Experimental and numerical study of oxygen diluted partially premixed dimethyl ether/methane counterflow flame

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Abstract

The oxygen diluted partially premixed dimethyl ether/methane counter flow flames were discussed in this paper. Flame images and flame structures were obtained through experiments and numerical simulation. Flame propagation velocity of premixed fuel and emissions were investigated over wide range of DME blending ratios. The methane / dimethyl ether ratio is varied from 1 to 0, while the premixed equivalence ratios of fuel-side and oxygen concentrations are unchanged. In order to exclude the influence of strain rate, the velocities of both sides keep invariable in the experiments and simulation processes and the strain rate are fixed at 49.2 s⁻¹. The results show that the premixed flames are much brighter and flame surfaces are becoming thicker with the increase of DME blending ratios, in addition, the flame surface gradually moves to the premixed side and the spacing between the double flames is increased. With the increase of the proportion of DME, the flame propagation velocities gradually increase, but they are not linearly related, that is the growth rate of flame propagation velocity gradually slowed down. For the oxygen diluted partially premixed flame, OH radicals have two peaks in the whole combustion zone, and they are consistent with the two temperature peaks. About two thirds OH radicals are produced in the premixed combustion zone. With the increase of DME blending ratio, temperature distributions are higher and the raised flame temperatures accelerate the produce of thermal nitrogen oxide, resulting in increase of NO emissions.