VELOCITY FLUCTUATIONS EFFECT ON AN AIR-METHANE FLAME BLOW-OFF AT LOW DAMKOHLER NUMBERS

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Fundamental problems have to be solved for development of perspective propulsion plants with high-velocity combustion chambers. In particular, extending the concentration range and kinematic limits of self-sustaining combustion has proved to be a salient issue, when Damkohler number ($Da = u_{ff}/u_{fl}$) is slightly higher than unit. Here u_{ff} is flame front velocity, and u_{fl} is flow velocity. Considering intensive flow velocity fluctuations in the combustion zone, it is important to study the influence of its frequency response on flame blow-off conditions.

The report provides the description of created experimental setup and obtained results on blow-off characteristics of turbulent flame for diffusion and kinetic air-methane combustion regime.

Obtained computational and experimental results demonstrate the impact of acoustic oscillations with frequencies from 10 Hz to 350 Hz and the amplitude up to 140 dB on reacting flow. The outcome is set out below:

1) Acoustic impact can ensure intensification of fuel mixing in turbulent flow for wide range of equivalence ratio and Reynolds number.

2) Velocity fluctuations at diffusion combustion regime lead to flame reaction zone shortening.

3) Blow-off velocity of premixed flame is reduced by 10…30 %, and concentration range of self-sustaining combustion is narrowed at considered conditions relative to combustion without oscillations.

Obtained results might be useful for combustion process analysis and for choice of configuration and operation regimes of the propulsion plants with high-velocity combustion chambers.

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