the mechanism of fast gas heating in H2 : air mixtures. In addition to the reactions, determining the fast gas heating of nitrogen-oxygen mixtures, the heat release due to the dissociation of H2 molecules by electron impact, as well due to the quenching of electronically excited O(1D) atoms and N2(A, B, C) molecules by hydrogen molecules were taken into account.



According to **Fig. 1**, at times 5-10 μs after the discharge, the gas temperature reaches 1100 K. Taking into account the gas-dynamic rarefaction of discharge channel, the specific energy spent to the gas heating is W ≈ 0.22 eV/mol. This heating is determined both by heat release due to the quenching reactions of electronically excited atoms and molecules (“fast” heating at t < 20-30 ns), and heat release due to the reactions of hydrogen oxidation that occur in this mixture.

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References

1. Popov N. A*.* // Plasma Sources Sci. Technol. 25 (2016) 043002
2. Ono R., Oda T. // Combustion and Flame. 152 (2008) 69
3. Shcherbanev S.A., Popov N.A., Starikovskaia S.M. // Combustion & Flame. 176 (2017) 272

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Pt/ru/GE-Popov.docx) [↑](#footnote-ref-1)