The concept of a low-emission combustion chamber, which uses a subcritical microwave discharge

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In the present work, the possibility of developing a low-emission combustion chamber with a reduced NO_x emission from natural or liquefied gas, as well as the possibility of burning extremely poor fuel mixtures with a subcritical microwave discharge, is considered.

A subcritical microwave discharge is created under conditions when the intensity of the initial field (E_0) is lower than the critical breakdown level (E_{cr}), and also when the air pressure exceeds the boundary pressure value and is a volume system of streamer channels.

Experiments on ignition of the fuel mixture subcritical microwave discharge were performed as part of this work. When the ignition is initiated by a subcritical discharge, a significant increase in the combustion efficiency is obtained. The possibility of ignition by a subcritical discharge of a particularly poor fuel-air mixture is demonstrated.

The experiments were performed on an installation, that generates electromagnetic oscillations with a frequency $f \approx 3.4 \cdot 10^9$ Hz, which corresponds to a wavelength $\lambda = 8.9$ cm, with a microwave pulse duration $T_{imp} = 40$ μs. The microwave beam power P_b can vary from 10^2 W to 10^6 W. As a fuel mixture, a stoichiometric, as well as depleted propane-air mixture was used with an oxidizer excess ratio higher than the ignition limit under normal conditions.

Experiments have shown that the use of a subcritical microwave discharge increases the combustion rate and the completeness of the combustion of the fuel mixture by about four times, and also allows burning a particularly poor fuel-air mixture. Combustion of super-poor mixtures allows to reduce NOx emissions, reduce specific fuel consumption, and also allows to maintain the necessary efficiency of the plant at a given temperature. A number of indirect signs indicate a virtually complete absence of nitrogen oxides in combustion products, which can be explained by the high burning rate and the absence of regions with a high temperature.

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