IGNITION OF PROPANE-AIR MIXTURE WITH SPATIALLY-NONUNIFORM REACTIVITY, GENERATED BY STREAMER DISCHARGES

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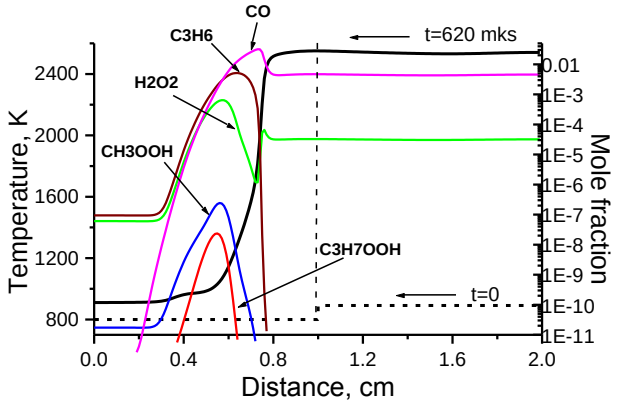
This work presents the numerical results regarding to ignition of the premixed lean C_3H_8-air mixture. The temperature and radical stratifications are created by a filamentary electrical discharge. The formation of combustion wave at the different specific deposited energy and the important role of low temperature oxidation chemistry (below 1000 K) in the preheating zone ahead the flame front for the acceleration of low flame velocity in lean mixture are shown.

In connection of modern requirements to the content of automotive exhaust gas, the use of a homogenous charge compression ignition (HCCI) engine with a stratificated reactivity of lean premixed mixture in the engine cylinder is considered. The stratification of lean mixture can provide a control of ignition and maximum temperature. A modified reactivity due to the fast discharge impact can be achieved by non-uniform discharges with the filamentary structure like in experiment [1]. The goal of given work was to show the discharge effect on the ignition of lean propane-air premixed mixture stratified on the temperature and concentrations of primary radicals generated by discharge at P_0=30 bar and T_0=800 K.



The system has stratification in the form of the alternation of discharge filaments (x>1cm in figure) and free space (x≤1cm). The initial heating and concentrations of radicals produced by the discharge were determined in an approximation of a constant reduced electric field at the different input specific energies Q. The spatial distribution of components at the ignition moment of at t = 620 μs is presented in figure at Q=0.05 eV/molecule. The broadening of zone in front of flame front due to low temperature oxidation reactions (zones of cool and blue flame stages) is clearly seen: the behavior of temperature has the stepped growth before the flame front. Due to this oxidation the mixture is heated additionally and the flame front propagates through the zone with T~950 K with a higher velocity than that in the undisturbed mixture at the normal conditions. This effect is known as a chemical acceleration flame.

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REFERENCES

1. M.A. Boumehdi, S.A. Stepanyan et al. *Combust Flame* **162** (2015) 1336.