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# COMBUSTION IN MICRO-CHANNELS WITH A CONTROLLED TEMPERATURE GRADIENT

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Nowadays with the demand for high efficiency systems, there is growing development and application of micro electro-mechanical systems (MEMS devices), which may generate more energy than the modern batteries. Many studies have been carried in the field of "micro fluidics" on flame propagation and extinction in micro-channels by Maruta et al. and through numerical simulations. With the reduction in combustor' size, the difficulty in sustaining stable combustion increases, due to larger surface-to volume ratio. The effects of thermal and radical quenching increase. With continuous heating of the solid phase it is possible to sustain combustion in a tube with an inner diameter smaller than the ordinary quenching diameter. Under such conditions it is possible to achieve combustion with very lean mixtures.

In this work, a new device has been developed. It consists of a micro-channel with external heating by three hydrogen/oxygen flames at the upstream side of the tube. This system ensures uniform heating inside the channel. The temperature profile along the tube is measured continuously by an infrared camera while an intensified camera is used to record the CH* emission from the flame. Two cylindrical quartz tubes with inner diameters of 2.15 and 2.5 mm were used at atmospheric pressure to study premixed methane-air flames at different equivalence ratios.

The present experimental study on methane/air mixtures reacting in a narrow channel has been undertaken to provide detailed information on flame behavior. The effects of fuel concentration and tube size were analyzed. Three kinds of flame behavior were observed: (i) bright and stable flames under high flow velocity, (ii) flames with repetitive extinction and ignition (FREI) in the middle flow rate range, and (iii) weak flames, typical of mild combustion, at low flow velocity. The flame stabilization occurs at a certain position: an equilibrium is established between the flame temperature, the wall heat loss and the fresh gases velocity. As observed by Popp and Baum the wall heat flux increases with increasing wall temperature and interaction between the flame and the wall is very fast: the higher the wall temperature, the higher the fuel consumption. Furthermore, the behavior of reactive mixture changes.

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