A Study on Operating Conditions of Disk-Type Rotating Detonation Engine

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A disk-type rotating detonation engine shown in Fig. 1 was newly constructed to study its stable operating conditions. Hydrogen is introduced into the combustion chamber through orifice holes and is mixed with air which is supplied from a circumferential slit. This hydrogen-air mixture flows radially inward and consumed by rotating detonation. The combustion product is centralized and exhausted in the axial direction to atmosphere. A special attention was paid in designing the combustion chamber so that its cross-sectional area along the flow path keeps constant up to the exhaust gas outlet. To estimate the operation frequency of rotating detonation waves, two pressure transducers (Kistler 603B1) were flush-mounted on the chamber wall.

From the obtained pressure histories, in which sharp pressure rises typical of detonation waves were detected, the operation frequency was measured for various mass flow rate as shown in Fig. 2. It is found that in the present test condition the operation frequency is insensitive to the mass flow rate, which is not the case with conventional rotating detonation engines. The equivalence ratio of the mixture is found to affect the operation frequency for the mass flow rate of 290 g/s as shown in Fig. 3. The maximum operation frequency is obtained around the equivalence ratio of 1.2.

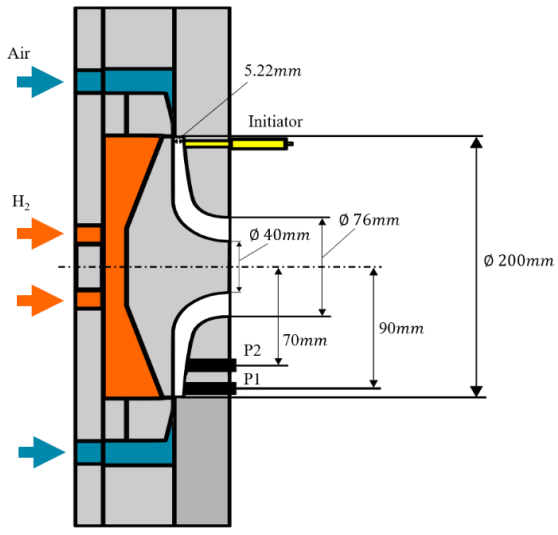

Fig. 1 Schematic of a cross-sectional view.

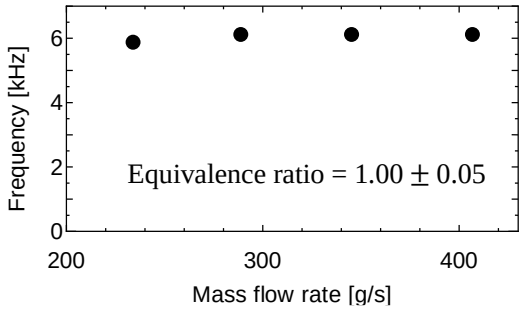

Fig. 2 Effects of mass flow rate on operation frequency.

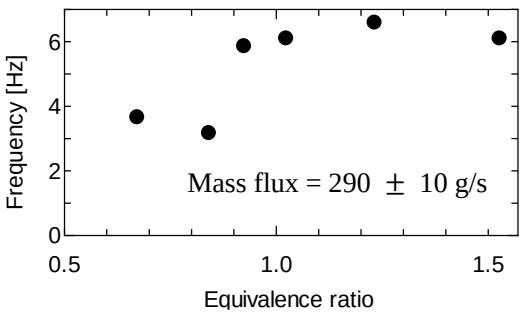

Fig. 3 Effects of equivalence ratio on operation frequency.