FLAME-JETS INITIATION OF DETONATION IN LARGE VOLUMES

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Key words: flame jet, detonation initiation, porous media combustion.

Usually, the onset of detonation in various confinements is often preceded by the formation of combustion driven shock wave. The flame speed achieved prior to the onset of detonation must be about the sonic speed of the combustion products [1]. One of the effective methods to rapidly increase the flame speed is a venting of hot jets into unreacted mixture [2]. Such venting is often accompanied by the formation of leading shock wave, which is strongly coupled with the flame front. Moreover, strong shock reflections from confinement walls and interactions of transverse waves caused by the spatial distribution of hot jets lead to the formation of localized explosions which are capable of sustaining the leading shock wave during its expansion in the large volume. This may significantly promote the transition or re-initiation of a detonation wave.

The effect of injection of hot jets could be dramatically increased with "spatial distributed injectors". The simplest model for such injectors might be based on the concept of “porous media combustion”. In porous media, under certain conditions, the flame can be accelerated up to *CJ* detonation velocities (Fig.1) [3]. Typical ranges of flame velocity developed in C_2H_2–O_2-N_2 mixtures are presented in the Figure 1. The transition of this flame from the porous media to the space occupied by air-fuel mixture can promote the onset of detonations.

A number of tests have been performed to study the flame acceleration and propagation downstream of the porous body in stoichiometric C_2H_2–O_2 mixtures diluted with nitrogen. The experiments revealed the efficiency of spatial hot jets-distributed ignition for the reduction of

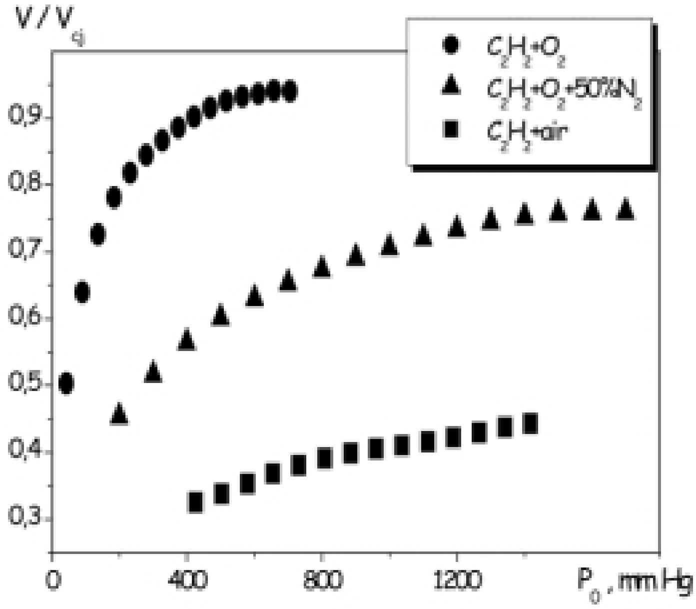
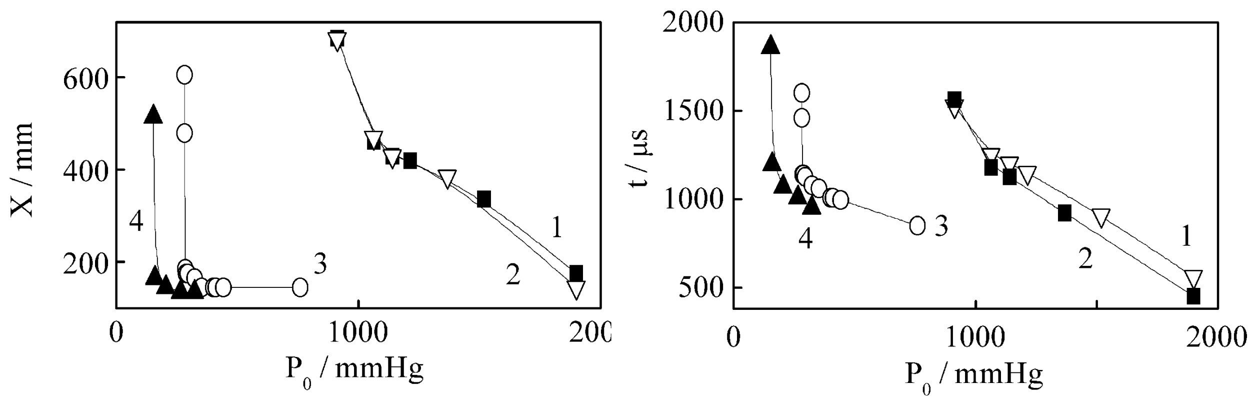


Fig.1. Normalized flame velocity V/V_{CJ} vs. initial pressure for different mixtures in the porous medium.



a) b)

Figure 2. DDT length (a) and time (b) in $C_2H_2+2.5\cdot(O_2+1.4\cdot N_2)$ versus initial pressure. 1 – hollow tube, 2 – tube with mesh, 3 – complex tube: mesh – inert porous filling, 4 – tube with foamed ceramics

DDT distance and time. A high-energy release rate with appropriate initial conditions in the porous matrix before venting of the jets, significantly facilitated the onset of detonation downstream of the flow. The stabilization of the position of DDT over a wide range of mixture compositions and initial pressures has been observed in experiment [4] (Fig. 2).

Transmission tests have shown that using porous media also increases the overall effectiveness of detonation transmission from an injection system to the large volume and, consequently, may reduce the power of the driver tube mixture.

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