Investigation of diffusive-thermal oscillations of the burner stabilized CH_4-H_2-air flames

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In this talk we present our recent results on the investigation of the onset and dynamics of the diffusive-themal instabilities of laminar flames of the binary fuel mixtures stabilized over a flat porous burner. The mixture of methane and hydrogen (hythane) is used as a fuel, which is considered today as a promising intermediate step in the transition to the hydrogen energy.

The experimental and numerical methodology is described in detail in our previous work [1,2]. In experiments, the flame is stabilized on the flat cylindrical porous burner with liquid cooling and nitrogen co-flow. The emergence and characteristics of the flame oscillations are analysed via the observation of the chemiluminescence signal emitted by OH* radicals. The structure of the combustion wave is also investigated by using the Laser induced fluorescence method allowing us to determine the time and space resolved profiles of OH* radicals. The experimental results are also compared to the data of numerical calculations obtained within the models with detailed reaction mechanisms. Several well known mechanisms are used such as GRI, San-Diego and Warnatz.

The employment of the nitrogen co-flow configuration to isolate the flame from the surrounding air allows us to obtain the experimental data of high fidelity such that the difference between the numerical data calculated with different reaction mechanisms is greater than the experimental uncertainty, demonstrating that the proposed technique can be used to verify the reaction mechanisms. The sensitivity analysis is carried out and allows us to find the most important reactions involved in both steady and pulsating regimes of combustion. Two critical events are found: the blow-off and the onset of pulsations. The critical parameter values for them are determined. It is shown that the addition of hydrogen to the fuel mixture extends the regions of the existence of flat combustion fronts and the onset of flame pulsations in the parameter space.

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References

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