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EXPERIMENTAL STUDY ON FLOW CHARACTERISTICS OF A MICRO JET DEFORMED BY THE INTERACTION WITH THE NEIGHBORING JETS

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ABSTRACT

Mixing of air with gaseous fuel is one of the major problems for the development of micro gas turbine (MGT) combustor since the jet flow in the MGT combustor may become laminar under the conditions of relatively lower Reynolds number linearly depending on its size and weak entrainment of the flow. The authors previously proposed an innovative arrangement of jet nozzles in a small-scale can-type combustor to enhance the mixing between air and fuel in low Reynolds number flows [A1, A2]. The combustor is cylindrical in shape, the fuel and air entering at one end of the combustor through multiple jets, which are parallel with the axis of the cylinder. Air jets are positioned in a ring around the fuel jet, which is located at the center of cylinder. In the present study, we focused on the velocity distribution of twin or triple parallel-situated jets and also hexagonally-arranged jets (cf. Fig. A-1) to see how their flow patterns are deformed by the jet interaction and the flow entrainment. The jet nozzles used in this study were 2 ~ 4mm in diameter. The flow patterns of entrainment were visualized with a digital camera and a pulsed laser. The local time-averaged velocity and its fluctuation were measured with hot wire anemometry. The experimental results show that the velocity distribution in multiple jet case under the relatively lower Reynolds number conditions (Re ~ 3,500) decays faster than the one in a single jet, and that the distribution does not correspond to the one linearly superimposed with the velocity distributions of individual jets. External acoustic sounds (St ~ 0.35, 74dB at the nozzle tip) were also found to be another dominant factor for the jet interaction in the present Re ranges, while the jet flow issued from a nozzle larger than around 10mm in diameter didn't have any influence by the sound under the same Reynolds number conditions. The jet located in the middle between the two same-size jets was split into two in the case with sound, entrained into the neighboring jets, and eventually merged into one developed flow, much quicker than the case without the sound. Thus, multiple jet flow arrangement for small-scaled nozzles can be very effective for the mixing in the space restricted within narrow limits. The instability caused by acoustic sound should also be taken into attentive consideration to control the mixing in such small devices.

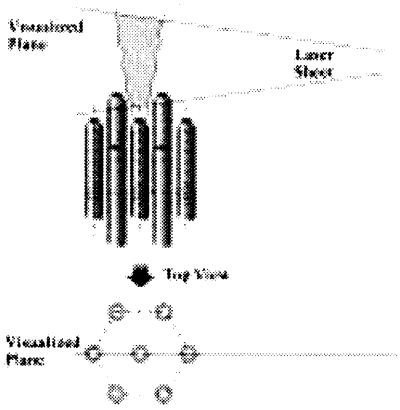

Fig. A-1 Test section.

REFERENCES

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