Study on Flame Development using the External Excitation in Baffled Combustion Chamber

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Since the technology of the liquid rocket engine advances, the high efficiency and high performance is important in the development of the space launch vehicles. The swirl coaxial injector has problems such as the high frequency combustion instability. In order to prevent and detect the combustion instability, the stability rate test has been performed with the external excitation. There are numerous methods of the dynamic stability, and the pulse gun is a typical measurement method for dynamic assessment. Structural baffle has been widely used as a means to decrease the intensity of the combustion instability. Liquid rocket engines applied this technology to prevent the combustion instability in the combustion chamber. Typically, an injector-forming baffle that the injector inserted in the baffle has been used to protect the combustion chamber from the heat load. However, the baffle injector affects the pressure field in the combustion chamber during the combustion. The objective of this study is to observe effects of the baffle on the flame development using the external excitation in baffled combustion chamber. The hot firing test was to verify the performance of the dynamic characteristics of a flame using the external excitation in the baffled combustion chamber. CH* chemiluminescence images were recorded using the high-speed camera. The pulse gun position will adjust to inject at the same distance from the injector. In the case with pressure wave, which was from the pulse gun, the combustion chamber pressure did not reach the steady state condition. This is because the pressure wave affected the flame development. In order to observe the detail of the case with pressure wave, dynamic pressure was measured in the combustion chamber. There are pressure peaks after the pulse gun operation. The reason of this is that the flame was interrupted by the pressure wave, and the propellant supply system was unstable. The image was captured using the high-speed camera with the band pass filter. In this study, the visualized images of CH* chemiluminescence will be captured in the case with pressure wave in the baffled combustion chamber. In previous studies, the hot firing test was performed to observe the performance of dynamic characteristics of a flame, and the cold flow test was conducted to confirm the effect of the pressures wave on the spray pattern. In this study the influence of the baffle in the combustion chamber will be analyzed quantitatively. Additionally, the CH* chemiluminescence images will be recorded to observe the effect of the structural baffle on the flame development using external excitation. Results from this study will be expected to identify the effects of structural baffle.

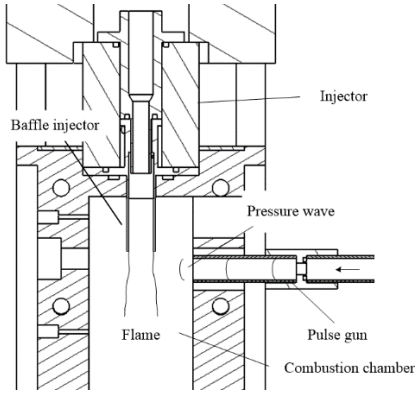

Figure 1. Schematic of the combustion chamber

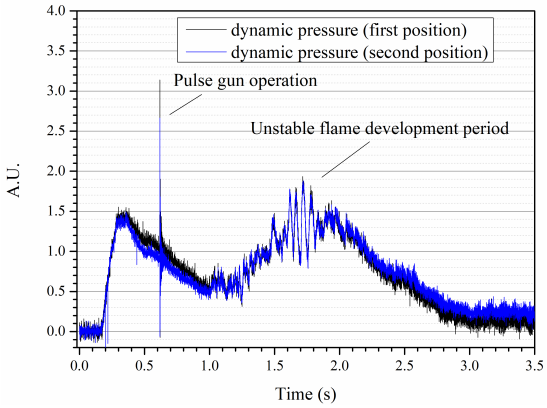

Figure 2. Time traces of dynamic pressure in the combustion chamber

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