Dynamics and hydrodynamic features of high-frequency corona discharge in methane-air mixtures

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High-frequency corona discharge fed by sinusoidal voltages at frequencies from 1 MHz is currently considered as a promising method for igniting lean fuel mixtures. The interest is primarily due to a significant increase in the volume of gas processed by the discharge compared to classical spark ignition systems. In addition, chemically active particles are effectively produced during discharge operation, which contributes to fuel conversion.

This work studies the effect of gas pressure and composition on the electrical characteristics and structure of the discharge. It is shown that with increasing pressure, a significant decrease in the discharge length and energy input to it is observed. In addition, at pressures less than 3 atm, the discharge has a complex morphology with branching of discharge filaments. It is shown that the discharge filament creates a thermal cavity, the dimensions of which in the first 200 μs approximately coincide with the discharge glow region. Thermal inhomogeneity disintegrates under the action of hydrodynamic instability, which leads to dissipation of the hot region in about 15 ms. It is shown that CH_4 in low concentrations do not affect the structure and dynamics of the thermal trace from the discharge filament. At higher CH_4 contents, local ignition centers are formed, which leads to an increase in the size and lifetime of the thermal cavity.

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