IGNITION AND COMBUSTION CHARACTERISTICS OF DME-AIR PREMIXTURE IN MICRO FLOWREACTOR

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Ignition and combustion characteristics of premixed DME-air were investigated using a micro flowreactor with temperature profile control experimentally and numerically. A quartz tube with inner diameter of 2 mm having stationary temperature gradient (300 - 1300 K) along the tube wall by external heater was used. In general, flame is stabilized at a certain location in this temperature gradient. Various flame responses were observed by changing an inlet velocity as shown in Fig. 1. Stable flat flames (Normal flame) were observed in higher velocity region. These flames shifted to the upstream with the decrease of velocity. Then flame responses to decreasing velocities were reversed at velocity about 30 cm/s. Flame went downstream as the velocity decreases to 28 cm/s. This tendency implies a negative temperature dependency. In a medium velocity region (5 ~ 28 cm/s), unstable flames called *flames with repetitive extinction and ignition* (FREI) were observed [1]. Ignition occurred at the "ignition point" in the downstream and flame propagated to the upstream to the "extinction point." And then flame quenched there because of large heat loss. After some time delay, re-ignition occurred at the "ignition point." Flame repeated this cycle regularly. Stable flames with weak luminescence (Normal flame) were observed in lower velocity region. These weak flames located on extrapolated line of "ignition points" of FREI. It was considered that these weak flames were stabilized close to the locations of their ignition.

1D computation [1] with detailed chemistry [2] was conducted for examining the experimental results. Computational results showed that there exists stable solution braches at high and low velocity regions as shown in Fig. 2. Two peaks in CH profile are found in a flame at the lower velocity solution branch. It is considered that the first peak of the upstream side is cool flame and another is exothermic main reaction. In solutions of high velocity region where only main reaction occurs, the distribution of mole fraction of formaldehyde (HCHO) has sharp peak as an intermediate. On the other hand, in solution of low velocity region where two reactions occur, HCHO is located between cool flame and main reaction. This implies that HCHO is a product of cool flame not an intermediate.

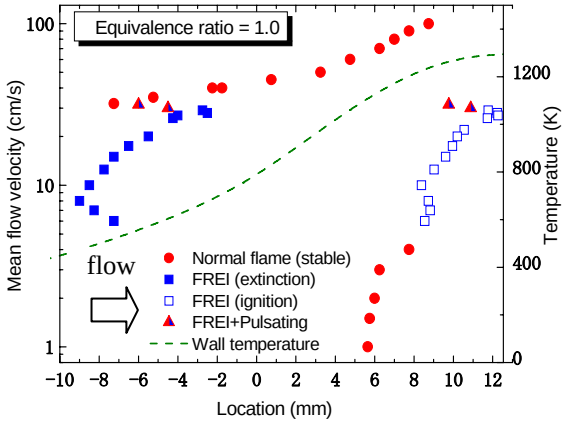

Figure 1 Various flame responses

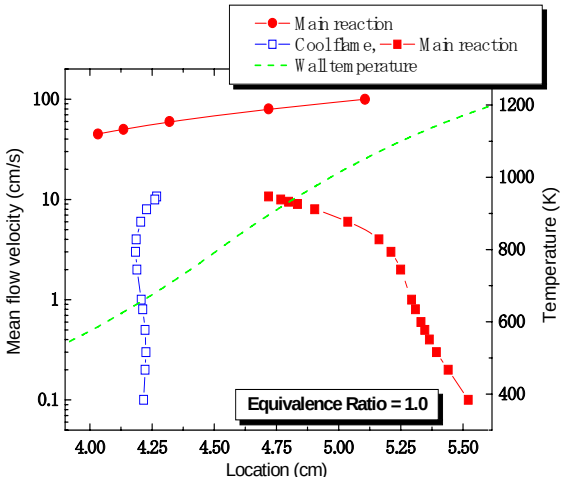

Figure 2 flame locations

[1] K. Maruta, T. Kataoka, N. I. Kim, S. Minaev and R. Fursenko, *Proceedings of the Combust. Inst*. 30, (2005), 2429-2436.
[2] H. J. Curran, S. L. Fischer and F. L. Dryer, *Int. J. Chem. Kinet.* 32, (2000), 741-759.