EXPERIMENTAL STUDY ON THE EFFECT OF FUEL DILUTION ON THE LIFT-OFF CHARACTERISTICS OF TRIBRACHIAL FLAMES

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The effects of fuel dilution on the lift-off characteristics of tribrachial flames were studied experimentally using a multi-slot burner, which can stabilize the lift-off flame especially at weak fuel concentration gradients. Contribution of diffusion branch to the propagation velocity of tribrachial flame was examined by employing three kinds of fuel compositions diluted by nitrogen (0%, 25%, 50% N_2). Lift-off height, axial velocity variation, OH-radical, and maximum temperature along streamlines are measured by various laser diagnostic methods (ICCD camera, PIV system, OH LIF, CARS technique etc.). Fuel dilution reduced the propagation velocity of tribrachial flame mainly due to the decrease of flame temperature in premixed branch, and resulted in a significant change in flame stabilization conditions. OH radical distributions of the tribrachial flames with different fuel concentration gradients are presented in Fig. 1. OH radical in the diffusion branch is not clearly observed behind the premixed branches at very weak fuel concentration gradient, but becomes prominently active at the specific fuel concentration gradient. Figure 2 shows lift-off height of tribrachial flame with the fuel concentration gradient. Despite the difference in fuel dilution, lift-off heights of tribrachial flame have minimum value during the increase of fuel concentration gradient resulting in U-shaped trends. This fact means that the propagation velocity has a maximum value at a specific fuel concentration gradient regardless of the fuel dilution even though the critical concentration gradient varies. The enhancement of the OH radicals near the maximum propagation velocity was more clearly detected in higher dilution case. Thus the effect of the diffusion flame on the propagation velocity of tribrachial flame needs to be reconsidered.

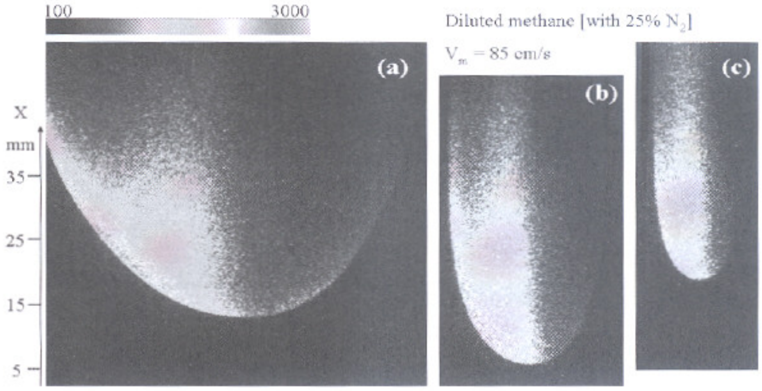

Fig. 1. OH radical distribution according to fuel concentration gradients; (a) $\nabla\phi = 0.1$, (b) $\nabla\phi = 0.3$, (c) $\nabla\phi = 0.7$

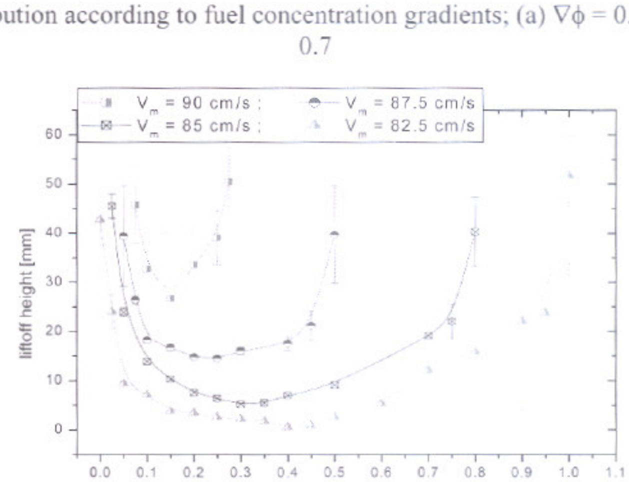

Fig. 2. Lift-off height with fuel concentration gradients for diluted methane with 25% N_2