別紙４－１（課程博士（英文））

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Abstract (Doctor)

Title of Thesis	Study on Flickering Behavior of Interacting Two Jet Diffusion Flames

Approx. 800 words

Appearance of mode change of interacting flickering flames at open normal atmosphere under a gravimetric field is focused on. Fundamentally, the dynamic behaviors regarding the interaction effect of buoyant two flickering flames are found the two modes of flame dynamics: namely, in-phase and anti-phase modes. For present study, the two jet flames are adopted in a systematic manner. The sequence of working series comes up with the goals divided into two research objectives. Firstly, to study about the "transition of the dynamic modes because of the effect of interaction" is paid an attention. Secondly, the application that is the similarity between the different systems (single and two flickering flame(s)) is discussed from scientific point of view. For simplest jet flame model, the interaction effect of two adjacent buoyant fires creates the two modes of flame dynamics; namely, axisymmetric (in-phase mode) and asymmetric (anti-phase mode) motions. Whereas a single fire exhibits the two dynamic modes; so-called, axisymmetric (varicose mode) and asymmetric (sinuous mode) motions. At certain prescribed condition, puffing motion (varicose mode) of fire irregularly exhibits swaying motion (sinuous mode). The flame keeps connecting along the downstream, snake-like creeping motion. In this regard, there must have a critical condition to evoke this instability. Meanwhile, the winding cold-air at the gap between the two identical burners is found with essentially physical similarity. For utilizing this interaction effect of two buoyant fires, the dynamics can well be controlled by systematic parameters. To achieve the transition and similarity of dynamic modes, a well-controllable laboratory experiment was constructed and carefully upgraded for a wide working-range; the factor of 5 of fire scale in term of dealing with the highly non-linear instability. The key parameters; such as fuel flowrate (Q), burner diameter (D), and burner separation distance (L), were examined. Periodicity of flame behaviors was observed and the frequency monitored by thermocouples mounted adjacent to the burner exit. Time-variation of flame shape was recorded by a high speed camera associated with the optical imaging visualization. It was found that the characteristic flickering frequency was insensitive to the fuel flowrate, Q, implying that jet inertia played the secondary role in transition phenomenon. Instead, the burner critical separation distance for the transition (L_{crt}) varied when various burner diameters (D) were used, confirming that the difference in distance played an important role in the transition. Thus the critical condition could be summarized by an updated correlation as $D \times L_{crt}^3 \sim const$. This is slightly different from the one recently proposed by Yang et al. (2019), which was given under a narrow range of fire scale. Accordingly, the critical condition can also be described by the critical value of the updated global parameter, such as $\alpha^3 Gr^{4/3}$, where α and Gr denote the length ratio (L_{crt}/D) and Grashof number based on the inner diameter. By introducing the numerical method, the influence of gravity on the interaction effect was examined. The results show that the critical separation distance is modified significantly so that the effect of gravity must be taken an account to correct the model. Aside from identifying any similarity in the dynamics, asymmetric motion of both systems was precisely observed. The thermal boundary layer surrounded by the jet flame was visualized, including 3-D numerical prediction. Frequency analysis was executed to determine global parameters to properly describe the observed dynamic motion and the transition phenomenon. The critical Reynolds number (Re_{crt}) was discussed as an ideal candidate to characterizing the transition in the system of single fire. The Re_{crt} is hypothesized to merely describe the transition, not indeed characterize a whole dynamic mode of interacting non-premixed flames.