EXHAUST COMPOSITION AT LASER IGNITION OF COMBUSTIBLE GAS MIXTURES UNDER CONTROLLED CONDITIONS

Anishchanka Yu. V., Loktionov E. Yu.*

BMSTU, Moscow, Russia

**stcpe@bmstu.ru*

One of the main advantages of laser ignition is the ability to ignite lean combustible mixtures, resulting in obvious economy and reduction of harmful emissions, primarily NO_x. Experimental data on exhaust composition are presented in the literature very poorly. As a rule, the studies were not of a systematic nature, affected only very specific conditions of combustible mixtures exposure and composition (mainly methane-air) and were obtained for experimental piston engines, the design and operational features of which could significantly affect the result.

A number of models simulate exhaust composition, but they are created either without taking into account the ignition mechanism, or for electric spark or compression ignition. For laser ignition, it is known that the formation of the combustion core occurs faster than from an electric spark. We suggested that in order to obtain a starting point for further optimization, a study of exhaust composition should be carried out under conditions of minimal impact on the engine design. For this purpose, an experimental stand was created, which allows to investigate the laser ignition of combustible mixtures of different composition in wide pressures range. Its peculiarity specific to this work is the presence of volume for combustion products storage after a series of impacts, it is coupled with the combustion chamber through the discharge valve. By means of the latter, the increase of the cylinder operational volume is simulated and the protection against excessive pressure increase is implemented.

We studied the laser ignition of gas mixtures based on hydrogen, methane, propane and butane with air excess coefficient α ~0.5–2, in pressure range p ~1–3 bar, ignited by radiation of the 1st–5th harmonics of the nanosecond Nd:YAG laser. The exhaust composition was analyzed by O_2, CH, CO, CO_2, NO_x. Correspondence of the obtained results, known from other experimental and theoretical works, is analyzed.